PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON INFRASTRUCTURE DEVELOPMENT AND INVESTMENT STRATEGIES FOR AFRICA

DII – 2015

16-18 September 2015
Livingstone, Zambia

Proceedings

Editors: Dr I Musonda, Dr JN Agumba & Mrs CS Okoro

Co-editors: Dr E Mwanaumo; Dr M Muya; Mr E Zulu; Prof WD Thwala & Dr CO Aigbavboa

NCC National Council for Construction

Copperbelt University

University of Zambia

University of Johannesburg

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII – 2015

2nd International Conference on Development and Investment in Infrastructure - Strategies for Africa

16 -18 September, 2015
Livingstone, Zambia

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September 2015

Published by
University of Johannesburg
PO Box 17011
Doornfontein
Johannesburg, South Africa, 2028

ISBN: 978-0-86970-787-6

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

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ENDORSEMENTS

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FOREWORD

On behalf of the Organizing Committee, it is my pleasure to welcome you to Livingstone, Zambia, the host city of the International Conference on Development and Investment in Infrastructure (DII-2015). The DII-2015 conference is a follow up event to the DII-2014 conference on Infrastructure Development and Finance in Africa. The DII Conferences aim to provide an international forum where leaders, researchers, practitioners and other stakeholders in infrastructure development and the general built environment can discuss, evaluate and devise ways to maximise benefits of infrastructure development in Africa. The goal of the DII conferences is to achieve outputs that will inform policy on Development and Investment in Infrastructure (DII) across Africa.The broad topics covered by the conference include:

- Infrastructure Finance, Procurement and Development;
- Environment, Safety and Health considerations in Infrastructural Development;
- Skills development, transfer and empowerment;
- Sustainable Development;
- Value Engineering;
- Development and Growth Infrastructure;
- Appropriate Design and Development Methods;
- Infrastructure Delivery and Investment return models;
- Infrastructure Development Strategies for Developing Countries;
- Integrative Infrastructure Development Planning;
- Information and Communication Technology in Infrastructure Development;
- Social Infrastructure Development in Developing Countries; and
- Infrastructure, Climate Change and Pandemics in Developing Countries

Warm gratitude is extended to the authors who have successfully gone through a two-tier peer review process in order to have their papers accepted and published in this proceeding. The peer review process would have been impossible without the support of the members of the Scientific and Technical review Committees (STC). The organizing committee is thankful for this voluntary service that is so central to the quality of the accepted papers.

Special thank you also goes to all the conference delegates that have travelled from different continents. Thank you for attending the event and please make the most of your time at the conference while enjoying the hospitality of the Zambian people here in Livingstone.

Innocent Musonda
For/DII-2015

ISBN 978-0-86970-787-6

ACKNOWLEDGEMENTS

The organizing committee of the DII-2015 is grateful to the University of Zambia, Copperbelt University, Zambia, National Council for Construction (NCC), Zambia, University of Johannesburg, South Africa, the Chartered Institute of Building, The South African Council for the Project and Construction Management Professions and other South African, African and International universities and Institutions for supporting the conference through their valued contributions.

The contributions and unique support of the International Advisory and Scientific Committees, who worked tirelessly to prepare refereed and edited papers, which produced this published proceedings of the highest standard including satisfying the criteria for subsidy by the South African Department of Higher Education and Training (DHET), is truly treasured. The contributions of Prof Mundia Muya, Dr Trynos Gumbo, Dr Justus Agumba, Prof Didibhuku Thwala, Dr Innocent Musonda, Dr Clinton Aigbavboa, Dr Erastus Mwanaumo, Dr Franco Muleya, Mrs Chioma Okoro, Ms Chama Mwansa, Mr Brian Mutale, Mr William Nkomo and Mr Tresor Mbayahe are recognised. The support of Mr Ansary Nazeem, Prof Steve Ekolu and Karishma Ganpath is also commendable.

ISBN 978-0-86970-787-6

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DECLARATION

All the papers in these conference proceedings were double-blind peer reviewed at abstract and full paper stage by the members of the International Review Committee. The process entailed detailed reading of the abstracts and full papers, reporting of comments to authors, modification of papers by authors whose papers were not rejected by the reviewers, and re-evaluation of revised papers to ensure quality of content.

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CONFERENCE COMMITTEES

Organizing Committee

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Dr Clinton Aigbavboa
Dr Trynos Gumbo
Dr Justus Agumba
Professor Didibhuku Thwala
Mrs Chioma Okoro
Mr Tresor Mbayahe Katembo
Mr William Nkomo

Zambia

Dr Erastus Mwanaumo (Co-Chair)
Professor Mundia Muya
Dr Franco Muleya
Ms Chama Mwansa
Mr Brian Mutale

Scientific Committee

This committee ensured that the final papers incorporated the reviewers' comments, were correctly allocated to the appropriate theme and met the requirements set by the organisers in line with international standards for inclusion in the proceedings. They also arranged the papers into their final sequence as captured on the USB memory stick and Table of Contents.

Dr JN Agumba, University of Johannesburg, RSA
Dr CO Aigbavboa, University of Johannesburg, RSA
Dr E Mwanaumo, University of Zambia
Dr F Muleya, Copperbelt University, Zambia
Prof M Muya, University of Zambia
Dr I Musonda, University of Johannesburg, RSA
Mr G Onatu, University of Johannesburg, RSA
Prof D Thwala, University of Johannesburg, RSA

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Technical Review Committee

The technical review committee comprised of experts from the built environment. The committee ensured that the papers were of the highest standard in terms of originality of material; academic rigor; contribution to knowledge; critical current literature review; research methodology and robustness of analysis of findings; empirical research findings; and overall quality and suitability for inclusion in the conference proceedings.

Mr O Aurobindo, University of Johannesburg, RSA
Dr Y Babatunde, Witwatersrand University, RSA
Dr N Chileshe, University of South Australia, Australia
Prof FA Emuze, Central University of Technology, RSA
Dr T Gumbo, University of Johannesburg, RSA
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Prof PD Rwelamila, University of South Africa, RSA
Prof KK Shakantu, University of Free State, RSA
Prof JJ Smallwood, Nelson Mandela Metropolitan University, RSA
Prof A Talukhaba, Tshwane University of Technology, RSA
Dr A Windapo, University of Cape Town, RSA
Dr SS Wong, University College of Technology Sarawak, Malaysia
Mr E Zulu, University of Kwazulu Natal, RSA

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THE PEER REVIEW PROCESS

Overview

The need for high quality conference proceedings, evident in the accepted and published papers, entailed a rigorous three-stage blind peer review process by no less than two acknowledged experts in the subject area. Experts including industry professionals and academics were assigned with the responsibility of ensuring that high standards of scientific papers were produced and included in the proceedings.

First stage of review

Submitted abstracts were twice blind reviewed. Each abstract was reviewed in terms of relevance to conference theme and objectives, academic rigor, contribution to knowledge, originality of material and research methodology. Authors whose abstracts were accepted were provided with anonymous reviewers' comments and requested to develop and submit their full papers taking into consideration the abstract review comments.

Second stage of review

Experts were once again assigned the submitted full papers relative to their areas of expertise. The full papers were reviewed in terms of relevance to conference theme and objectives; originality of material; academic rigour; contribution to knowledge; critical current literature review; research methodology and robustness of analysis of findings; empirical research findings; and overall quality and suitability for inclusion in the conference proceedings.

Third stage of review

Authors whose papers were accepted after the second review were provided with additional anonymous reviewers' comments on evaluation forms, and requested to submit their revised full papers. Evidence was required relative to specific actions taken by the authors regarding the referees' suggestions. Final papers were only accepted and included in the proceedings after satisfactory evidence was provided. To be eligible for inclusion, these papers were required to receive a unanimous endorsement by all the reviewers that the paper had met all the conditions for publication. Out of 53 submissions, 40papers were finally accepted and included in the DII-2015 conference proceedings.

At no stage was any member of the Scientific Review Panel or the Organizing Committee or the editors of the proceedings involved in the review process related to their own authored or co-authored papers. The role of the editors and the scientific committee, was to ensure that the final papers incorporated the reviewers' comments and to arrange the papers into the final sequence as captured on the USB memory stick and Table of Contents.

Regards

C. S. Okoro
Conference Secretary
Johannesburg

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The University of Johannesburg (UJ), is the largest, multi-campus, residential university in South Africa. Born from a merger between the former Rand Afrikaans University (RAU), the Technikon Witwatersrand (TWR) and the East Rand campuses of Vista University in 2005, the University of Johannesburg's unique academic architecture reflects a comprehensive range of learning programmes, leading to a variety of qualifications ranging from vocational and traditional academic to professional and postgraduateprogrammes, across the four campuses, namely: Auckland Park Kingsway, Auckland Park Bunting Road, Doornfontein and Soweto campuses. The campuses vary in size and each has its own character and culture, contributing to the institution's rich diversity.

The University of Johannesburg has benefited from a large pool of researchers bringing together various fields of expertise and research focus areas. The university provides the ideal ground for interdisciplinary research and the university has more than 87 rated researchers. Five of these researchers are A-rated - all of whom are recognised as world leaders in their field. The university is also home to nine research centers.

The University fosters ideas that are rooted in African epistemology, but also addresses the needs of the South African society and the African continent as it is committed to contributing to sustainable growth and development. We continue to build a culture of inclusion, embracing South Africa's rich history, culture, languages, religions, gender, races, social and economic classes. Additionally, the University encourages a culture of service as part of the university student experience and it proudly pursues a four-language policy of English, isiZulu, Afrikaans and Sesotho sa Leboa.

Our staff and students come from over 50 countries in Africa and the world. The university has also built links, partnerships and exchange agreements with leading African and other international institutions that further enrich the academic, social and cultural diversity of campuses. It is also the recipient of the highest levels of external financial support, from donors and partners all over the world. This demonstrates the high esteem in which we are held internationally.

In its mission, UJ commits itself to the following:

- Quality education;
- Leading, challenging, creating and exploring knowledge;
- Supporting access to a wide spectrum of academic, vocational and technological teaching, learning and research;
- Partnerships with our communities; and
- Contributing to national objectives regarding skills development and economic growth.

The values guiding all University activities include:

- Academic distinction;
- Integrity and respect for diversity and human dignity;

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- Academic freedom and accountability;
- Individuality and collective effort; and
- Innovation

In giving expression to its vision of being a pre-eminent South African and African University, UJ has set itself ten strategic goals. Its priorities are to:

- Build a reputable brand;
- Promote excellence in teaching and learning;
- Conduct internationally competitive research;
- Be an engaged university;
- Maximise its intellectual capital;
- Ensure institutional efficiency and effectiveness;
- Cultivate a culture of transformation;
- Offer the preferred student experience;
- Secure and grow competitive resourcing; and
- Focus on the Gauteng city regions.

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The Copperbelt University

History

With its motto "Knowledge and Service", the Copperbelt University (CBU) was established in 1987 as part of the University of Zambia. It was initially intended to be located in Ndola, about 50km South East of Kitwe, as UNZANDO (University of Zambia in Ndola). But since the University of Zambia (UNZA) had no infrastructure in Ndola at the time, UNZANDO was allowed to operate in Kitwe using the Zambia Institute of Technology (ZIT) infrastructure. ZIT was integrated into Copperbelt University in 1989, two years after the university was established. Until recently (when many public and private universities are being established), the Copperbelt University was the only other university in the country after the University of Zambia. Currently, the university has eight academic schools – Schools of the Built Environment, Engineering, Medicine, Graduate Studies, Business, Mines and Mineral Sciences, and the School of Natural Resources. In addition, the University offers distance education through its Directorate of Distance Education and Open Learning. The Dag Hammarskjold Institute for Peace Studies is accommodated at Copperbelt University.

The School of Built Environment

The School of the Built Environment (SBE) (formerly School of Environmental Studies) was established in 1981 under ZIT when the School admitted its first students. The School remained temporarily situated at ZIT until 1989. The School of the Built Environment (SBE), therefore, increased its scope by taking on the ZIT Diploma courses in Architecture, Quantity Surveying, Land Surveying and Town & Country Planning, and Advanced Technician course in Construction. The University began to offer these programmes at degree level. Currently, the School consists of four departments, namely: Architecture, Construction Economics and Management (CEM), Real Estate Studies (RES, formerly Land Economy), and Urban & Regional Planning (URP). In addition, the school also offers a Master of Science programme in Project Management. The School also runs a Project and Consultancy Section called the Practice Office, which is responsible for undertaking consultancy services in various fields of the built environment. Currently, there are 5 undergraduate and 1 masters' degree programmes offered in the school. These are BSc. in Quantity Surveying, and BSc. in Construction Management (both offered by the CEM Department); BSc. in Real Estate Studies (offered by the RES Department); BSc. in Urban & Regional Planning (offered by the URP Department); Bachelor of Architecture (BArch, offered by the Architecture Department); and the MSc. in Project Management (offered by the School of Graduate Studies).

After successful completion of their degree programmes, our students join both public and private sector reputable organizations within and outside the country where they work as Architects, Design Consultants, Construction Managers, Valuers, Planners, Project Managers, Quantity Surveyors, Investment Bankers and many more. Other than the masters programme, which takes up to two years to complete, all our undergraduate programmes should take five years to complete. Our students come from within and outside Zambia. In terms of staffing, it is the policy of the University that it recruits highly qualified personnel. For this reason, the university has put in place a policy where the minimum

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qualification of a lecturer is not only a masters' degree but also that the masters' degree must be in the same discipline as the lecturer's first degree. In addition to this profile, the SBE has a very ambitious programme where it intends to expand the school by introducing more programmes like the MSc. Degree in Land Management. This will help in meeting the ever increasing demand for qualified professionals within and outside the SADC region. More information on CBU in general and SBE in particular, can be found on our website at www.cbu.edu.zm.

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THE UNIVERSITY OF ZAMBIA

The School of Engineering, University of Zambia

Introduction

University of Zambia opened its doors in 1966, two years after Zambia attained its independence. The main purpose was to produce human resources (graduates) for the government and industry in Zambia. From the first intake of students of 300, the population has grown to the current population of 21,700. The School of Engineering located at the main campus of the University of Zambia in Lusaka is one of the nine schools in the university. Over the years, the school has responded to various national challenges through teaching, research, training, consultancy and public service. The School of Engineering, now comprising the Departments of Agricultural Engineering, Civil & Environmental Engineering, Electrical and Electronic Engineering, Geomatics Engineering and Mechanical Engineering was established on 1st May 1969.

The school has a student population that is in excess of 450 undergraduate and 90 postgraduate students across all the departments. There are currently 40 academic members of staff in its five departments. The school is realigning itself to become a trainer of trainers by increasing its capacity in training at postgraduate level. The postgraduate programmes aim at training engineers with advanced and in depth knowledge in specialised fields.

The number of postgraduate programs remained small for a long period of time until the year 2010 when it became clear that there was a serious gap in trained manpower in the energy sector. To address this gap, the University of Zambia, School of Engineering with the financial support from NUFFIC, developed a master's degree program in Renewable Energy. This programme is hosted by the School of Engineering. From this experience, the School identified many gaps in engineering management fields, the ICT sector, and project management area and developed a number of other programs in electronics, construction and engineering management. The aim was to elevate the caliber of engineers in the country to improve the management of engineering firms in line with the new technologies.

Postgraduate Programmes in the School

PhD research programmes

PhD research programmes offer a vast range of opportunities to students who relish the chance to undertake a research project with clear intellectual, scientific, industrial or commercial relevance and challenge. Currently these programmes are being offered in the Departments of Civil & Environmental Engineering and Mechanical Engineering. The School also undertakes interdisciplinary research in conjunction with other institutions.

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MSc programmes

The following is the list of programmes offered at MSc level:

- Master of Engineering Research Programme;
- Master of Engineering in Agricultural Engineering;
- Master of Engineering in Environmental Engineering;
- Master of Engineering in Structural Engineering;
- Master of Engineering in Electrical Power Systems;
- Master of Engineering in Production Engineering and Management;
- Master of Engineering in Thermo-fluids Engineering;
- Master of Engineering in Renewable Energy Engineering;
- Master of Engineering in Project Management;
- Master of Engineering in Construction Management;
- Master of Engineering in Engineering Management;
- Master of Engineering in Geo-Informatics and Geodesy;
- Master of Engineering in Telecommunications Systems;
- Master of Engineering in Information and CommunicationTechnology;
- Master of Engineering in Information and CommunicationTechnology Security;
- Master of Engineering in Information and Communication Technology Policy and Management;
- Master of Engineering in Computer Communications; and
- Master of Engineering in Wireless Communications.

With these new strides, the university answers the call from society, which requires a pool of well-trained engineers meeting the challenges of operating in the developing world while meeting the challenges of both the developing and developed economies.

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CONFERENCE PROGRAMME

WEDNESDAY, SEPTEMBER 16, 2015			
14:30 - 16:50	**Workshops:** Postgraduate research; Safety and Health Management for Contractors and Designers		
17:00 - 19:00	**Conference registration**		
	Networking opportunity & welcome cocktail		
THURSDAY, SEPTEMBER 17, 2015			
08:00 - 09:00	**Registration**		
Welcome & keynotes			
09:00 - 10:10	**Chair:** Mundia Muya –Dean Engineering – UNZA		
	Welcome address by Executive Director – National Council for Construction – ***Eng. Charles Mushota***		
10:10 - 10:30	Official opening by the Minister of Transport, Works, Supply and Communications, Zambia - ***Hon Yamfwa Mukanga***		
10:30 –10:50	The Role of Education in Re-Culturing Local Contractors through Calibrated Capacity Building Programmes for Sustainable Infrastructure Investments - ***Prof Clive Chirwa***		
10:50 - 11:10	Investment in Infrastructure Development in Africa: Identifying the Gaps and Opportunities - ***Prof P.D. Rwelamila***		
11:10 - 11:30	**Morning Tea**		
Technical Sessions			
	Breakaway Session 1 **Theme: Infrastructure Investment, Development and Finance** **Session chair: Dr F. Muleya**	**Breakaway Session 2** **Theme: Integrated Infrastructure Planning and Management** **Session chair: Mr D. Phiri**	**Breakaway Session 3** **Theme: Health and Safety, Empowerment and Skills Transfer in Infrastructure Development** **Session chair: Dr E. Mwanaumo**
11:30 – 11:50	Re-thinking infrastructure development sequences in low income housing projects: Lessons from Cowdray Park, Zimbabwe - **Gumbo, T.**	Risk management: Improving supply chain management - **Musonda, M. M. J. et al**	Examination of safety performance regulations in the Ghanaian building construction industry – **Mustapha, Z. et al**
11:50 -12:10	Economic development post Sichuan Province disaster - **Daw, O. D.**	Analysis of facilities history: A tool for effective facilities management - **Ogbeifun, E. et al**	Assessment of crane safety practices on construction sites in Abuja, Nigeria –**Momoh, S. et al**
12:10 – 12:30	Land-based financing for urban infrastructure in sub-Saharan Africa – **van Niekerk, B. et al**	Project management: Perspectives of small and medium-sized construction firms in Ghana - **Arthur-Aidoo, B. M. et al**	Examining the influence of mentoring functions on job satisfaction and organizational commitment of new construction employees: A literature review - **Nkomo M. W. et al**
12:30 – 12:50	Prompt Payment Act as a means of reducing payment delays in the Zambian construction industry- **Chiponde, D. B. et al**	Programme management of informal settlements In South Africa: The case of region A in the city of Johannesburg Metropolitan Municipality- **Hlatshwayo, S. et al**	Construction camps in building and civil engineering construction **Deacon, C. et al**
12:50 -13:50	**Lunch**		
Symposium : Infrastructure Leadership and Governance			
14:00 -16:00	**Chair:** Dr Albert Malama -Dean SBE – CBU		
	Rethinking Construction Management Education - ***Prof A.A. Talukhaba***		
	Strategic Capabilities for Megaproject Architects - ***Prof Nuno Gil***		
	Q&A Session on Strategic Capabilities for Megaproject Architects - ***Prof Nuno Gil***		
	Guest Speakers and Panel		
19:00 - 22:30	**Conference Dinner**		
FRIDAY, SEPTEMBER 18, 2015			
	Chair: Dr E Mwanaumo – UNZA		
08:30 - 09:20	Mega Infrastructure Leadership and Governance -***Prof Nuno Gil***		
09:20 - 09:40	Dichotomies of an African City: Insight into Housing Infrastructure -***Dr Lovemore Chipungu***		
09:40 -10:00	**Morning Tea**		
10:10 - 10:30	Developing an Infrastructure Watch Culture - **Prof Mundia Muya**		
10:30 - 10: 50	Monitoring the Kariba Dam –**Zambezi River Authority**		

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FRIDAY, SEPTEMBER 18, 2015 **Technical Sessions**			
	Breakaway Session 4 **Theme: Integrated Infrastructure Planning and Management** **Session chair: Prof W. Thwala**	**Breakaway Session 5** **Theme: ICT Infrastructure and Mega projects** **Session chair: Mr P. Mukalula**	**Breakaway Session 6** **Theme: Infrastructure Leadership and Governance** **Session chair: Ms B. Mwiya**
10:50 – 11:10	The use of reverse logistics principles in achieving zero waste cities in South Africa- **Mbayahe, T. et al**	Adoption of building information modelling in the Zambian architectural, engineering and construction industry- **Chipulu, C. et al**	Challenges of joint ventures in the construction industry: Literature review – **Bekale Mba, M. F. et al**
11:10 – 11:30	Performance evaluation of contractor development programmes In South Africa - **Dapaah, A.et al**	Urban growth analysis for Lusaka city using Remote Sensing and GIS - **Phiri, L. et al**	A technical framework for assessing a higher education e-learning readiness - **Chikohora, T. et al**
11:30 – 11:50	Examining public sector procurement systems of construction projects in Zimbabwe: An exploratory study - **Dhliwayo, R. A. et al**	Using digital mobile GIS for occupancy audit and beneficiary administration to improve human settlements in Ekurhuleni Metropolitan, South Africa- **Mabaso, M. et al**	Contextualizing global mindset: The case of multinational construction firms in Ghana - **Owusu-Manu, D. et al**
11:50 – 12:10	Construction risk management in developing countries **Tembo, C. K. et al**	Strategies for implementing value management in the construction industry of Ghana-**Kissi, E. et al**	Investigating the South African government's experience with regard to the effectiveness of PPPs in meeting BEE policy aspirations- **Sekgothudi, K.et al**
12:10 – 12:30	Bamboo use in construction industry- How sustainable is it?- **Akwada, D. R et al**	Application of value management methodologies to project Selection in the Nigerian construction industry – **Ogunsanya, O. A. et al**	Evaluating claims and their impacts on project delivery in the Zambian Construction Industry - **Chisumbe, S. et al**
12:30 – 12:50	Use of labour production rates in the Zambian road sector- **Siamatu, R. et al**		Provincial roads CAPEX programme in South Africa: Payment claims and reporting gaps - **Emuze, F. et al**
12:50 - 13:50	**Lunch**		
	Breakaway Session 7 **Theme: Social Infrastructure and Sustainability** **Session chair: Dr T. Gumbo**	**Breakaway Session 8** **Theme: Social Infrastructure and Sustainability** **Session chair: Mr D. Chiponde**	**Breakaway Session 9** **Theme: Sustainability** **Session chair: Dr C. Aigbavboa**
14:00 – 14:20	Stakeholders and sustainability considerations for mega infrastructure projects: A case of Accra airport city project, Ghana - **Eyiah-Botwe E. et al**	Urban infrastructure, housing markets and housing development: An institutional analysis - **Munshifwa, E. K.**	Traditional procurement system as a source of unsustainable development in the developing countries: Empirical evidence of cost performance on public Infrastructure projects from Botswana- **Adeyemi, A. Y. et al**
14:20 – 14:40	Conceptual framework for sustainable affordable housing construction in South Africa **Ganiyu, B. O. et al.**	Nutritional awareness in the construction industry **Okoro, C. S. et al**	Gas-fired power station: An air inlet case study **Wasserman, B.**
14:40 – 15:00	Improving social and urban infrastructure in Zambia's slums through urban renewal and regeneration- **Phiri, D. A.**	Bamboo as a construction material: Prospects of the Ghanaian species - **Akwada, D. R. et al**	Sources and types of credit for construction small and medium enterprises: A literature review - **Balogun, L. et al**

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15:00 – 15:20	An evaluation of workers' welfare facilities and effect on productivity on Zambian construction sites- **Chisumbe, S. et al**	A critical analysis of the impact of sinkholes and dolomite on the settlement distribution of Ekurhuleni Metropolitan Municipality- **Onatu, G. et al**	Evaluating design-build procurement method in relation to the types of projects- **Ilori B.**
	Conference End and Closing		
15:20 - 16:10	**Prof Clive Chirwa- (**Dean Engineering – CBU**)**		
16: 10	**Sunset Cruise on the Mighty Zambezi River – (Optional event)**		

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KEYNOTE SPEAKERS

The DII-2015 Conference Launch and Keynote sessions will feature high profile experts and speakers, addressing the important issues affecting development and investment in infrastructure in the developing world. The keynote addresses will set the tone for the two days of conference sessions, networking and business development. The keynotes will speak to developments and challenges the developing world is facing on infrastructure, both in the near and medium term, and how we can overcome these challenges and realize the economic growth needed in our countries.

The biographies of experts at the conference **include:**

Hon Yamfwa Mukanga

The honourable Yamfwa Mukanga, Minister of Transport, Works, Supply and Communications has also served as the Minister of Mines, Energy and Water Development in Zambia. Before this, he was again the Minister of Transport, Works, Supply and Communications following the election of the Patriotic Front Government in September 2011. Hon. Mukanga is an Engineer by training and the former Provincial Governor for the Copperbelt Province - the focal point for mining activity in Zambia.

Prof Clive Chirwa

Professor Clive Chirwa is a Distinguished Professor of Crashworthiness. He is a Member of the Society of Automotive Engineers, Chartered Engineer, the Founder and Editor-in-Chief of the International Journal of Crashworthiness, the Founder of International Crashworthiness Conference (ICRASH -Series) and the Acting Dean of the School of Engineering, Copperbelt University, Kitwe, Zambia. He has been the United Kingdom Transport Safety advisor and the European Union Advisor to the Transport Commissioner. He has been an Appointed Member of the Advisory Team - UK Department of Transport on Road & Rail Vehicles, Aircraft and Spacecraft crashworthiness; Elected Member of the European Safety Advisory Team to the EU Commission; Appointed Member of the Advisory Team, Materials Section, Japanese Research Council; and an appointed Member of the Assessors Committee, Australian Research Council. He has over 105 peer-reviewed journal and conference publications. Prof Clive Chirwa has received numerous honours and awards including the Henry Ford Prize for contributing to the safety of passenger vehicles;British Rail Award (Crashworthiness in Rail Vehicles) and the Institution of Mechanical Engineers ***Holman Brothers*** **Safety Award in Mechanical Engineering** for the Best Research work and Paper Published on the Aspects of Eliminating Danger to Health.

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ISBN 978-0-86970-787-6

Prof P.M.D. Rwelamila

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ISBN 978-0-86970-787-6

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ISBN 978-0-86970-787-6

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ISBN 978-0-86970-787-6

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

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KEYNOTE ADDRESSES

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-049

The Role of Education in Re-Culturing Local Contractors through Calibrated Capacity Building Programmes for Sustainable Infrastructure Investments

E. C. Chirwa

Abstract

This presentation looks at the economies of scale of developed Countries vis-à-vis those of developing countries through sustainable infrastructure investments by employing well-structured strategies. A case study of Zambia that has experienced colossal infrastructure growth in the past four years will be presented. The impact of over-centralized implementation institutions executing directives centrally and a hierarchical bureaucracy that is ineffective in understanding complex tasks encompassing regions away from the center will be evaluated. He will argue that centralization has failed to serve beneficiary participation, acceptable maintenance, and best utilization of infrastructure, appropriate management co-ordination and responsiveness to local needs through efficient adoptability.

He will further argue that decentralization, which is the second other alternative, has its own flaws especially under conditions of uncertainty with severely limited resources. In this presentation, Chirwa will contend that decentralization has not been a widely successful solution when it comes to empowering local contractors.

A system that was meant to increase the role of local beneficiaries in executing projects through decentralization has failed mainly due to education levels of the contractors and deficiency in required skills for the jobs. This lack of academic understanding enables the empowered not to correctly implement policies that result in quality-dedicated workmanship. He will argue that one of the main reasons for the status quo is that for too long there has been a neglect of human behavior and its relationship with organisations.

Therefore, his presentation will postulate a third alternative strategy that is not controlled centrally or decentralized, but that is centred on human behavior or individuals as units of analysis. The theory developed herewith requires organizations' analysis of the incentives and disincentives involved in making people perform slightly above their maximum effort on specific tasks relating to specific goals. Consequently, training institutions should re-programme themselves so that engineers, technicians, artisans and managers are educated to think outside the box with the work culture that is comparable to the population in the Far-Eastern regions of Asia.

The costs associated with inadequate quality of infrastructure are unacceptable and Zambia as is the case in the rest of Africa is littered with such infrastructure not meeting the purpose. Engineers, technicians and artisans must open up to research, design, development and quality implementation. Future engineers, technicians and artisans should be re-cultured and taught to embrace work and emphasizing the three pillars of excellence, namely: research, innovation and execution straight from the word go. By acquiring these skills, long term economic benefits from infrastructure investments will be realized.

ISBN 978-0-86970-787-6

Keywords: education, infrastructure, investments, sustainability, Zambia

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-54

Investment in Infrastructure Development in Africa: Identifying the Gaps and Opportunities

Rwelamila, P. D.

Abstract

Progress within the developing sub-Saharan African infrastructure in the last two decades has been uneven across countries and sectors, despite sustained investment levels, and points to inefficiencies of the investment process. Although data show that public investment efforts have improved the overall infrastructure stock, the infrastructure deficit remains important, particularly in the energy and transportation sectors. As Africa is seen as one of the World's fastest growing economic hubs, meeting the demand for key infrastructure is one of the priority areas. This translates into exciting opportunities. Greater economic activity, enhanced efficiency and increased competitiveness are hampered by inadequate transport, communication, water and power infrastructure. There are strong indications to suggest that the world is eager to do business in Africa, but finds it difficult to access African markets, especially in the interior, due to poor infrastructure. Emphasizing the importance of Infrastructure in Africa, the African Development Bank (AfDB) and World Bank contend that Africa's infrastructure is by far the most deficient and costly in the developing world. They further argue that on just about any measure of infrastructure coverage, Sub-Saharan Africa countries lag behind their developing country peers, and the gap with Asia is widening over time. A closer analysis of Africa's existing infrastructure stock shows a very depressing picture. Some 30% of Africa's infrastructure is dilapidated and in urgent need for refurbishment. Furthermore, the prices of Sub-Saharan Africa's infrastructure services are up to at least twice as high as other developing countries, due to diseconomies of scale and lack of competition. There is no doubt that inadequate infrastructure in Africa is the single biggest threat to Africa's long-term growth, hence representing a significant opportunity for investors to finance physical infrastructure assets such as ports, railway lines, toll roads, power stations, hospitals and broadband information communication technology (ICT).

This keynote paper is largely based on various studies which have been carried out by various international organisations, researchers and the author's experience of eight African countries where he has practiced in various roles within academia and practice as a consultant in private practice. Four primary areas are covered by this paper: firstly a summary of Africa's profile; secondly the importance of infrastructure development and implications for investment; thirdly a review and analysis of Africa's current infrastructure status, future demand and investment gaps; and fourthly conclusions and recommendations are given.

Keywords: Africa, development, infrastructure, investment

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-5

Rethinking Construction Management Education

Alfred A. Talukhaba

Abstract

Construction management has evolved and developed through years of training and dissemination of information through educational institutions, industry and government agencies. However, the construction industry is still being challenged with lack of innovation as a result of imbedded education systems and the processes. Construction education and training need to be continuously aligned with the changing business, production processes and innovation. Successful construction management education should be able to provide technical expertise, social awareness, multi and interpersonal expertise and innovation if we are to meet the challenges we face on infrastructure.

The presentation deals with how high quality management education can be achieved. It asks the questions: What is the range of knowledge, skills and attitudes that students should possess when they leave institutions of higher learning? How can we ensure that students learn effectively? The presentation reveals that new higher education graduates should possess technical knowledge (comprising aspects such as underlying science, as well as core construction and advanced management fundamentals); personal and professional skills and attributes(including reasoning and problem solving, knowledge discovery, as well as personal and professional skills and attitudes); interpersonal skills (including multi-disciplinary teamwork and communication); and societal context (including external context, enterprise and business context, and system thinking).

In this presentation, I argue that construction management education has to take a different path that can lead to innovation, hence re-thinking the way we educate if are we to meet the challenges of infrastructure requirements in Africa. The breadth and depth of knowledge must be recognised in teaching, learning and research. In addition, there should be continuous development of knowledge, conscious of the dynamic changes in society; teaching and learning methods that are appropriate; and assessment methods that are commensurate to the teaching and learning methods.

Keywords: construction management, education, knowledge, skills, training

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-6

Strategic Capabilities for Megaproject Architects

Nuno Gil

Abstract

In this presentation Nuno will discuss the strategic capabilities that the project sponsors or 'architects' of large infrastructure developments (e.g., elected politicians and senior officials in government departments and city authorities) and the top leadership teams of the corresponding executive agents need to acquire in order to improve megaproject performance and achieve superordinate goals. Nuno will first argue that infrastructures should be seen as systems of non-decomposable components, this is systems of large assets each of which is shared in use by many autonomous stakeholders. For example, railways are decomposed into track, stations, and train cars; airports include concourses, runways, and car parks; Olympic parks include sport venues. As such, the task of the megaproject architect is twofold: i) design the technical structure of the infrastructure system; and ii) design the organizational structure of the network of stakeholders who control the resources critical for the scheme to forge ahead, e.g., land, finance, planning consent, political support, technical capabilities etc. Hence, Nuno will argue, megaproject architects face a complex managerial problem since the misalignment between integral designs and modular organizations creates large arenas of consensus-oriented collective action.

To succeed sustainably, architects need to be strategic without misrepresenting the true expected costs without building large time and cost buffers. Rather, architects that are strategic, Nuno will claim, directly influence the sequence of arrival of the stakeholders and create governance structures that are inclusive whilst judiciously keeping some actors at bay. An ideal sequence aligns the growth of the megaproject network with the hierarchy of development choices and creates cohesive local working groups in charge of developing the monolithic infrastructure components. A strategy that seeks an orderly elimination of the development bottlenecks attenuates inter-organizational conflict and enables it to nip controversies in the bud. This, in turn, contributes to stabilizing the performance expectations in terms of scope, as well as cost and schedule targets, and thus sustains the legitimacy of the megaproject in the eyes of third parties.

Keywords: architects, infrastructure, megaprojects, performance

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-7

Dichotomies of an African City: Insight into Housing Infrastructure

L. Chipungu

Abstract

An African city is a divided city which suffers from a number of dichotomies arising out of competing interests. At the centre of these competing interests is the magnetic power of the city which manifests itself as the provider of opportunities which in turn acts as a pull factor in attracting people. This in turn has largely contributed to the concentration of people in the urban environment and therefore making housing as one of the most challenging components of the urban environment. Equally interesting is the realisation that the provision of housing is a complex process that goes beyond the construction of individual housing units – but exhibits itself through ideological differences that in turn depict the African city as dichotomous. Some of these differences, created through different historical epochs, are depicted in the urban form while driven by institutional forces. Indeed prevailing formal and informal housing, low income and high income housing, townships and suburbs, urban and peri-urban; are all physical manifestations created by myths in history and perpetuated by contemporary institutional frameworks. Accordingly, the typology and level of provision of housing infrastructure is a response to all these competing interests. Therefore, in order to address the housing infrastructural challenges bedevilling African cities, it is equally essential to unravel the underlying forces that drive these dichotomies.

Keywords: Africa, housing, infrastructure, urban environment

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-058

Developing an Infrastructure Watch Culture

Mundia Muya

Abstract

Infrastructure for water, energy, transport and telecommunications are fundamental to a country's economic prospects. Adequate and on-going investment in public infrastructure is required to maintain the quality of infrastructure in order to meet present and future needs. This presentation reports on the status quo of infrastructure in Zambia.

The focus in the current study was on critical infrastructure which included roads and bridges, airports and railways, water supply, sanitation and solid waste, electricity, information and communication technologies. The study was conducted by a team of infrastructure experts from the Engineering Institute of Zambia (EIZ). The desk and field studies were conducted and covered components, namely: condition, capacity, operations and security.

Findings revealed that Zambia's infrastructure is inadequate, in a number of aspects and in meeting present and future needs. In addition, it was found that the infrastructure system as a whole is failing to keep up with current trends and as a result, investment in infrastructure is faltering. In view of the inadequacies established from the current study, many opportunities for infrastructure investment are evident. In addition, it is noted that a continuous assessment of the state of infrastructure provides valuable information for government and the public to make informed decisions when allocating resources for construction, operation and maintenance of infrastructure.

Keywords: assessment, infrastructure, investment, Zambia

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

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INFRASTRUCTURE INVESTMENT, DEVELOPMENT AND FINANCE

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-026

Re-thinking HousingInfrastructure Development Approaches: Lessons from Zimbabwe

Trynos Gumbo

Abstract

Globally, housing provision has always been a mammoth task for all spheres of governments, whether national, provincial or local, as they struggle to meet the ever soaring demand. The situation has however been grimmer in African, Asian and South American continents that lack mostly financial resources and advanced low-cost technologies. The majority of the urban poor have perpetually been excluded from most land and housing projects that religiously follow the traditional planning-servicing-building-occupation (PSBO) frameworks. Most often than not, rigidities in housing development sequences condemn and compel the urban poor to rely on the occupation-building-planning-servicing (OBPS) frameworks that give informal settlements as outcomes. This paper discusses an innovative and less costly housing development framework, the planning-occupation-building-servicing (POBS) sequence that was adopted by the Zimbabwean government in almost all the urban centers of the country in 2005, just after Operation Murambatsvina. The data were gathered through interviews with key informants and housing plots allotters. Observations and photographic surveys of the housing structures and community infrastructure services that have so far been developed incrementally were also conducted. The findings revealed that allocating unserviced but formally planned and surveyed housing sites to the urban poor considerably improves targeting of the urban poor and makes housing more affordable. Such schemes not only contribute to housing supply by providing orderly and standard houses but also assist in eliminating or massively reducing down-raiding of aided self-help housing schemes by the middle and high income groups. The paper concludes by observing the critical need for governments of developing countries to innovatively solve housing problems of the urban poor by adjusting the currently rigid housing infrastructure provision sequences and making them affordable and flexible.

Keywords: housing infrastructure, low-income households, unserviced housing sites, urban land delivery

1. Introduction

Soaring urbanisation continuously exerts pressure particularly on governments of developingcountries thatare grappling with capacities to provide basic and sustainable human settlements for the urban poor (Aigbavboa & Thwala 2011; Hague 2007; Olotuah&Bobadoye, 2009). More than half of the world's population now live in urban centres. However the majority of urbanites are found within developed countries. Developing countries are still lowly urbanised and as such they continue to experience rapid

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

urbanisation. High urbanisation is also attributable to natural increase of population and spatial horizontal expansions of urban centres into surrounding rural areas as more peopleassimilated into the urban centres. This trend is common in the African continent where the majority of the people still live in rural areas. It has however been observed that the continent is urbanising rapidly as cities offer better opportunities in terms of income generation as well as health and educational services. Such developments have led to the proliferation of both income and housing poverty, a process now commonly known as the impoverishment of urban centres. However, it is housing poverty that clearly manifests itself in slums where millions of the world population live in substandard and inhuman conditions, particularly in the less developed countries (Ibemi & Amole 2010; UNCHS, 1996).

This paper explores and highlights experiences of Operation Hlalani Kuhle or Garikai housing development and provision programme that can loosely be translated as Operation Live Well in Cowdray Park suburb of Bulawayo City, Zimbabwe. The programme was launched by the government in 2005 to innovatively facilitate the development and provision of decent accommodation largely to the victims of the earlier Operation Murambatsvina, a programme that had purportedly sought to clean urban centres of filth in the same year. The victims of the earlier programme had lost not only their livelihoods but also housing structures. The paper also highlights possible areas of improvement of this unique programme of allocating planned but unserviced housing plots to the urban poor particularly in developing countries that may lack financial and technical resources but has reasonable urban land to accommodate the majority of low income households.

2. Land and Housing Delivery Approaches

Basically, land and housing delivery approaches can take two forms. The conventional and formal approach is the most dominant form of land and housing delivery in developed, transitional and developing countries. However, in most developing countries the shortages of resources, both financial and capital have led to the emergence and dominance of unconventional and informal approach to housing development.

2.1 Conventional and formal land and housing delivery sequences

Conventional housing programmes that religiously follow theplanning-servicing-building-occupation (PSBO) sequence have for a long time proved to be very ineffective and inefficient in most developing countries (Berner, 1998, 2000; Tu& Wong 2002). Generally, there is a tendency to put emphasis and strict adherence on orderly parcelling of space, provision of water, sewer and roads infrastructure before construction and certification of housing units before occupation; processes that are time consuming and very expensive and stringent (Berner, 2000). According to the PSBO framework, planning precedes all the stages. It is done at the first stage of land and housing development process where land is allocated for various uses on the layout plan that include plots for housing, commercial, community facilities and on-site infrastructure. Equally important is the provision of services; a stage that immediately follows planning. At this stage water, sewer and road infrastructure services are provided before the actual construction of houses commences (Baross 1990; Gumbo 2014a, b). Occupation of the completed housing units can only take place when documents that certify and approve the standard and quality of finishes are issued. The sequence is depicted in Figure 1. Most Governments have been emphasising on the implementation of this formal and rigid sequence (Baross 1990).

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

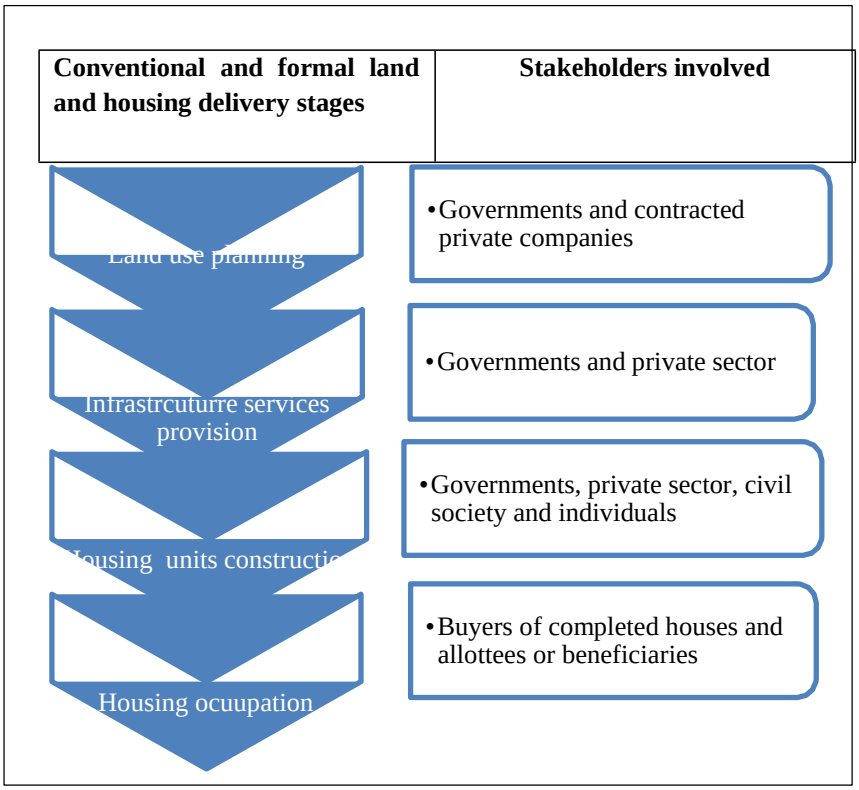

Figure 1: The conventional sequence of formal land and housing delivery (Author 2015, developed from ideas put forward by Baross, 1990; Gumbo 2014a, b)

As has been noted by various scholars, this framework has for a long time failed the majority of the urban poor as it has delivered very few and unaffordable houses (Baross, 1990; Berner, 2000; Gumbo 2014a, b). At various stages of the process that include servicing and building, several built environment stakeholders are engaged to perform tasks towards the achievement and fulfilment of formal land and housing development standards, thus strong bias for representation of space by professionals (Lefebvre, 1991). The various stages of the land development and housing production process lead to substantial increases in costs that are unaffordable to urban poor households. In response, there have been clarion calls to governments to facilitate and enable housing development by other stakeholders such as the private sector, civil society organisation and communities to reduce costs and promote access (UNCHS, 1996; World Bank, 1993).

2.2 Unconventional and informal land and housing delivery sequences

The conventional and formal land and housing delivery system yields a few adequate and standard houses thatonly serve the interests of the few high and middle income households leaving out the urban poor forcing them to search for solutions outside the formal systems, thus leading to the proliferation of informal settlements (Berner 2000; Gumbo, 2014a; UNCHS 1996). This alternative approach delivers affordable housing unitsinformally, for the majority of the urban poor with precarious incomes, albeit substandard. The homeless start by occupying land illegally before they start developing their housing structures. This can be viewed as the recognition of the rights of the urban poor to cities and efforts to achieve social justice as thousands of housing plots were allocated to the urban poor (Lefebvre, 1991).

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

The World Health Organisations (WHO), the United Nations (UN) and several governments of developed, transitional and developing countries recognise housing as a basic human right. Consequently, housing is considered more than a physical product as it is multifaceted and encompasses the decision making processes of producing the structures, thus impacting strongly on the occupants and societies' economic and environmental well-being, security and health (Turner, 1976; WHO, 1989; Mohammad & Lee, 2010). Imperatively, governments engage in informal settlements upgrading thus demonstrating an acknowledgement of the existence of the urban poor in sub-standard settlements aswell as granting their rights to live in cities (Lefebvre, 1991; UN-Habitat, 2009; Watson, 2009, 2010; Chirisa, 2012).As governments come to the rescue of the poor in informal settlements they start by planning for the housing schemes and then service the areas to transform them into formal settlements. As a result, the unconventional land and housing delivery follow the sequence of Occupation (O), building (B), planning (p) and servicing (S), thus adopting the OBPS model (figure 2) (Berner 2000).

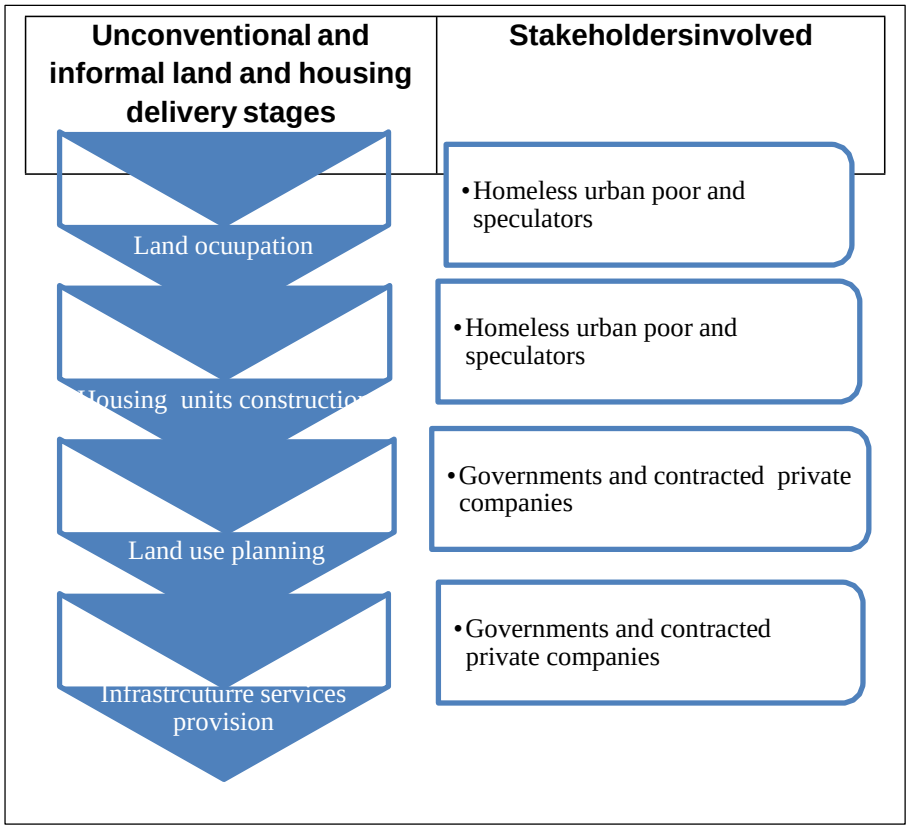

Figure 2: The unconventional sequence of informal land and housing delivery (Author 2015, developed from ideas put forward by Baross, 1990; Gumbo 2014a, b)

The OBPS land and housing delivery sequence serve millions of the urban poor residents as access to plots is not constrained by either income or regulations as squatting is the dominant approach. Besides, investments in the housing units can be phased and when governments intervene to upgrade informal settlements, the OBPS helps to promote the targeting of the poor compared to the PSBO. Notwithstanding the benefits of unconventional and informal land and housing delivery approaches; there are negative outcomes that among others include substandard housing units that not only lack security and are open to destruction anytime by authorities but are also devoid of basic infrastructure services, facilities and utilities as water, sanitation and electricity. Overcrowding and filthy within informal settlements have serious repercussions on the lives of the urban poor residents and their

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environments. Besides, informal settlements lack adequate space for both future expansions of housing units and developments and provision of community infrastructure such as road, sewerage reticulation and water supply.

Given the two extreme land and housing delivery approaches that give out opposing outcomes; there is therefore need for innovations that should seek to bridge the yawning gaps between the conventional and unconventional land and housing delivery approaches. Such an innovative approach needs to take into account the urban poor's needs, rights, capabilities and the gross spatial inequalitiesthat are prevalent in most cities of the developing world. The approach should eliminate the risks that lie in losing investments in both housing development and community infrastructure, thus; promoting investments in the two areas by the urban poor. According to Chitekwe-Biti (2009) if the urban poor feel secure on the land they occupy, they can improve their physical environments towards making it adequate and liveable without any fear of victimisation and loss in the future.

3. Operationalising the Study

The study applied a case study research design approach. Bulawayo,the second largest urban centre in the country after the capital city Harare was selected for study as it benefitted immensely from Operation Garikai or Hlalani Kuhle or Live well. The reconstruction programme was implemented by the government immediately after Operation Murambatsvina of 2005. An existing low income residential suburb within the city that benefitted from the programme was identified and selected for empirical study. A qualitative research approach was applied to gather informative data from key informants who work for relevant government organisations, leaders of active and participating co-operatives and officialsworking for Bulawayo Home Seekers Consortium Trust (BHSCT). The BHSCT co-ordinates collective activities of participants that seek to provide community infrastructure. Purposive sampling was applied to select key informants from all the relevant organisations within the city. Snow balling was also used to identify officials that work with participants to develop their communities into adequate and habitable housing environments.

A combination of stratified sampling and convenience sampling was used to select participants in the housing programme for study.The suburb was divided into new and old sections depending on the period of settlement and when the participants of the housing programmes were granted the housing plots. This was done to understand the processes of accessing the housing plots and the levels of development since the inception of the programme. Convenience sampling was then applied to select individual participants within the selected sections of the sprawling suburb. Balance was also ensured by selecting those that had made extensive developments of their housing structures and those who had just started to clear their housing plots inn preparation for construction. Semi- structured interviews were conducted with both key informants and participants of the housing programmes. The interviews were conducted face to face. Also, observations and photographic surveys of housing and infrastructure developments that are taking place within the Cowdray Park Extension suburb were conducted. The data was analysed using the content analysis methods where in themes were developed from categories and meaning from the responses that were gathered from participants.

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4. Experiences of Land and Housing Delivery Sequences in Zimbabwe

Zimbabwe is a developing country that has been experiencing rapid urbanisationas well as serious shortages of decent housing for the majority urban poor since the attainment of its independence from colonial rule in 1980 (Gumbo 2013; 2014a). The country's urban population increased from 23% during the early 1980s to 38.3% in 2010 (Mutizwa-Mangiza, 1986; UN-Habitat, 2012; Zinyama, 1986). This is mainly attributable to the annulment of the previously restrictive legislative frameworks such as the vagrancy and pass laws that had been used during the colonial period to curtail black immigrants out of urban areas but were abolished at independence by the new black majority government in its quest to achieve an egalitarian society and meet the ideals of the political liberation struggle (Gumbo & Geyer, 2011; Kamete, 1999). Regrettably, this created population pressure on African townships that had strictly been developed to provide temporary dormitory and rented accommodation to the black majority during colonial rule. The country's urban centres had been developed and designed to cater only for a privileged few (Gumbo 2013). Consequently, the high numbers of rural migrants strained local government resources. The sad situation also led to high housing poverty levels that in turn led to widespread illegal extensions of houses in established low income and high density housing neighbourhoods as well as informal settlements although they have always been few by developing countries standards (Chipungu, 2011). The government instead maintained very stringent, high and costly planning legislation and housing standards that were inherited from the former government that had followed the British planning system religiously (Kamete, 1999).

Several initiatives have been adopted to inform the delivery of land and the development and provision ofadequate residential areas that are well served with commercial, industrial and community facilities to meet people's aspirations and environmental and health conditions (Chaeruka, 2009; Chimowa, 2005; GoZ, 2004). With the assistance of bilateral and multilateral International and local stakeholders, the government adopted several strategies, policies and initiatives for instance the sites and services approaches (see Turner 1968; 1976) to improve the urban housing situation (MLGH, 1981;MPCNH, 1992).Among others, the institutions included local building societies such as the Central Africa Building Society (CABS) and Beverly Building Society and International institutions such as the World Bank (WB) and the United States Agency for International Development (USAID) participated in low income housing development schemes.

Although several planning statutes and Model Building By-Laws were revised over the years, they still ostensibly reflected British land and housing development standards (GoZ, 1996a; GoZ, 1996b). The adoption of full cost recovery conditions in the sites and services as well as core house schemes and the continued adherence to extremely high standards resulted in the failure of these governments' efforts in providing housing for the urban poor and lowly paid civil servants and informal sector operators, as the only not so poor could afford to service the loans (Gumbo 2005; Kamete, 2000; Mohammad & Lee, 2009). Some of the stipulations for instance the insistence on providing on-site infrastructure such as well drained gravel roads, reticulated water supply and sewerage systems remain unaffordable to the urban pooras they are not aligned to local contexts of rapid urbanisation and high demand of low cost and affordable housing (The Herald, 2013).

Most of the programmes yielded very few and very expensive housing products leading to massive targeting errors as most of the schemes had been hijacked by the affluent who in most cases already owned houses. Such housing programmes left out the majority of urban poor who could not raise adequate funds to secure the housing products of such schemes. the delivery of few and unaffordable

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housing units to the urban poor through the rigid and strict PSBO sequence left the urban poor with no option in Zimbabwe but to resort to informal means of accessing housing such as squatting and illegal subdivision as well as unsanctioned extensions of houses in high density suburbs (Chirisa 2012; Chitekwe-Biti 2009).

In response to the proliferation of informal housing, the government destroyed all illegal houses and settlements. Due to its strong adherence to strict urban planning regulations, high standards of housing and infrastructure development forced the government to launchanationwide demolition and eviction exercise, dubbed Operation Murambatsvina in May 2005 (Gumbo & Geyer, 2011; Magidimisha&Chipungu, 2011). The campaign led to widespread and destruction of illegal housing extensions and informal houses as well as eviction and relocation of the urban poor throughout the country's urban and rural centres.As can be expected of demolition and eviction programmes of such magnitudes, the catastrophe attracted the attention and condemnation by local and international institutions among them the United Nations-Habitat (Gumbo 2010; Tibaijuka 2005). Immediately the government launched the Operation Live Well in the same year to provide planned but unserviced housing plots to several thousands of the urban poor who had been negatively affected by the earlier operation, particularly those who had been on local authorities' waiting lists.

5. Innovations in Land and Housing Delivery Sequences in Zimbabwe

Following the folding up of the Operation Murambatsvina that had left thousands of urban low income households homeless in Zimbabwe's urban centres (Tibaijuka 2005), the government, launched Hlalani Kuhle or Garikai housing programme. The programme was implemented through the Ministry of Local Government, Public Works and Urban Development (MLGPW&UD), local authorities, housing co-operatives and affected individuals. Swiftly, innovatively and for the first time in the history of low income housing development; the Zimbabwean government with the assistance of urban councils and housing co-operatives, provided unserviced housing plots to several thousands of residents across the country. The innovation was mainly in the allocation of well surveyed and planned housing plots but without services for immediate occupation and housing construction. The housing programme led to the adoption of an extensively adjusted land and housing delivery approach; that follows the planning-occupation-building-servicing approach (POBS) Figure 3. The hybrid sequence borrows positive and progressive attributes from both the conventional/formal land and housing and theunconventional/informal land and housing approaches, thus producing a well blended approach.

Equally, the bridged land and housing delivery sequence integrates the two extremes. Just like in the conventional approach, land is planned for before occupation. The parcelling out of adequate housing plots is done and spaces are left out for future incremental infrastructure developments where roads, water and sewer systems are provided. The same applies to spaces for community facilities such as schools, clinics, halls and churches that are planned for before occupation and building of houses on the innovative schemes.It has repeatedly been observed that land is the essential ingredient in low income housing provision; hence efforts should be made to provide land at affordable rates, within appropriate locations and also without any complications (Baross, 1990; Berner, 2000).

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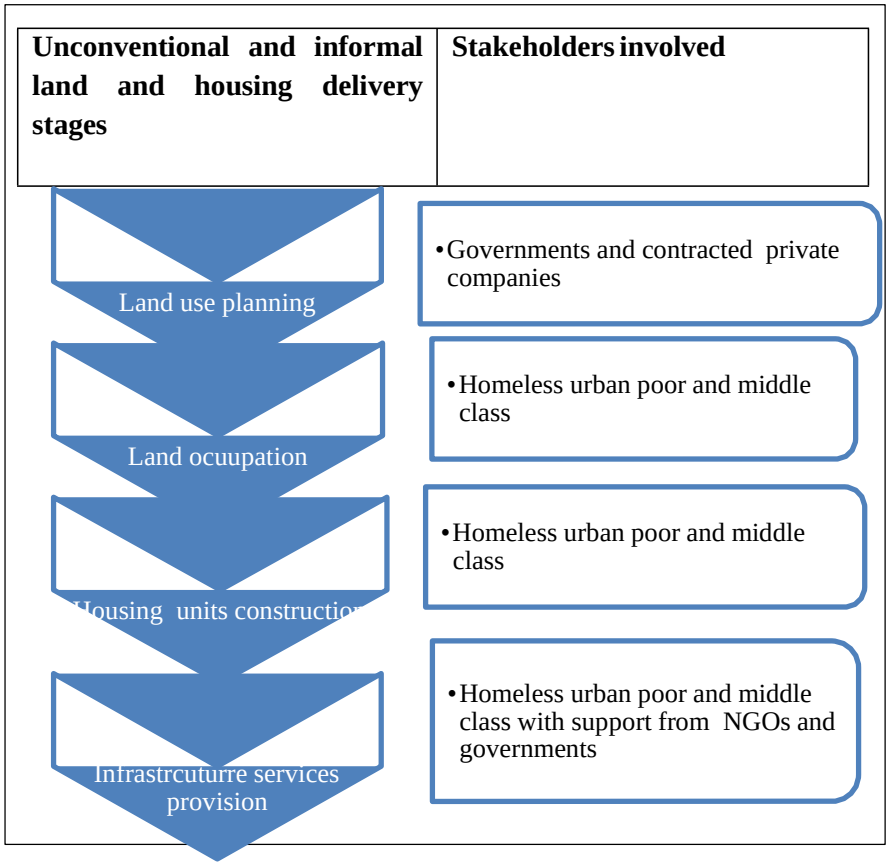

Figure 3: The hybrid sequence (bridging the conventional/formal and unconventional/informal) of land and housing delivery approach (Author 2015, developed from ideas put forward by Baross, 1990; Gumbo 2014a, b)

The orderly planning and allocation of plots by local government authorities ensures orderly development of urban spacesand guarantees security to the low income households that in turn gives them confidence and fosters a sense of security to invest in the development of housing plots. To promote affordability, the government supported the use of alternative materials such as burnt farm bricks or blocks and in some cases non-standard but appropriate alternative building materials and construction techniques that largely help to reduce the overall cost of the final housing product (Adedeji, 2011; Mohammad & Lee, 2011). Although in some few cases private land was also 'grabbed' by the homeless people; in the majority of cases urban councils had planned and surveyed land within their jurisdiction but were lacking resources to service the land before they could sell it to the homeless for housing construction.

Participants in these innovative programmes confidently contribute towards the development of onsite infrastructure such as access roads, sewer and water reticulation and electricity without fears of losing their investments through evictions that are common with informal housing schemes. Similarly, encouraging the participants to occupy the plots and build their houses as they save for servicing promotes affordability and greatly improves targeting of the urban poor who are in most cases left out

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of formal housing development approaches. Learning from the two extremes necessitates the integration of positive elements from conventional and informal land and housing provision systems, thus helping the urban poor to access standard, secure and affordable housing over time.

5.1 Lessons from Cowdray Park, Bulawayo – Towards the composite and affordable land and housing delivery approach

Bulawayo is a modern metropolis boasting of wide and well-ordered streets and meticulously designed architectural buildings.The cityis a major industrial, commercial and cultural hub and capital for the south-western parts of the country. The city has however been experiencing rapid urban population growth (CSO 2002) mainly due to rapid rural – urban migration and natural increase, leading to housing shortages and deteriorating living standards. While the city unlike Harare did not record widespread informal settlements and illegal extensions prior to the demolition exercise of 2005, two factors nonetheless that manifest the housing crisis are the ever bulging housing waiting list and high numbers of occupants per room so much so that in some old townships, a room can accommodate over 6 people.The city has always loathed and heavily discouraged informal settlements with only a few standalone informal shacks such as Ngozi Mine in Killarney and some few homeless people living adjacent to the city's dumpsites. However, before 2005, there the city had witnessed numerous illegal extensions and outbuildings in mostly in very old high density suburbs of the city such as Njube, Pumula, Mzilikazi, Makokoba, Iminyela and Lobengula. The urban poor renting such outbuildings were largely affected by the operation; hence many surveyed and planned but unserviced housing plots were allocated to those affected by Operation Murambatsvina and other struggling (Gumbo, 2010a). Specifically, in Cowdray Park extension alone about 7 860 high density housing plots were allocated to the low income households to incremental build their houses and collectively provide on-site infrastructure services such as water, sewer, roads, schools and other essential utilities progressively. The innovation in making land and housing accessible to low income households resulted in the experimentation of a composite and hybrid approach (Figure 4) that makes housing affordable and improves targeting of the poor.

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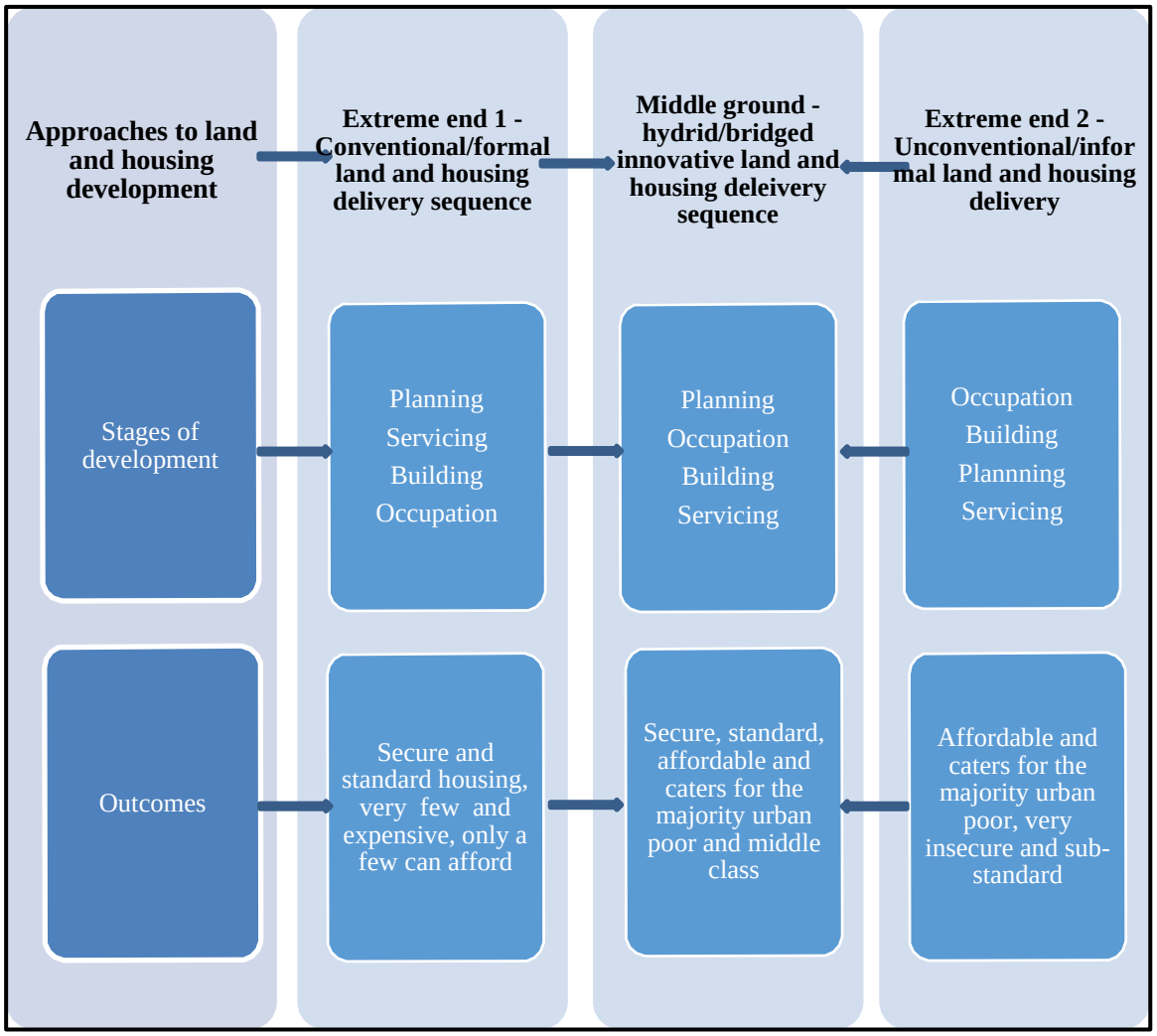

Figure 4: Hybrid and composite approach to land and housing delivery- bridging the gaps between formal and informal land and housing delivery approaches (Author 2015, developed from ideas put forward by Baross, 1990; Gumbo 2014a, b)

The adoption and use of the POBS sequence in land and housing delivery in this programme assistedin addressing the traditional problems of housing programmes that inadvertently miss intended low income households due to their lack of affordability considerations. Through the allocation of unserviced but well plannedhousing plots that had been part of already existing layout plans as well as the use of approved but a variety of house designs, the massively adjusted sequence helped to ensure orderly development and arrangement of plots that had spaces for future onsite infrastructure development. Participants paid very nominal deposits of US$ 150.00 after acquiring their housing plots. They are also contributing very low monthly subscription fees of US$ 5.00 towards the servicing and development of theircommunities. This made housing very affordable even to the informal employed that have erratic and unreliable incomes especially if compared to housing plots and completed units in the private market that are costing between at least US $ 3 000. 00 and US$12 000.00 respectively and require huge amounts of over US$ 1 000.00 as deposits and regular instalments of more than US$ 150.00 monthly.Generally, private companies in the city service very few stands for salaried high and middle income people that can afford these high costs leaving out the low income people. This programme has witnessed extensive development of housing plots, where participants have put up structures of varying sizes and levels since 2005 as portrayed in Figure 5.

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Figure 5: Incremental developments of structures on unserviced housing plotsby low income households in CowdrayPark Extension since 2005 (Field Studies 2010-2015)

Incremental development of structures and investments that have been made as funds permit have led to the empowerment of the urban poor and enabled them to control the development process as espoused by various scholars and international institutions (Adebayo, 2011; Turner, 1976; World Bank, 1993).The community is being transformed into a liveable environment.To make the community accessible, habitable and eliminate any likelihood of outbreaks of environmental and health disasters, the community is being provided with access roads and serviced with sewerage system so that households stop relying on blair toilets that pollute underground water (Figure 6).

Figure 6: Incremental developments of road and sewer infrastructure services in unserviced housing sites by low income households in Cowdray Park Extension since 2005 (Field Studies 2010-2015)

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The low income households have been integrated within the greater Bulawayo city through massive access and district distributor roads construction. They are also participating in the wider economic and social activities of the city.Households are actively involved in the development of the wider community by making contributions towards the purchase of sewer and water pipes and the construction of roads and culverts. Field observations also revealed that communal water taps have also been provided throughout the communities as the households wait to be connected to the running water system of the

city. Essential facilities such as primary schools and pre-schools have been built and more are being developed for the community (Figure 7).

Figure 7: Incremental developments of school and water facilities in unserviced housing sites by low income households in Cowdray Park Extension since 2005 (Field Studies 2010-2015)

Housing co-operatives and the consortium of the low income households have been instrumental in the pooling of resources together for the purposes of developing the suburb to the status of any other low income housing neighbourhood in the city. To avoid speculative tendencies by those who already have houses and high incomes; housing plots that are not occupied or not being developed after a reasonable period are repossessed. On a case by case basis, the urban poor that genuinely struggle to develop their housing are given a reprieve.

6. Conclusions and Recommendations

The adoption and use of innovative land and housing delivery approaches promote access and affordability of decent and adequate housing to the majority of the low income households in developing countries. Most cities of the developing world, particularly in the African continent have large stretches of land that can easily be planned for to ensure order in the development process and housing plots of reasonable sizes. The urban poor in most African have made huge investments in precarious and informal housing units of which if they could be allocated well planned and located housing they could house themselves and contribute to infrastructural development incrementally. Making occupation of allocated planned plots a major element of the low income housing programmes promotes affordability and help to achieve targeting objectives as those who genuinely need a formal piece of land will be willing to live in temporary structures pending incremental development of both the plot and onsite infrastructure. Considering that governmentsthat are mandated by relevant town planning regulations to develop and service land for housing the low income households before they can be allowed to build and the fact that the private sector only cater for those that cannot afford huge amounts of private

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infrastructural development, government should adopt programmes that allocate planned but unserviced housing plots to deserving urban poor.

There is urgent need to put in place enabling and empowering instruments to facilitate the participation of the urban poor in finding solutions to their housing problem. Chief among the critical ingredients to massive low-cost housing programmes for millions of the urban poor is land delivery. It is believed that emphasis on innovative land delivery approaches will significantly ameliorate the urban housing problem in the continent's urban centres. If millions of the urban poor that currently live in informal settlements of the continent were situated on secure planned and surveyed but unserviced plots, the provisioning of on-site infrastructure could be taking place without much challenges as currently experienced particularly the reorganising and relocation of some informal settlers to make space for roads, sewer and water infrastructure. In the quest to find common ground between the formal and informal land and housing delivery approaches that are fraught with serious challenges specifically when targeted to the urban poor, this study the asserts that governments should adopt a significantly adjusted model; the planning-occupation-building-servicing (POBS) as it facilitates affordability and significantly achieves targeting of the urban poor in African cities. The model recognises the urban poor's needs, rights, and capabilities and also the gross inequalities commonly experienced in most cities of the developing world.

As long solutions to urban housing poverty leave out the critical and central factor of land provision and ways of innovatively making it available at reasonable costs to the urban poor, the majority will always live in informal settlements or sub-standard housing in cities of the developing world. African governments should pro-actively, continuously and timeously identify and efficiently expropriate suitable idle land around the boundaries of cities and cede it to local planning authorities for the purposes of allocating parcelled plots to low-income people before the housing problems get worse and informal settlements proliferate. In cases where the land is privately owned, central governments and local planning authorities should timeously and effectively enter into arrangements with owners to compensate appropriately. Local planning authorities should also identify vacant idle land between existing residential suburbs for the purposes of planning for it and allocating to deserving urban poor. Governments of African countries should build the capacity of their departments that are mandated to conduct physical planning and surveying of land for housing purposes. This will enable them to timeously and efficiently support city councils that always need the support of central government institutions to discharge their duties, functions and roles. Similarly, local planning authorities need to improve the resourcefulness of their physical planning and land surveying departments. Resources that should be prioritised to improve the operations of both central and local government planning and land surveying departments include finance, equipment and machinery, engaging technically skilled and experienced human resources and occasionally retrain them with also the ability to retain them. Such efforts will ensure that land is timely surveyed and planned for to produce layout plans that necessitates the allocation of land for housing development as well as commercial, industrial and community facilities and on-site infrastructure to attain self-contained communities.

The allocation of the housing plots should take into consideration the needy and those without properties and mostly on the waiting list and already organised in co-operatives to achieve targeting objectives of low –income housing programmes. There is greater need to support the beneficiaries of housing plots by organising them in pooling their resources building their houses and contribute towards the serving and physical development of the community at large. Non-Governmental Organisations (NGOs) should actively promote the transfer, adoption and use of low cost technologies by working closely with the

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urban poor (Madubeko, Ingirige& Sexton 2009) Community Based Organisations (CBOs), city councils and the central government. There is also need for continuous research, development, use and mainstreaming of affordable and building materials such as stabilised earth, innovative low cost technologies for servicing and developing these low income communities for example in the prefabrication of sewer and water pipes. There is also need to reflect innovations in land delivery and housing and building statutes hence they should significantly be adjusted.Eccentric sources of housing finance by the urban poor (Gumbo, 2010b) should be supported. These could be in the form of urban poor's income generating initiatives that predominantly lie outside the formal sector activities and micro-finance institutions. Supporting informal economic activities such as home based trading and manufacturing facilitates the linkages between home and work for the greater benefits to the urban poor. This works towards supporting supply side instruments of making housing affordable such as revision of serving and building standards by strengthening the demand side instruments such as income generation support.

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-029

Economic Development post Sichuan Province disaster

Olebogeng David Daw

Abstract

The earthquake of May 12, 2008 in the South West of China, and specifically in Sichuan Province, is ranked as the most devastating natural disaster of the past 59 years in China. It registered a magnitude of 8.0 on the Richter scale, with a high intensity and with a large number of aftershocks. It affected a vast area of that province, with the most prominent being Beichuan and Wenchuan Cities which were almost destroyed. Although the earthquake occurred in a remote south-western Chinese region, with a small population and where local agricultural production was not damaged, the impact on China's economy as a whole was not too great. Post-disaster reconstruction work and the injection of financial investment in the region have had the effect of promoting local economic development in the province.

In this paper, a review of literature relating to the challenges and opportunities that Sichuan province had to deal with in the aftermath of the earthquake and how this led to opportunities that have resulted in economic development in the Province was conducted. The study revealed that the earthquake negatively impacted on the construction sector of the economy with regard to infrastructure for transport, telecommunications, water, energy, health and education. Providing financial support and enforcing policies that encourage reconstruction and redevelopment of infrastructure will continue to engender economic development in the province. This approach could prove a valuable lesson to Africa.

Keywords: earthquake, economy, development, disaster, Sichuan province

1. Introduction

Economic growth is regarded as a prerequisite for economic development. Developing countries are unable to grow their economy with the rest of the world, partly due to poor infrastructure to support their economy (European Commission, 2010). Therefore for developing countries to attain economic development more needs to be put in building or repairing infrastructures. The Millennium Development Goals (MDG) do not account for infrastructure development as a priority and yet without infrastructure most of the MDG cannot be achievement. Improved infrastructure in a country attracts foreign direct investment and efficiency of business. Infrastructure also leads to economic activities flowing freely. Roads, electricity and communications can be delivered and technological capacities can be promoted in the workplaces with good infrastructure. China is characterized by both achievements and challenges.

The People's Republic of China (PRC), is a sovereign state located in East Asia. It is the world's most populous country, with a population of over 1.35 billion people. The PRC is a single-party state governed by the Communist Party, with its seat of government being based in the capital city of Beijing. It exercises jurisdiction over 22 provinces, five autonomous regions, four direct-controlled municipalities

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

(Beijing, Tianjin, Shanghai, and Congquing), and two mostly self-governing special administrative regions (Hong Kong and Macau).

China had the largest and most complex economy in the world for most of the past two thousand years, during which it has seen cycles of prosperity and decline. Since the introduction of economic reforms in 1978. China has become one of the world's fastest-growing major economies. As of 2013, China had the world's second-largest economy by both nominal total GDP and purchasing power parity (PPP), and is also the world's largest exporter and importer of goods.

The Sichuan Province is in the Southwestern part of China; it is a land-locked province and is not a major manufacturing hub. In addition, Sichuan's GDP and industrial production is only about 4.2 % and 2.5 % respectively. Its exports are less than 0.2 %. However, the Sichuan province is a major agricultural province with its produce accounting for 20% of its local GDP mainly from rice and pig products. These in turn accounting for 6.1 % and 7.3% respectively.

According to 2007 statistics, the population of Sichuan province was 81.7 million people, and accounted for 4.2 % of the total population in China. The Wenchuan earthquake which affected most parts of the mountains only affected a small number of factories, and the agricultural production output value accounted for 0.3 % of Sichuan Province. Sichuan has a unique advantage of resources. Sichuan has a long history of outstanding people, and has since ancient times been known as the "Land of Abundance." It is rich in natural resources, agricultural resources and tourist resources. There are five World Heritage sites and many charming tourist attractions. Sichuan is located in the hinterland and the Yangtze River upper reaches to the Southwest. It covers an area of 485,000 square km and with a population of more than 81.7 million, it is China's populous western region. In 2007, Sichuan's GDP was 10505 billion.

Cultural tourism is one of the pillar industries in Sichuan; The Wenchuan earthquake caused most types of small and medium-sized damage to cultural tourism.

2. Economic Development

Economic development is a process, in which an economy not only experiences an increase in its real output per head, but also undergoes major structural changes such as infrastructural development. It can be regarded as a process of growth and change aimed at raising people's living standards. It involves growth in total and per capita income. It is also accompanied by fundamental changes in the structure of an economy.

Development theories seeks to explain and predict how Economy do or not develop over time, The Harrod-Domar Growth Model theory discusses the level of saving and productivity of capital and its impact on economic growth. The model states that a country should save part of its national income in order to replace damaged capital stock. The theory views investment as a necessity to growth in the economy. The Harrod-Domar model was built independently by Roy F, Harrod 1939 and Evsey Domar in 1949. Their model reported same results and model was built during a recession, which resulted in high unemployment and lower economic growth in the periods of 1929 and 1930. The theory was built from the Keynes discussion on why markets fail to bring full employment. For economic growth to be achieved, saving needs to happen in order for investment in infrastructure to be realised in the economy.

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

3. Earthquake in Wenchuan region of Sichuan Province

A massive earthquake measuring a magnitude 8.0 on the rector scale struck the southwest area of China, on 12 May .2008. The epicenter was in Wenchuan County, 92 kilometres (km) northwest of the Sichuan provincial capital of Chengdu. The earthquake affected a vast area, including 10 provinces, (Sichuan, Shaaanxi, Gansu, Chongqing, Yunnan, Hubei, Guizhou, Henan, Shaanxi, and Hunan), 417 counties (cities and districts), 4,667 towns, and 48,810 villages. The total disaster area covered 500,000 square kilometers, in which the 51 worst-affected counties (cities and districts) in Sichuan, Shaanxi and Gansu provinces covered 130,000km2. The Wenchuan earthquake had a high intensity with a large number of aftershocks. The earthquake-affected areas in Sichuan, Shaanxi and Gansu provinces which are mainly mountainous and hilly, and the altitude across most of the area is high. These conditions caused secondary disasters, such as landslides, collapse and mud-rock flows.

According to the strategy of sustainable development, Chinese Academy of Sciences, Chief Scientist, Staff Officer State Council, Professor Niu WenYuan's preliminary calculation, the Wenchuan earthquake caused direct economic losses of up to 1300-1500 billion Yuan, representing 70% of China's losses in the last decade due to natural disasters.

However the Wenchuan earthquake damaged only a small number of factories and agricultural production, accounting for 0.3% of Sichuan province's output value. The pertinent question was therefore whether the earthquake had effects on the food prices or had led to an increase in inflation?

The Wenchuan earthquake did not have a significant impact on the country's agricultural price level, because:

a) The reduction in agricultural production from Sichuan accounted for only 0.3%. China's economy is large, therefore this 0.3% of agriculture output value could not have pushed up the price level of national agriculture products.

b) Second, the majority of hard-hit area's damaged houses, post-disaster reconstruction did not increase demand for cement and construction steel. However transport and cement storage cost, the cement demand in the affected area and price saw a significant increase during post-disaster reconstruction, but did not push the national price because the affected areas had a small population and the economic activity in these areas was relatively backward.

The center of Wenchuan earthquake in the mountains were not grain-producing areas, the region's contribution to the national output was relatively low and so the Wenchuan earthquake did not lead to price hikes of food and agricultural products. Therefore, the Wenchuan earthquake's effect on food production was limited. Of course, when the market is big and is affected by a disaster and to see a lot of food being sent to the disaster area can have psychological impact, and could result in human or psychological panic, resulting in an increased pressure on inflation in the short term. For example in Taiwan's earthquake of 1999 inflation increased by 0.5%, for 2 months. However, China is vast, has more food production bases, therefore the influence on national food production would not be significant.

The earthquake in the Wenchuan area, in spite of the large seismic amplitude and the wide extent of the local economic loss, because these areas are sparsely populated, with a relatively backward economy, underdeveloped market and little contribution to the GDP, the impact to the national economy as a whole

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ISBN 978-0-86970-787-6

was not to be too great. But also in post-disaster reconstruction process, as a result of the earthquake-stricken area in which the economy suffered a devastating blow, the central government in the region had enormous financial investment for example, road transport.

According to the ABS Consulting report 2008, Total Dead: 68,683, Total Injured: 360,358, Total Missing: 18,404, Total Homeless: 5 Million (estimated), Total Displaced: 15 Million, More than 80,000 survivors had been rescued from the ruins and over 8 million people had been resettled.

4. Losses after Earthquake

According to the United Nations Economic and Social Council report of March 2009, the following factors made the rescue and relief effort challenging:

a) The most seriously affected areas were mountainous, with deep valleys, and were frequently marked by significant secondary geological disasters, which caused one third of the total earthquake deaths;
b) The quakes and consequent landslides destroyed, damaged or blocked roads, bridges and waterways, which made the transport of required rescue personnel and equipment to many areas hit by the quake and urgently in need almost impossible;
c) Telecommunications facilities were disrupted throughout most of the area affected by the quake, particularly in the eight most damaged cities and towns, where telecommunications were totally disabled for at least 30 hours. No information could be sent out of these areas and rescue teams could not be deployed in a timely manner. In areas where satellite mobile handsets became available, the sharp increase in the number of calls jammed the systems;
d) Unrelated heavy rainfall and dense fog further impeded the deployment of rescue personnel, equipment and vehicles, particularly to areas where airdrop and helicopter were the only means of delivery.
e) By 27 May, more than 8,668 aftershocks had occurred, including 28 which were above magnitude 5.0 and 5 above magnitude 6.0. Many secondary geological disasters, such as landslides and mud-flows, had been triggered and the devastation they caused was intensified by heavy rains.

They also led to the formation of 35 high-risk quake lakes that were in danger of collapsing and causing more casualties and damage. In addition, 2,385 reservoirs had been reported to be in dangerous condition. These potential risks posed grave threats to evacuated people and rescue teams, and consumed resources that were used to prevent those situations from becoming disasters themselves.

The Wenchuan earthquake caused extensive damage and heavy losses, mainly in Sichuan, Shaanxi, and Gansu provinces; and caused some damage in another seven provinces. Transport infrastructure, power supply, water and sanitation facilities, critical infrastructure such as hospitals and clinics and lifeline facilities, and communications were destroyed or badly damaged throughout the affected region.

A large number of rural and urban houses collapsed, infrastructure facilities were damaged on a large scale, agriculture and industry suffered heavy losses, and there was severe environmental destruction. The earthquake caused high altitude landslides, rock falls, and debris flows, and formed barrier lakes. The total direct economic loss caused by the Wenchuan earthquake was estimated at CNY852,309

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ISBN 978-0-86970-787-6

million; losses in Sichuan, Shaanxi, and Gansu provinces were also estimated at CNY845,136 million (99.16% of the total).

5. The Response after the Earthquake

The Chinese State Council set up an earthquake disaster relief headquarters as soon as the Wenchuan earthquake was reported.

However emergency response relies heavily on telecommunications. Urgent needs for telecommunications were first met by satellite-based means, as 25,000 persons were mobilized to restore telecommunications facilities that had been seriously damaged. A total of 383 emergency telecommunication vehicles were dispatched, many of them equipped with satellite communications facilities, but due to road damage, these vehicles could not reach some of the most seriously hit areas. More than 2,000 satellite mobile handsets were deployed.

The three provincial governments (Sichuan, Shaanxi, Gansu) launched a multi-level (provincial, city, and county) contingency plan to facilitate rapid and effective rescue and relief activities in the affected areas. Local governments organized search and rescue teams to rescue the people trapped in the collapsed structures and isolated, remote mountainous areas (in Sichuan alone 84,017 people were rescued from collapsed structures and 1.49 million were rescued from isolated mountainous areas and then relocated); medical teams and ambulances were organized to rescue the wounded; medicines, food supplies, milk powder, drinking water, tents, clothing, quilts, and other urgently needed supplies were delivered to the affected areas; quick action was taken to restore critical infrastructure such as water and power supplies, roads, bridges and telecommunications; urgent measures were taken to reduce risks from the dangerous reservoirs that had formed; and relocated people were provided with tents, food, drinking water, clothes, and other basic needs, and arrangements were made to treat people with post-disaster psychological distress.

Within the National Research and Development Programme, funds were urgently allocated to enhance response-related technical support activities in the following priority areas: a comprehensive assessment of the formation mechanism of the Wenchuan earthquake and the damage and loss it caused; the monitoring and prevention of secondary disasters; and other research and development projects supporting the rehabilitation and reconstruction effort.

6. Post-earthquake rehabilitation and reconstruction

The Regulations on Post-Wenchuan Earthquake Rehabilitation and Reconstruction were promulgated on 8 June 2008 by the State Council to ensure an effective and orderly post-earthquake rehabilitation and reconstruction and a stable resumption of normal life and economic activities. The regulations emphasized that the following guidelines should be followed throughout the rehabilitation and reconstruction period:

a) People-oriented actions to ensure a safer environment;
b) Scientifically sound and comprehensive planning;
c) Phase-by-phase implementation;
d) A joint funding mechanism combining self-reliance, government subsidies and social donation assistance.

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Under the regulations, a survey would be conducted to assess the damage and the resource needed for rehabilitation and reconstruction.

The central Government, in addition to the assistance it provided to the quake-hit areas for rehabilitation and reconstruction, also promoted the establishment of a paired assistance mechanism via which 19 provincial level administrations were assigned to establish one-to-one paired relations with a specific one of the 19 most seriously affected counties. The modalities of the paired assistance included the following:

a) Providing services such as reconstruction planning, building design and expert advisory, construction and supervision services;
b) Building and repairing residential buildings and public service facilities such as schools, hospitals, broadcasting and television facilities, and cultural, sports and welfare facilities;
c) Building and repairing infrastructures for services such as roads, water and gas supply, drainage, sewage and garbage disposal;
d) Building and repairing the agricultural infrastructure and providing agricultural technical services;
e) Providing machinery, tools, equipment, building materials and other support goods;
f) Providing teachers and medical personnel, organizing training and assisting in the provision of human resources and in job placement;
g) Encouraging investments in industrial and commercial service facilities and in commercial infrastructure development.

By 5 October, 2008 the resources committed for the mechanisms had reached 22.7 billion Yuan for the subsequent three years (UN Economic & Social Council, 2009)

7. Sichuan Economic Development

Sichuan had the unique advantage of post-disaster reconstruction policy. To support post-disaster restoration and reconstruction, the State Council and relevant state ministries and the province issued a series of preferential policies. Fiscal policy, from the central to the four affected counties had established financial disaster restoration and reconstruction funds, investment through project grants, corporate capital injection discount loans, 3 year hard-hit areas of some government relief funds and administrative fees and charges.

The financial policy and financial institutions were geared towards strengthening the building of grass-roots network, increase credit, enhance lending capabilities, to give a strong support. The January-September balance of RMB loans in Sichuan saw a 20.54 % growth, which was a high rate of increase much more than the national average of 5.7 %age points.

Tax policy, in the promotion of enterprises to resume production, reduction in personal tax burden to support the affected areas, the construction of infrastructure, and encouragement to the community to support post-disaster reconstruction to give preferential tax breaks also assisted ameliorating the problem.

Special policies were developed and inacted to specially address land policy for the restoration and reconstruction projects, arrangements for the use of land, while building approvals, as well as

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ISBN 978-0-86970-787-6

compensation for the use of free land and land sale revenues, the allocation of land were given a special treatment.

The birth of post-disaster restoration and reconstruction brought a large number of investment opportunities. The next few years, saw the restoration and reconstruction in Sichuan province add 47,800 hectares agricultural land, restoration and reconstruction of urban and rural housing 4.5 million, roads 51,000 kilometers, 5500 kilometers railway, 11,700 schools (including the teaching points, with classes), and enterprise 4,000 households. The massive reconstruction saw a consumption of 37 million tons of construction steel, 370 million tons of cement.

As announced by the State Council Information Office on 25 September 2008, government spending on immediate disaster responses topped 80.936 billion Yuan, with 90.8 per cent of that amount coming from the central Government and the rest from local Governments. Domestic and foreign donations reached 59.468 billion Yuan in cash and goods. Of the 53,295 kilometers of roads damaged by the quake, 53,020 kilometres were cleared; 128,163 of the 138,960 business outlets damaged by the quake were reopened; 215,851 quake-affected people found new jobs outside of the quake zone; and another 856,560 people resumed work in their hometowns

January-September of major economic indicators showed that the size of the province saw more than 360.33 billion Yuan of industrial added value, an increase of 20.0% on prior numbers; total fixed asset investment of 514.78 billion Yuan, up 29.5 %; total retail sales of consumer goods 338.56 billion Yuan, an increase of 19.5%., 32,000 SME's were affected with 93.4% of small and medium-sized entities or all of them having returned to full production capacity. As of the end of September, the province's small and medium-sized organisations achieved the added value of 333.15 billion Yuan, an increase of 19.0%. Therefore, Sichuan had again returned to a solid industrial base and the province's economic and social development fundamentals remained good.

8. Relief Financial Assistance

The Government allocated various monies to assist its citizens cope with the disaster. About CNY27.5 billion was allocated for disaster relief by the central Government, and this was supplemented by assistance provided by provincial and local governments. Financial assistance included a solatium of CNY5, 000, which was provided for each Deceased person; a subsidy of CNY28, 000, provided for the seriously injured; a special relief subsidy of CNY600 per month, which was being provided for orphans, the elderly and handicapped people.

Further, the Government provided a subsidy of CNY10, 000 to farmers whose houses were severely damaged, which was supplemented by the local government. The Government also established a system of counterpart restoration and reconstruction support, with provinces helping heavily affected counties—each province provided 1% of their revenue over the previous financial year to support reconstruction and rehabilitation in a heavily affected county.

The Government requested support from the local and international Community and donations totaled CNY59.5 billion. The assistance from the international community was mainly focused on providing funds and relief supplies, sending rescue and medical teams, and providing technical support.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

The disaster's financial impact represented about 3.3% of the country's gross domestic product for the 2007 fiscal year, and obviously impacted the country's economy. The earthquake was the second significant disaster to hit the PRC in 2008 (after the snow disaster in the southern provinces).

The $1.5 billion in loans included requests for:

(a) a loan from the World Bank of $710 million, of which $510 million was allocated to Sichuan for reconstruction of urban and public health facilities, and $200 million to Gansu for reconstruction of education facilities;
(b) a loan from ADB of $400 million, of which $300 million was for Sichuan for rural road reconstruction and $100 million for Shaanxi for reconstruction of rural roads and bridges and primary and middle schools;
(c) a loan from Agence Française de Développement of $200 million for urban infrastructure reconstruction and biogas facility restoration in Sichuan;
(d) a loan from International Fund for Agricultural Development (IFAD) of $30 million and a grant of $1.5 million for biogas facilities restoration in Sichuan; and
(e) A loan from the European Investment Bank of $160 million for ecosystem restoration in Sichuan.

9. How the Post-Disaster Reconstruction led to Economic Development

Huang Xiao Xiang said that the post-disaster reconstruction had the potential to provide great business opportunities. Areas of roads, bridges, housing and other infrastructure need massive reconstruction, and reconstruction process is not a simple copy, but a higher level of construction and the development of a higher starting point, which would lead to industrial restructuring and upgrading. In addition, the post-disaster reconstruction would have a derivative investment, in parts which were not taken seriously or in areas were marginalized as a result of new investment opportunities.

The post-reconstruction plan led to economic development of the province by:

a) The reconstruction and improving of road conditions and accessibility in townships and villages in Sichuan ,Shaanxi and Gansu;
b) The reconstructing and improvements in schools and building of new schools which created local employment opportunities in construction and related activities;
c) The economic benefits of the rural roads and bridges including savings in vehicle operating costs as a result of improved traffic and road conditions, time savings for rural road users, savings in road accident costs as a result of fewer accidents, and economic benefits from generated traffic.
d) The reconstruction and upgrading of rural roads in Sichuan and Shaanxi provinces benefited millions of people;
e) As reliable transport to markets became more readily available, cash crop farming in remote or isolated areas was stimulated and access to off-farm employment opportunities was be broadened;
f) The focus on reconstruction of and improvements to schools brought immediate benefits to the schools and long-term benefits to future students drawn from the 460,000 residents of the areas serviced by the schools 40% of whom were from rural areas of remote counties.
g) The reconstruction plan contributed to the government efforts to rebuild the economy, by rehabilitating public infrastructure and utilities, reinstating seismic code compliance, and generating employment.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

The rehabilitation and reconstruction of damaged schools, dams and parks, enabled education services to be restored, and ofered long-term benefits for affected persons by supporting opportunities for employment and participation in economic activities.

10. The Sichuan Province Contraction Development Projects

The construction industry around the world encounters various challenges and problems that hinder its performance. However in a developing countries, these problems are real along with a general condition of socio-economic pressure, institutional weakness, shortage of resources, and payments delays (Barnor, 2010). The Sichuan post disaster project had a number of emergency development programmes which where successful because:

a) The programmes / Projects were well publicized for everyone to know about them;
b) There was enough support given by the private sector and the government;
c) The china government had taken the responsibility for growth and success of the contractors;
d) Work and funding was provided by Governments Departments at local and national level.

In every industry it is important to have experience for the role to be performed with excellence. The contractors focused on the practical training of contractors' site supervisors, in addition, the contractors themselves received management and business guidance aimed at increasing their management abilities and work productivity.

11. Conclusion

The large-scale post-disaster reconstruction work greatly promoted local economic development. The Wenchuan earthquake did not have a major impact on the Chengdu business environment, businesses continued to operate normally, although there was some impact on some sectors such as tourism and residential/ commercial real estate, there was a push for foreign investment into the region. Therefore, Sichuan remained solid on its industrial base and the provinces economic and social development fundamentals remained good. Developing nations and Africa in particular could learn a lot from the Chinese response in addressing the challenges they face on infrastructure.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-035

Land-based Financing for urban infrastructure in Sub-Saharan Africa

Ian Palmer[1], Brendon van Niekerk[2], Nick Graham[3]

Abstract

In the coming decades, Sub-Saharan Africa is projected to experience ongoing and increasing population growth, economic growth and urbanisation, with consequent pressures on demand for land, housing, infrastructure and services. Access to capital finance is a critical constraint in providing and improving infrastructure and consequently, the quality of life of urban residents. In the past cities have had to rely heavily on transfers from national government and contributions from donors. However, future success is clearly dependent on cities raising their own capital finance. This paper is based on research funded by the United Kingdom (UK) Department for International Development (DfID) relating to 'Harnessing land values for urban infrastructure in Sub-Saharan Africa'. This was performed primarily through a review of published literature, three country case studies (Ethiopia, Kenya and Zimbabwe), experience of the authors of South Africa, and 28 property development 'mini' case studies undertaken in 22 cities in 15 countries (including South Africa and the three other country case studies). It was found that there is a significant amount of land-based financing occurring in Sub-Saharan Africa, particularly in the form of 'in kind' contributions towards urban infrastructure. It was also noted that there is a significant amount of 'reverse land-based financing' occurring where developments are unnecessarily subsidized by the local authority. It is imperative that correct infrastructure investment plans are put in place to coordinate development, particularly 'in kind' contributions', as well as the development of Development Charges and policies which are a relatively simplistic method of being reimbursed for public investment in infrastructure.

Keywords: development, finance, infrastructure, land-based finance, land value capture

1. Introduction

This piece of work was necessitated by the fact that infrastructure deficits in Sub-Saharan African cities are extensive, with over 200 million people, 62% of Sub-Saharan Africa's urban population, living in slums with the rate of urbanisation resulting in continuing growth of poorly serviced areas. The World Bank has calculated Sub-Saharan Africa's infrastructure investment requirements at USD 92 billion per year (Foster and Briceño-Garmendia, 2010). It is anticipated that the land-based finance techniques discussed herein could contribute to raising revenue for capital finance.

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

This paper is based on research work undertaken by the African Centre for Cities for the UK Department for International Development (DfID) on 'Harnessing land values for urban infrastructure in Sub-Saharan Africa'. The DfID project covered a wide range of issues associated with infrastructure finance in the sub-continent with the conceptual framework and key conclusions from the study incorporated into this paper.

The traditional measures of capital financing have considerable limitations, as they are dependent on local authority financial viability which is constrained in most Sub-Saharan African cities. Financing techniques whereby cities can raise their own source revenue require further attention, with details specific to the Sub-Saharan African context. One such technique is land-based financing which is the focus of this study.

For the purposes of this document, the term 'land-based finance' includes land value capture: both of the terms are utilised internationally and are generally interchangeable with one another. A useful definition of land value capture is taken from Suzuki et al, 2015:

Land value capture (LVC) is defined as a public financing method by which governments (a) trigger an increase in land values via regulatory decisions (e.g., change in land use or floor area ratio) and/or infrastructure investments (e.g., transit); (b) institute a process to share this land value increment by capturing part or all of the change; and (c) use LVC proceeds to finance infrastructure investments (e.g., investments in transit), any other improvements required to offset impacts related to the changes (e.g., densification), and/or implement public policies to promote equity (e.g., provision of affordable housing to alleviate shortages and offset potential gentrification).

However, in applying the term 'land-based financing' for this document, instruments which result in the cost of infrastructure being provided or financed by a developer, or the infrastructure being provided itself by the developer are included. This goes beyond the land value capture definition above.

2. Conceptual Framework for Infrastructure Finance

Cities evolve over time as they grow physically and economically and as they gain increasing control over the management of the services which allow them to function effectively. This transition is usefully illustrated in the diagram below which illustrates the progressive evolution of cities. In considering this progression it needs to be recognised that different parts of individual cities may progress in different ways. Nevertheless the concept of an evolution of a city as a whole is relevant.

In order to better understand Sub-Saharan African cities, a conceptual framework for land-based infrastructure finance was created. This helps to identify which types of land-based finance instruments are more appropriate for cities at different points of evolution.

Associated with the physical evolution of cities illustrated above, and aligned with a change in property configurations and the nature of urban services, there is a change in the way cities finance their service provision activities. This is illustrated inFigure 2 below which shows a transition in the way cities finance their operating activity (the day to day costs of governing the city, operating and maintaining the infrastructure and associated services provided by the city) and their investment activity (primarily the capital works required to provide new infrastructure and renew existing infrastructure).

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Livingstone, Zambia
ISBN 978-0-86970-787-6

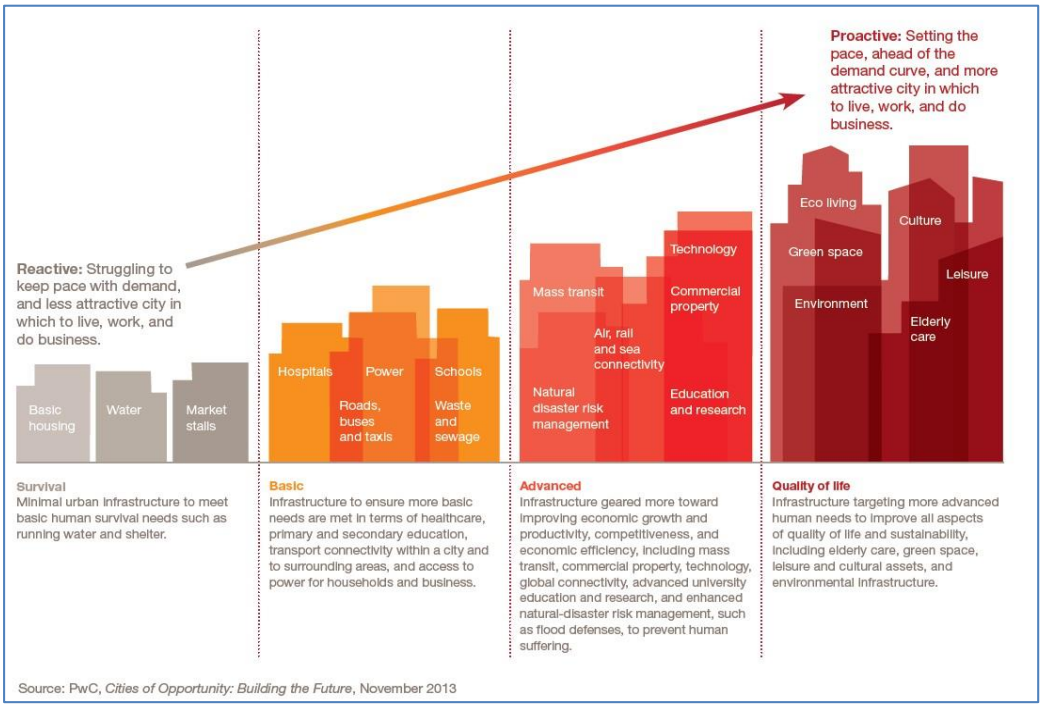

Figure 1: Illustration of the evolution of cities (Source: PwC 2013)

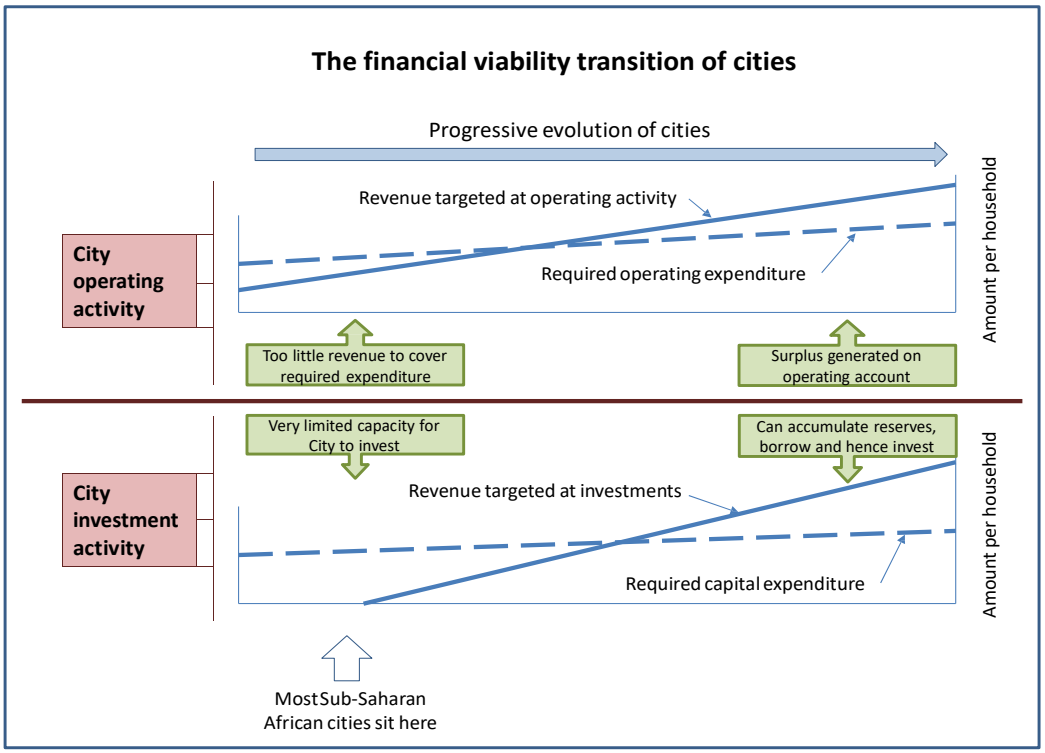

Figure 2: Illustration of the financial viability transition of evolving cities (Source: Authors)

In the case of **operating activity**, there are costs which need to be incurred to provide the expected service 'package' for the specific city. This cost will vary depending on the level of evolution of the city and the specific mix of functions which the City is mandated to undertake (albeit not consistently legislated). Costs will vary firstly based on the level of service which the City chooses (or is required)

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to provide at a particular stage of its evolution. Secondly cost vary depending on the stage of evolution of the city with costs increasing as the services provided shift from basic services to a fuller and more complex services package associated with a more 'advanced' city. Regardless of the stage of development, there is a minimum cost which the City will incur to provide an adequate level of service to all citizens and enterprises within the city's jurisdiction.

Cities have a range of sources of revenue for covering operating and capital expenditure, which are discussed below. These include revenue raised internally from citizens and enterprises and revenue that is, or can be, external to the City. However, the diagram above relates specifically to City own-source revenues. The opportunities for raising revenue vary firstly based on the revenue raising instruments assigned to the City in terms of national policy, and secondly based on the revenue collection capacity of the City at its specific stage of evolution. Thirdly, they vary because revenue generallyincreases as the city evolves and the economy grows. Onone hand this leads to increased consumption of services, while on the other, it relates to greater ability to pay for services as there is an increase in income to citizens and enterprises.

At the survival stage, which happens early in a city's evolution, the city typically cannot access sufficient revenue, even if it well managed, to cover the required operating cost to keep services functioning effectively. There is, therefore, a **fiscal gap**. It may be possible to close this gap through using external sources of finance, but this is not always possible. This means thatcities have to cut operating costs to match what revenue they have and hence the effectiveness of the services they provide is compromised. More evolved cities, however, are able to generate more revenue than they need to cover required operating costs, taking external funding into consideration, and hence have the potential to raise a surplus which can, *inter alia*, be used for capital investment in infrastructure.

With regard to the transition relating to the City's **investment activity**, cities which struggle to raise sufficient revenue even to cover essential operating expenditure such as salaries and emergency maintenance, typically cannot provide funding for infrastructure whether this be from reserves or from borrowing. In the latter case the inability to borrow relates to the perception of lenders that the City does not have sufficient revenue on its operating account to cover the costs of such borrowing (interest and redemption of loans, for example). As the City evolves and can raise more revenue it becomes able to accumulate reserves and hence receive a loan. In both cases this provides a source of finance for capital investment in infrastructure.

If cities in their early stage of evolution cannot raise capital for infrastructure provision themselves, how does this infrastructure get provided, if at all? Figure 3illustrates a range of options with the trend in the extent to which capital finance becomes available as cities evolve.

2.1 Funding provided by cities

The first block on the diagram relates to the previous figure (Figure 2) and demonstrates a position where cities in 'survival' mode cannot provide funds for significant capital works to a significant extent but that this situation improves progressively as a City evolves. This includes the special case, rarely applied, where the City sets up a ring fenced department or unit within its organisation and this ring-fenced unit can borrow money independently of the city and service the loan from its own cash flow. This means that the unit must be able to generate revenue itself through fees charged to consumers of the service it provides. While it may be possible for a city in or close to 'survival' mode to do this, it is more likely

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that this becomes a feasible option for cities which are more evolved, particularly for services which people are willing to pay, such as electricity and water.

2.2 Transfers and donations

The second block on the diagram relates to transfers of funding from national government (and in some countries regional government) to local government (cities specifically, given the focus of this paper). The term 'transfers' is applied here broadly, based on the approach by Shah (2013) to include tax sharing, general purpose grants and specific purpose grants. Also included in this category is donations (sometimes also called grant funding) provided by international development agencies and other donors.

The extent to which transfers are applied in a particular country, or through which national revenue is shared with local government in other ways, is highly variable across Sub-Saharan Africa (Paulais, 2012)and globally. At one extreme South Africa has a well-developed and administered set of transfers, backed by legislation, and Addis Ababa in Ethiopia also has a progressive system of national tax sharing which provides the majority of revenue for the City but is not sufficient for the City to provide services effectively. At the other extreme, Harare receives virtually no funding from the national government of Zimbabwe, and must rely on very limited internally generated funds.

2.3 External service providers

The third block relates to funding from sources external to the City where there is an external service provider appointed by the City or mandated by national government to provide services to citizens and enterprises within the city. There are two groups of service providers; parastatal organisations (independent legal entities with majority ownership by national, regional or local government) or public-private partnerships where a service provider is appointed to provide a service, which appointment requires the private partner to invest in infrastructure. As the provision of capital funding is included, the contracts will be in the form of concessions, build, operate and transfer (BOT) or similar contractual arrangements.

In Sub-Saharan Africa there are few PPPs providing **urban infrastructure** (Paulais, 2012) although private companies have been engaged in water supply in South Africa, Tanzania and Mozambique, with varying levels of success.However, the provision of services by parastatals is common. In the case of electricity most countries in the sub-continent have national electricity provision parastatals with little or no private sector participation (Foster, 2008; and Eberhard et al., 2008). Water and wastewater services are also commonly provided by parastatals, with local authority owned parastatalsbeing the most common (Banerjee et al., 2008; and Eberhard, 2014).

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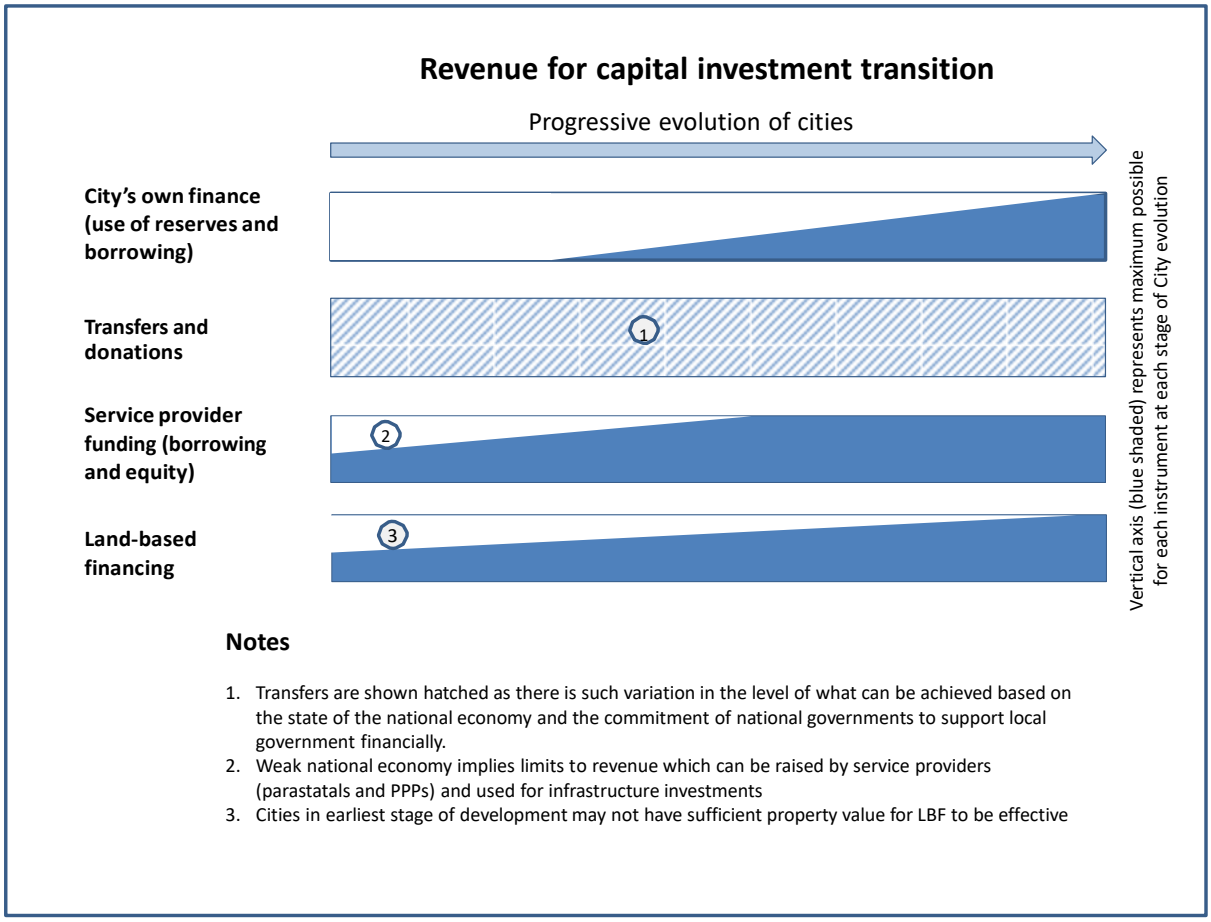

Figure 3: The transition for main options for raising revenue for investment in infrastructure (Source: Authors)

The extent to which these parastatals can raise funds to cover infrastructure investments in cities is an important consideration. Typically they do not have the fiscal resources to do so. They devote less than 20 % of their spending to capital, relying heavily on national government for finance: the funding of infrastructure which the parastatals provide in Sub-Saharan Africa is usually 80%-90% funded by the national government (Briceño-Garmendia et al., 2008).

With regard to the shape of the transition illustrated in Figure 3, the evidence given above of a lack of capital for investment by parastatals in cities in the sub-continent means that those in 'survival' and 'basic services' modes (see Figure 1) do not have sufficient capital to cover required costs. However, as the economy of countries improves, typically associated with an improvement in city economies, the ability of parastatals to raise funds for investment in infrastructure improves.

2.4 Overview of land-based financing

Considering the limited extent to which transfers, city own source revenue and service provider funding are able to cover the investments in infrastructure required for cities in Sub-Saharan Africa to function effectively, land-based financing becomes an important funding option. This option is discussed further in the remainder of this paper but the nature of the transition in the extent to which this funding option can be applied is relevant here (block 4 in Figure 3). The diagram shows that a form of land-based financing can function even for cities in 'survival' mode which is the most important feature of this

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grouping of financing instruments. However, at this stage of a city's evolution, the value of property in the city is relatively low with much of the infrastructure needed being for poor households who can pay very little, if anything, towards the capital cost of infrastructure. This is not to ignore the fact that in some of these cities in 'survival' mode pockets of very high value land are found, mainly because they fall within areas that are both well located and which have some access to infrastructure.This shows that even in those cities there is an unmet demand for serviced land, which is what will make land-based financing of one sort or another viable even in these cities.It won't meet the cities overall infrastructure needs but it will support a higher proportion of more formal land development than would otherwise have been the case. However, overall land-based financing for cities in 'survival' mode has its limitations too.

3. Land-based Financing Instruments

3.1 Principle of land-based finance linked to the application of subsidies

The principle of land-based finance and its linkage to subsidies is applied in this paper. Land based financing for infrastructure only occurs where an investment additional to requirements of the specific property investment occurs. This can be in the form of additional bulk capacity, connector infrastructure used by other developments or social infrastructure utilised beyond the property development. Preferably, there should be some form of cross-subsidy from commercial and middle to high income residential property owners to fund infrastructure for poor households. This situation is illustrated in figure 4.

The neutral point (rating 0) relates to the 'benchmark' situation where a property developer covers the full cost of internal infrastructure, land and the building. Moving to the right on this diagram indicates a positive trend with regard to land-based financing as the developer (and ultimately property owners) pays progressively more for connector, bulk, social and community infrastructure. Finally, on the very right-hand side (rating 5) the developer will also contribute infrastructure, or funding for infrastructure, which serves poor households.

On the left-hand side of the diagram the public sector is contributing to the cost of internal infrastructure, land and, at the extreme, the building itself. In relation to the 'benchmark' position it is argued that this represents a subsidy to commercial, high and middle income residential property owners.

3.2 Individual instruments and where they are applicable

There is a range of land-based financing instruments through which property owners - often with the developer acting as an intermediary - contribute to providing connector, bulk, social and community infrastructure, and possibly subsidise infrastructure for poor households. Figure 5 relates to the way individual land-based financing instruments are applied to fund the provision of infrastructure across the city evolution scale. Land-based financing is directly related to the property development process as the funding is raised from property developers or property owners. In the early stage of a city's evolution there is a strong emphasis on providing new property on undeveloped land (often rural land) and as the city evolves there is an increase in building height and on improved building performance. There is also an increasing emphasis on the relationship of property to the living environment within cities, with improved green spaces, recreation and health facilities.

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This property transition is related to the transition with regard to infrastructure requirements shifting from basic infrastructure which serves individual property developments (water, sanitation, roads, stormwater drainage and electricity systems) to infrastructure which serves the city as a whole including higher order roads, mass transit systems, CBD improvements, ICT access, parks, public squares etc.

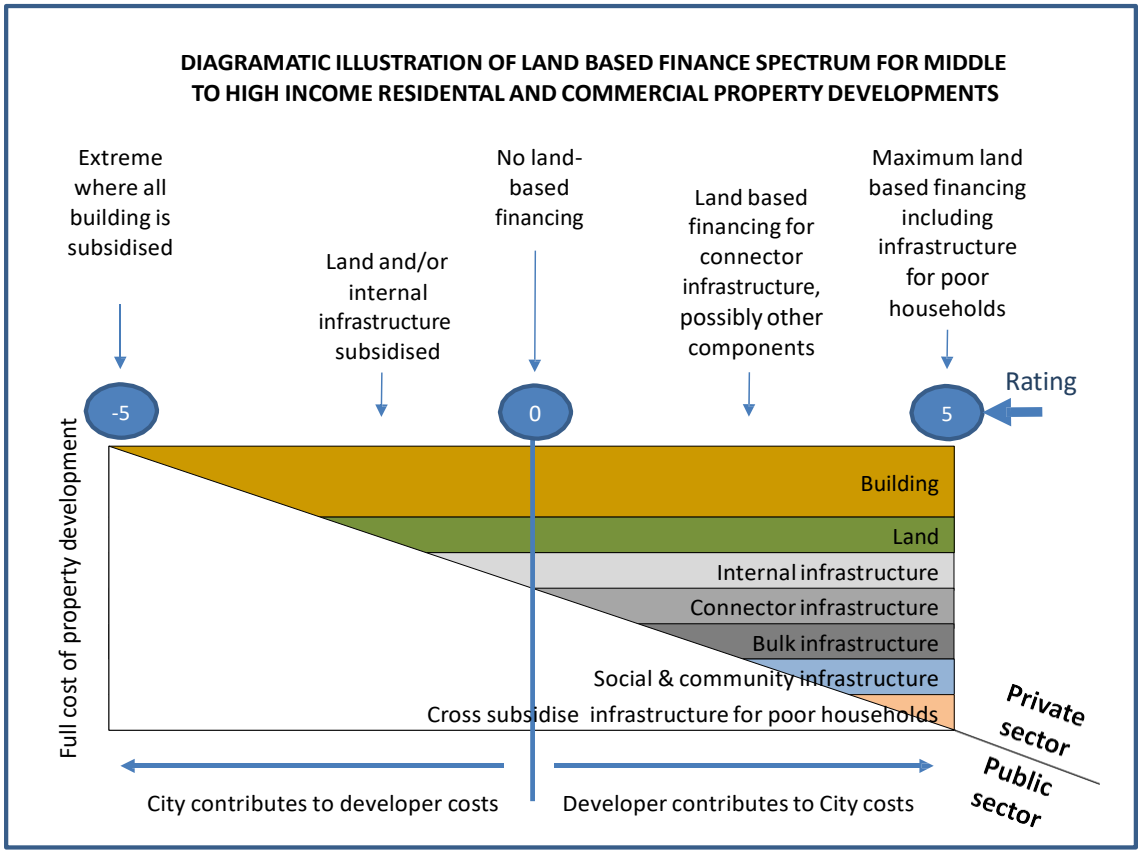

Figure 4: The concept of land-based financing applied to the cost elements of a commercial or middle to high income residential property development (Source: Authors)

Land-based financing instruments allow for funding to be raised through the property development process or through the process of increasing property rights or through increasing the benefits brought by improved infrastructure. Some of the instruments are more effective for cities in 'survival' or 'basic services' mode and others become effective as cities evolve and have the more complex administrative arrangements in place to support these more sophisticated instruments. Highly evolved cities have the ability to employ any of the land-based financing instruments.

There is a wide range of land-based financing instruments with many different names, much depending on where they are applied in the world and literature source used. The most popular or appropriate terminology has been applied. For the purpose of this paper the most important instruments are identified and defined in Table1.

There are other ways of applying land-based financing which require rearranging parcels of land to optimize their value. This is referred to as ***land readjustment*** whereby landowners pool their land together for reconfiguration and reconstruction, and potentially contribute a portion of their land for infrastructure, or to raise funds to defray infrastructure costs. Some of the land may also be sold to generate additional funding and some may be contributed towards streets and parks.

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Figure 5 uses the same horizontal axis as Figure 1, the city evolution scale. The key feature with the land-based finance instruments on the left hand side of it are that they are suited to cities which are at an early stage of development. ***Contributions 'in kind'*** can be negotiated with developers without the City having any complex systems in place although the capacity to negotiate with a developer remains key to success. Similarly a ***negotiated payment***, within a properly regulated and structured environment, for a particular property development does not require a system other than one which can ensure that the money raised by the City is in fact used for infrastructure to serve the property development concerned. But there is the disadvantage in this case that the negotiation requires a particular skill and there is room for corruption.

In the case of ***land sale and land lease*** options, the starting point needs to that the City has control over the land and can therefore sell or lease it. A proactive City with the requisite resources and capacity, could choose to buy up land, particularly where it is aware of its expansion plans or plans to provide new infrastructure. Ideally, this land can later be sold for more than it cost, to generate revenue. The ***sale of development rights*** is also a once off transaction relating to a particular piece of land or developed property where the developer gets increased value through a rezoning or through increase in permitted floor area ratio. Funding raised through all these instruments, as once off payments, should be directed towards infrastructure investment and hence be 'protected' within the City's accounting system to be considered a land-based finance mechanism.

While the literature sometimes differentiates between impact fees and development charges in other cases they are synonymous. This latter approach is taken in this paper with the term ***development charge*** preferred. The key feature of this charge or fee is that it is based on a considered policy and a formula which relates the amount to be paid to the anticipated impact of the development on different infrastructure networks, and which can be applied equally across all property developments. To a large extent it avoids the need for individual negotiations associated with each property development. The other key feature of this charge is that the finance which is raised needs to be ring-fenced for infrastructure provision.

The land-based financing options on the right-hand side of Figure 5 are associated with an ongoing payment of money by property owners. In the case of ***property tax*** these amounts paid are typically paid into the operating account of a City. If property tax is to be considered as an infrastructure financing measure then the operating account needs to be in surplus so that funds are available either for direct investment in infrastructure or for servicing loans or repaying bonds. It is possible for surcharges on property taxes to be charged to property owners in specific areas (city improvement districts, for example) but these are not typically used for providing infrastructure, although this is possible.

Betterment taxes or levies are amounts charged to specific property owners which will benefit from an improvement in infrastructure or through in increase in property rights. One of the best examples of this is in Columbia where (in Medellin, for example) betterment taxes are charged as an addition to property tax bills for those properties which will benefit from new public transport infrastructure (Ochoa, 2011). Typically a betterment tax is paid into a dedicated account and used to fund specific infrastructure through, for example, repaying the bond which is issued to finance the infrastructure that triggered the land value increase.

Tax increment financing (TIF) is a tool which is used in developed countries, particularly in the United States. A TIF area is designated, for any one of numerous reasons, and a charge is levied on properties

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within that area. The TIF is generally used to finance loans taken out by the City, via the City's operating account. The loans which the City takes out should be allocated for use in the TIF area. This is an advanced tool, requiring up to date property valuations, and hence has limited applicability in Sub-Saharan African cities.

In fact it is argued that in Sub-Saharan Africa generally (with South Africa as a notable exception), land-based financing for urban infrastructure using property taxes, betterment taxes and tax increment financing have limited applicability. In the case of property tax the main reason is that cities in the sub-region have not yet established sufficiently good systems for raising revenue from this source (Fjeldstad et al., 2014) and what they do raise needs to be directed to covering operating costs. Betterment taxes and tax-increment financing typically build on property tax systems and hence share the same limitations and, in addition, require special accounting and capital financing instruments.

4. Methodology

Current practice in Sub-Saharan Africa has been assessed through four approaches:

- A review of published literature.
- Three country case studies (Ethiopia, Kenya and Zimbabwe) undertaken as part of the DfID 'Harnessing land values' project.
- Experience of the authors of South African practice.
- 28 property development 'mini' case studies undertaken in 22 cities in 15 countries (including South Africa and the three other country case studies).

Given the complexity and variation of property development and associated infrastructure finance arrangements across the sub-continent, the situation which emerges cannot be stated as being fully representative but it does give and indicative picture of what is happening on the sub-continent.

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Table1: Land-based financing tools

Land-based finance instrument	**Definition**
In-kind contribution	The developer will be notified by the City that it is unable to provide infrastructure, and the developer will provide at least connector, or potentially connector and bulk infrastructure themselves. This maybe done under instruction from the City or as a voluntary contribution by the developer.
Negotiations and voluntary contributions	A bilateral negotiation, before the investment occurs, is used to determine a rate that property owners in the area of influence should pay for the improvement. (Peterson, 2009)
Sale of development rights	The sale of the right to convert rural land (agricultural or unzoned) to urban use; and the right to build at greater densities than normally would be allowed by zoning rules or height restrictions. (Peterson, 2009)
Public land leasing	If the relevant local authority owns the land, it would lease the land out for a period of time, thus generating revenue which should ideally fund urban infrastructure (Peterson, 2009)
Land acquisition and resale	The purchase of land around a development, and subsequent resale of that land by the public sector or relevant authority is a method to capture some of the gains that an infrastructure investment may create. (Peterson, 2009)
Land Sales	This instrument relates to the sale of publicly – preferably city - owned land and using the money to fund urban infrastructure (Peterson, 2009)
Impact fees and development charges	Impact fees and development charges are a once off capital contribution designed to cover the costs of the bulk and connector infrastructure required for a new property development or property development improvements and possibly fund other infrastructure not directly linked to the property development. The charge is based on a formula of some kind in a way that it can be applied consistently to all property developments (Peterson, 2009)
Betterment levies/taxes	Any tax or charge to a specific group of properties bases on some measurable feature of the property such as frontage, area or value which tax is levied based on the projected increase in value of the property resulting from some public infrastructural investment or change in property rights presumed to be of general benefit to property values in that area (Paulais 2012, Peterson 2009)
Property taxes and property tax surcharges	A property tax is a tax levied on the value of property (sometimes including land) by the local government. A surcharge may be applied in some situations, such as if the property is in a business improvement district or receiving benefit from a public investment (UN-Habitat, 2009).
Tax Increment Financing (TIF)	Tax increment financing (TIF) is a tool that allows municipalities to promote economic development by earmarking property tax revenue from increases in assessed values within a designated TIF district (Dye & Merriman, 2006).

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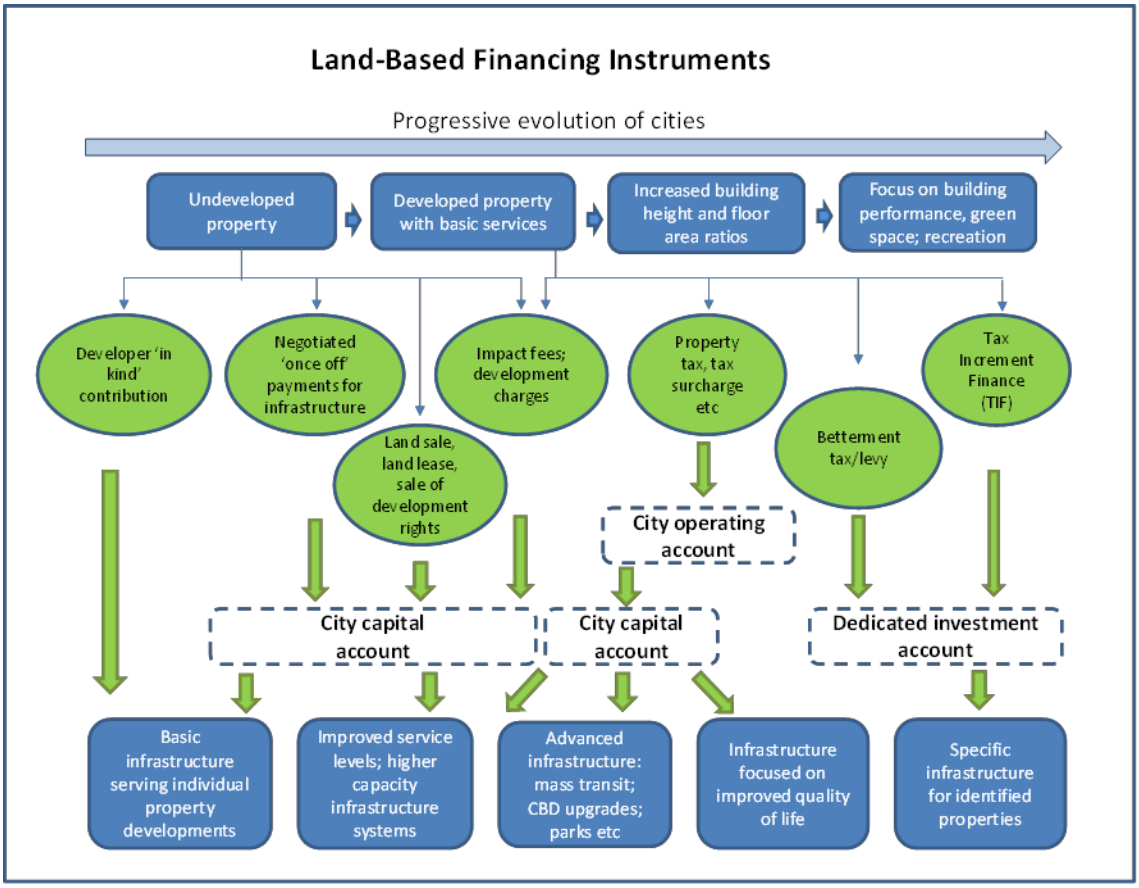

Figure 5: Diagram showing land-based financing instruments as they apply across the property development and infrastructure provision spectrum (Source: Authors)

5. Findings and discussion

The primary finding is that 'in kind' contributions by developers, where they construct connector and sometimes bulk infrastructure is common in the 15 countries. Secondly, aside from these 'in kind' contributions, only South Africa, Nigeria, Cameroon and Ethiopia apply other types of land-based finance instruments for financing infrastructure which are reasonably effective: South Africa has an evolving practice of development charges which is being applied progressively across all municipalities and Ethiopia (and Cameroon to a lesser extent) has a land lease system. There are other countries, notably Kenya and Zimbabwe, where developers are charged what could be called a development charge ('endowment contribution' in Harare and 'infrastructure levy' in Nairobi) but the funding raised is not used to finance infrastructure provision.

Thirdly there is a form of reverse value capture taking place in many cities where the public sector is funding all or part of the buildings, land and internal infrastructure for commercial and middle to high income property developments. It is evident from the case studies that the motivation is often that this is necessary in order to encourage developers to invest and hence promote the city economy in the long term. However, the benefits of the developments are not always clear and it can also be argued that the potential for the properties to rapidly appreciate in value is high; hence subsidising them may not be necessary, particularly if this is at the expense of subsidising infrastructure for poor households.

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Taking the findings from the 28 property development mini case studies, the results are summarised in table 2, which indicates the degree (scored from -5 to +5) to which land-based financing is being applied. It is evident from the table that there is a wide range in the way infrastructure for new property developments in Sub-Saharan African cities are funded and in the extent to which these developments – none of them being for low income housing – are 'subsidised' by the public sector in the way which is defined above.

6. Conclusions

Land-based finance is being applied quite widely in Sub-Saharan African cities, with by far the most common method being 'in kind' contributions by developers. Other instruments which are being applied relatively effectively are development charges in South Africa and land leasing in Ethiopia. Although this research has not been able to assess the scale of funding from these sources overall, it is evident that a substantially greater contribution towards providing urban infrastructure financing could be made through land-based financing. Further, it is evident that there is a lack of planning relating to the way funding can be accessed and applied to infrastructure.

There is also evidence that property developments for commercial and middle to high income residential property developments are being subsidised in the sense that the public sector (city or state) is funding internal infrastructure, land or even building costs. This too could be addressed through better planning in terms of how scarce resources are used to fund infrastructure.

There are several key recommendations which emanate from this research:

Firstly, it is important for cities to develop **infrastructure investment plans** which quantify the capital costs they need to incur to provide a functional system of infrastructure and match these costs with sources of funding. Typically there will be a shortage of funding which means the plan will have to deal with prioritising priority investments.

Secondly, there is a large financial gain which can be made through sound application of **development charges**. The biggest advantage in this case is that a city-wide – or country wide – policy can be applied to all property developments which allows for ease of administration and equitable treatment of developers.

Thirdly, once there is a sound plan and a commitment to a development charges policy, the negotiations with individual developers becomes easier. But this does not remove the need to negotiate **'in kind' contributions** for unusual and/or large scale property developments which may be in lieu of a development charge. However, the plan should provide a sound basis for entering into these negotiations.

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Table 2: The type of development and the number of property development in this category of land-based finance

Type of developer	**Rating**	**Number of property development in this category**
Developer finances a large proportion of bulk and connector, contributes to social and community infrastructure and some degree of cross-subsidy to low income households.	5	No developments in this category
Developer finances a large proportion of bulk and connector and contributes to social and community infrastructure but gets subsidised land.	4	6 (one each from Angola (mixed use), DRC (mixed use), Ghana (mainly commercial), Nigeria (commercial), Rwanda (residential) and Senegal (mixed use))
Developer finances connector infrastructure and contributes to bulk	3	2 (one each from DRC (mixed use) and Kenya (mixed use))
Subsidiary developer and/or Property owner pays for right to develop land through purchasing lease rights or through purchasing development rights in some other way.	3	2 (both from Ethiopia and mainly commercial)
Developer pays a fee based on a formula or some sort, which is intended to cover cost of bulk and connector infrastructure.	3	1 (Nigeria (residential))
Developer provides or finances connector infrastructure	2	3 (2 from Ghana (commercial malls) and one from Zambia (commercial mall)
Developer provides land and internal infrastructure; some degree of cross subsidy of low income housing	2	1 (South Africa (residential))
Developer provides land and internal infrastructure and limited connector infrastructure.	1	3 (one each from Kenya (mixed use), Nigeria (commercial mall) and South Africa (mixed use))
Neutral with respect to land-based financing: developer provides land (at market price) and internal infrastructure	Zero	2 (one each from Mozambique (residential) and Zimbabwe (residential))
Close to neutral in that developer provides land and internal infrastructure but with some softening of taxes, rates and other fees.	-1	2 (both from Côte d'Ivoire (both residential)
Close to neutral in that developer provides land and internal infrastructure but with land at below market prices	-2	2 (one each from Uganda (mixed use) and Rwanda (residential))
Developer only provides buildings with land and all infrastructure (including internal infrastructure) funded by the public sector.	-3	2 (one each from Benin (residential) and Cameroon (residential))
Developer only provides buildings with a partial subsidy (in addition to land and all infrastructure being provided by the public sector).	-4	2 (Cameroon and Angola (both residential))
Complete development, including buildings, funded by the State	-5	No developments in this category

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-003

Prompt Payment Act as a Means of Reducing Payment Delays in the Zambian Construction Industry

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Abstract

Timely payment in construction projects contributes to the success of contractors, consequently the project. This study therefore focused on assessing the viability of using a Prompt Payment Act (PPA) as a way of reducing payment delays in the Zambian Construction Industry (ZCI). To achieve this, questionnaires were distributed to a selected sample of construction parties in the ZCI. Findings indicated that main factors that cause payment delays are clients' poor financial management and delay in certification. Errors in claims and disagreements over the valuation of work done between the client and contractor were also noted. The findings further revealed that the serious effects of payment delays include cash flow problems for the contractor, time overruns and disputes which in turn create a negative relationship between clients and contractors. Consequently these factors inhibit the growth of local contractors in the ZCI. As such, it was recommended that the PPA be enacted as it would reinforce the existing legal remedies for contractors to enforce their right to claim payment. Hence, it is envisaged that the PPA will improve the current situation of payment delays in the ZCI and advance growth among contractors and other participants in the construction process through timely payments.

Keywords: construction industry, payment delays, Prompt Payment Act, Zambia

1. Introduction

Payment is considered as the lifeblood of the construction industry because construction works often involve very huge capital and take a considerable time to complete (Ali, 2005; Ameer, 2005). Thus, timely payment is a major factor that contributes to the success of projects and individual firms. However, payment delays are a serious problem in the construction industry of many countries (Ramachandra and Rotimi, 2011; Latham, 1994; Eagan, 1998; Maritz and Robertson, 2012). Further, payment delays affect the cash flow of contractors which is critical to meeting their financial obligations. According to Euginie (2006), this may lead to additional financing and transactional costs which may also lead to insolvency. This has thus been a challenge which construction professionals are seeking to address, world over. The Zambian Construction Industry (ZCI) is not an exception from such effects and

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

so are its firms operating in it. Hence this research focused on establishing how the Prompt Payment Act (PPA) can be used to help solve this challenge.

1.1 Payments in the construction industry

According to Judi and Rashid (2010) payment is a "monetary consideration for the contractor's performance or work done" in accordance with the contract. Contractually, the said money must be paid quickly and fully unless there are specific reasons for delaying or withholding it. Its importance to contractors cannot be overemphasized because these are the funds the contractor uses to settle their site and office expenses. With respect to forms of payment, under a typical construction contract, there are four types namely: interim payment; stage or phase payment; advance payment and lastly payment after completion or final certificate (Ramus et al., 2006).

1.2 Payment delays: Causes and effects

According to Ameer (2005), payment delay is defined as the failure by the employer to pay the contractor within the time stated in the contract. Further, Donkor (2011) asserts that payment delay is a situation where the Interim Payment Certificate (IPC) is not paid within the contractual stipulated time. This situation affects many players in the construction industry. It causes severe cash-flow problems especially to contractors and has a devastating effect down the contractual payment chain. This problem could possibly lead to a formal dispute resolution such as 'arbitration' or 'litigation' and those processes are very costly and take a long time (Ansah, 2011). Further, there are many factors that are said to be causing payment delays in construction (Nazir, 2006). Based on the research conducted by the Construction Industry Development Board (CIDB) of Malaysia (2006), payment delays are caused by both employers and contractors, and sometimes caused due to the contract. These are discussed below:

1.2.1 Employer-related causes of payment delays

These factors include the following:

- *Employer's poor financial management* – This may cause them to have insufficient operating funds to pay contractors (Ameer-Ali, 2005).

- *Employer's withholding payment* – This could be as stipulated by the contract which may be due to reasons such as major defective construction work, disputed work and failure to comply with material provisions of the contract (Lip, 2003).

- *Delay in certification* - This happens when the client takes longer than the stipulated time in the contract (Ramachandra, 2012; Reeves 2003).

1.2.2 Contractor-related causes of payment delays

Contractors also contribute to payment delays. In his work, Reeves (2003) identified that submitting wrongly calculated claims, submitting claims without adequate supporting documents, or using incorrect procedures, contribute to payment delays. Contractors usually need to resubmit the claims after making the necessary corrections. Additionally, when contractors fail to agree with the valuation of work on site, payment delays occur (Adballa and Hussein, 2002).

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

1.2.3 Contractual related factors

There are cases where contract agreements do not bring any justice to both main contractors and subcontractors (Artidi and Chotibongs, 2005). Thus where terms are not clearly outlined to handle any disputes, this may escalate and result in payments being delayed. By and large, the pay-when-paid clause also leads to delays.

2. The Prompt Payment Act

The Act had been enacted by countries that faced delayed payments in light of conclusions that the problem of late payments could only be addressed by adopting statutory remedies (Maritz, 2012). It gives a mandatory obligation to provide reasonable evidence, prior to entering into a contract, financial arrangements to fulfil the owner's obligations under that contract, as well as an obligation to provide updated information after the contract is entered into (Ramachandra, 2012). Further, if the construction contract is silent, or if it prohibits suspension or termination, the contractor or subcontractor who does not receive payment may still do so (Cox, 2013). It also provides remedies for any breach of its obligation and an expedited adjudication system to settle performance disputes (Robinson, 2002).

2.1 Advantages of the Prompt Payment Act

The PPA:

- *Provides clients with the right to withhold payment for unsatisfactory performance* - This is subject to the condition that the client within 10 days of receipt of the claim states in writing the reasons for withholding payment (Tricker et al., 2009).
- *Provides contractors with the right to suspend construction work for non-payment* –This is when a default has not been rectified after 7 days notice has been given with reasonable remobilization time given before works restart (Ontario Prompt Payment Legislation, 2013).
- Provides contractors with the right to reasonable information as to the client's financial arrangements which help contractors in evaluating the likely payment risks involved (Linscott, 2014).
- Reduces the major source of conflicts in the construction industry which is payment delays resulting in the industry being less litigious (Cox, 2013).
- *Encourages speedy resolution of disputes*- It introduces a rapid system and expedited adjudication to resolve disputes as a result of payment delays (Manuel, 2014).

Overall, the act will support the contractors' growth in the sense that with timely payments, the contractors will be able to pay their suppliers or subcontractors on time and consequently reduce the time spent on negotiations and sourcing finances which may in some cases attract interest. Relationships will be improved further along the supply chain.

2.2 Criticisms of the Prompt Payment Act

Outlined below are some of the major criticisms of the the PPA or legislation:

- *Limited Negotiation of Payment Terms* – It limits and prevents payment terms from being structured to best suit the project, having instead to follow a prescribed formula set out (Kinastowski and Pennachetti, 2013).

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

- *Disclosure of Financial Information* - According to Linscott (2014), the administrative burden to provide financial information for each project would be unnecessary and costly, especially for government projects. This right is also extremely broad with no limits as to how often a request would be made.
- *Payment Application Deemed Approved in 10 days* - Nebel (2014) noted that it would be very difficult for clients to comply with this time frame since sometimes it is impossible to certify work within 10 days due to a variety of factors such as verifying quantities, scope, lack of supporting documentation, material testing and non-compliance with regulatory requirements.

2.3 The potential benefits to the Zambian construction industry

If enacted the Prompt Payment legislation will offer the following benefits to the ZCI which have been noted in countries where it has been applied:

- *A level playing field in the ZCI* – The client is more protected than the contractor when it comes to performance. For example, clients have retention and performance security as ways of recovery and ensuring performance by the contractor while contractors have none of such ways of ensuring performance by the client (Banfai and Blaikie, 2013).
- *Increase participation in tenders for Government projects***.** Some contractors do not tender for government projects due to the high risk of delayed payments. By reducing this risk, it will enable more contractors to participate in these tenders, thereby making the government to receive competitive bids (Michael, 2007).
- *Reduce construction costs.*Contractors that bid for Government projects factor in the payment risk which increases construction costs. The act will remove the need for contractors to 'factor in' compensation for payment risk and the result will be lower but reasonable bids, reducing construction costs (Nebel, 2014).
- *Make the construction industry less litigious.* The legislation will eliminate or rather reduce the major source of conflict in the ZCI which is payment delays resulting in the industry being less litigious (Cox, 2013).
- *Provide clients with the right to withhold payment for work that is deficient.*This will provide clients with a right to withhold payment for work that is deficient or incomplete or which caused loss or damage (Tricker et al. 2009).

3. Research Methodology

Data collection was carried out in Lusaka and on the Copperbelt Provinces because these areas have higher construction activities than other provinces. 70 contractors, 9 construction clients and 27 consultants were interviewed. Quarter sampling was used to select of participants from contractor's category, from grades 1, 2, 3 and 4 with sample sizes of 14, 8, 12 and 36 respectively. Sample selection for clients was conducted purposively, to ensure that only those clients who would provide relevant information were approached. 27 consultants in total were interviewed involving. The consultants comprised 8 Quantity Surveying, 13 Architectural and 6 Engineering who were selected using quarter sampling as they were in subgroups. The response rate was 59%.

Data Analysis – Qualitative and quantitative data analysis methods were employed. Qualitative data analysis used included discourse and grounded theories. The Relative Importance Index (RII) was also

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used as a quantitative method, to determine the ranking of the causes of payment delays using the following formula:

$$RII = \left\{ \frac{5n5 + 4n4 + 3n3 + 2n2 + 1n1}{5(n1 + n2 + n3 + n4 + n5)} \right\} \times 100$$

Equation 1 – Relative Importance Index Source - Donkor 2011

Where RII = Relative Importance Index,

n1= Number of respondents who answered "Very Low Contributing"
n2= Number of respondents who answered "Low Contributing"
n3= Number of respondents who answered "Medium Contributing"
n4= Number of respondents who answered "High Contributing"
n5= Number of respondents who answered "Very High Contributing"

Research Limitation **-** In the ZCI various standard forms of contracts are used (e.g. FIDIC, NEC, JCT etc.). However, this research focused on the General Condition of Contract (GCC) which is mostly used in Zambia. The research did not cover how the PPA would be implemented in the ZCI but only assessed its viability.

4. Research Findings and Discussion

From the data collected, the following were the research findings:

4.1 Prevalence of payment delays

90.2% of the contractors indicated that they had experienced delays in payments. This clearly indicated that this is a huge problem which must be addressed if growth of the local contractors is to be enhanced. Respondents also indicated that delays were experienced more often on government funded projects as compared to the private sector funded projects. As a consequence, some responded indicated that they preferred working on private sector funded project to public ones. However, the government being the major client, they are still compelled to tender for government projects due to limited job opportunities from the private sector.

4.2 Causes of payment delays

The research categorized the causes as being contractor, client, and contract related:

4.2.1 Contractor-related factors

Failure to agree on the valuation amount was the highest ranked factor as indicated in table 1. Other factors included contractors' errors in their claim and delays in resubmitting the claim. These finding further indicated that the blame cannot be attributed only to one party to the contract, but to both the contractor and the client's representatives managing the financial side of the project (QS). Even though some of the factors such as 'failure to submit corrected claim in time' have a lower RII, they too contribute to payment delays.

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Table 1 - Ranking for Contractor-Related Factors

	Contractor-related factors	RII (%)	Ranking
a	Failure by contractor to agree with valuation of work on site.	55	1st
b	Contractor's delay in submitting claims.	44	2nd
c	Contractors' failure to understand the contract agreement.	35	3rd
d	Errors in submitted claims by contractor.	34	4th
e	Contractor's failure in submitting a new (corrected) claim.	22	5th

4.2.2 Client-related causes

Table 2 indicated that the highest ranking factor causing delayed payments amongst those attributed to the client was poor financial management. This factor had the highest RII implying that 'clients' poor financial management' must be addressed as a top priority issue. Clients delays in certifying work done for payment purposes came out second to poor client's financial management. Without any mechanism to compel clients to pay within the time frames stated in the contracts, this problem is likely to continue even in future. Clients disagreement to valuations was ranked least as can be seen from the table. This indicated that the likelihood of a dispute on the value of the certificate or work done was the least of the causes of delayed payment in the ZCI.

Based on the above findings, there is need for a mechanism within the ZCI to compel clients to abide by their contractual obligations in a quest to minimise delayed payments. Without any compelling mechanism, the problem of delayed payments occasioned by the clients will continue, all to the detriment of the contractors and the construction industry at large. Thus the proposed PPA, which emphasises disclosure of financial status, may be able to help the contractors have confidence in the financial capacities of the clients they would be dealing with.

Table 2 - Ranking for Client-related factors

	Client-related factors	RII (%)	Ranking
a	Clients' poor financial management.	92	1st
b	Clients' delay in certification.	86	2nd
c	Clients' poor financial sources/conditions.	77	3rd
d	Clients' failure to cultivate a good payment attitude.	75	4th
e	Clients' disagreeing on the valuation of work done.	39	5th

4.2.3 Contractual-related causes

The pay-when-paid clause was ranked as the highest cause of payment delays amongst contractual related factors as indicated in table 3. It can be inferred that beyond the adoption of the PPA, the ZCI will need to explore other types of contracts. The contract (GCC) that the research was based on, was found to be less effective by the respondents. Further to that, the clauses dealing with the terms of payments were found to be incomprehensive and were ranked second highest as can be seen from the table below. . It can be noted that the pay-when-paid clause creates a chain reaction with respect to delays in paying subcontractors mostly. Regardless of the strength of the clause dealing with payments

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Livingstone, Zambia
ISBN 978-0-86970-787-6

in the contract, the Act will also ensure that the main contractors meet their payment obligations to the subcontractors. This in turn will also protect the subcontractors and suppliers.

Table 3: Ranking for Contractual-Related Factors.

	Contractual-related factors	RII (%)	Ranking
a.	The use of pay-when-paid clauses	87	1st
b.	Contracts used are not comprehensive enough in terms of payment issues.	61	2nd
c.	Contracts used are too complicated to be understood by both parties.	32	3rd

4.3 Effect of delays on contractors

All the respondents indicated that the major effect is the cash flow problems as shown in figure 1. Other effects such as delayed completion and in worst situations, companies being bankrupt were also noted. Realising that cash flow is vital for the operation of any organization, delayed payments clearly have a huge negative effect on the growth of contractors.

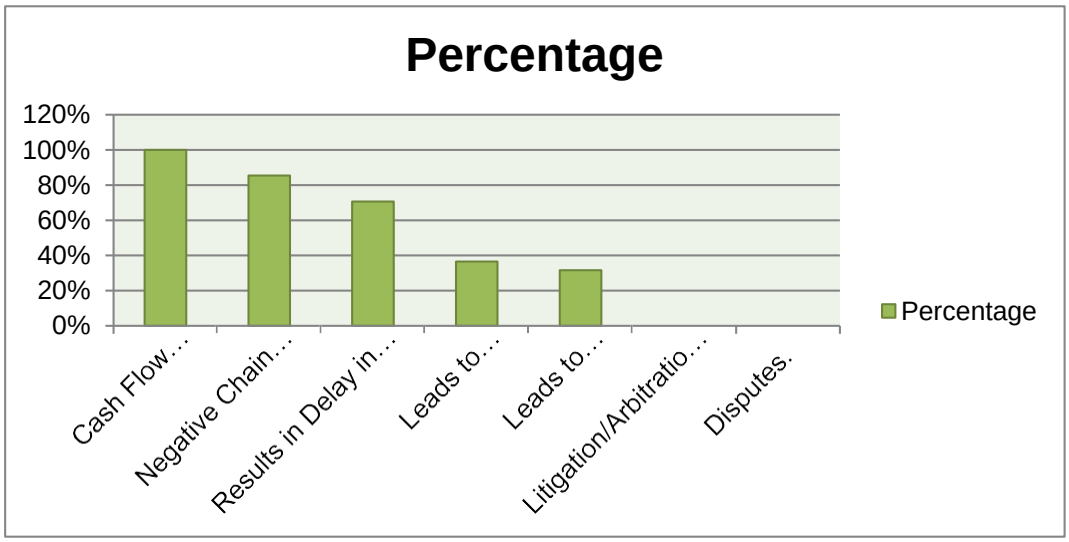

Figure 1 – Effects of Payment Delays on the contractors

Worth noting is the fact that the above stated effects of payment delays also affects the client due to the consequential delays on projects. Interestingly, none of the contractors indicated that they have had any litigation or arbitration cases due to the delayed payments. This may indicate the limited powers they have in using the contract when demanding for payments and invoking any rights thereto.

4.3.1 Adequacy of current remedies to avoid delays

Largely, the industry relies on the contract to make sure that the contractor is paid on time. However, the survey revealed that 52.4% of the respondents indicated that the problem was inadequacy in enforcement of the existing remedies provided for in the contract. 47.6% indicated that the available

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ISBN 978-0-86970-787-6

remedies are in fact inadequate in addressing such delays. Hence this clearly indicated that there is a need for the industry to assess other options that would help to minimise the problem of delayed payments in the ZCI or even to adopts other forms of contracts if need be.

4.3.2 Challenges in implementing the Prompt Payment Act

Respondents indicated that the legislation process usually takes long and this may not immediately help the contractors who are facing delayed payments at the moment. The findings further indicated that the levels of awareness or familiarity with the operation of the PPA within the ZCI were low. This is depicted by the low proportion of respondents (26.8%) who indicated that they were familiar with the Act while the rest were not familiar. Hence the lack of knowledge itself will also present a challenge to the use of the PPA. It was also found that the government which is the major client was not be too keen to adopt the PPA due to the disclosure clause and the time it take to prepare and disclose financial information.

5. Conclusion and Recommendations

Currently the ZCI is faced with serious problems of payment delays and urgent intervention is needed. This is because payment delays have been hampering development of contractors since these delays have a negative effect on the cash flows. These delays have been largely caused by both the client and contractor related factors. The major factor however was attributed to the clients' poor financing and management. Delays in certifying works is also one of the major factors. Currently, the remedies, which hugely rely on the contract, have been known to be inadequate due to their limitation in enforcement. Hence to spar growth amongst the local contractors, it will be imperative to ensure that the payments to contractors are not delayed and this is by adopting the PPA. However, this will present a challenge since much of the industry does not know how the Act operates. The act also seems to focus on eliminating client related causes of delayed payment. The biggest challenge also is that the government which is the biggest client may not be too keen to adopt it. On the other hand, it can be argued that the benefits of the PPA will add value to the clients' products since the contractor will be assured of steady cash inflows, to procure materials and pay the workforce on time. This will result in motivation and reducing unrest on site. Consequently, there will be assurance of projects getting completed on time due to its smooth cash flow. Therefore the act will not only help the contractors to grow but also allow other sectors to develop through the improved delivery of construction projects through timely payments.

Thus going with the above conclusions, it was recommended that all stakeholders must participate in ensuring that the act is implemented. Other causes identified which relate to the contractor and the contract, must also be mitigated by enlightening contractors on the preparation of claims and the use other forms of contract such as NEC and FIDIC. Ultimately, a holistic approach must be taken by ensuring that all contractual, client and contractor factors are avoided or eliminated. However, the long legislation process may not yield immediate benefits for the contractors. Going by this concern, stakeholders must also consider the other option of utilising the Prompt Payment Bond as an alternative to PPA as it offers a quicker recourse to the affected party.

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

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INTEGRATED INFRASTRUCTURE PLANNING AND MANAGEMENT

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-050

Risk Management: Improving Supply Chain Management

Mario M. J. Musonda[1], Erastus M. Mwanaumo[2]

Abstract

The purpose of this study was to establish descriptively the risks that affect the efficiency of public sector supply chain management through a case study for medicines in Zambia. The study focused on using project risk management processes as a tool for improving supply chain management. It was thus carried out with a main objective of identifying and assessing the risks affecting the supply chain management. The assessment included both qualitative (probability or likelihood) and quantitative (impact). Literature review was done through a desktop study of published studies on risk management and supply chain management using journals, books, conference proceedings and different peer-reviewed reports. Data collection was conducted through interviews and through a questionnaire survey. The sampling strategy was that of purposive sampling. The collected data was analysed using statistical tools in the Microsoft Excel package. The results showed that financing in supply chain management was the highest prioritized risk while weak information management among involved organisations was also among the high prioritized risks. The other risks included weak quality assurance and procurement systems. The results of this study can be adopted and adapted in improving management through implementation of project risk management and its processes, which include risk identification, assessment and control.

Keywords: risk assessment, risk control, risk identification, risk management, supply chain management

1. Introduction

All supply chains exist to ensure that materials are manufactured and delivered to the consumer. Therefore, the Canadian Supply Chain Sector Council(2015) asserts that Supply Chain Management is an integrating function with primary responsibility of linking major business functions and business processes within and across companies into a cohesive and high-performing business model. The

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

management includes logistics as well as manufacturing, warehousing, transportation, marketing and financing among other activities as shown in Figure 1.

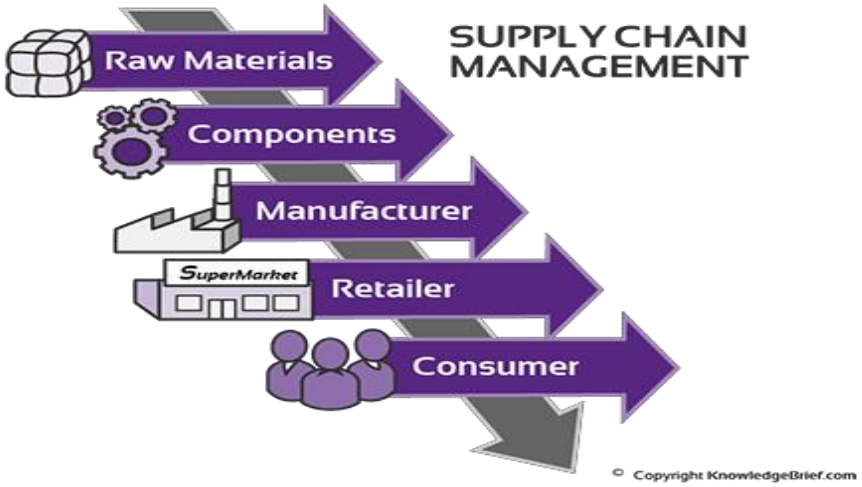

Figure 1: Supply Chain Management **(KnowledgeBriefManage, 2015)**

Further, PWC (2011) opines that project risk management helps the project to be successful. It contributes and assists in increasing visibility of the project, reducing the cost and increasing stakeholder communication and participation into the project. Therefore, project risk management could be used as a tool in improving management of supply chains of materials. Understanding that there are different parties that contribute to the overall performance of supply chain management, risk management can increase visibility, reduce the cost of management and subsequently increase stakeholder communication and participation through different risk management processes. Inefficiency of supply chain management will directly affect the success of any project and programme as the required materials will not be made available at the right place, right time, right quality, right quantity, and right price and from the right source. Consequently, the project cost, time and quality will be affected as well. Supply Chain Quarterly (2015) agrees with this view and further indicates that making the supply chain efficient increases profitability and reduces costs of achieving business objectives. This study focused on improving the efficiency of supply chain management of medicines through project risk management processes.

The study was undertaken to determine the risks in supply chain management of medicines in Zambia using case study approach. The study involved identifying, assessing and prioritising the risks within the supply chain that affect the efficiency of the supply chain management. This was done following principles of risk management processes from risk identification to risk ranking.A desktop study of the published literature was undertaken which involved journals, research studies and academic books among others. Literature that was reviewed included those in risk management and supply chain management of medicines.

2. Literature Review

Kerzner, (2009) defines risk as a measure of the probability and consequence of not achieving a defined project goal and/or its objectives. This measure is purely determined by the likelihood (probability) and

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ISBN 978-0-86970-787-6

the consequences (impact) of not achieving the project objectives. Mona et al., (2013) also asserts that supply chain is a set of players, processes, information, and resources which transfers raw materials, and components to finished products or services and delivers them to the customers.

Therefore, using project risk management principles provided a theoretical framework that its use can improve the efficiency of supply chain management. It has been used before in health products and materials to ensure that they are delivered at the right place with the right quality (Watson, Brian, Joseph, & Andrew, 2013). Consequently, using project risk management processes in supply chain management showed that its performance increases and thereby contributing to the success of the programmes and projects. This is because performance of supply chain management is dependent on the performance of individual contributions of the organisations and institutions within the supply chain. The Supply Chain Management Faculty, (2014) also affirms that the supply chain risks affect the supply chain management.

3. Methodology

The study was done using descriptive method and qualitative research methodologies through case study approach. Therefore, the sample population was Lusaka District and related national offices where activities and programmes are undertaken that are part of the supply chain management activities for medicines. The study focused on the public sector in Lusaka District with regards to risks that reduce the efficiency of supply chain management. Therefore, individuals that participated were purposively (judgementally) selected to ensure reliability, dependability and validity of the collected data. The study divided supply chain management risks into the following categories; Product Design Risks, Regulatory Risks, Procurement Risks, Warehousing Risks, Quality Assurance Risks and Financing Risks.

3.1 Sampling and data collection

The study was conducted through implementing purposive (judgmental) sampling. This method was adopted due to the nature of the research field as well as maintaining reliability and validity of data to be collected. Just as Michael et al. (2000) affirms, case study research can achieve integrity or rigour of validity through five approaches: construct validity; confirm-ability; internal validity/credibility; external validity/transferability and finally, reliability/ dependability.

Data was collected using two instruments; namely the discussions and interviews with selected experts; and self-administered questionnaires to participants selected purposively with a view of obtaining responses/feedback that can be used with confidence. The interviews and discussions were held with selected experts by their individual professional work experience of more than ten (10) years. These sessions were used as platform to identify risks apart from literature review. A total of ten (10) experts participated in the research through interviews and discussions which were held using one-on-one approach. For the second stage, the identified risks from the reviewed literature and interview/discussions were then drafted into questionnaires for validating the identification of risks. Therefore, 35 self-administered questionnaires were received, accepted and analysed from the initial 50 that were distributed to assist with the risk identification and analysis qualitatively and quantitatively. All questionnaires were hand-delivered and collected to avoid non-responsiveness from the participants.

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ISBN 978-0-86970-787-6

Ethical consideration was taken into consideration in conducting the research. This was done by seeking permission from organisations and individuals while ensuring and guaranteeing that confidentiality and anonymity is preserved.

4. Results

The majority of the total participants had working experiences between five (5) and ten (10) years which comprises of approximately forty – six per cent (46%) of the total participants and then followed by those with more than ten (10) years working experience with forty (40%) per cent. This was considered to be a good contribution to the reliability and validity of the questionnaire responses/feedback in the research. However, contribution of those new in the profession (less than five years) was vital as their responses were used to account for changes with professional practice due to technological advancements and also with knowledge advancements by research and developments necessitated by need to improve supply chains management. Table 1 summarises the results.

Table 1 confirms that despite the experts not having hands on daily experience with the activities that have an effect on the efficiency of the supply chain, certain risks have existed for a period as that of the experts' experience or longer without being mitigated making them very repetitive and thus constantly affecting negatively the efficiency of supply chain management through costly completion of already delayed projects and programmes.

The identified and assessed risks were prioritised and ranked to provide a profile that shows which risks affect the supply chain management efficiency the most. The risk ranking was based on the region of the percentage risk score of each individual risk on the risk map as shown in Table 2.

The percentage risk score (PRS) was calculated using the following formula:

Percentage Risk Score (%RS) = Priority Score * 20.

This formula was applied on the identified and analysed risks that were classified as the most important based on their priority scores. They were organised as described in Table 3.Table 3 shows the most important risks as identified based on the results of the study. These risks were considered to be the most important in the order they have been presented and also to direct attention to where resources could be channelled to improve the efficiency ofthe supply chain management.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

Table 1: Identified and analysed risks in public sector supply chain of essential medicines

SN	Supply Chain Management Category	Risk from Interviews/Discussions	Risks from Questionnaires
1	Product Design Risks	Weak information management system Weak coordination and transparency among stake holders Insufficient finances	Insufficient financial resources Lack of technical skills/training Logistical and organizational Lack of consumption information Lack of understanding the process
2	Regulatory Risks	Long process Inadequate capacity (required expertise and sufficient HR) Insufficient finances	Long regulatory process Insufficient human resources
3	Procurement Risks	Inadequate technical input Long lead times Inconsistent fund disbursement Insufficient finances	Insufficient finances Lack of coordination by stakeholders Procurement lead times
4	Warehousing Risks	Inadequate communication between users and stores Inadequate coordination and cooperation among stakeholders Insufficient storage spaces Inadequate human resources Lack of security	Insufficient finances Long procurement and delivery lead times Insufficient storage infrastructure Insufficient vehicles for transportation Inadequate communication Inadequate human resources
5	Quality Assurance Risks	Lack of infrastructure Inadequate infrastructure Insufficient skilled personnel Inadequate infrastructure	Insufficient finances Insufficient quality control facilities Inadequate human resources Inadequate quality management systems
6	Financial Risks	Lack of cooperation by stakeholders Disbursement of funds delay	Inadequate financial disbursements Delayed and irregular disbursements

Table 2: Risk mapping

Risk likelihood, R(L), From 1-Low to 5-Very High						
	5					VH
	4				H	
	3			M		
	2		L			
	1	VL				
		1	2	3	4	5
	Risk impact, R(I), From 1-Insignificant to 5-Catastrophic					

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

Table 3: Percentage Risk Score

Supply Chain Management category	Important Risks - Description	Priority Score	PRS (%)
Product Design Risks	Insufficient financial resources	5	100
	Lack of technical skills/training	4	80
	Logistical and organisational	4	80
	Lack of consumption information	4	80
	Lack of understanding the process	3.5	70
Regulatory Risks	Long regulatory processes	4.5	90
	Inadequate human resources	4	80
Procurement Risks	Insufficient finances	4.5	90
	Lack of coordination by stakeholders	3.75	75
	Procurement lead times	3.5	70
Warehousing Risks	Insufficient finances	4.5	90
	Long procurement and delivery lead times	4	80
	Insufficient storage infrastructure	4	80
	Insufficient vehicles	3.5	70
	Inadequate communication	3.5	70
	Inadequate human resources	3	60
Quality Assurance Risks	Insufficient finances	4.5	90
	Insufficient quality control facilities	4	80
	Inadequate human resources	3.5	70
	Inadequate quality management systems	3.5	70
Financial Risks	Inadequate financial disbursements	4	80
	Delayed and irregular disbursements	4	80

5. Discussion of results

5.1 Financial risks

It can be deduced from Table 3 that the most import risks in all the categories are associated with insufficient financing of the activities. The risks related to finance were shown to have the highest perccentage risks scores of ninety (90 %) and hundred (100 %) per cent in five of the six categories. These results are in agreement withHessam & Ava, (2011) and Supply Chain Risk Leadership Council, (2011) that are the most frequent risks in supply chain risk management which contribute to disruption of supply chains across the globe.

5.2 Product design risks

Lack of technical skills/training, consumption data and understating the process under selection and quantification are some areas that using project risk management can reduce or avoid the impact of the risks on supply chain management. Tan, (2010) and Pablo & Christopher, (2012) confirms that product design is a risk that contribute to supply chain disruptions. This is mainly caused by product failures for the intended purpose resulting in recalls that not only affect the project completion but increase the cost of the product.

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

5.3 Regulatory risks

The two most important risks of the category are inter-related in nature because one risk can be hugely reduced and avoided by mitigation of another. The risk of having a long regulatory process based on a number of factors but discussions and interviews revealed that the process is lengthened by the insufficient human resources and expertise to handle the required work. The results are supported by Department of National Treasury, (2015) indicating that procurement and strategic sourcing in supply chain management is affected by regulatory compliances for the products to be supplied and delivered within the expected duration.

5.4 Procurement risks

The most important risks from the category were lack of coordination and cooperation by stakeholders and long procurement lead times. The risks however, had some interdependence on financing risk. This was because completion of the entire procurement process effectively required availability of sufficient funds for the activities and programmes to be successfully done.Hessam & Ava, (2011) supports the results by indicating that procurement risks in supply chain management are caused by lack of coordination of parties involved and that the process depends on the available financial resources.

5.5 Warehousing risks

The length of procurement lead times had an effect on how the storage and distribution was carried out. This is because stores departments plan the storage and distribution in line with the procurement plan as provided. Hence, changes in procurement process implied an equal effect of the storage and distribution plan. In addition, distribution is hugely affected by limited number of vehicles to use in transporting materials. Sunil & Manmohan, (2004) affirms that inventory risk causes disruptions to supply chain and increases the cost in supply chain management. The cost is attached to losing materials that cannot be stored appropriately due to insufficient space and eventually gets demaged.

5.6 Quality assurance risks

Scope, time and quality are the three major cornerstones of any project and programme. Therefore, quality should be assured throughout the supply chain management of any material as it has direct effect on the results and its performance. Therefore, having insufficient and inadequate quality management system affected the overall performance of the supply chain management. This is because there was a quality system that couldn't include quality control of materials as well as sufficient procedures to guide in carrying out the related activities. Pablo & Christopher, (2012) and Tan, (2010) in agreement with the results assert that risk management should be integrated into quality management to assure quality of the product.

6. Conclusion

The study provided a descriptive view of the risks obtained in public sector supply chain management by using project risk management system. The risks were identified, analysed, ranked and prioritised to outline those risks that had the most effect (impact) on the efficiency of supply chain management. These results contribute to the body of knowledge as they show that project risk management can be used to improve performance of management systems in projects and programmes. This could be done by

ISBN 978-0-86970-787-6
application of project risk management processes that can increase visibility, cost reduction, improved

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

stakeholder participation and communication as supported by PriceWaterhouseCoopers, (2011) that effective risk management contributes to project success through reducing costs and improving visibility that is considered in making decisions by management.

The results show that supply chain management of materials of any system can be improved through use and implementation of effective project risk management. The results are in agreement with Enyinda et al., (2009) and Mona et al., (2013) that risk management can improve supply chain management by using risk management processes in handling supply chain risks and avoid disruptions. However, achievement of improved performance of the supply chain also would depend on other external factors which were not part of the study. Therefore, it is recommended that another study could be conducted to ascertain and quantify other factors that could improve efficiency of supply chain management.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-041

Analysis of facilities history: A tool for effective facilities management

Edoghogho Ogbeifun[1], John Agwa-Ejon[2] and Charles Mbohwa[3]

Abstract

The analysis of information available in the operational history of each facility in the portfolio of facility managers provides useful insight on the quality and functional state of the facilities and contributes to the education of the end-users. It also assists in the development of objective forward planning and realistic budgeting to definite line items which guide senior management in objective decision making. Such analysis identifies what is required to ensure that the facility is available to meet the needs of the customer and highlights the potential risks of sudden breakdown resulting from the neglect of deferred maintenance. Furthermore, detailed facility analysis provides guidance for the management of renovation, modification, change of use, and conservation of heritage facility.

The principle of document analysis was adopted in reviewing the periodic operational report of the facilities management unit of two Higher Education institutions in South Africa. The findings revealed that though the units produce regular monthly and annual reports, no analysis of the report is available. Therefore, the programmed renovation exercises are based largely on visual assessments and use of good professional judgement. Recommendations were made on how to conduct asset analysis and use it as tool for developing operational budget, renovation and rehabilitation plans.

Keywords: end-users, facility analysis, forward planning, operational budget

1. Introduction

Facilities Management (FM) unit in many Higher Education (HE) institutions have made remarkable progress in effective communication with the relevant stakeholders during capital developments but not so well during operation and maintenance. The reasons for the gap include the fact that capital development is intensive requiring the input from different stakeholders at different times from inception to completion of the project; the financial out lay is huge as well as the component parts are complex and require progressive explanation, continuous flow of information and education of the stakeholders, so that the resulting edifice will 'fit for purpose' for the costumer (Campbell and Finch, 2004). However, during operation and maintenance phase, FM unit play more reactive than proactive roles, since the service demands follows an undulating curve of high and low peaks but require a steady flow of increasing financial resources. Research shows that in the life cycle of a typical facility, the ratio of the construction cost to that of operation and maintenance (including capital renewal) is about 1:5 (Lavy, 2008). In HE institutions, the support facilities are meant to enhance the performance of the core functions of teaching and research, facilitate the achievement of the objectives of the institution and

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

promote its image among the community of similar institutions. The standard, quality, aesthetics and functional state of the physical facilities and the environment within and around a HE institution contributes to its being attractive to prospective students and staff (Lateef, *et al*, 2010), and affects the quality of its teaching and research which are the fundamental considerations in the discussion about "excellence in a university" (Taylor and Braddock, 2007, p. 246). Over a period of time, due to wear and tear, the support facilities are subject to different levels of distress that affects their functionality. The onus lie with the FM operatives to inform and educate the costumers on the functional state of the facilities and their availability for the performance of the core function of the institution; this they can do through periodic reports and objective analysis of the information in the operational history of each facility. The analysis of facilities history should progress from the identification of distress recorded against each facility and cost incurred, classify the distress recorded according to the constituent component-sections, determine the frequency of distress, the Component-section Condition Index CSCI (Uzarski and Grussing, 2008), Component Index (CI) and Facility Condition Index (FCI) (Lavy, 2008). The information provides the FM operatives with the appropriate tool for effective communication, education of the customer, forward planning and pro-active solutions to the facilities need of the customers.

This paper is an abridged form of two separate researches into the operation of FM units in two HE institutions in South Africa. They will be referred to in generic terms as institution A and B respectively. In this paper, emphasis will be on the quality content of the periodic reports (for operation and maintenance rather than capital developments) from the FM unit and suggest improvements in the current format so that the documents can serve as a tool for effective communication with costumers.

2. Literature review

The introduction of information communication technology (ICT) into FM has made documentation and archiving easier, but that is yet to translate into objective analysis of the information store in the data base of the respective facilities. This section will provide synthesis of literature focusing on documentation of facility's operational history, analysis of the historical information and its use in forward planning, budgeting and the management of change of use.

2.1 Documentation of facilities history

The historical documents of a typical facility include detailed as-built drawings, manuals, repairs, renovations, and alterations, accumulated in the process of developing and operating the facility. The documentation of authentic facilities history should commence from developing "as-built documents" (ABD). ABD is the documentation of all modification, alteration and changes in the specification in the original 'as-designed contract drawings'. The final as-built documents made available at the project commissioning and handing over exercise is helpful for the preparation of the "facilities operation documents" (FOD) (Erdener and Gruenwald, 1997). In the event that existing buildings or facilities do not have authentic 'as-built' information, it is possible to develop a near exact document by using either manual or digital methods (Gupta, 2005; Murphy *et al*, 2009). The FOD should be comprehensive and dynamic reflecting the progressive situations of the facility which will continuously serve as input for producing new documentation output (Clayton *et al*., 1998).

A typical FM unit spends considerable time in the operation and maintenance of the support facilities suitable for the performance of the core functions of the organization, but pays little attention to

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

documentation, reporting, or analysis of the information on the data base of each facility in its portfolio. However, Carder (1995) suggests that FM operatives should present periodic reports in a simple format, so that the customers can relate with the state of the facilities in their portfolio, identify possible constraints to the effective performance of the core function of the organisation and the report should demonstrate prudent financial management. The analysis of facility operational history is an extension of periodic report through a long time period with the objectives of determining the functional state of the whole facility as well as the component parts.

2.2 Analysis of facilities history

The majority of FM units have facilities history stored in their computer or file (Lavy, 2008), for many years, without objective analysis to determine the functional state of the facility or its components. Lavy (2008) demonstrates this by analysing the facility history found in the database for an engineering building of Texas A&M University; the building provides accommodation for "an engineering department and a science department" (Lavy, 2008, p. 307). Though the FM unit is resident in the faculty, they were pre-occupied with reactive response aimed at keeping the facilities functioning, that includes the regular repairs on the "HVAC system that continues to break and leak" (Lavy, 2008, p. 308). The analysis highlighted the negative impacts of the faulty HVAC system on the quality and functional state of the building through the computation of the Facilities Condition Index (FCI) and Component Index (CI).

The FCI is "defined as the ratio of estimated cost of remedying any current deficiencies (CD) in a facility to estimated current replacement value (CRV) of the facility" (Reindorp and Fu, 2011, p. 109). This involves the computation of the total cost of repairs (including capital renewal) and the cost of replacement of the component or the facility. The value of FCI varies from 0 (for brand new facility) to 100 (where each component of the facility should be replaced) (Lavy, 2008; Uzarski and Grussing, 2008). The FCI presents a tool for assessing the quality state of the facility and the financial implications of maintaining or improving on the quality state of the facility, "to prevent expansion of deferred maintenance backlog (Briselden and Cain, 2001, p.34). Furthermore, the analysis should progress from the macro level of the whole facility to the individual components that make up the facility, by measuring the 'component-section condition index (CSCI) and the component index (CI). The CSCI can be computed by analyzing the distress information in the data base for each component, observe the frequency and magnitude of distress over time to determine the ability of the component to "perform properly as it degrades from use, exposure, and/or other mechanisms" (Uzarski and Grussing, 2008, p. 150). The CI is computed by dividing the remaining service life of the component by the design life, and the factor ranges from 0 to 100 (Lavy, 2008). A high CI factor is an indication that the component is closer to the end of its design life. While FCI indicates the quality of the whole facility, the CI clearly shows which component is close to or have exceeded its design life. Each component is susceptible to frequent breakdown when it is closer to its design life or experiences sudden collapse, without warning signs, when the component has exceeded its design life (Lavy, 2008; Uzarski and Grussing, 2008). Comprehensive analysis of both operational history and dedicated facilities condition survey are useful tool for effective decision making in regards to forward planning, resource allocation, renovation, rehabilitation and change of use.

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Livingstone, Zambia
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2.3 Facilities analysis and management of change of use

The requests for alteration, modification or extension in the form of refurbishment or up-grade of structures are common experiences of FM operators in HE institutions. The exercise will be difficult if the facility does not have authentic ABD and FOD information. Extended analysis of the periodic information in the data base of each facility in the portfolio of the facilities manager provides detailed and objective information on the quality state of the facility, the fabric and component parts. The analysis also provides the financial implications of rehabilitations or executing change of use (Lavy, 2008). The content of specific facility assessment is useful for objective decision making; it helped a suburban university (Hayes, 2006) to know that a historic building they intended to rehabilitate and increase the height could not support another floor and if executed, it would have been at great cost. In another institution, the officials needed to know if a 1960s science building could accommodate a program expansion. The facility assessment and its analysis suggested that, "the best option was to build a new structure" (Hayes, 2006, p. 311). The comprehensive analysis of periodic report or dedicated survey should be communicated to the relevant stakeholders of the institution as a guide for objective and timely "decision making, planning and budgeting, and ultimately shift administrators from a reactive to a proactive standpoint" (Hayes, 2006, p. 312).Furthermore, "whether a campus is urban, suburban or rural, it needs periodic assessment, which puts campus planning into perspective and assists in the development of a multi-year budgeting tool" (Hayes, 2006, p. 310).

Though literature supports the importance of analyzing the historical information in the database of each facility in the FM portfolio, for informed decision making process, the common practice is that the majority of FM units do not pay adequate attention to the analysis of facilities history (Lavy, 2008); thus FM units ends up providing reactive instead of proactive services to its customers. This gap can be bridged through objective review of the quality of periodic reports from typical FM unit and make suggestions for their improvements; which is the focus of this research.

3. Research Methodology

The use of case study as qualitative research method is well developed in literature. The case study method of research seeks to "explore and investigate contemporary real-life phenomenon through detailed contextual analysis of a limited number of events or conditions, and their relationships" (Zainal, 2007, p. 1). It is seen and employed as a research strategy useful when holistic, in-depth investigation is needed (Green and Thorogood, 2009; Lateef *et al*, 2010).

The data for the research being reported were collected using the combined instrument of semi-structured questionnaire complemented with interview and detailed review of the quality content of the periodic reports on operation and maintenance, from two FM units of HE institutions and compared with best practice exemplified in literature. The X-ray underscore the importance of comprehensive facility analysis as a tool that enable the FM unit to educate its customers and develop functional forward planning programmes to assist senior management for timely decision making.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

4. Findings and discussions

Facilities Management (FM) functions require effective management of the relationships between the people, workplace interface, technology and services to ensure harmonious relationship between the service provider (FM) and those responsible for the execution of the core functions of the organization (costumers), in order to facilitate the achievement of the objectives of the organization (Carder, 1995, 1997). In order to achieve improved customers' satisfaction, FM operators need to be proactive, use the soft skill of effective communication in the form of costumer friendly periodic reports and detailed analysis as a tool of information and education of the costumer about the functional state of the facilities available for the performance of the core functions of the organization. The information flow should be seamless throughout the life cycle of the support facilities.

4.1 Project closeout, handing over and end-users' orientation

Capital development exercise, in both institution, follows similar approach in the development process which include the involvement of end-users from the inception of the project, translation of project briefs into the development of project execution documents, incorporating of the end-users into the project execution team (known as Technical Execution Team' (TET)). The active involvement of stakeholders in capital developments follows best practice, where "line function" departments work closely with project personnel from the earliest part of the project to completion phases (Heywood and Smith, 2006). Representatives of the stakeholders that participated at the planning stage should translate into the execution governance for effective implementation (Pemsel *et al*, 2010). Furthermore, though the reporting structure for capital projects are highly technical, the customers can identify with it somehow because they see the progressions during execution and the FM operatives are readily available to explain the details, where necessary. The same cannot be said of operation and maintenance reports.

4.2 Operation and maintenance report

The FM unit in both institutions produces monthly and annual reports on operation and maintenance activities. The reports are too technical, economical in details, easily understood by those who prepared it and somehow to those at the strategic level of leadership, because the report is presented and explained to them. Otherwise, the reports are not very helpful in educating or communicating with the leaders at the tactical levels. For example, in the annual report for 2012, from institution B, one of the campus director reports:

- A large amount of time was spent on day-day maintenance issues, which is indicative of ageing infrastructure. Of the R3.7m spent on maintenance, the larger portion was spent on plumbing and electrical reticulation breaking down.
- Various projects were identified and R12.2m was spent on reviving/replacing ageing infrastructure. (Annual report, 2012, p. 3)

The fact that the above amounts were spent on legitimate projects is not in doubt, but due to limited analysis of operational records, the projects being reported were not specifically identified in the operational plans for the period under review, and the report did not mention the specific location of the projects being reported on; this further inhibits effective communication between the FM unit and its customers (Campbell and Finch, 2004).

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Livingstone, Zambia
ISBN 978-0-86970-787-6

The monthly report or its summary provides generic information on the quantity of request lodged with the unit, the quantity resolved and outstanding volume, without classification of distress into the component-sections they represent in the facilities or provide explanatory notes. Institution A provides information on the cost incurred but institution B did not. Table 1 represent a typical structure of the monthly report from institution A.

Figures 1 and 2 represent the executive summary of the monthly reports from institution B. Unfortunately, these reports are only circulated within the FM units and presented in an executive summary form for discussion at strategic levels of leadership in the respective institutions. The reports from both institutions are usually in large volumes, though institution B presents its executive summary in graphical format.

The FM unit, in institution B, provide information on the volume of unresolved requests; an indication that these outstanding issues are kept in perspective. However, the report is silent on what the unit is doing with these outstanding requests. Figure 2 shows the year – to – date statistics of outstanding work requests.

Table 1: Typical structure of monthly report from institution A

Building code	**Assigned work order**	**Work Description**	**Date work requested**	**Service contractor's code**	**Date work completed**	**Total cost**
127	70792	Remove, investigate and quote on repair of leaking pump. Replace packing with mechanical seal.	2010/03/01	PUMDATA	2010/05/10	R5,462.88
127	70794	Repair noisy pump motor fan.	2010/03/01	MJL	2010/03/29	R538.65
127	70795	Professional service to HVAC. Supply and install 1x 24000 BTU York Mid-wall unit in room GH525.	2010/03/01	PERFECTAIR	2010/04/12	R10.180.20
131	70796	Supply and install 1x18000 BTU York Mid-wall unit in room 236.	2010/03/01	PERFECTAIR	2010/04/12	R9,234.00
446	70797	Repair/replace broken toilet soap dispenser in room 2B34. Urgent	2010/03/01	SUPERCARE	2010/03/18	R0.00

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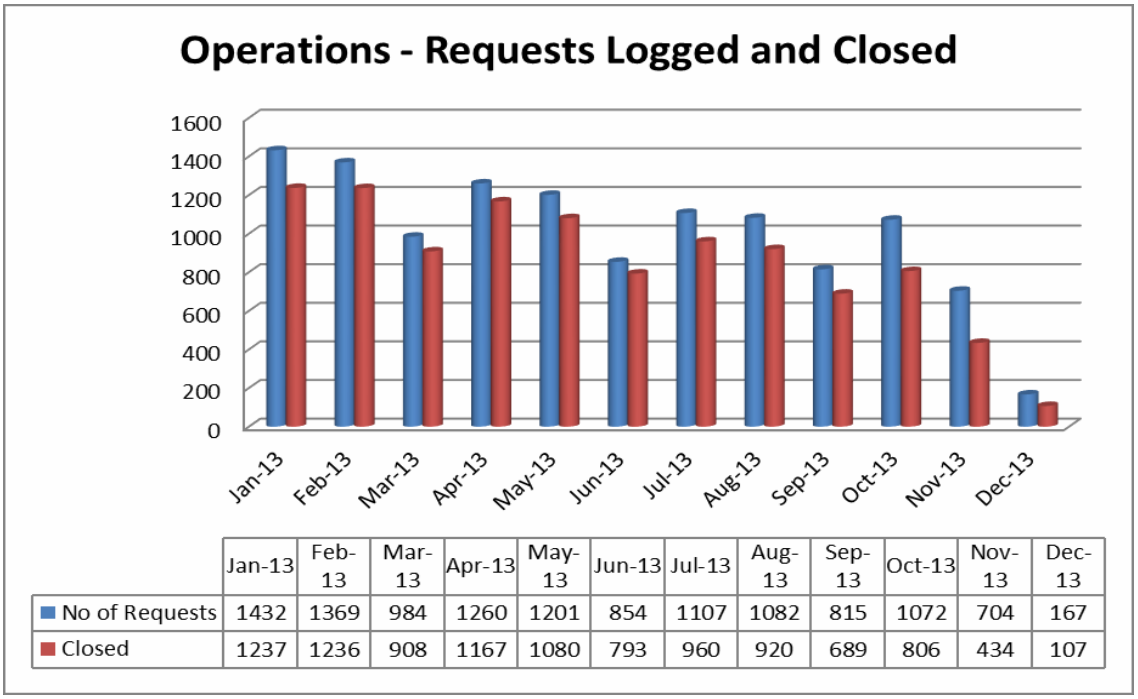
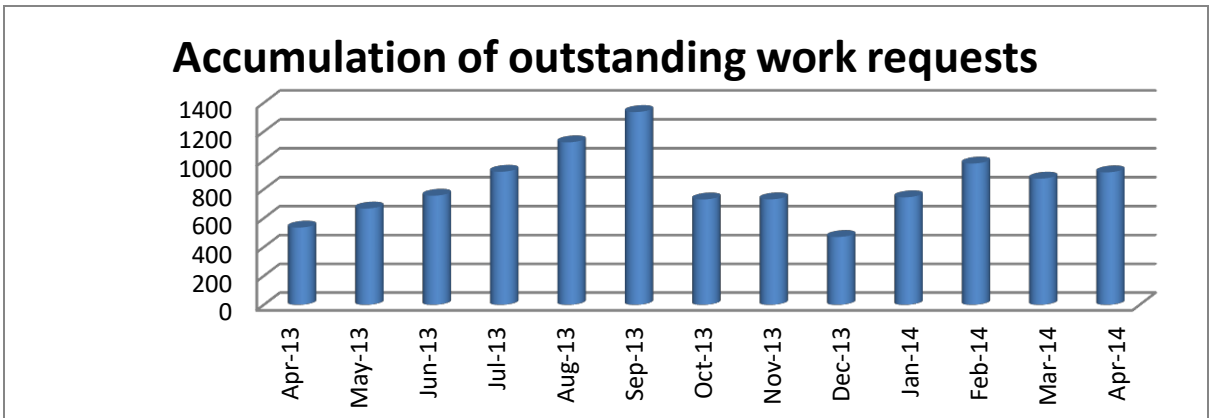
ISBN 978-0-86970-787-6



	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13
No of Requests	1432	1369	984	1260	1201	854	1107	1082	815	1072	704	167
Closed	1237	1236	908	1167	1080	793	960	920	689	806	434	107

Figure 1: Summary of performance on logged requests for the year 2013 (CTS annual report, 2013, p.14)



	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14
Accumulative	535	667	756	922	1126	1336	730	731	470	745	979	874	918

Figure 2: Summary of outstanding work requests (CTS Annual report, 2013, p.14)

During the course of these researches, the majority of the heads of department complained that they do not receive progress reports from FM unit on the status of execution of their requests. However, if the generic periodic reports were sent to them, they cannot identify the component of the report that reflects the situation in their department. FM operatives should bear in mind that customer satisfaction include, but not limited to 'technical performance' but also "effective communication and management of expectations" (Campbell and Finch, 2004, p. 178). One of the tools of effective communication is

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ISBN 978-0-86970-787-6

detailed and customer friendly periodic reports with appropriate analysis and visual representations (Carder, 1995; Lavy, 2008; Chou, *et al.*, 2010).

4.3 Analysis of operational history

There is no evidence of the analysis of operational history in both institutions. The progression in the analysis of facilities history include identification of distress recorded against each facility and cost incurred, classify the distress recorded according to the constituent component-sections, determine the frequency of distress, the CSCI, CI and FCI. This set of information provides the FM operatives with the appropriate tool for effective communication, education of the customer, forward planning and pro-active solutions to the facilities need of the customers.

To demonstrate the importance of customer friendly periodic report that include analysis of operational history, the requests lodged with the Call Centre from institution A for the School of Civil and Environmental Engineering for the period of January to March 2010 were compiled. The eight page report was reduced into a table format as shown in Table 2. At a glance, the table provides the essential information contained in the eight page report. Figure 3 shows the graphical presentation of the status of execution and components of the facility affected, while Figure 4shows the financial commitment.

Table 2: Summary of periodic report on work requests

Problem type	JAN	FEB	MAR	Total issued	Total completed	Cost (R)
Electrical	9	5	5	19	18	10,837.80
Plumbing	6	3	3	12	11	15,763.90
Quotation	1	1	2	4	1	136.80
Building		1	1	2	1	695.14
HVAC		1	3	4	3	2,547.90

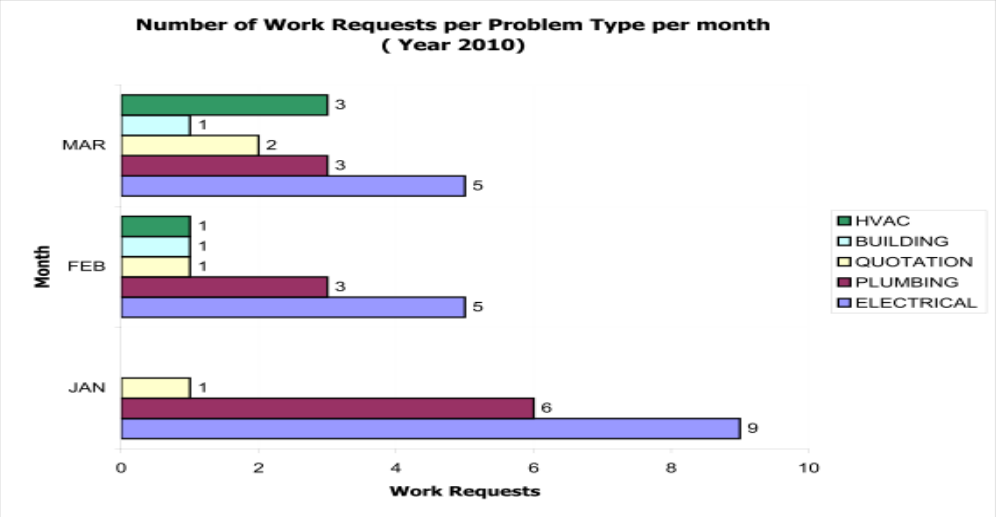

Figure 3: Graphical presentation of the report

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

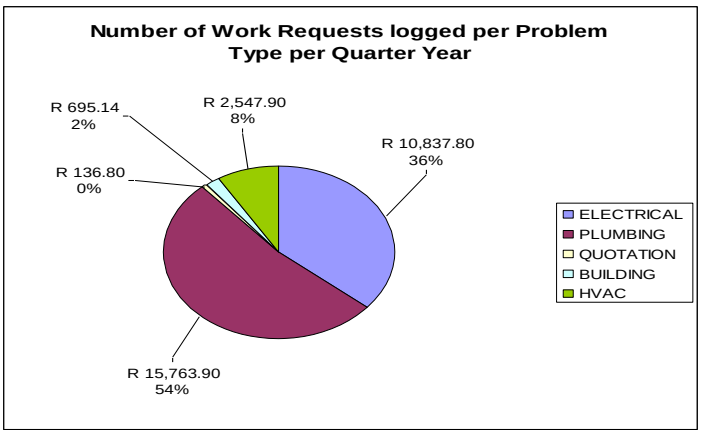

Figure 4: Financial involvements of the work request

However, due to some logistic problems, it was not possible to provide explanatory notes to this report. The notes should provide explanation to terminology, such as Quotation; reasons for uncompleted works; emphasis on recurring requests or deferred maintenance and their implications on the component they represent. The notes should also indicate the cost implication of executing the outstanding repairs or alternative suggestions for addressing the problem. Despite this shortcoming, the structure of this report elicited the following comments from the Head of the School of Civil and Environmental Engineering: "The layout is easy to determine the state of maintenance and it is easy to read. It also indicates that the FM Unit is concerned about maintenance" (Ogbeifun, 2011, p. 133).

If the information in the database of the facility for five years or more was available and analysed, it will be possible to identify the frequency of distress recorded against each component-sections of the facility, the cost incurred, and the magnitude of deferred maintenance backlog as well as the current replacement values (CRV). These are the data set required for the computation of the CSCI, CI and FCI that are needed for the interpretation of the quality state of specific facilities in the portfolio of the customer or the facilities of the institution.

5. Conclusion and recommendations

Though the FM unit put in lot of efforts in the development, operation and maintenance of appropriate support facilities for the performance of the core functions of teaching and research, such efforts are not reflected in the periodic assessment of the level of customer satisfaction. This, in part, can be corrected through the development of detailed and costumer friendly periodic report, providing continuous stream of information through asset analysis, functional budget and using the soft skill of effective communication (Carder, 1995; Hayes, 2006; Campbell and Finch, 2004; Lavy 2008). The analysis of the operational history in the data base of each facility enables the FM operatives to determine the quality and functional state of the support facilities of the institution, and the effect on the execution of the core function of teaching and research (Lavy, 2008, Uzarski and Grussing, 2008). The comprehensive and progressive assessment of facilities "provides valuable information about the age and condition of campus infrastructure, identifies the greatest facility needs" (Kennedy, 2005, p. 52), identifies the maintenance gap, backlog of maintenance and renovation (Kennedy, 2008), and "provides holistic understanding of the existing conditions of all buildings and grounds so that a school can plan and budget for campus growth and upgrades" (Hayes, 2006, p. 311).

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

Therefore, it is recommended that FM operatives should use the soft skill of effective communication which include costumer friendly periodic reports and detailed analysis as tool for information and education of costumer about the state of the facilities in their portfolio.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-004

Project Management: Perspective of Small and Medium-sized Construction Firms in Ghana

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Abstract

Studies in the construction industry revealed the extent of importance and the need of good project management practice on a construction site. Efficient compliance with project management practices by firms within the construction sector has yielded results such as minimization of waste which tends to maximize returns of the client, ensured fruitful communication among the project team members. Reworks and accidens are also avoided with proper project management practices. The research explores how project management is practiced within small and medium-sized firms. The study reviewed literature on project management practices with a focus on the execution phase of project management process. The results showed that the small and medium-sized firms are mostly owned by one person who controls and adapts self-style project management techniques. This nonstandardized project management practice among small and medium firms was found to affect progress and contributed to wastage. Statutory provision for small and medium-sized construction firms should be instituted to make the SMEs project management compliant and therefore enhance project success.

Keywords: Ghana, perspective, project management, SMEs

1. Introduction

The role of small and medium-size firms (SMEs) have been characterized in the literature as a result of their contribution in terms of growth, employment and innovation (Turner *et al.*, 2010). SMEs have also been recognized around the world as a vital vehicle that stimulate poverty reduction and also assist large firms. According to Turner (2008), SMEs need project management to manage their innovativeness in a focused manner and to achieve growth and satisfy their strategic objectives. Ownens (2006) argued that SMEs have poor project management practice because they do not have systems in place to monitor and control the projects.

Further, SMEs in Ghanaian construction are described as prolific job creators without being project management compliant. In Ghana, SMEs are also believed to contribute to about 70 % of GDP and account for 92 % of businesses (Abor and Quartey 2010).

In addition, most of this construction SMEs in Ghana are family-owned businesses and, therefore, adapt self-styled management for their operations. Also, the construction SMEs do not survive within the sector after executing major projects. This may be as a result of noncompliant and lack of project

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

management standards regarding personnel management, financial management, logistics and the managing of the entire operations of the firm thereby diminishing their profits and growth. It is against this backdrop that this study seeks to explore into how constructions SMEs embark on project management techniques and also to promote a standardized project management practice by these SMEs. The study intends to benefit Construction SMEs and other firms aspiring to enter the sector to improve on their project management method that brings profit to the companyin the long run. The study also focused more importantly on the project execution phase.

1.1 Purpose of the study

The aim of the study is to assess how project management is practiced among Construction SMEs and to highlight constraints when embarking on project management technique.

2. Literature Review

2.1 Overview of the Ghanaian construction industry

According to the Government of Ghana (GOG, 2010), the Ministry of Water Resource, Works and Housing (MWRWH) is responsible for formulation of and coordination of policies and programmes for the systematic development of the country's infrastructure. Further, the Ministry has a classification register which aims at the proper grading of Contractors into categories and financial classes (MWRWH, 2004). The register only permits listed Contractors to be eligible to undertake building and civil contracts awarded by the Government. Anvuur, *et al.* (2006) in the established that the Ghanaian Construction industry over the years has developed into two sectors: the formal sector and the informal. The formal sector adopts a variety of procurement systems (Anvuur *et al.*, 2006). The informal sector took an approach similar to the historical approach of master craftsman engaging labor in product delivery Well and Wall, 2003). The MWRWH has a financial classification of building and civil engineering construction firms operating within the country. Building Construction firms are placed under category D, and class K for civil engineering works with groups G and E for Plumbing and Electrical works respectively (MWRWH, 2004). There are four further sub-categories 1, 2, 3 and 4 based on the financial and equipment holding of the company. In Ghanaian Construction industry, small and medium-sized firm's falls within categories D3 and K3 for building and civil engineering works.

2.1 Definition of small and medium enterprises

Abor and Quartey (2010) affirmed that definitions of SMEs vary among countries. Some researchers use capital assets whiles others use skills of labor and turnover level. These essential characteristics that define SMEs need to be managed using the traditional project management practices. The Ghanaian economy is no different; literatures have defined SMEs in that same context without any universal definition. The Ghana Statistical services (GSS) considers a firm with up to 9 employees as SMEs (Kayanula and Quartey, 2000). The Construction industry is directly linked to the Ghanaian economy as Government is the biggest client that has engaged most of the SMEs with projects (Boadua *et al.*, 2015).

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Livingstone, Zambia
ISBN 978-0-86970-787-6

2.2 Project management practice by small and medium enterprises

White and Fortune (2002) established that project management is now a well developed and has been accepted as a core skill of professional expertise and for academic research discourse. Cheng (2005) supported that project management technique are seen in many emerging sectors including consultancy services manufacturing and service including consultancy services, manufacturing, and service industries, information Technology among others. Accordingly, the construction sector is seen as the largest and the most established sector that practice project management technique (Craford *et al.*, 2006). Murphy and Ledwith (2007) postulated that project management is a well-established descriptive that defines in details the tools and techniques required to embark any project. Project management from the perspective of SMEs in Ghana has become an issue due to numerous of challenges encountered by these firms. Notable of these challenges includes personnel management, financial management, logistics and general management. This assertion was supported in by Addo-Abedi, 1999: Eyiah and Cook 2003 which stressed that local construction SMEs in Ghana lack managerial capacity with regard to financing, material and personnel resources. A study by Laryea (2010) further supported that contractors in Ghana stressed that there are lack qualified construction professionals with the necessary knowledge in construction works. Kayanula and Quartey (2000) maintained that lack of entrepreneurial and business management skills and know-how significant constraints are faced by SMEs in their development and growth. Project Management Book (PMBOK) (2000), defines aproject as a group of interrelated work activities by a particular scope budget and schedule to deliver capital assets needed to achieve the strategic goals. Every project has a unique characteristic that includes the scope; schedule and the budget that must be managed throughout the lifecycle of the project. The PMBOK (2000) emphasized that project management process can be organized into five groups of processes mainly initiating, planning, executing, controlling and closing (as shown in figure 1). This study however focuses on the execution phase including control and closing.

2.2.1 Project execution phase

The execution phase involves the coordination of people and other resources to carry out the plan. The controlling process involves ensuring that project objectives are met by monitoring and measuring progress regulatory to identify variances from the plan so that corrective action can be affected. Closing phase on the other hand highlights the formalities with regard to the acceptance and an orderly end of the project.

2.2.2 Controlling Phase

This phase of a project involves the regular review of metrics and reports that will identify variances from the project baseline (PMBOK, 2000). The differences are determined by comparing the actual performance metrics in the Execution phase against the baseline parameters assigned during the Planning Phase. These variances are incorporated into control processes to evaluate their meaning. Accordingly, a significant difference does not explicitly require a change to the project plan but these variances should be reviewed to determine if preventative action is necessary. Eldridge (2013) postulated that Controlling also includes taking preventative action in anticipation of possible problems. Eldridge (2013) further supported that Project Control has a direct correlation to project progress and stakeholder's expectations.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

2.2.3 Closing phase

This is also referred to as project closure and it involves handing over the deliverables to the customer, passing the documentation to the business, cancellation supplier contracts, releasing staff and equipment, and informing stakeholders of the closure of the project (Burke, 2011). After the project has been closed, a post-implementation review is embarked on to determine the project success and identify the lessons learned out of the completed project (Morrison and Brown 2004). SMEs usually close their projects hand it over to the main contractor once all outstanding works and repairs have been made good.

2.2.4 Personnel management

The execution phase of a project captures human resource planning including the skills, number of employees, when their services are needed, how to motivate them and the agreed period to effect remuneration, forms integral part of personnel management (Duen-Ren and Chouyin, 2004). Personnel management within the construction sector becomes mandatory since different skills persons from different backgrounds are recruited. This personal management enables individual talents and competencies to be tailored towards the goal of a project as well as the entire targets of the firm. Accordingly, personnel management mainly revolves around the following: human resources, planning, recruitment staffing, appraisal, training and development; compensation (wage, salary, fringe benefits health & Safety and labour relations and personnel research (Burke, 2011). Logistics management as part of project can be expressed as the management of the flow of materials, tools, and equipment (and any related object) from the point of discharge to the point of use or installation (Lee and Sweeney, 2001). Coordinating these three vital components between the project's principal parties would increase productivity substantially. On a construction site, these components must be properly managed to ensure a project's success (Morrison and Brown, 2004).

2.2.5 Quality Control management

The construction industry, unlike many manufacturing sectors, is concerned mostly with one-off projects (Harris and McCaffer, 2001). This virtually creates difficulty for effective quality control because each new contract is often characterized by ad hoc recruitment of labor and engagement of fresh management team. Notable among quality control management isfinancial management and cost control, quality assurance amongst others. To manage financially or control cost is an apparent objective of managers, but it should be noted that no amount of paperwork archives this control (Lock, 2000). Harries and McCaffer (2001) argued that the element cost control system includes the following (i) observation (ii) comparison of observation with desired standard. Small and medium-size firms are notable for having a low level of project management techniques. As a result, most projects executed by the companies do encounter financial problems such as multi-cost overrun that affect the particular project and the entire financial standing of the enterprise. Spalek (2014) stressed that economic assessment and appraisal of projects prior to their kick-offs are not embarked correctly by these SMEs rather they focus so much on the profit to be yielded after executing the project. Quality control involves maintaining the set standards per best practice in terms of workmanship, designed strength work and procedures.

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ISBN 978-0-86970-787-6

2.2.6 General management

Quite naturally, contract administration control is the process of ensuring that the vendor's or section within the organization's performance meets contractual requirements (Burke, 2011. This is accomplished through the use and monitoring of a Project Plan from the vendor, estimates from performing parts, periodic progress reports, and the completion of deliverables as delineated in a project statement of work. Contract closure should be coordinated with the Contract Manager of the agency. According to Thomas and Mengel (2008) this general management is quite renowned among large firms. SMEs rarely practice this technique due to their low level of project management knowledge.

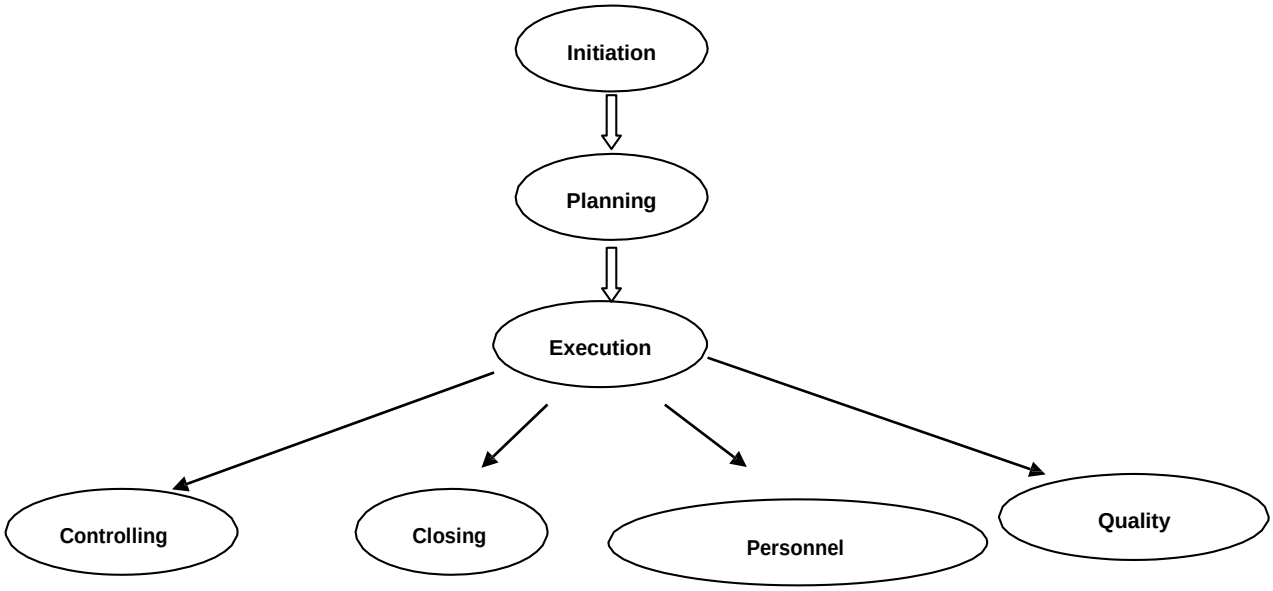

Figure 1: Project management process (Adapted from PMBOK, 2000)

3. Research Methodology

In order to achieve the goal of the study, literature review was conducted. This research made use of the relevant literature on construction SME's and project management practices using journals, conference papers, books and accredited information from the internet related to the study. This method was found appropriate as a result of the extensive literature that was established from related project management studies.

4. Findings and Discussion

Project Management technique is the interrelation of all the project resources for the successful delivery of the project. However, the general concept of Project management studies phases which must be properly coordinated for in order to achieve the success of a project.

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Findings revealed that project management is a well-established technique which is mostly practiced in manufacturing sectors in the construction industry (Cheng, 2005). The study also found that project management method defines the tools and techniques required to undertake a project (Murphy and Ledwith, 2007). Generally, local construction SMEs in Ghana lacks the managerial capacity to manage (Addo-Abedi, 1999; Eyiah and Cook, 2003). The study established that every project has unique characteristics, and as such vital features include schedules, scope, and budget, these must be managed properly throughout the project life cycle.

The research concentrated on construction SMEs firmswhich practice project management techniques when embarking on projects. It is not commonly practiced in Ghana for SMEs to use different project management companies as a means of achieving completion of projects. However in extreme cases, the main contractor engages the services of a separate project management firm.

Construction SMEs in Ghana practiced the standardized project phase as captured in the PMBOK (2000) namely, initiation, planning, execution, controlling, and closing. However, it is not all project embarked by these SMEs that considered vividly this technique it depends on the client need and the type of project. Although the technique of project management has been credited with numerous merits such as attaining of precisions, good communication, quality control, minimising waste, rework thereby ensuring high returns for the client amongst others, there are some inherent variables hindering good project management practiced among construction SMEs.

Further findings from literature established the following inherent variables hindering good project management practices construction.

- Poor communication of project goals and strategies to meet milestones among project teams (Abbasi and Al-Mharmah 2000).
- Inadequate knowledge of PM technique among professionals (Lee and Sweeney 2001).
- Conservative attitude to change by construction professionals. The complexity of project and scarcity of human capital (*Crawford et al.*, 2006).
- Constraints in accessing information on project management theory and practices (Koskela and Howell, 2002).

5. Conclusions

The study focused on the project management practices by SMEs in the construction industry of Ghana. SMEs make a significant contribution to the Ghanaian economy as a result of contributing to about 70 % of GDP and account for 92 % of businesses (Abor and Quartey 2010). In addition, most of this construction SMEs in Ghana are family-owned businesses and, therefore, adapt self-styled management for their operations. A Large number of the construction SMEs in Ghana does partially practice the standard Project Management techniques depending on the size and type of project. Further, SMEs need to be guided as to what tools sets they should use, not given a longer list from which they need to choose (PMBOK, 2000). Also, identify that for all firms the necessary success factors are client consultation; planning, monitoring and control; and resource allocation.

This nonstandardized project management practice among small and mediumfirms affect progress and contributes wastage. Statutory provision for small and medium-sized construction firms must be instituted to make the SMEs project management compliant to enhance project success.

ISBN 978-0-86970-787-6

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-027

Programme Management of informal settlements in South Africa, the case of Region A in City of Johannesburg Metropolitan Municipality

Sabelo Hlatshwayo[1], George Onatu[2]

Abstract

Informal settlement upgrade is a process by which informal areas are gradually improved, formalized and incorporated into the city, through extending land, services and citizenship to slum dwellers. It involves providing slum dwellers with the economic, social, institutional and community services available to other citizens. The services include legal (land tenure), physical (infrastructure), social (crime or education, for example) or economic. Consequently, the management of the settlement programme can be problematic.

This research paper therefore is based on the programme management of informal settlements with specific attention to Region A of the City of Johannesburg Metropolitan Municipality (COJ). Various approaches and instruments applied for the informal settlements upgrading programme will be reviewed. These instruments include those used by other states, Non-Governmental Organizations (NGOs), other metropolitan municipalities within and outside the boundaries of the Gauteng Province, and other Provincial Governments in South Africa.

This research is both quantitative and qualitative in nature and it is intended to assist government in determining the key aspects and instruments required in the upgrading of informal settlements programme. The findings reveal that effective and proper management of informal settlements will go a long way in tackling the three triple challenges facing South Africa i.e. inequality, unemployment and poverty.

Keywords: development, formalisation, services, socio-economic, upgrade

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

1. Introduction

The socio-economic landscape of South Africa is faced with the triple challenges of high unemployment, poverty and inequality. One can argue that this triple challenge was exacerbated by the apartheid and colonial policies. The issue of racial and land segregation policies such as the Group Areas Act of 1950, (Act 41 of 1950) and the Natives Land Act of 1913, (Act 27 of 1913) were amongst many legislations which emphasised the isolation of certain sectors of the society, particularly blacks. Furthermore, subsequently to the enactment of the Group Areas Act, another harsh legislation was promulgated which dealt with the forceful removal of the so called squatters, the act was known as Prevention of Illegal Squatting Act, Act No 52 of 1951.This was a very harsh law. The Act gave landowners, local authorities and government officials power of evicting people or demolishing their houses as well as getting them off the land.

Another legislation which played a bigger role in the land and socio-economic landscape of this country was the Natives (Urban Areas) Act of 1923, (Act 19 of 1923). The Act was to regulate the presence of Africans in the urban areas. It gave local authorities the power to demarcate and establish African locations or townships on the peripheries of White urban and industrial areas.

The intention of this research paper is to look at the programme management of informal settlements upgrade programme with specific attention in Region A in the City of Johannesburg Metropolitan Municipality (COJ). The study seeks to assess the tools in place to address the mushrooming and existence of informal settlements, whether the available resources are able to address this challenge. The research further investigates the quality and quantity of services provided to the identified informal settlements, as compared to those provided inneighbouring suburbs (high income) areas such as Midrand and Dainfern.

This research will focus on three informal settlements situated in Region A, i.e Adelaide Tambo, Diepsloot Reception Area), and K60. These informal settlements were selected by the researcher from the list of informal settlements compiled by the COJ Housing Department. The study further looks at the profiling of these informal settlements in the selected study areas with the sole aim of informing policy and to contribute to the debate.

1.2 Problem statement

In South Africa, the post-apartheid era has seen all three tiers of government tasked with various responsibilities in relation to housing provision and this created high expectation on service delivery. The past 10 years after independence has seen government focusing more on housing delivery, however, since 2004 there has been a paradigm shift to human settlements and informal settlements upgrade which requires integrated service delivery and social amenities such as water, electricity, sanitation, schools, primary health, community facilities, tenure, etc. The Government of the Republic of South Africa is party to the United Nations Millennium Development Goals, which provides for the significant improvement in the lives of at least 100 million slum dwellers by 2020 (Housing Code, 2009). In addition to these conventions, South Africa adheres to the following declarations under the UN Habitat programme: the Vancouver Declaration on Human Settlements (1976), the Istanbul Declaration on Cities and Other Human Settlements (1996) and the Habitat Agenda (1996), the focus of which is to address the plight of persons without adequate housing.

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The Upgrading of Informal Settlements Programme is consistent with the above conventions with its primary objective being to cater for the special development requirements of informal settlements. The continual mushrooming of informal settlements is still a reality in spite of all these conventions and treaties. The City of Johannesburg Region A has about 53 informal settlements which are recognised by authorities' i.e Housing Department which makes it the second region with largest number of informal settlements in the city. There are various informal settlements and sustainable human settlements instruments in place in South Africa and the world over, but it is vital that these instruments are explored and probed if they serve the desired purpose and outcomes. The lack of skilled and experienced capacity in local authorities also poses severe delivery challenges, (Smeddle-Thompson, 2012:8).

1.3 Definition of "informal settlement"

The definition of informal settlement is very contentious and differs from context to context. According to the COJ Informal Settlement Upgrading Programme there is a difference between formalisation and upgrading of informal settlement, hence formalisation or upgrading is used as different terms in this paper. Considering that different countries, institutions, organizations and scholars use various definitions to describe informal settlements, it is against this background that the following interpretations are provided:

In terms of Statistics South informal settlement is referred to, an unplanned settlement on land which has not been surveyed or proclaimed as residential, consisting mainly of informal dwellings (shacks) (Statistics South Africa, 2001). In this instance informal dwelling is a makeshift structure not approved by a local authority and not intended as a permanent dwelling. Although this definition may be correct, however one can argue that human settlement in rural areas takes place on land that is not proclaimed and some if not all the dwelling units are not approved by the local authority. Can one therefore refers to a rural area as an informal settlement, perhaps it is in terms of not being proclaimed as a township in terms of the Town Planning and Townships Ordinance, 1986 (Ordinance 15 of 1986). However, the characteristics of a rural area and informal settlement are not necessarily similar.

The Department of Human Settlements 2009 Housing Code defines informal settlement by listing the following characteristics: illegality and informality, inappropriate locations, restricted public and private sector investment, poverty and vulnerability and social stress, (South Africa, 2009). Although these characteristics are relevant however, some of them are also found and experienced by people in the rural areas and most of the black townships in South Africa, particularly within the COJ are faced with poverty, vulnerability and social stress, yet they are proclaimed. In this instance one assumes that this 'illegality and informality' refers to land invasion and informal settlements without properly land surveyed layout plans which is in terms of the necessary legislation. Perhaps it means human settlement that was not approved and land or demarcated stands not allocated by the municipality. The researcher contends that this definition creates confusion, because there are informal settlements which exist without land invasion, i.e Adelaide Tambo, which was established by the COJ as a transitional settlement for future development.

In the COJ, there is no formal definition, however the city uses the following working definitions: "An informal settlement comprises of an impoverished group of households who have illegally or without authority taken occupation of a parcel of land (with the land owned by the Council in the majority of cases) and who have created a shanty town of impoverished illegal residential structures built mostly

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from scrap material without provision made for essential services and which may or may not have a layout that is more or less formal in nature". (Housing Development Agency, 2013: 7).

This definition seems to be focusing much on the structure or dwelling unit as opposed to the locality or how the land was occupied. Notwithstanding that this is an academic paper; however the COJ definition of informal settlement seems to be of academic nature which was trying to cover all gaps. Should a landowner, none other than government or its entities demarcates and provide land to individuals without following the township establishment processes, would that signifies the area as an informal settlement?

Some scholars such as Mark Misselhorn, argues the definition of informal settlement by bringing in government and scholars misconception of informal settlement. He argues that, there seems to be limited understanding of the dynamics within informal settlements and the social and survival challenges faced by people living in the informal settlements. This lack of understanding leads to development programmes such as the housing or human settlement programme which are premised on theoretical assumptions of what is practical and desirable, (Misselhorn, 2008: 4). In view of this argument, it is imperative that the affected society is encouraged to be at the fore-front of determining how their place should be developed. Government should play a technical and supportive role.

Various definitions have thus been proposed, but that suggested by the UN Habitat Programme is probably the most widely applicable. This defines informal settlements as:i) residential areas where a group of housing units has been constructed on land to which the occupants have no legal claim, or which they occupy illegally; ii) unplanned settlements and areas where housing is not in compliance with current planning and building regulations (www.who.int/ceh/indicators/informalsettlements). Many other terms and definitions have also been devised for informal human settlements, for example: unplanned settlements, squatter settlements, marginal settlements, unconventional dwellings, non-permanent structures, inadequate housing, slums, and housing in compliance etc. *Unconventional dwellings* are commonly defined by the number of housing units occupied by households, but considered inappropriate to human habitation. Problems occur in measuring the extent or defining the boundaries of such settlements. By definition, officially recognized boundaries to these settlements rarely exist, and the settlements themselves often merge almost imperceptibly into formal areas of housing, industrial or rural areas (Ibid).

Although different countries, organizations and communities use different names while referring to informal settlement, however they are denoting the same thing or type human settlement arrangement. Terms such as favelas in Brazil; Slums / squatter camps in many countries across the globe; *Imijondolo* in Kwazulu-Natal; *Mekhukhu* in the northern provinces of South Africa i.e Mpumalanga, Gauteng, Limpopo and North West; *aashwa'I* (Egypt); *JhuggiJhompri clusters (India)* and *ciudadesperdidas* (Spanish, "lost cities"). For purposes of common understanding and in line with the United Nations' Millennium Development Goals (MDGs) declaration in 2000, the term informal settlement shall be used in this research paper.

In view of this argument, it is important that the residents in the informal settlements are fully consulted by the authorities about or how they need to be developed or assisted. Authorities should understand the dynamics of each informal settlement to avoid a one size fits all approach. However, this does not suggest that each informal settlement must have its own development policies, but understanding the needs of the affected community will assist in yielding what the community desires.

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2. Literature Review

Although there are so many studies about the informal settlements upgrade programme, but it is still vital that proper solutions are discovered and applied according to the needs of the informal settlement residents. Theoretical review will assist in assessing the previously conducted studies and research findings and explore such in the case study. This will be done by looking at human settlements, housing, sustainable human settlements and informal settlements upgrade programmes that have been undertaken by various scholars and researchers, global trends and government policies and legislations such as the Breaking New Ground (BNG); Outcome 8 for 2010; Housing Act of 1997; Programme 9 as a strategy used by the COJ to address the informal settlements upgrade programme. The existence of informal settlements is a global occurrence which takes place mainly in developing countries. However, this does not suggest that the First World Countries are immune to this trend. Informal settlements were selected from the BRICS (Brazil, Russia, India, China and South Africa) countries, Kenya and Nigeria. From the BRICS community the focus is in Brazil, India and South Africa.

2.1 Brazil and Favelas

The Brazilian Geography and Statistics Institute (IBGE), the country's census bureau, defines them as "subnormal agglomerates." It stipulates that any area with more than fifty one homes illegally occupying a plot of land with precarious public services falls under this category. For those living in the favelas, the most popular term is *comunidade*. Other definitions include "shantytown" and "slum," due to the prevalence of irregular and self-constructed housing structures and to the mostly low-income population that resides within these areas, (Charma, 2015: 1). It is interesting to observe that in defining favelas the IBGE uses the number of households, this suggests that not any informal settlement can be treated as informal and qualifiers to be one. It will be interesting to know how did they arrived at the minimum of fifty one and how Brazillians treaty a settlement with less than fifty one households. Furthermore, the COJ informal settlement list on the other side has as little as six households and that is also considered as an informal settlement.

In the South African point of view we have observed many cases of such nature taken to the Human Rights Commission even to the Constitutional Court. The recent case in point is the Rio's favelas which have experienced major changes since the IBGE's last census in 2010. Internet access, the increased presence of the state and NGOs, mobility improvements, mapping and official land titles have led to huge development leaps. Larger favelas, like Rocinha, have opened their doors to commerce and become microcosms within Rio. The favela's "downtown area" now has a drug store, a state of the art gym, a bank and several sushi restaurants. State presence has increased through government development initiatives, (Charma, 2015: 6). People living in the informal settlements deserve to be treated with dignity; to this end government has a responsibility to make a proviso for service delivery and infrastructure regardless of the locality.

2.2 India

Chakrabarti (2001) contends that "In India the massive exodus of population from the rural to the urban areas as also from the smaller towns to the larger metropolis has been driven by a combination of the push and pull factors, but the central element has been the opportunity cost of employment in urban informal sector, which has grown rapidly in a two way process – on the one hand, the relative impoverishment of urban economy has offered a large space for the informal sector, on the other cheap

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labour market has encouraged the growth of processing and service industry in the household and tiny sector". The view of push and pull factors is a normal occurrence which leads to mushrooming of informal settlements. Furthermore, urbanization usually leads to migration towards urban or developed areas. Migrants they most of the time end up without proper accommodation and that result into land invasion and settling in compromised areas without proper services.

In the Indian context they do not necessarily define 'informal settlement', but settlement is clearly defined. "In simpler terms we can define settlement as any form of human habitation which ranges from a single dwelling to large city. The word settlement has another connotation as well as this is a process of opening up and settling of a previously uninhabited area by the people. In geography this process is also known as occupancy. Therefore, we can say settlement is a process" (www.nios.ac.in). Increase in Indian Population over a period of time has also resulted to the mushrooming and informal settlement growth across the country. Despite of Government efforts to build new houses and other basic infrastructure, most of the people living in slum areas do not have electricity, water supply and cooking facilities.

Sufaira (2013) contends that "the experience of Kerala shows that the condition of the people can be improved even at low levels of economic development through appropriate public action for social provisioning and redistribution. Kerala has been able to provide for the basic needs of most of its citizen. This is revealed by the comparative indicators of health education and demographic transition" (p.12)

2.3 Kibera in Kenya

Kibera is an informal settlement in Kenya which was founded almost a century ago. It is said to be a fifth of Nairobi's population, however over the years it has not featured much on any government development plans until recently. About fifteen densely populated villages make up this informal settlement. The building material used varies from mud huts to tin shacks.

"Until recently Kibera had no running water and it had to be collected from the Nairobi dam. The dam water is not clean and there have been reports of water-borne diseases. Furthermore government has installed communal taps which are shared by the community. It is still a long way off but many hopes the work done here means that one day, Kibera will no longer be synonymous with poverty and chaos and instead become just another Nairobi neighbourhood - one that its residents can proudly call home" (Fihlani, 2015: 1). In Kenya they use different approaches in addressing the issue of human settlements, but the dominant ones are KENSUP and KISIP. The central difference between KENSUP and KISIP is that KISIP has a short-term (5 years, 2011-2016) focus on infrastructure and land tenure in 15 municipalities, while KENSUP is a country-wide, long-term strategy (2005-2025), focusing on housing and other issues, (Anderson & Mwelu, n.d.: 2).

Community development in its context is a demand multiplicity of stakeholders' involvement i.e community, government, Non-Governmental Organisations (NGOs) and the business community. Each stakeholder must be afforded space to perform its roles. This view is in line with the approached adopted by the Government of Kenya where the Government in collaboration with United Nations Human Settlement Programme (UN-HABITAT) established the Kenya Slum Upgrading Programme (KENSUP) to provide a framework that can sustain long-term nationwide slum upgrading in Kenya. KENSUP seeks to harness political will while strengthening fledgling slum-dweller organisations in order to promote all-inclusive processes based on consensus building and partnerships, (UN-Habitat,

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2005: 1). Basically, not all responsibilities should be left in the hands of government, because the challenges confronting people in the informal settlements are societal and they have repercussion in the stability of the economy, politics, health and the environment.

2.4 Nigeria

Most scholars agree on how informal settlements are created, for example Bobadoye and Fakere (2013: 45) mention that "Urban decay in Nigeria is essentially caused by rapid urbanization and the mismatch in the provision and maintenance of housing and infrastructure. Most of the housing quality related problems in Nigeria results largely from inadequately planned land use and non-secure land tenure, poverty, poor construction and weak development control. The outcomes are the proliferation of slums which are characterized by overcrowding, flooding, dilapidated structures, existence of stagnant waste water in generally dirty and unhygienic living environments". A case study here is Makoko in Lagos.

The Makoko slums exist in their own peculiar world. Dubbed - with a heavy sense of irony - the Venice of Africa, the oily waters provide a way of life for the fishing community but also the greatest dangers, spreading disease through the cramped population (Mail Online, 2015). Sprawling out from what was originally a small village in the 18th century, it has been consumed by Lagos, Nigeria's largest city. But, a warren of twisting canals and puffed-up gangs, it's somewhere even police hesitate to tread. However, after more than a century of being left to its own devices, local officials have suddenly taken a keen interest in the slum. It is described as a floating slum in Nigeria.

For decades, residents in Makoko have had no access to basic infrastructure, including clean drinking water, electricity and waste disposal, and prone to severe environmental and health hazards. Communal latrines are shared by about 15 households and wastewater, excreta, kitchen waste and polythene bags go straight into the water they've lived on top of. The only way to get potable water is to buy them from vendors who get it from boreholes. Indeed, the government doesn't want Makoko residents living there at all. On July, 2012, the government swooped into the low-lying coastal community and demolished many of the floating houses and other illegal structures. The officials cited health and sanitation concerns, but some people suspect that the underlying motivation is a desire to sell off the area lucratively to property developers.

The media outcry following the demolition and the community's protest led the state government to announce a regeneration plan to provide accommodation for 250,000 people and employment opportunities for a further 150,000. Recently, a team of architects devised a floating school built from plastic barrels that has space for classrooms as well as play area (Ibid).

2.5 South Africa

In the South African point of view the democratic government came into in 1994 and it inherited a state which was fraught with unemployment and inequality. Most of all the issue of landownership was a major concern, because some sectors of the society were not legible to own land and minerals. Although, by 1994 the mushrooming of informal settlements was already visible, there was perpetual increase even post the apartheid era. Post 1994, the South African Government engaged in a process and made strides to develop various policies, legislations and instruments to address the housing backlog and the mushrooming of informal settlements. Amongst those is the following; the Reconstruction and Development Programme (RDP), Housing Act of 1997, (Act 107 of 1997), the Constitution of the

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Republic of South Africa, the Breaking New Ground (BNG), Outcome 8, the Upgrading of Informal Settlements Programme (UISP), National Development Plan, etc.

In its preamble the Social Contract for the Development of Sustainable Human Settlements document reads, "At its inception, South Africa's housing strategy focused on stabilising the environment to transform the extremely fragmented, complex and racially-based financial and institutional framework inherited from before 1994. Whilst simultaneously establishing new systems to ensure delivery to address the housing backlog and fulfil the constitutional obligations regarding housing, the initial housing programme was not sufficiently able to respond to the dramatically changing scope, scale and pace of the unfolding human settlement environment. The policy review culminated in the Comprehensive Plan for the Development of Integrated Sustainable Human Settlements, Breaking New Ground (BNG) adopted in 2004. BNG developed a more holistic response that looked not only at housing, but also at what is required for the development of more sustainable human settlements" (South Africa 2015: 4).

Scholars such as Graham Alder contend that, there is a common perception that land management (allocation, tenure and use) is fundamental to solving the problems of informal settlements, (Alder, 1995: 91). To this end this study will also seek to review the following key areas of concern in upgrading, namely:

- Addressing land tenure security and regularizing land ownership;
- Provision of infrastructure and basic services;
- Existing and effective institutional approaches for informal settlements upgrade
- Socio-economic transformation and improvements for people living in the informal settlements.

2.5.1 Diepsloot case area 1

The project area i.e. Diepsloot West Reception is located on the Farm Diepsloot 388 JR within the jurisdiction area of the Johannesburg Metro. Diepsloot West Reception is located on the Portions 139, 140 and 141 of the Farm Diepsloot 388 JR. The sites are surrounded by well-developed housing units with proper roads infrastructure. The study area complies with the infill planning concept that is in line and supported by the SDF, (Emendo Africa, 2008: 9). Within Diepsloot Reception area there are pockets of informal settlements (shacks), formal government subsidised (RDP) houses and bonded housing. The number of households in the area is always contested by the officials themselves, however it estimated between 25 000 and 30 000 households. This area started as a result of people evicted from Lanseria and some were relocated from Alexandra Township as part of disaster management due to floods in the area and government had promised to assist with housing since 1996.

In the drive to engage in the process of upgrading of informal settlements the COJ embarked on developing a policy and using other existing legislations meant to address the issue of informal settlements in the country. The following policies have been identified as significant towards the promotion of sustainable human settlements for the targeted communities: Integrated Development Plan, BNG, Housing Act, Spatial Development Framework (SDF), Upgrading of Marginalised Areas Programme (UMAP), Outcome 8, Programme 9, etc. The City of Johannesburg has formulated these policies in order to enable for the fulfilment ofthe formalization of informal settlements, (Emendo Africa, 2008: 8).

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According to the information obtained from the COJ Region a Housing officials this informal settlement has water and sanitation provision which is supplied and maintained by the city through it Municipal Entity, Johannesburg Water. The information sourced from the city indicates that the area has 88 communal taps of which some of them are attached to communal toilets. As such there are 88 communal toilets, 42 VIPs and 20 chemical toilets. Due to congestion these toilets and water taps are situated along the mini-roads or pathways. Meanwhile in terms of primary health, the entire Diepsloot area has two clinics. There are three community centres such as halls which belong to the COJ. Refuse collection is collected by Pickitup an entity of the COJ, each household is provide with a refuse plastic bag and the entire community is expected to use five skips, (City of Johannesburg, 2014).

The lack and or absence basic services make people vulnerable to poor health. Illnesses that incurred as a result of poor health increase pressure on community health care and social welfare services and the loss of productive capacity of members of society, (Khosa, 2000: 8). From time to time the Diepsloot community find itself had to deal with cholera outbreaks and other hygienic related illnesses.

2.5.2 Adelaide Tambo informal settlement case area 2

Adelaide Tambo informal settlement is situated on the north of Johannesburg Central Business District (CBD). Adelaide Tambo is located on Diepsloot RE-1/388JR. A Street separates Diepsloot Reception Area and the Adelaide Tambo informal settlement, this proximity makes the two areas share most of the available services and amenities such as schools, clinics, community centres. Furthermore, it is important to mention that the area falls within a buffer zone (smell zone), because it located adjacent to the sewer treatment plant.

Most definitions of informal settlement assume that land invasion has to take place into process of mushrooming of these settlements. However, in this case the informal settlement was created by the COJ Housing officials as a transit camp. Notable in this, is that Adelaide Tambo was created by government and this happened after the enactment of the Housing Act, 1997, BNG and various human settlement policies. Perhaps government should have been cautious about this by exploring other alternatives of dealing with the non-qualifiers for the Cosmo City Housing project. Basically the households who reside in Adelaide Tambo were those who used stay in Zevenfontein and through the Cosmo City project those who qualified for government subsidy they were the beneficiaries of the project. However, over the years this area is used by the city as a ‘dumping’ site, hence the figures increase.

In terms of the COJ formalisation of informal settlements programme the area is fairly organised in relation to the layout. Basically, each household has its own demarcated stand which was allocated by the city. Each household was allocated 80m^2 stand/lot in extent. This informal settlement is made up of 4550 households as per the city’s list of informal settlements. When people were relocated from Zevenfontein they were provided with communal rudimentary services i.e water and chemical toilets where 10 families had to share one chemical toilet. Water was supplied by water tanks which were strategically positioned along the wider streets to allow a water-tanker to manoeuvre. There are internal narrow gravel roads about 5m wide where two cars cannot pass one another.

As part of the City’s Formalisation of Informal Settlements Programme which is referred by the city as Programme 9, Johannesburg Water which is an entity of the city has provided 4003 VIP toilets per stand/household. Currently there are 547 households which do not have VIP toilets on their stands

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however, they use chemical toilets. Johannesburg water has also increased the number of communal taps, currently they are 38 and 13 water tanks, (City of Johannesburg, 2014).

2.5.3 K60 informal settlement case area 3

The project area i.e. K60, is located on Erf 1345 Rabie Ridge Ext. 2, Erf 2329, Rabie Ridge Ext. 4 and Portions 44 and Remaining Extent of Portion 47 of the farm Allandale 10-IR, to the north of Midrand in Region A, City of Johannesburg Metropolitan Municipality. This informal settlement is surrounded by well-developed housing units which include self-built, bonded and government subsidized housing. The area is referred to as K60, because it is located on the Gauteng Provincial road-reserve, hence the prefix 'K' which signifies provincial road.

In terms of the COJ formalization of informal settlements list, obtained from the city's the area has 1819 households which have demarcated mini-stands. The types of services provided in this informal settlement are individual chemical toilets which are maintained by Johannesburg Water, (City of Johannesburg, 2014). Where mini-stands have been demarcated the services provided at least per household, but the densely populated and congested areas are subjected to communal services. To this end, one will argue that as first step in the upgrading of informal settlement programme it is imperative for government to intensively engage with the affected community to assist in prioritizing their basic needs.

3. Programme Management of Informal Settlements

In the formalization of the above informal settlements, focus is on the identification of projects to be undertaken against the following broad principles:

1. To maximise the impact of the programme by reaching as many households as possible and to achieve the national goal of upgrading of all informal settlements by 2014;
2. The primary focus should be on settlements located in areas posing a threat to health and safety;
3. Projects should promote the objective of spatial restructuring and integration;
4. Settlements that are threatened with eviction or have been the subject of a Court Judgement must be prioritised; and
5. Responsible authorities should adhere to the principle that community participation is the key to success and that relocation of communities should be a last resort.
   (Housing Code, 2009).

3.1 Infrastructure and service delivery in the informal settlements

Across the globe, most if not all informal settlements are lagging behind in terms of infrastructure and service delivery provision. This view is supported by the regular service delivery protests experienced in the informal settlements. This argument is also supported by other scholarwho remark the high incidence of service delivery protests in response to the inadequate services in recent years and these protests are justified (Nnadozie, 2013: 85**)**. In the South African context it is a common view that in 1994 the democratic government inherited a rapidly deteriorating infrastructure which was also reserved for a selected minority. Access to social and domestic infrastructure was restricted to those who were settled in urban areas; however such infrastructure was also not adequate to the consumers in black townships, (Khosa, 2000: 1).

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Considering that most black townships had very limited or no provision to infrastructure and services, one can remark that people in the informal settlement were in dire need of basic services. Post 1994, the democratic government came to realize and recognise informal settlements, however many people in these areas are still faced with abject poverty, lack of basic services, unemployment and unhealthy living conditions. Access to basic services is not a privilege, but a right. "This Bill of Rights is a cornerstone of democracy in South Africa. It enshrines the rights of all people in our country and affirms the democratic values of human dignity, equality and freedom" (South Africa, Constitution: 1996).

Notwithstanding the locality of these informal settlements, the Constitution of the Republic, is unambiguous in compelling the State to make a proviso to access to basic services to all and sundry within the borders of this country. This paper argues that the first priority to be considered in each informal settlement regardless of it locality is the issue of access to basic services. In this case basic services refer to: primary health (clinics), water, electricity, sanitation, community centres and refuse removal. In this research paper the focus is based on the basic services provided in the five informal settlements in Region A, City of Johannesburg Metropolitan Municipality.

3.2 Human resources and capacity

"You are not going to do it all by yourself. Any change that amounts to anything involves other people, maybe even a lot of people. Although few people will have sustained involvement over the life of the change effort, many people will play a role in its success. These people aren't just sitting around offering advice (well, maybe a few are); they are doing things to accomplish a specific purpose or set of purposes" (Homan, 2008: 179). In line with this view it is important for government (National, Provincial and Local), to create departments which will be responsible for the programme of informal settlements upgrade.

Notwithstanding that authorities in the South African context have developed so many human settlement prescripts, but these policies they need professionals to interpret and implement them. Furthermore, non-human resources such as financing, land, infrastructure and services. In this study the focus is based on human resources and expertise available in the COJ Region A Housing Department. In this paper it was mentioned what skills are recommended to assist in driving the informal settlement upgrading programme and most of the expertise should come from the built environment.

A preliminary interview was conducted with one person (cannot be mentioned as she had no mandate to participate in the research interview) at middle-management from the Housing Department in the region. The aim of the interview was to discover the available human personnel responsible for human settlement and whether they have expertise to carry the mandate of upgrading or formalization of informal settlement. To start with there is not a single official who has got a qualification from the built environment. There is no one qualified as a project manager and quantity surveyor. This is a serious concern, because it is the very same officials who must implement all the projects that require such expertise. Due to the shortage of the relevant skills and expertise UISP is bound to fail and that negatively affects people on the ground.

4. Conclusion and Recommendations

Considering that most informal settlements are densely populated, congested and not easily accessible by utility vehicles it is recommended that the reblocking or cluster approach be considered. "Reblocking

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or Cluster" means grouping of shacks or households into groups of ten then each group be provided with a communal tap, ablution facility with showers and toilets and skip for refuse removal. Through this each cluster must be faced off to regulate access. This approach will minimize crime and also make residents responsible for their cluster and on the other side it will create space for roads and a proviso for maneuvering of utility vehicles. In relation to services and infrastructure the three spheres of government should undertake measures to improve the physical environment of the dwelling places, proper drainage, sewerage system and adequate water supply. Mobile clinics should be arranged for treatment of common illnesses and health promotional activities to prevent possible outbreaks. The COJ should develop strategies to prevent the formation of new informal settlements. These should include access to affordable land; regulate the pricing of building materials, employment opportunities and basic infrastructures, (Sufaira, 2013: 19). Informal settlements management should entail the prevention, control and upgrading of informal settlements as opposed to being reactionary.

A clear and transparent structure of government institutions with roles and responsibilities clearly defined and well-coordinated between each other is necessary to tackle complex issues like informal development. Mechanisms should be implemented to legalize all types of properties where the current residents have long-standing tenure of the land. Mechanisms should be put in place also, not only to legalize existing informal structures, but also to encourage new structures to be built in the formal sector. Legalization programmes are most effective when compliance with planning regulations is not a prerequisite for title issuance. The right to own property should not be dependent on the presence of informalities. Spatial planning and zoning should be undertaken in a coordinated manner, based on updated cadastral information, to both allow for legalization and discourage further informal development. Overly strict and expensive formalization procedures can severely limit the realestate market's ability to function.

Formalization policies should be formulated and enforced in a way that protects theenvironment, encourages secure tenure and promotes economic growth (UN, 2015). Property laws must be clear, and the Government should not, in most cases, retroactively enforce ownership rights over land that has been in the private propertyfor an extended period of time. The private sector can contribute to surveying and quality control for legalization, but it must be regulated and its role must be clearly defined. Finally, Policies should encourage the proper training of all relevant experts. Planning amnesty programmes can be useful measures to bring large amounts of informalproperties into the formal sector. Informal settlement's households need to be made aware of the advantages of legalization and the necessary procedures to legalize their property.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-030

Performance Evaluation of Contractor Development Programmes in Gauteng, South Africa

Dapaah Ambrose[1], Didi Thwala[2], Musonda Innocent[3]

Abstract

Contractor Development Programmes (CDPs) are aimed at creating an enabling environment for the survival and sustainability of Small, Medium and Micro Enterprises (SMMEs) contractors. However literature informs that the opinions of beneficiaries of these CDPs have not been adequately evaluated to access the impact of these CDPs. The purpose of this study was to establish the extent to which these CDPs have helped to improve contractors' management skills and the extent to which the CDPs have ensured contractors' upgrade in CIDB registration status. A questionnaire was administered to contractors to establish their views on the benefits of the CDPs. Findings revealed that the CDPs had achieved their objectives of improving management skills and ensured contractor upgrade in CIDB registration status. Other observations were that continuous contractor mentorship (CCM) was critical and should be an integral part of every CDP. To improve the benefits of CDPs, all implementing stakeholders should introduce CCM into their programmes instead of the once-off mentorship programmes that currently exist. The study will assist in enlightening CDP stakeholders of the need to modify the programmes to meet the beneficiaries' objectives.

Keywords: CDPs, improvement, mentorship, performance, upgrade

1. Introduction

Contractor Development Programmes (CDPs) have been seen as the panacea needed to assist Small, Medium and Micro Enterprises (SMMEs) to develop their capabilities to the standard of large enterprises. The CDP in South Africa can be traced back to 1995 when the National Department of Public Works (NDPW) introduced programmes aimed at assisting contracting organisations owned by Previously Disadvantaged Individuals (PDI) develop their expertise and managerial skills so that they can compete with established construction firms (NDPW, 2004:3).

Subsequent to this initial programme, most provincial governments established CDPs with the same objectives as that of the NDPW. The modelling, configuration and the execution of some of these programmes have been widely researched (CIDB, 2011:1-35), South African Construction Excellence

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

Model (SACEM) (Dlungwana, et al, 2002:1-8) and the Integrated Emerging Contractor Development Model (IECDM) (Hauptfleisch, et al, 2007:1-13).

Even though there are some positive outcomes achieved by some of these CDPs in the past as postulated by McCutcheon and Parkins (2003), Havemann (2001), Söderbaum (2001) and Mojapelo, et al (2001), there still appears not to be enough literature on the effectiveness of these CDPs and whether they are beneficial to the end users. As Jacquet (2002:7) observed: *"The greatest challenge that exist today in South Africa lies at the fact that no data is available on how effective interventions are, whether they are achieving successes, and which sector require most assistance*".

The Construction Industry Development Board (CIDB, 2011) concurs with this assertion by recommending that the CPDs must be evaluated to seek "the perceptions of the programme beneficiaries on the direct effects of the programme in addressing their needs" (CIDB, 2011:84).

The participation of SMMEs in the construction industry is significant and their contribution to the industry is clear and cannot be overlooked especially when considering the importance of the construction industry to most national economies. In Sri Lanka, for example, the construction industry contributed almost 8 % of the Gross Domestic Product (GDP) and was 7thamong 13 major sectors contributing to the country's GDP (Chamber of Construction Industry Sri Lanka, 2012:2). In South Africa, the construction industry contributed almost 4% to the GDP in 2012 (Industry Insight, 2012:17).

For most parts of the world, the construction industry is very critical. In India, the construction industry is the second largest employer after agriculture. The industry employs about 18 million people directly and 14 million people indirectly (IHG Global Insight, 2009:7). In Palestine, the construction industry contributed about 26 % to the country's economy in 2000 (Mahamid, 2011:1).

Having recognised the SMME construction businesses' potentials to contribute to national economies, it is worth noted that the various initiatives aimed at improving contractors' performance in South Africa seemed to have failed to ameliorate contractors' ability to run successful business. Greyling (2012:43) lamented that most SMME contractors do not have enough understanding of the basic contracts being used in the country. Coupled with the lack of understanding of basic contracts, most SMME contractors lack the knowledge of tendering and procurement and as a result they forfeit an average of 7% of their profit margin due to wrong costing and pricing calculations (Greyling, 2012:7). Furthermore, construction clients are generally dissatisfied with the quality of work delivered by SMME contractors (Mbachu and Nkado, 2006 and Smallwood, 2010:941). The CIDB (2011:4) reported that 10% of Department of Human Settlement's budget for 2009/10 was used to repair houses due to poor quality of work from SMME contractors.

There are numerous literature on the development and implementation of CDPs and models in the country (CIDB, 2011:1-35; Dlungwana, et al, 2002:1-8; Hauptfleisch, et al, 2007:1-13). Despite these numerous studies, there appeared to be limited literature on how the beneficiaries of these programmes perceive them. It is therefore warranted that research be conducted to ascertain the perception of the beneficiary contractors on whether the CDPs assisted in ameliorating contractors' management skills and whether the CDPs have translated into an upgrade in CIDB grading.

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

2. Background

The concept of CDP started around 1969 when the ILO initiated World Employment Programme (WEP). The WEP then transformed into small contractor development programmes in Sub-Saharan- Africa in the 1970s due to the lack of local, indigenous contractors to enforce the policy and overriding presence of large foreign contractors (Croswell and McCutcheon, 2001). The small contractor development programmes have been successful in some sub-Saharan such as Ghana, Kenya, Lesotho and Malawi (Larcher, 1998; Ofori, 2002; Eyiah, 2004). Based on the small contractor development programmes, the National Department of Public Works (NDPW) of South Africa in 1995 introduced programmes aimed at assisting contracting organisations owned by Previously Disadvantaged Individuals (PDI) to develop their technical and managerial skills to enable them compete with established construction firms (NDPW, 2004:3).

Historically, most countries have developed their local contractors (Larcher, 1998; Croswell and McCutcheon, 2001; Verwey, and Havemann, 2001; Ofori, 2012) to withstand challenges and adversities caused to them by foreign construction companies and for South Africa, the marginalisation caused by historical events.

It should be remarked that the challenges facing SMME contractors in South Africa are not only historic but also from current challenges such as globalisation, demographic changes, and demand for green and sustainable building, technical advancement and threats from emerging economies (DBIS, 2013:7).Therefore it is prudent that all contractor development stakeholders keep track of the charges and requirements of the industry to enable them to be abreast with all aspects of the sector.

CDPs are capable of influencing contractors' human resource development; materials development; engineering development; company growth; development of documentation, routines and working environment; institution building and evolution of working environment (Ofori, 2012:8). Croswell and McCutcheon (2001:365-379) observed that successful CDP should have certain approaches which include inter alia;

3. continuity of contracting opportunities;
4. training and ongoing mentoring;
5. high level support and
6. Institutional support.

Croswell and McCutcheon (2001: 365-379) further recommended that a successful programme be structured as a series of consecutive contracts, during which the fundamentally-trained small contractor is progressively mentored until he or she finally becomes able to act independently, that is having the entrepreneurial approach towards marketing for work and tendering successfully to ensure their sustainability.

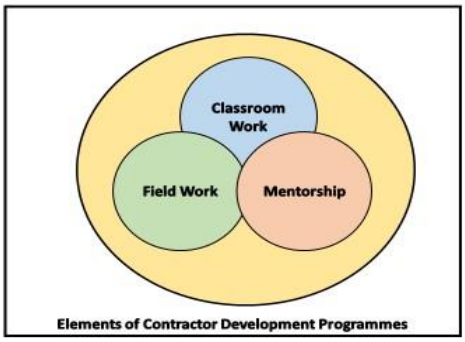
The South African CDPscame into being at the roots of a constitutional requirement as set out in section 217 (1 - 3) of the Constitution of the Republic of South Africa, 1996 (Act 108 of 1996), which requires that any contract for the supply of goods and services to every state, provincial and local government organ or whatever other institution must be conducted in a system which is fair, just, transparent, competitive and cost-effective. The constitution does not prohibit the organs of state or institutions referred to in the above sub-section from implementing a procurement policy providing for (a) categories of preference in the allocation of contracts (b) the protection or advancement of persons, or categories

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

of persons, disadvantaged by unfair discrimination and it also sets aside the framework within which the policies mentioned above may be implemented to be dictated by the national legislation (CIDB, 2011:15-16).

CIDB (2011:76-78) identified the best practices for as successfully CDP implementation as the implementing client knowing the rationale for the programme. Furthermore, a successful CDP must have political and administrative backing and the size of the programme should be determined by the implementing agents. The programmes should also have clear entry and exit points and commitment of funds from management and political bodies where applicable.

The selections of contractors into the CDPs and the procurement strategies of the programmes should be transparent, open, cost-effectiveand fair. Finally, the documentation for the CDP implementation should be simplified to conform to the CIDB Standards for Uniformity. Literature informed that the common elements for a successfully CDP implementations include the integration of classroom work, field work and mentoring as depicted by Figure 1.



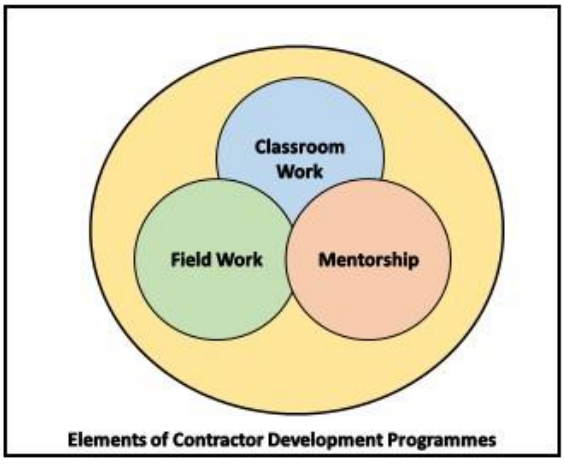


Figure 6: Elements of Successful CDP -Theory

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ISBN 978-0-86970-787-6

3. Method

The research method employed to achieve the objectives of the study was self-administered questionnaire sent to the respondents by hand and by email. The survey was limited to mainly contracting firms registered with the CIDB in categories 1 to 7 who fall in the description of small, medium and macro enterprise as they were the targets of the CDPs. The list for the survey sample was established from the construction, education and training authorities (CETA) database in Johannesburg.

In addition, the department of National Public Works offices in Pretoria was contacted for contact details of contracting firms who had undergone their contractor development programme under the Expanded Public Works Programme (EPWP).

Other respondents were obtained through links with ESKOM's training academy, Khuthaza, Gauteng Department of Transport's Maintenance section and CIDB's contractors' registration register. The researchers' network links in the construction industry were also utilised to reach out to more potential respondents.

Questionnaires were delivered to respondents' offices in person and in most cases the researcher waited for the questionnaires to be completed and handed back to the researcher. This approach was taken in order to increase the response rate to the questionnaires. However, a few of the questionnaires were emailed to respondents and were returned via electronic mail as well.

A total of one hundred and twenty eight (128) questionnaires were distributed to respondents and one hundred and four (104) questionnaires were received from the respondents translating to a response rate of 81%. According to Baruch and Holtom (2008), Nulty (2008) and Fincham (2008) a response rate of 81% is acceptable for a survey.

Cronbach's Alpha Coefficient was used as a measure of the internal consistency index and an alpha of 0.956 was recorded which implied that the research instrument was 96% reliable. The good thing about an internal consistency index of reliability is that it is assessed after only one test administration and consequently evades the problems associated with testing over multiple time periods (Miller, 1986: 2).

Rating scale was used to measure variables, such as beliefs, positions, perceptions and many other behavioural variables. The rating average was computed as follows:

$$\frac{X_1W_1 + X_2W_2 + X_3W_3 \ldots\ldots\ldots\ldots\ldots\ldots X_nW_n}{\text{Total}}$$

Where: W = weight of answer choice; and
X = response count for answer choice.

4. Findings and Discussion

4.1 Implementation of the contractor development programmes

The respondents were requested to rate how the CDPs were implemented and whether they thought the CDPs were achieving their intended goals. The results from the survey indicated a weighted mean of

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ISBN 978-0-86970-787-6

3.30 overall on the implementation of CDPs (Table 1). This value was below the 3.5 rating which leans more to the 'strongly agree' rating. 99% of the respondents either 'agreed' or 'strongly agreed' to CDPs being implemented properly and to their satisfaction. The respondents rated highly at 3.56 the statement that 'the trainers delivered and explained the training clearly'. The least rated statement at 3.14 was that there was a single point of contact and the statement that 'the training met their set objectives' was rated to at 3.17 which leans more towards disagreed than agreed. This rating therefore contradicts the overall finding that the respondents were satisfied with the implementation process.It was observed that the three attributes of CDPs namely, Classroom work, Site work and Continuous mentorship scored ratingsof 3.43, 3.32 and 3.35 respectively,these ratings placed them between strongly agreed and agreed. The proposals made by most of the respondents in the open ended questions in the questionnaire for continuous mentoring instead of the once off mentoring seemed to indicate that mentoring was lacking in the CDPs they underwent and this was supported by the rating of 3.21 achieved by the statement 'the mentoring processes were helpful'.

4.2 Improvement of management skills of the CDPs

One of the objectives of the study was to investigate the extent to which the CDPs have assisted in improving contractors' management skills. A weighted average rating of 3.38 was achieved for the CDPs improvement of contractors' managerial skills. As can be seen in Table 2, the results showed that 90% of the respondents either agreed or strongly agreed to the assertion that the training improved their management skills. The weighted average rating was determined to be 3.38 indicating a leaning towards agreeing as opposed to strongly agree. 76% of the respondents indicated that the training had given them more confidence in management skills and rated this statement at 3.75 entailing a strongly agreed. However respondents did not think that the training had necessarily enabled them to complete projects as that statement achieved a rating of 3.27 which leans more towards disagree. The rating of 3.33 for 'the training has improved my knowledge on estimating and tendering' placed the statement closer to agree than strongly agreed.

4.3 Contractor upgrades

As depicted in Figure 2, 8% of the companies represented by the respondents were registered in Grade 1 before the CDP, but this changed to 1% after the CDP indicating a drop in numbers and hence suggesting an upgrade. This was also the case for those that had indicated that they had been registered in Grade 2. 50% of the respondents indicated that they had been registered in Grade 2 before CDP, but this statistic changed to 10% after training completion, 31% had Grade 3 before CDP, but this figure changed to 46% after CDP. Grade 4 companies were at 7% before CDP, but improved to 24% on completion from CDP, again, there were 2% of Grade 5 companies before CDP but this figure increased to 13% after CDP, Grade 6 had 1% before CDP, but improved to 3% after training completion, Grade 7 companies made up of 1% before CDP, and this too changed to 2% and finally 1% of thecompanies were able to attain Grade 8 after graduation from CDPs. The movement in the %age registrations namely from high to low %ages in the lower categories and low to high %age in the higher categories seemed to indicate an improvement in registrations after undergoing the CDP.

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Table 1 - Implementation of contractor development programmes

ID	Implementation of CDP	Strongly Agree (4)	Agree (3)	Disagree (2)	Strongly disagree (1)	Not Sure (0)	TOTAL (%)	Weighted average rating
1	The trainers delivered and explained the training clearly?	57	42	1	-	-	100	3.56
2	The time allowed for the classroom work was appropriate?	46	52	-	1	-	100	3.43
3	The site work was adequate?	32	68	-	-	-	100	3.32
4	The mentoring processes were helpful?	24	74	1	1	-	100	3.21
5	Continuous mentorship will be very helpful to the successful CDP implementation?	37	61	2	-	-	100	3.35
6	The materials given at the training were effective and helpful?	33	66	-	1	-	100	3.31
7	There was a single point of contact for communication between trainers and trainees?	16	82	2	-	-	100	3.14
8	The training was scheduled and communicated to clearly?	30	68	1	1	-	100	3.27
9	The training was executed according to the predetermine schedule?	26	74	-	-	-	100	3.26
10	The training met their set objectives?	18	81	1	-	-	100	3.17
	Mean %age	**31.90**	**66.80**	**0.90**	**0.40**	**-**	**100**	**3.30**

5. Summary and Recommendation

The findings of the study suggested the beneficiariesagreed that the CDPs were implemented properly, however their request for continuous mentorship programmes are supported by literature and are an indication that the CDPs requires some improvement. There were also the sentiments that the CDPs had assisted the beneficiaries to improve on their management skills; contrary to this, the findings on estimation, tendering, claims and contract laws scored average rating points.And finally, it is believed that the CDPs had helped the companies achieve higher CIDB grading.

The general impression was that the beneficiaries were satisfied with the CDPs and regarded them as being useful to their sustainability and upgrade, however, there were certain aspects or gaps such as continuous contractor mentorship during the CDPs that they suggested the implementing agencies needed to attend to in order to ensure the successful implementation of the CDPs.

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Table 2 - Improved Management Skills

ID	Improved Management Skills	Strongly Agree (4)	Agree (3)	Disagree (2)	Strongly disagree (1)	Not Sure (0)	TOTAL %tage	Weighted average rating
1	The training has given me more confidence in my managerial skills?	76	23	1	-	-	100	3.75
2	The training has improved my knowledge on estimating and tendering?	35	64	-	1	-	100	3.33
3	The training has broadened my knowledge on project planning?	40	59	-	1	-	100	3.38
4	The training has enhanced my knowledge on financial planning?	50	49	1	-	-	100	3.49
5	The training has enhanced my confidence in contract laws and claims?	32	66	1	1	-	100	3.29
6	The training has improved my ability to market my services to clients?	31	67	1	1	-	100	3.28
7	The training has enhanced my knowledge of effective quality control?	33	65	2	-	-	100	3.31
8	The training has enabled me to complete projects within the contract period?	29	69	2	-	-	100	3.27
9	The training has assisted me to complete projects within project budget?	36	62	1	1	-	100	3.33
	Mean %age	**40.22**	**58.33**	**1.00**	**0.56**	**-**	**100**	**3.38**

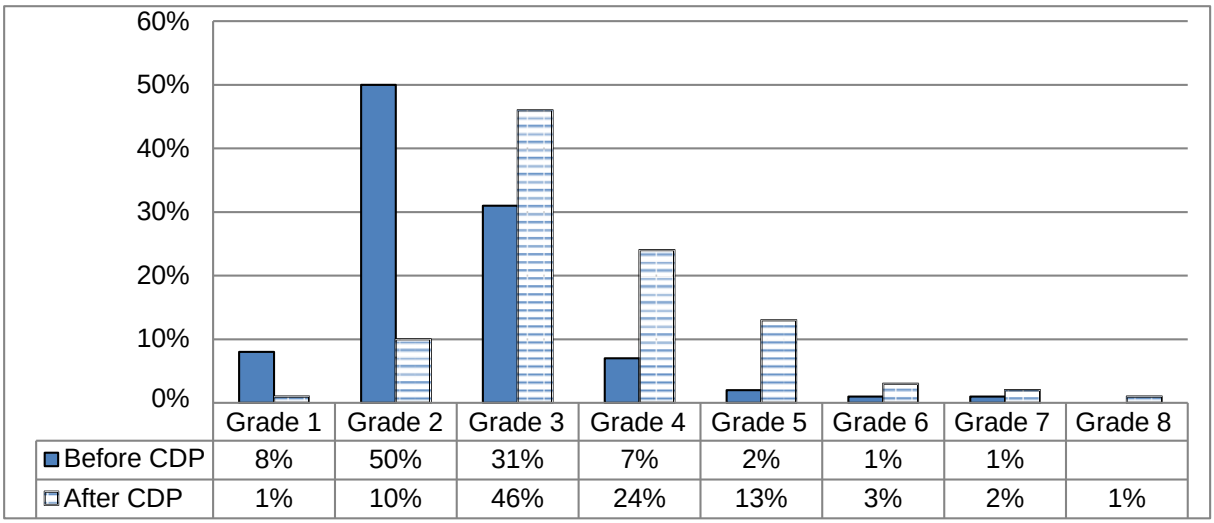

***Figure 2** - CIDB grading before and after CDP*

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

It is recommended that:

- CDPs must have continuous mentorship programmes to progressively mentor contractors until they are able to act independently.
- Cost of contractor mentorship be made free or subsidised.
- CDPs should have organised intuitional structures which are appropriately staffed to deliver the programmes.
- CDPs should have a well-defined training and development models with concise syllabus structure.
- CDPs should have well-defined entry and exist levels enable the implementing bodies evaluate learners performance.
- Implementing stakeholders should observe mentorship as continuous process and just a once off process.
- Mentors implementing these programmes must meet the minimum qualifications as prescribed by The South African Council for the Project and Construction Management Professions (SACPCMP).

6. Conclusion

The study revealed that to ensure successful CDPs there are some best practices to follow, most of which were recognised and followed by most of the CDPs reviewed. It was observed however that, one of the three main successful attributes of CDP which is mentorship is either not implemented or not taken serious in the CDPs reviewed. It was therefore recommended that Continuous Contractor Mentorship (CCM) be made mandatory in all CDPs to ensure their successful implementation to enable them improve contractors' management skills and also ensure their upgrade in CIDB registration status.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-045

The Use of Reverse Logistics Principles in achieving Zero Waste Cities in South Africa

Mbayahe, T.[1], Onatu, G.[2]

Abstract

According to a report by the UN-Habitat, the rate of urbanisation on the continent has increased from 15% in 1960 to 40% in 2010, and is expected to reach 60% by 2050 (UN-Habitat, 2010). Urbanisation is seen as an opportunity for economic growth. However, rapid urbanisation has become a major problem in Africa. It poses challenges for managing service delivery particularly waste management. The growing population of African cities has led to a high waste production which has become an important factor of environmental pollution. In South Africa, the management of waste is also a real issue. The role of waste management is a responsibility of municipalities and it has become a key performance indicator for most of the local government. The study therefore evaluated the current state of waste management systems in South Africa, specifically solid waste management, modelling against a Zero Waste Management (ZWM) strategy as an approach to deal with the waste management problem. The findings reveal that waste management is problematic, and identified key areas in which the country needs improvement to achieve an efficient waste management system. Factors such as financial resource management, equipment management, human capital management and community behaviour were identified. The article concludes that ZWM can be a sustainable tool that could help to ameliorate the problem of waste management with the main objective of reducing, reusing and recycling waste. As the ZWM system includes principles of reverse logistics, the paper highlighted the crucial role that the logistics manager would have to play in the process and suggested an integrated logistics plan that could facilitate the zero waste process.

Keywords: cities, reverse logistics, solid waste management, South Africa, zero waste

1. Introduction

In South Africa, the government is responsible for making available basic services to all South Africans (CSIR, 2011). This role is crucial in the success of the implementation of different strategic plans and governmental development programmes like the Reconstruction and Development Programme (RDP) (CSIR, 2011). In synergy with local governments, the central government has to make sure that all South Africans have free access to basic service. Regrettably, in recent years, there has been an increase of violent protest over service delivery. Based on media reports on most of South African media platforms, it was observed that a large portion of those subversive complaints were linked to waste and sanitation issues. A recent research conducted by the Public Affairs Research Institute demonstrated that

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

grievances against waste and sanitation management consistently feature amongst the top five reasons of the protests.

The generation of waste is one of the critical problems cities are facing in the world (Zaman and Lehman, 2013). Managing waste has become an important indicator of how well a city is run (Zaman and Lehman, 2011). Solid waste (also known as trash or garbage) is perceived to be the most common waste produced in municipalities. It consists of everyday unwanted items or goods thrown away after utilisation. Solid waste management and Service delivery systems play a pivotal role in improving public health, environmental sustainability, economic development and poverty reduction (National Treasury, 2011). South Africa is confronted with solid waste management challenges driven by a rapid population growth and urbanisation (Kasay, 2014). An effective solid waste management system can significantly contribute in improving the environment as well as the sanitation (Kasay, 2011).

This paper therefore aims to study the status quo of solid waste management in South Africa and explore solutions that could improve the solid waste system. The article proposes Zero Waste Management (ZWM) as a tool that could help in improving the management of solid waste in South Africa. Pursuant to this, the paper suggests the use of reverse logistics to facilitate the implementation of the ZWM. Reverse logistics is a process of reusing utilised materials or goods with the objective of capturing its value or for proper disposal (Dowlatshahi, 2011). The ZWM plan proposed on this paper incorporates reverse logistics principles to achieve the goal of creating zero waste cities in South Africa.

2. Solid Waste Management in South Africa

Solid wastes comprise of all wastes generated by human or animal activities which are compact and perceived to be unusable or undesired (Tchoubanoglous et al, 1993). They may be grouped in terms of origins, since its composition is the result of the remaining produced by a specific activity. Some of the common types of solid wastes includes: residential or domestic waste, commercial waste, industrial waste, agricultural waste, special waste, etc.

The quantity of solid waste depends on various factors such as economy, geography and population. These factors are linked to different variables such as social and cultural profile of the population, income, employment and land use (Tchoubanoglous et al, 1993).

In South Africa, the solid waste management function is assured by local municipalities. The solid waste management process includes waste generation, waste in refusal bin, waste collection and transportation, disposal at community, skin bin truck and landfill sites (as shown in figure 1).

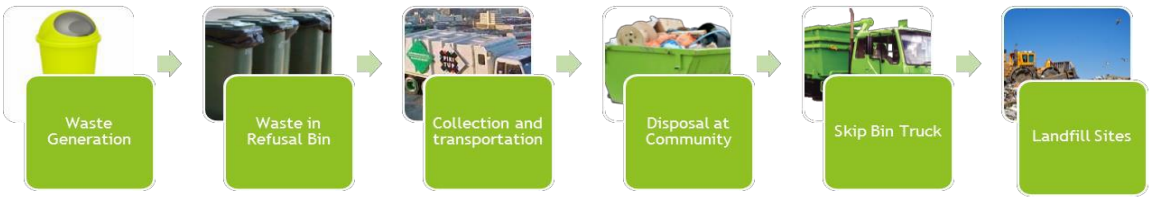

Figure 1: Solid waste management system in South Africa (National Treasury, 2011)

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In the recent years, some municipalities in the country have been experiencing critical issues in terms of solid waste management (CSIR, 2011). These problems are the result of the ever changing environment combined with some administrative constraints and human behaviour (CSIR 2011).

2.1 Challenges in waste management

South Africa is faced with challenges with regard to waste management. Some of the key challenges are discussed below.

2.1.1 Growing population and rapid urbanisation

According to a report from UN Habitat, the majority of the world population would be living in urban areas (Pillai and Shah, 2014). This rapid urbanization combined with the growth of the population predict a high amount wastes that would be generated (Pillai and Shah, 2014). As a growing economy, South Africa is also affected by the problem and would have to start finding sustainable ways of managing wastes (Kasay, 2011).

2.1.2 Insufficient financial resources to implement sustainable waste management and to maintain landfill sites

The rapid growing population has also sensitively increased the quantity of wastes produced. This has specialist in waste management to propose innovative techniques that would assist in managing wastes (Mannie and Bowers, 2014). However, the implementation of those ground – breaking methodologies have proven to be expensive. This has led most of the municipalities to stick to the traditional waste management process due to the budget constraints (Kasay, 2014).

Landfill sites have also become the source of serious concerns from local municipalities (National Treasury, 2011). There has been a growing need in building new landfill sites as the amount of wastes generated is getting bigger every day. Adversely, the process of rehabilitating existent landfill sites and developing new landfill infrastructure has proven to also be onerous and inaccessible to some of the municipalities (Western Cape, 2005).

2.1.4 Lack of expertise in the Waste Management sector

Some cities in South Africa are facing a problem with illegal dumping. This is usually the result of lack of ecological responsibility from some communities and absence of adequate refusal infrastructure in some areas (Western Cape, 2005). The mushrooming of informal settlements also around the country has also contributed in increasing the problem of illegal dumping (National Treasury, 2011).

Although some local government have taken important measures against those challenges, waste management has remained a critical concern (Western Cape, 2005). Communities are also encouraged to bring their contribution by adopting an ecological mind and assist the state by avoiding illegal dumping (Kasay, 2014).

These critical impediments would only be alleviated if local government and communities can work together in synergy (Mannie and Bowers, 2014). The adoption of innovative and strategic approach to

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waste management can also contribute in proposing solutions that could assist in protecting the environment (CSIR, 2011).

3. Zero Waste Management

3.1 Zero waste management concept

The Zero Waste Approach is a concept that aims at encouraging the design of the resources life cycle in order to reuse the product and reduce the amount of waste send to the landfill (Williams, 2005). The life cycle of a product usually follow the process in figure 2.

Fig. 2: Solid waste life cycle (Shankar and Tiwari, 2007)

The Zero waste technique acknowledges that in each step of the product life cycle, wastes are generated. It is therefore important to find a way of reducing, reusing and recycling them. The technique suggests (Williams, 2005):

- No trash should be sent to the landfill or incinerators
- Trash of a person can be someone else treasure
- The amount of waste sent to landfills can be reduced up to 66%
- Consumer should aware on environmental issues

The modern world has turned into a society rooted on consuming new items or technologies. Consumerism has become the life style of most of the population nowadays. Waste is generated when consumer articles are disposed after use. Nevertheless, the disposed items still contain some valuable materials that can reutilise. The Zero waste approach encourages people to avoid throwing a good that has not been fully utilized. Indeed, as long as a good is not yet discarder, and still utilisation, it can be considered as waste.

The first action proposed in the zero waste process as highlighted on the above figure is to reduce the amount of waste produced by avoiding to dispose of any good that still have important materials (Worrel and Vesilind, 2012). The next pivotal action in zero waste is reusing the good as much as possible, recycling waste and then analyse the opportunity of gaining any different benefit out of it. The disposal to landfill is the last option and least favoured because (Worrel and Vesilind, 2012). This paper would therefore try to assess how this methodology can be included in the South African waste management system to try to propose a potential solution to the current issue of waste production in the country.

The zero waste concept can be considered as a sort of a reverse logistics approach (Vahabzadeh and Yussuf, 2012). However, the next sections would highlight how the logistics component can be integrated to support the zero waste approach.

In South Africa, the Department of Environmental Affairs and Tourism (DEAT) held a National Waste Summit in Polokwane in 2001, which resulted in a declaration committing South Africa to reducing

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waste generation by 50% and disposal by 25% by 2012, and to work towards achieving zero waste by 2022 (DEAT, 2012).

3.2 The role of integrated logistics support in zero waste management

Logistics engineering is described as the technical process of transporting, storing, and handling a product until it reaches its final destination (Langford, 1995).

One of the key parts of the logistics engineering process is the integrated support plan. An integrated logistics support (ILS) has as main objective the improvement of the availability at an optimum life cycle cost. It has essentially nine elements which are represented on the below figure (Langford, 1995).

For the purpose of this research, the reverse logistics component would be integrated to facilitate the implementation of the zero waste process and make the cycle more effective and sustainable.

Reverse logistics can be defined as the process of reutilising goods that have reached their end of life. The hierarchy followed by the reverse logistic cycle is more or less the same with the zero waste diagram. This aspect can be seen on the representation of the hierarchy as presented in figure 3.

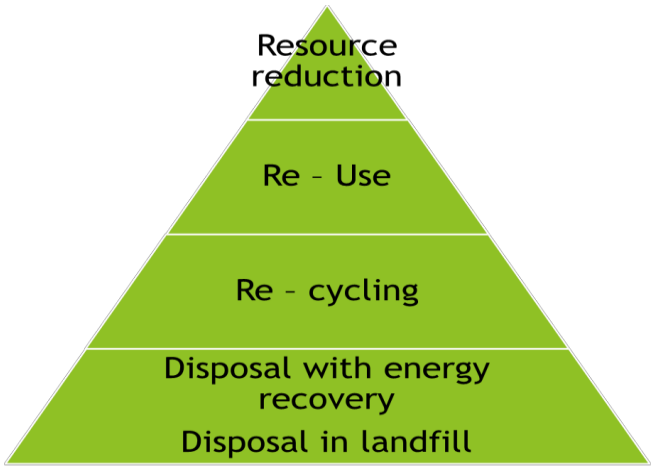

Figure 3: Reverse logistics hierarchy for waste management (Source: Shankar and Tiwari, 2007)

3.3 The role of the logistics engineer in zero waste management

The term logistics has always been perceived as engineering rooted, however it has to be noted that logistics principles can also be linked to activities that can promote the wellbeing of the people.

In this research, the logistics engineer would have to play the role of social and environmental technician. His/her role would be extended in the facilitation of stakeholders administration and make sure that all the key participant in the Zero Waste Management approach would be working collaboratively. The stakeholders in the process of zero waste management are:

Municipal Governments

Local governments play an important role in South Africa. According to the South African Constitution, they are the entity in charge of regulating the waste management system. Local authorities have also to

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make sure to enforce the law and guide citizens on what are their rights and responsibilities. In terms of waste management some of their main roles are: use of public funds to implement the waste management, regulate tenders for appointing private contractor and respond to the concerns of the population (CSIR, 2011).

Private Sector

This sector includes individuals or group of people who own a certain firm or company that would provide certain services. Although private firms are mostly profit orientated, they have to make sure that their projects respond to the norms implemented by the state and propose plans that are sustainably and environmentally correct. Their involvement in waste management system usually intervenes in the transportation and maintenance of waste infrastructure. However, the state has the duty to ensure that while appointing a private consultant, they would be able to still keep inline the interest of the community (CSIR, 2011).

Local Communities

They are maybe the most important stakeholder as they have to benefit of most of the programmes developed by the government. However, when coming to waste management they are encouraged to take initiatives in order to maintain their environment. Communities are encouraged to be eco responsible in avoiding any type of behaviour that could harm their ambient milieu (Ulfik, 2014).

Non-Governmental Organisations

NGOs are various organizations such as religious entities, academic and research institutions, and philanthropic groups. They play an important role in sensitising the population on different environmental issues and they are also involved in community empowerment. Their research usually assist in terms of producing the right knowledge that would provide a sort of guideline to the local government (Ulfik, 2014).

Therefore, the responsibilities of the logistics engineer and manager are therefore active management, collaborative partnerships, active site logistics, efficient sites, managed logistics consolidation, programme certainty, cost efficiency, total project resource efficiency and reduced environmental footprint (Williams, 2005).

3.4 Integrated logistics plan for zero waste management

Integrated logistics support would assist in terms of providing the availability of resources so that the product utilised in terms can be fused in its full potential. This process would include aspect such as recycling, reusing and reducing waste. The reverse logistics aspect would propose a view on how the product that was supposed to be discarded can be transformed in a way that it can be reutilised by the person who thrown it away at the first place. Some of the features of an efficient reverse logistics process are:

- A reverse logistics process must develop suitable collection points to receive the used goods from the final users.

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- Packaging and storage systems must ensure that the remaining value in the used good is not lost due to careless handling.
- The transportation would be used less as people would be encouraged to transport their own waste. Only special waste would require a specific transport mode
- Disposition of waste should be reduced to use as less as possible the landfill sites.
- Waste distribution or separation: waste needs to be collected and brought from the end user or consumer to the point of recovery. After an intensive inspection and selection, separation is done which is followed by a final sorting. Once the products are sorted according to the plan within each option products are once again distributed according to their state and quality.

Activities that would be involved in the reverse logistics process presented in figure 4. In this process the main actions are: reduce, reuse, recycle and recovery. Each Action would involve different stakeholders who would have to make sure that their roles are well played (Gonzalez-Feliu et al, 2014). The product after reaching its final destination would be scrutinise so that potential resources can be extracted and in order cases it could be revitalised for being reuse.

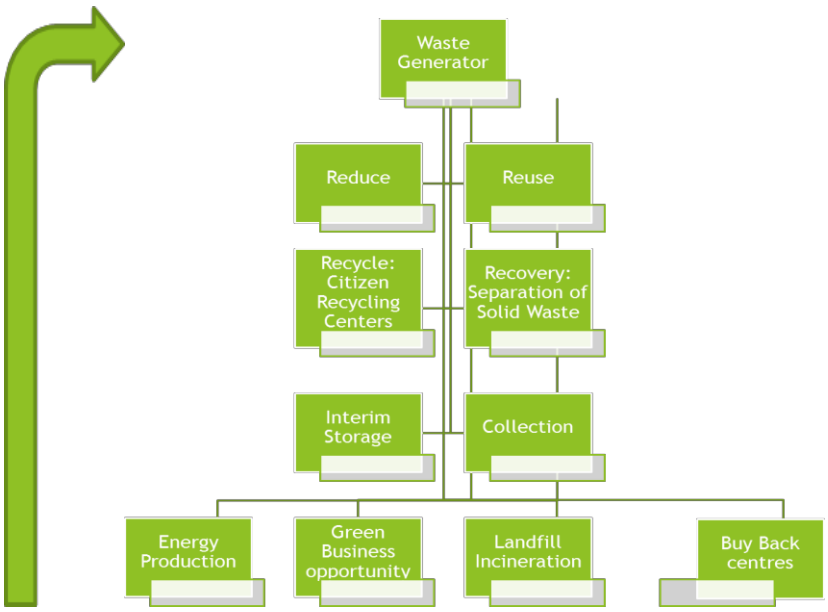

Fig. 4: Zero Waste Logistics Support Plan (Source: Author)

4. Zero Waste Management Benefits

The 21st Century has been described by many scholars as the century of sustainability. Most cities are trying to move towards applying principles of sustainable development and energy saving. By 2020, the majority of the world population would be living in urban areas; as a result, an influx of waste production is also expected by 2020. In 2008, cities were generating more than 1.3 billion tonnes of waste, and the volume is expected to increase to 2.2 billion tonnes by 2025 (Zaman and Lehmann, 2011). Green cities are the future of the world. Zero waste management can indeed highly contribute to establish sustainable and strong cities (Mckinnon et al, 2015).

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Zero waste management means to try as much as possible to capitalise on the value of a certain product in order to avoid or eliminate waste. Most of modern societies in the role, have been following the ZWM in reusing and recycling material to avoid unwanted or unnecessary wastes from a product at any level of its life cycle (Zaman and Lehmann, 2011). Hence, ZWM strategies would be critical in building resilient cities that could efficiently manage its solid waste production (Zaman and Lehmann, 2013). A zero waste city can only be achieve by designing cities that incorporate ZWM principles.

In the South African context, not only the approach will improve the sanitation and the environment, it will also create jobs through social entrepreneurship (National Treasury, 2011). A sustainable solid waste management system will therefore requires an integrated ZWM plan on which education and social awareness will be on the top (Zaman and Lehmann, 2011).

5. Conclusion

Zero waste management is a concept in which government can make the population involved in the management of detritus. In this critical time in which resources are becoming rarer every day, it is primordial to find an appropriate way that could help sustain the role. Although government has an important role to plan, it also encouraged that communities take charge of themselves in situation in which government actions are taking time.

The logistics engineer would need to redefine the process and use all his/her logistics skills to propose a collaborative way in which maintainability, and reliability would strongly depend on how different stakeholders collaborate in a continuous way. He would also have to ensure the availability of materials or technologies that would be needed when the waste has been fully utilised in order to be properly disposed.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-022

Examining Inefficiencies in the Public Sector Procurement Systems of Construction Projects in Zimbabwe: An exploratory study

Ringisai Abigail Dhliwayo[1], Kahilu Kajimo-Shakantu[2]

Abstract

There is a growing need for public infrastructural services in Zimbabwe. Yet, the resources for providing these services are limited in quantities. Consideration should be given to how those limited resources are put to good use through an appropriate procurement system in order to provide value for money. The present study aimed to examine the inefficiencies of the current procurement system in Zimbabwe using the principal-agent framework as the lens through which to better understand the research. The empirical study used interviews and questionnaires to acquire data on the public sector procurement systems that are used in Zimbabwe as well as their various degrees of success. Results showed that the traditional procurement system is prominently used in Zimbabwe and various problems such as time and budget overruns have been cited by the participants. The principal-agent framework proved better insights into understanding the problems associated with the traditional procurement system in the Zimbabwean context. This is because agents sometimes act in their capacities to fulfil their hidden objectives other than the objectives of the principal. This research recommends that the construction industry should adopt alternative procurement systems such as Public Private Partnerships; and should train procurement officers on procurement procedures. This has potential to improve the performance of construction projects and client satisfaction among others. The recommendations would contribute to the delivery of construction projects within time and cost limits thereby providing value for money on construction projects. In addition, public resources can be utilised in an efficient and sustainable manner.

Keywords: construction, inefficiencies, procurement, projects, public sector

1. Introduction

World over the need for public infrastructure services is fast outpacing the resources for providing them (Anvuur, Kumaraswamy and Male, 2006). To address these challenges, research has been conducted in recent years to come up with more innovative means of delivering public services and achieve value for money (Anvuur*et al.*, 2006; Ibbs, Kwak, Ng and Odabasi, 2003). Regardless of these efforts, Ibbs *et al.* (2003) found out that no single procurement system is most appropriate for all projects. However the

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

public sector has increasingly adopted the Traditional Procurement System (TPS) and appointment of contractor on low bid award basis (Bedford, 2009), and this have brought about problems.

TPS are called "traditional" because they had been in existence for a long time and have been the only choice available for most clients of the construction industry for many years (Mathonsi and Thwala, 2011). This procurement system has normally been used in conjunction with the open tendering. An open competitive bidding process that is awarded based only on price is highly transparent(Bedford, 2009 pp1), and this works well for the public sector which must be seen to award contracts fairly (Morledge and Smith, 2013). However the public sector delivery is governed through bureaucratic rules and procedures which leave little incentive for the pursuance of efficiency and productivity thus sometimes making it impossible to enjoy full advantages offered by TPS.

As a result of administrative characteristics found in the public sector, government projects procured through TPS are bound to face numerous challenges. For instance, the shortcomings of TPS include bid collusion, cost overruns (Dorée, 2004, Thai, 2001 and Bologna and Nord, 2000), favouritism (Bologna and Nord, 2000) in tender awards and structural bid rigging (Dorée 2004). This means that public sector projects do not bring out value for money as they should. Out of all these problems, the more rational approach was for the public sector to make some reforms in the procurement systems. Apparently it's not always easy and straightforward for Governments to make procurement reforms (Govender and Watermeyer, 2000).

In Zimbabwe, the public sector procurement started to be governed by the State Procurement Board (SPB), which came into being in 2001 after the enactment of the Procurement Act in 1999. Before the formation of the SPB, in the late 1990s, Zimbabwe started using PPPs in the absence of a guiding framework. PPPs guidelines were then issued in 2004but these have not been passed as a statutory instrument (Deloitte and Touche, 2013). This resulted in failure to achieve the much desired efficiency from PPP. Whilst SPB is centralized in the capital city (Harare), many African countries have decentralized procurement responsibilities (Arrowsmith and Quinot, 2013). Whilst centralised procurement offers advantages such as consolidated purchasing thereby reducing number of employees needed for purchasing and costs (Partida, 2014 and Agaba and Shipman, 2007), centralized procurement systems are unable to keep pace with the expansion of government activities and procurement requirements (Agaba and Shipman 2007).This resultsinbacklog of tender submissions and delay in processing of tenders. This has found to be affecting the public procurement of Zimbabwe. Therefore the study wishes to examine public procurement systems for construction projects so as to determine the effectiveness or shortcomings of procurement systems that are being used for Zimbabwe government construction projects with a view to improving project delivery. Revisions to the PPPs arrangement and their use took place in 2004.

The SPB is responsible for performance of procurement proceedings on behalf of any ministry, statutory body, department or other division of the Government wishing to undertake construction works (Government of Zimbabwe (GoZ), 2001). Sections thirty one and thirty three of the Procurement Act outline the procedure to be followed in public procurement, and these have pointed to tendering proceedings as the most preferred means in the procurement of goods and services although procuring entities have the authority to adopt another method (GoZ, 2001). On the ground discontentment has been witnessed on projects that have been procured through the SPB. For example, projects are being awarded to undeserving companies and incompetent contractors (Musanzikwa, 2013 and ZINWA, 2011) and delays in decision making result in project delays (Musanzikwa, 2013 and APPERI, 2011). These delays

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Livingstone, Zambia
ISBN 978-0-86970-787-6

which result in time and cost overruns are a result of procedural requirements demanded by the public procurement legal framework (ZINWA, 2011andDzuke and Naude 2015).

This research is very important because construction procurement (which has a greater proportion of public procurement)involves excessive magnitude of expenses that has a great impact on the economy (Thai, 2004).For instance, procurement accounts for 10% to 25% of gross domestic product in most countries (European Commission, 2014). Procurement systems are also important because, they are a key in determining the success or failure of any particular project (Mathonsi and Thwala, 2011). Construction project success is achieved if it is delivered at the right time, at the appropriate price and quality standard as well as achieving high level of client satisfaction (Birchall and Ramus, 1996), whilst additional criteria such as environmental impact, work environment and innovation are increasingly being considered in determining project success (Garbharran, Govender and Msani, 2012).

If recommendations from the study are adopted and implemented, projects are expected to be completed on time, within cost limits and ultimately resulting in client satisfaction from projects (i.e. resources are going to be utilized efficiently). The study is significant as it would also enable the government officials (mandated to carry out procurement) to have a clear understanding of the procurement process and the manner in which it should be managed.

1.1 Problem formulation

The research problem being investigated is the inefficiencies in public sector procurement of construction works in Zimbabwe characterized by project delays and cost overruns. Reports (World Bank, 2012 and PMIZ, n.d.) revealed that projects in Zimbabwe suffer from time and cost overruns. For example, delays in decision making at the SPB resulted in the construction of a United States (US) $600 000.00 district hospital in Gokwe North lagging behind schedule (Musanzikwa, 2013 and APPERI, 2011). Delays in completion of projects attributable to delays in decision making results in cost overruns.(ZINWA, 2011).Dzuke and Naude (2015) pointed out that the time delays are a result of procedural requirements demanded by the public procurement legal framework.Projects are being awarded to undeserving companies and incompetent contractors (Musanzikwa, 2013 and ZINWA, 2011)). Thus, the Government of Zimbabwe was quoted higher prices compared to other customers as the people involved in the mainstream of these activities need to get their share.The main research question is that; what problems are associated with the procurement system in use for public sector construction projects in Zimbabwe? The following sub-questions are also addressed:

1. How is public sector procurement of construction projects undertaken?
2. What are the problems associated with procurement systems being used as viewed from the principal-agent theory viewpoint?

2. Literature Review

In general terms procurement is defined as the acquisition by any means of goods, construction work or services (Government of Zimbabwe, 2001). Masterman (2002 pp 17) stated that a procurement system is the organizational structure adopted by the client for the implementation and at times eventual operation of a project. From the definitions stated above it is evident that procurement is the process which involves the implementation and final handover of projects. However the definition that was put

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forward by Masterman (2002) included the important issue of the operation of the finished project under the procurement aspect where most projects are now delivered through the Public Private Partnerships (PPPs) approach. PPPs describe ways in which the state relies on private actors instead of government employees to deliver certain infrastructure and services to the public (Custos and Reitz, 2010).

Procurement might have first began with the emergence of trade perhaps 5000 years ago (Callender, 2007), although formal public sector procurement might have begun in the United States of America around the 1950s. (Thai, 2001).From these earliest dates up to recently now a number of reforms have occurred in the area of Public sector procurement. Notably the first international model law on enforcing procurement actions in countries was passed in 1994, the United NationsCommission on International Trade Law (UNICITRAL) model law on procurement. Before the enactment of the model law (before World War 2), a majority of public sector projects were procured through the TPS in America, and UK (Greenhalgh and Squires, 2011; Larmour, 2011; Birchall and Ramus, 1996). Continued development resulted in the consideration of other new procurement systems such as Design and Build, management oriented procurement systems and PPPs to increase efficiency in project delivery.

2.1 Traditional procurement systems

Traditional procurement systems are characterised by the separation of design and construction (Brooke, 2008), and this usually bring about a mismatch between the design and construction, thus the client getting what he did not contract for.The selection of the contractor is based on competitive tenders (open or selective), uniform documentation and predetermined quantities (TCIOB, 2010). Consequently, the significant advantage of the TPS is that the selection criteria is believed to be transparent (Winch, 2010). Main problems include selecting the wrong contractor (Winch, 2010), vulnerability of client to financial risk, possibility of errors and discrepancies in contract documents that an unscrupulous contractor might exploit to the disadvantage of the client (Uher and Davenport, 2009).

2.2 Design and build

Contractor would be responsible for both the design and construction activities on a project (Brooke, 2008 and TCIOB, 2010). Under design and build arrangement variants such as package deals and turnkey exist. Package deal is an arrangement for the contractor to provide a semi-standardised building which can be adapted to meet the client's needs. The "turnkey" arrangement often include the usual design and construction activities and unusual activities like land acquisition, short- and long-term finance, commissioning, fitting out and recruitment and training of personnel (Brooke, 2008). Winch (2010) postulates that D and B is unsuitable for projects where there is high mission uncertainty insinuating that they are used for largely repeated building types e.g. industrial and commercial facilities.

2.3 Management-oriented procurement systems

The variants under these are Management Contracting (MC) and Construction Management (CM). MC arrangement allows the contractor to be appointed to work with the professional team thus the MC will contribute construction expertise to the design team (Brooke, 2008). Difference between this method and TPS is that the MC is that he does not carry the construction works, his main responsibility is that coordinating the design and management of work contracts. The professional team is led by the Architect (contract administrator) and is also responsible for issuing instructions to the MC. In the CM arrangementthe employer appoints a manager at a professional fee (or a salary) to manage the

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construction work on site from beginning to end by using specialist contractors (TCIOB, 2010). The significant advantage of MC and CM are that they offer advantages of an early start on site for large scale and complex projects (Brooke, 2008), although they usually increase the vulnerability of the client to financial risk.

2.4 Public Private Partnerships

In some countries these are known as Private Finance Initiatives (PFIs). A PPP is a contractual agreement between a public entity and a private entity, whereby the privateentity performs part of a government organization's service delivery functions, and assumes the associated risks for a significant period of time (ZNCC, 2009). This arrangement has become the most commonly used method of procurement for public sector projects. PPPs offer speed, efficiency and cost effectiveness in the delivery of projects (CIFOZ, n.d.). Zimbabwean projects that have been procured through this method include the construction of Bulawayo Beit bridge Railways line (BBR) in 1996 to 1998 and Newlands Development Project in 2006 to 2007(ZNCC, 2009) and Rehabilitation of the Plumtree – Bulawayo-Harare- Mutare Highway (CIFOZ, n.d.).

2.5 Theoretical framework

This research used the principal – agent theoretical framework as the lens through which the research was looked at. The agent problem is that of the procedure that the client will utilise to choose the agent that is appropriate, competent and trustworthy yet the agent knows more about its real competence than the principal (Winch, 2010).This is exacerbated by the fact that the desires or goals of the principal and agent conflict. The principals are after quality effort from the agent while the agent is after enrichment of personal interests and this causes the agent to utilize all information asymmetries to achieve maximum achievement of self-interests. Agency theory suggests that principals will try to bridge the informational asymmetries by installing information systems and monitoring mechanisms (Shapiro, 2005:264). Principals also offer incentives to try and align the interests of the agent with their interests, and principals often pay agents in accordance with what they would have delivered (outcome-oriented contract) (Shapiro, 2005).When the principal has information to verify agent behavior, the agent is more likely to behave in the interest of the principal.

3. Methodology

Purposive sampling techniquewas been utilized to draw sample of subjects for the interviews and the questionnaires. Both face to face and telephone Interviews were done to try and get the data on the phenomenon which was being studied. Five interviews were carried with local authorities' representatives, state enterprises, and representatives, government personnel involved with public sector procurement and contractor representatives. Twenty questionnaires were administered to consultant quantity surveyors and architects distributed in Harare and Bulawayo. Building and construction companies and service providers are widely spread throughout the country but have a higher concentration in Harare, Bulawayo and several other cities and towns (Saungweme, 2011).Data was firstly presented on tables and graphs. Content analysis and weighted mean was been used to analyse the data collected from the field. The weighted mean formula used is as shown below. The weightings for the variables where unlikely= 1, Likely = 2, and more likely =3. The weighted mean formula was adopted from How statistics (2015).

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$$\bar{x} = \frac{\sum_{i=1}^{n} (x_i * w_i)}{\sum_{i=1}^{n} w_i}$$

Where Σ = the sum of; w = the weights; x = the value; and n = the total number of respondents

4. Results

The respondents of the questionnaire survey were quantity surveyors (64%), Engineers (18%), Architects (9%) and others (9%). Experience levels amongst the respondents varied from those with one year to those who were above twenty years. This showed that the majority of the respondents were fairly well experienced and their opinions can be trusted.

4.1 Procedure undertaken in the procurement of construction projects

The survey respondents pointed out that the procurement system of public sector works was centralized (64%) whilst 36% believed that public sector procurement of construction works is not centralised. The majority (69 % of the questionnaire respondents) pointed out that they used the TPS whilst 13 % pointed out that they used DB. MC, CM and PPPs had been used to procure projects by 6% of the respondents for each of the methods. The interviews confirmed that public sector projects are mainly delivered through the TPS. Some of the interviewees even stated that:

'*Who are we to change what we found existing*….'

This then mean that the TPS will continue to be used and no immediate changes are foreseen in the time to come.

The construction projects were procured through the SPB (67%), although 25 % of the respondents felt that they projects were procured by the Ministry of Local Government, Public Works and National Housing (MLGPWNH) and 8% was procured by other avenues. The findings also indicated that the procurement regulations stipulated in the Procurement Act are the ones that are followed when deciding on which procurement method to use for a particular project.From the survey, 100% of the respondents of the survey and interviews cited that the defined procedure outlined in the Procurement Act is followed when procuring public construction works. The Act postulates that all public projects are supposed to be advertised in the local newspapers and any bidder who best meets the stated requirements would be awarded the project. However, the Interviewees denied that projects are awarded to the lowest tenderer and asserted that the lowest tenderer to specification is the one that would be awarded the project. Contractors who were interviewed argued that the procurement system in use favours the award of projects to the lowest tenderers despite the fact that they may have been the lowest due to errors in their tenders. The interviewees from state owned enterprises stated that before calling out tenders they carry out estimates for the proposed works thereby the tender which would be close to the estimate would be selected.

The results also indicate that a consideration of other procurement systems is undertaken during the selection of an appropriate procurement system to use (89%), although 11% of the respondents felt that no consideration of other procurement systems is done during the selection of an appropriate procurement system. The interviewees cited that they were now starting to consider the use of other

ISBN 978-0-86970-787-6
procurement methods like the PPPs although they haven't yet used that method for any projects.

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Interviews carried with State University Personnel revealed that plans were under way to use the PPPs for residences, and shopping centers for students. The interviewees from local authorities cited that PPPs had been effectively used on smaller projects e.g. street lighting and minor road repairs thus they could also be used for larger projects.

4.2 Problems associated with the procurement system in use

Survey respondents cited problems associated with the procurement system being used as lack of transparency, awarding of contracts to unsuitable contractors, corruption and favouritism. Other problems which are resulting due to the procurement system in use are under-pricing of contracts by unscrupulous tenderers (and claiming of unreasonable price escalations later during the progress of contract), bureaucratic systems, unavailability of project funding during contract performance, absence of government legislative framework and failure of contractors to meet requirements. The problems which were cited by the interviewees were slow uptake of technological advancement in procurement, lack of transparency in evaluation of tenders, absence of prequalification process and wide variations in tender prices of bidders. Apart from these cited problems, interviewees also pointed failure to complete projects (as a resulting of engaging unskilled contractors on projects), high cost of collection of tender documents (everything centralised in Harare) and delays in tender processing, adjudication and award. Above all, the interviewees cited that the procurement system in use offers opportunities for chancers (briefcase companies) and these usually would be incompetent.

Respondents of the survey proposed some solutions to problems faced in the public sector procurement of construction works. Solutions include introduction of technically educated personnel at tender board, introducing anti-corruption commission and decentralisation of procurement function. Adherence to procurement regulations, complete overhaul of the SPB and employment of knowledgeable estimators by the Indigenous contractors, consideration of other procurement methods and adjudication of tenders should be based on other factors, not price only will help thwart these problems.

5. Discussion

Findings have revealed that the Zimbabwean public sector construction projects are mainly procured under the TPS. This shows that not many reforms have taken place in public procurement which may be attributable to fear of fully adopting newer methods. Failure to adopt newer and efficient methods to a larger extent might have been caused by macroeconomic challenges that Zimbabwe started facing at the start of the last decade. These newer procurement systems especially PPPs require investor confidence which is impossible in such a harsh economic climate.All procurement activities are guided by the Procurement Act of Zimbabwe which is used in conjunction with supplements which are published usually to review the threshold values of works. If these regulations are properly followed then project success is guaranteed. The fact that projects are failing evidenced by delays, cost overruns and suspension of project, mean that the procurement regulations are not being followed.

Problems being faced as a result of the use of the TPS mainly include award of projects to undeserving contractors, lack of transparency, corruption and favouritism. This all contravenes the requirement of transparency for the public sector which is outlined in the UNICITRAL model law of procurement which advocates for transparency. From the principal-agent framework one would see that the agent problem is also present in the Zimbabwean context. The government is contracting its employees and the consultants on the belief that these agents are going to be competent and trustworthy i.e. they are going

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to select the right contractor based on the guidelines stated in the Procurement Act. Contrary, the agents of government are not doing the right job because one of the problems charged against the existing procurement system is selection of wrong contractors. This supports the findings of Chigudu (2014:24) who pointed out that the procurement system is being abused; i.e. pretense of compliance with procurement procedures whilst in actual fact compromising the spirit of the rules. The consultants would know more than the government but keeps the information and uses it to their benefit.

Other problems cited by respondents include bureaucracy, high cost of tender documents, centralized procurement machine and failure to complete projects by contractors. This supports the findings of Dzuke and Naude (2015). All these are caused by failure to fully exploit technology and embracing e-procurement. Some of these problems may be mitigated if e-procurement can be used, although issues like corruption are very difficult to reduce. Further, Zimbabwe does not have a legislative framework for the implementation of PPPs and thus this procurement method cannot be used even in a time when the country is facing financial challenges.Solutions to the problem at hand include decentralization of procurement function to lower levels with the SPB retaining the monitoring function. Decentralization would help a long way as problems associated with corruption, delays due to decision making and tender costs can be reduced (Agaba and Shipman, 2007). Other ways cited by respondents are to formulate PPP policy and framework so as to improve efficiency.

6. Conclusion and Recommendations

The study concludes that the main procurement system that is being used is the TPS although traces of PPPs are existing. Problems being faced as a result of the dominance of TPS are corruption, award of tenders to undeserving contractors.The study recommends that the government increase the use of PPPs as a procurement method on construction projects. This should also be accompanied with the formation of a clear legislative framework for the implementation of PPPs. TPS is no longer adequate as a delivery method for construction projects especially in these times when countries are facing financial challenges.The study was carried on a few number of government organs, future research could be carried on all government departments to determine extent of the problems associated with the current procurement system.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-024

Construction Risk Management in Developing Countries

Chipozya Kosta Tembo[1], Nthatisi Khatleli[2]

Abstract

Risks are common in all construction projects regardless of the magnitude. Risk management (RM) is a systematic approach that can enhance project delivery. However, using appropriate risk management techniques with a proper fit to the nature of the project is usually difficult due to nuanced peculiarities of each project. The research is aimed at establishing the risk management technique/practices used in developing countries, the prevalent risk factors and the existential formalities of RM practices. The review covers published literature available on risk management in developing countries from various peer-reviewed sources from the period 2000 to 2015. Content analysis was used to identify the relevant themes for the study. Practices/techniques in developing countries are identified and suggestions of other practices that can be adopted are given. Various risk management techniques/practices are used in different developing countries with various applicable levels of standardization. However, developing countries, more often than not, are exposed to risk management techniques which are subjective and intuitive. This paper highlights risk management processes or techniques that are used in developing countries and concludes that the process could be beneficial in improving project performance in the construction industry.

Keywords: developing countries, performance, practices, project, risk management

1. Introduction

A developing country is one whose standards of living or level of industrial production are supplemented by financial or technical aid; or a country that is not yet highly industrialized anon-industrialized poor country that is seeking to develop its resources by industrialization (Developing country, n.d.). Developing countries are defined according to their Gross National Income (GNI) per capita per year. Countries with a GNI of US$ 11,905 and less are defined as developing (World Bank, 2013). Consequently, on many occasions, either the resources required to satisfy the basic needs in human settlements, or the capability needed to transfer the available resources into the final products are not available at an acceptable level (Moavenzadeh, 1978). In many cases these inadequacies are due to socioeconomic constraints or lack of appropriate technology (Moavenzadeh, 1978). Infrastructure development is important to the development of any nation more so developing economies. However at a global level construction projects are faced with cost and time overruns; quality shortfalls, disputes, and claims (Diekman et al., 2011; Janipha & Ismail, 2013; Muya et al., 2013; Meng, 2012; Zhang & Fan, 2014). This is mainly attributed to the risks that normally eventuate in the implementation phase (Osipova & Eriksson, 2011). Consequently, risk management in construction projects has been

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Livingstone, Zambia
ISBN 978-0-86970-787-6

recognised as a very important process to achieve the project objectives of time, cost, quality, safety and environmental sustainability (Zou et al., 2007).

Baloi and Price (2003) underpin the fact that there is a direct relationship between risk management and project success since risks are assessed by their potential effect on the objectives of the project. Risk management is needed to improve performance of projects in developing countries. The objectives of this paper are as follows: 1) to identify prevalent risk factors in developing countries; 2) to establish risk management practices in developing countries; and 3) to determine the state of formalisation of risk management in developing countries. It is necessary to identify risk factors in developing countries to understand how to best manage them, as for the level of formalisation and risk management practices, these forms a basis for improvement of how risk management is practiced to act as an enabler for enhanced project performance in the construction industry.

2. Risk Management

Risk Management (RM) is "the logical method of establishing the context and of identifying, analysing, evaluating, treating, monitoring and communicating the risk involved within any activity, function or process in a way that enable losses to be minimised and opportunities to be maximised" (Australian & New Zealand Risk Management Standard-AS/NZS 4360, 1999, p.4). The underlying goal of risk management is to manage risk effectively (Thevendran & Maudesley, 2004). Risk management as a process has the merits of (1) enabling systematic and less subjective decision-making, (2) making the relative importance of each risk apparent, (3) alleviating risks by planning, (4) assessing and ascertaining project viability by analysing and controlling risks, (5) giving improved understanding of the project through identifying the risks and thinking through response scenarios, and (6) having a powerful impact on management by enforcing the realisation that there is an array of possible outcomes for a project, hence enhancing the profit margin and minimising losses (Lam, et al., 2007). According to the Project Management Body of Knowledge (2008) the following are the stages of the Risk management process:
- Risk identification, Risk analysis, Risk Response, monitoring and control; and communication. These are discussed below.

2.1 Risk identification

To effectively manage risk in the construction industry, it is crucial to correctly identify important risks (Andi, 2006). Al-bahar and Crandall (1990) define risk identification as the process of systematically and continuously identifying, categorising and assessing the initial significance of risks associated with a construction project. Risk categorization is important as it helps to identify the possible root cause for a risk factor, for instance political risk may indicate instability in a given area thus necessitates that contracts for use in such an area cover political risks. Ward and Chapman (2003) identify internal (with contracting parties control) and external risk (risks outside the control of parties) as the major categories. Methods for risk identification include checklists, brainstorming, the Delphi technique, interview/expert judgment, influence diagrams, flowcharts, and cause-and-effect diagrams. Of these the most common are checklists, interviews and brainstorming (Osipova & Eriksson, 2011). These methods are subjectivemoreover, Eybpoosh, et al., (2011) argue that these methods ignore multiple risk occurrences and interdependencies. It is unclear in the method(s) to be adopted given that the ones in use have short comings.

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ISBN 978-0-86970-787-6

Lack of understanding of the risks leads to inefficiency where each party may end up paying more and could make less out of the venture (Dutta 2014). An unidentified risk cannot be controlled, transferred or managed (Toakley and Ling 1991; Henriod and Lantran 2000). Various reasearches have been carried out in developing countries (see section 4.1) for risk identification. Other researchers have gone further from just identification to design Influence frequency matrix for risk identification and quantification (Mbachu & Nkado, 2007).

2.2 Risk analysis

Risk analysis sets out to quantify the effects of major risks that have been identified (Mills 2001) and sets out to understand the risks (Mead 2007). Fan et al, (2008) defiine risk analysis as a process that examines each identified risk, refines the description of the risk and assesses the assocaited impact. Methods used to quantify risks include error, possibility and influence analysis; risk porfolio, risk team analysis (Schieg 2006); decision trees, expected monetary value, simulation or intuitive approcaches, expert judgment (Chege and Rwelamila 2000); and code optimisation (based on subjective estimation), monte carlo simulation, kinetic tree analysis (Mills, 2001); and sensitivity testing and risk adjusted discount rate (Choudhry and Iqbal, 2013). The risk analysis methods can be classified as either qualitative or quantitative. Qualitative risk analysis attempts to rank risks into high, medium and low based on; 1. The severerity of the impact and 2. The probability of the event occuring. While quantitative risk analysis attempts to estimate the frequency of risks and the magnititude of their consequence by utilising different methods (Banaitience, et al., 2011). Taroun's (2014) review of journals papers in the last five decades up to 2013 on risk analysis concludes that there is no suitable method for risk assessment as a consequence there is a proliferation of various models in literature based on different types of logic such as fuzzy, and Bayesian; probability impact models are the most common and risk analysis is strongly related to risk modelling. . Methods used to assess risk in practice are subjective, as they are based on perception (Lu & Yan, 2013). This view is supported by Wang and Yuan (2011), who state that decision-makers perceive risk differently due to experience, educational background, beliefs and culture. In addition, Lu and Yan (2013) argue that using subjective methods such as gut feeling may result in attention being paid to risks with potentially serious effects but ignoring the ones that have a high chance of occurrence Risk analysis techniques have been mainly developed to address the project deliverables of schedule (time), budget (cost) and quality (Imbeah and Guikema, 2009). Yet shortfall in quality, time and cost overruns continue to be a common feature of the construction industry.

2.3 Risk response

Risk response is the process of formulating a management strategy including establishing risk allocation and developing a management plan for resolving the risk (Lam, Wang, Patricia, & Tsang, 2007). It involves choosing alternative response strategies; implementing a contingency plan, taking corrective actions and re-planning the project (Bakr, Hagla & Rawash, 2012). Response measure could be alternative procurement method, construction method/material, use of insurance or bonds, contingency (time or money), sub-contracting or even collaboration (See Bakr, Khaled, & Ayda, 2012; Karde et al, 2013; Loosemore and McCarthy, 2008). It is during the risk response stage that risks are allocated. Risk allocation is the assigning of management responsibility and accountability for risk (Alsalman & Sillars, 2013).

Akintoye and MacLeod; (1997), and Mead (2007) name risk acceptance/retention, risk mitigation/reduction, risk elimination/avoidance and risk transfer as risk response methods. Serpella, et

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ISBN 978-0-86970-787-6

al., (2014), in addition to the aforementioned methods, included monitoring; and Smith et al. (2006) add doing nothing as a distinct response. Lu and Yan (2013), Osipova and Eriksson (2011) and Lehtiranta (2014) advocate for risk sharing. Ehsan et al. (2010) claim that the most utilised risk response measures in the construction industry are risk elimination and risk transfer. Other studies show that project participants allocate risks by aversion: owners tend to shift risks to the primary contractor, who in turn transfers them to the subcontractors (Alsalman & Sillars, 2013; Baloi & Price, 2003). In contrast Osipova and Eriksson (2011); and Lyons and Skitmore find risk reduction as a common method of risk allocation. Jarkas and Haupt, (2015) found risk retention and mitigation as prevalent methods of risk allocation. Clearly the nature of the risk is closely linked to response method. Risk allocation in the construction industry has been described as inappropriate and unbalanced (Alsalman & Sillars, 2013; Lehtiranta, 2014). Consequently modelling balanced risk allocation has been an area of interest in developing countries for example Khazaeni, et al., (2012) devised a Fuzzy adaptive decision modelling in Iran for balanced risk allocation; and Zhang and Fan, (2014), developed a work breakdown structure in China to help balance risk allocation.

2.4 Risk monitoring and control

Risk Monitoring and control are usually necessitated by the presence of a contingency plan. Risks managed through contingencies (money) or float (time) need to be subjected to comprehensive analysis so that measures are adequate to cover the risks once they have become reality; risk monitoring and control are rarely done (Serpella, et al., 2014). Risk communication of the project risk is poor, incomplete and inconsistent in the construction industry (Choudhry & Iqbal, 2013).

3. Methodology

The study was based on a desk study. The methodology used was a literature review of peer-reviewed papers from developing countries on risk management in construction. A list on the international statistic institute was used as a guide for determining developing countries (World Bank, 2013). Once this was done a search for published papers in various peer reviewed journals was done using science direct and Google scholar as the main data bases. When the identification of papers was complete the analysis was carried out to answer the set objectives using only the risks identified as significant. The countries included in the study are: Uganda, Mozambique, China, Indonesia, Hungary, Romania, India, Brazil, Venezuela, Malaysia, Sri-Lanka, Egypt, Nigeria, Ghana, Romania, Tanzania, Poland, South Africa, Swaziland and Zambia.

4. Findings and discussion

4.1 Risk factors in developing countries

Risks were identified from studies done in various developing countries and these include country and authors as follows: Jordan (Odeh & Battaineh, 2002; Sweis, et al., 2008), Ghana (Frimpong, et al., 2003; Agyakwa-Baah & Chileshe, 2009), India (Iyer & Jha, 2005; Doloi, et al., 2012), Indonesia (Wiguna & Scott, 2006; Soepriyono, 2013), China (Zou, et al., 2007), Vietnam (Le-Hoai, et al., 2008), Poland (Skorupka, 2008), Zambia (Muya, et al., 2013; Kaliba, et al., 2013; Mang'elele & Muya, 2008), Sri-Lanka (Perera, et al., 2014; Perera, et al., 2009), Uganda (Apolot, et al., 2011), Mozambique (Muianga, et al., 2014), Malaysia (Goh & Abul-Rahman, 2013; Shehu, et al., 2014), Nigeria (Belel & Mahmood,

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ISBN 978-0-86970-787-6

2012; Aibinu & Odeyinka, 2006; Tipili & Ilyasu, 2014), Pakistan (Choudry, et al., 2014) and Egypt (Khodeir & Mohamed, 2014). The methods of data collection for the studies were as follows: surveys (80%), interviews (12%), and other methods such as case study, brain storming and the Delphi approach account for 8%. The methods used for data collection indicate that there is need for in-depth studies to be carried out. Figure 1 shows prevalent risk factors in the aforementioned developing countries.

Financial difficulty of client and contractor and late payment, operational risks and design risks are the most significant factors impacting on projects in developing countries, followed by improper and inadequate planning. The aforementioned risks are not only significant but also prevalent as they were found in all the studies in the countries mentioned. However, it appears that inadequate site investigation and poor contract and project management are not prevalent risks. Nevertheless these could be project specific risks.

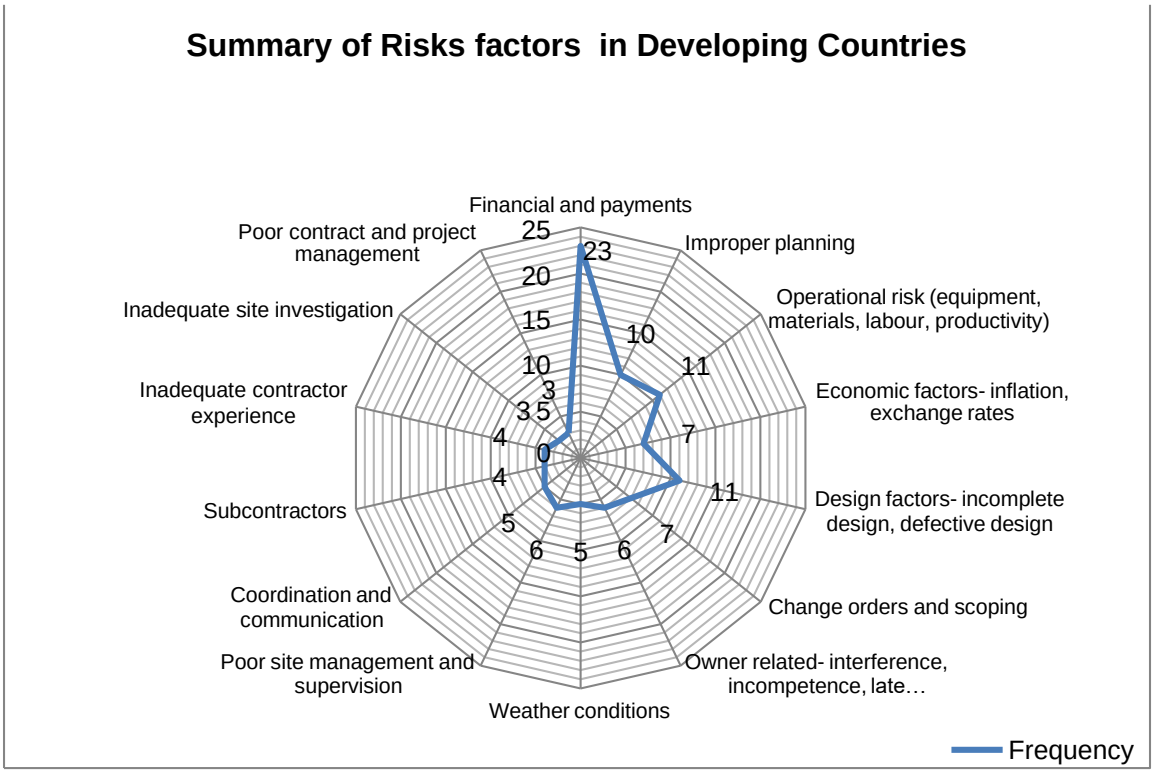

Figure 1: Risk factors in developing countries

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ISBN 978-0-86970-787-6

4.2 Risk identification

Table 1 shows the various practices used for identifying risks in selected developing countries. Brainstorming, document review and experience are the most common methods used for risk identification in developing countries. However these are subjective methods and they do not allow for identifying of interrelated risks (Eybpoosh et al., 2011). Therefore other methods such as risk mapping should be considered for use in addition to the intuitive practices.

Table 1: Risk identification practices in selected developing countries

Author	Country	Methods identified
Skorupka (2008)	Poland	Expert knowledge
Zaini and Haron (2010)	Malaysia	Brainstorming/discussing, Consult Specialist/Employ analyst, Experience, Documents desk research
Kikwasi (2011)	Tanzania	Document review and assumption
Dinu Ana-Maria (2012)	Romania	Brainstorming, flowchart, swot analysis risk surveys and questionnaires
Calzadilla et al., (2012)	Venezuela	Experience
Goh & Abul-Rahman (2013)	Malaysia	Brainstorming and checklists
Gorzen-Mitka (2013)	Poland	Experience, document review, brainstorming, opinions of experts
Olamiwale (2014)	Swaziland	Brainstorming, document review, Delphi-technique, expert systems, interviews
Shunmugam & Rwelamila (2014)	South Africa	Judgment , experience, intuition

4.3 Risk analysis/assessment

Table 2 shows various risk analysis practices in selected countries. The most common methods are brainstorming, Monte Carlo and contingency sum. The use of risk consultants and simulations has proved useful in risk management and should be considered elsewhere. Furthermore, contingency sums can also be considered for quantifiable risks. However care must be taken when calculating contingency sums to they are sufficient to cover eventuating risks.

Table 2: Risk analysis practices

Author	Country	Methods identified for analysis/assessment
Vissler and Joubert (2008)	South Africa	Risk inventory register, Consult Specialist
Skorupka, (2008)	Poland	Monte Carlo simulation
Kikwasi (2011)	Tanzania	Contingency sum
Garrido, Ruotolo, Ribeiro and Naked (2011)	Brazil	Checklist, interview/ expert judgment, brainstorming, creation of scenarios, flow chart
Goh and Abdul-Rahman (2013)	Malaysia	Brainstorming, risk register, Monte Carlo simulation, sensitivity analysis, checklist
Kansal and Sharma (2012)	India	Brainstorming, checklist, flow chart, Delphi method
Ikupolati and olaleye (2014)	Nigeria	Experience and judgment, Response contingency sum, meetings
Khazaeni, et al., (2012); Shi, et al., (2014)	China	Fuzzy theory
Olamiwale, (2014)	Swaziland	Monte Carlo, sensitivity analysis, decision analysis, probability, probability & impact matrix

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4.4 Risk response

Diverse methods of responding to risk are shown in the literature (see table 3) with contingency fund being the most common method. This could be due to the fact that nature of risk and procurement method determines how the response and allocation should be. A diverse nature of risks are impacting various construction industries hence the findings are expected. Contingency sums are a common feature in managing risks in developing countries while methods such as risk sharing are rare perhaps due to procurement methods used in developing countries. Therefore developing countries could use more management or integrated oriented methods of procurement to enhance risk allocation.

Table 3: Risk response strategies

Author	Country	Methods used for allocation/response
Skorupka (2008)	Poland	Contingency (budgets)
Kikwasi (2011) consultants	Tanzania	Transfer (as insurance, fixed contract, bonds and guarantee)
Soepriyono (2013)	Indonesia	Transfer, avoidance, acceptance , mitigate
Khodier and Mohamed (2014)	Egypt	Avoidance, share, transfer
Ikupolati and Olaleye (2014)	Nigeria	contingency sum
Olamiwale (2014)	Swaziland	Claims, insurance, contingency fund, sub-contractors, %age of unit rate

4.5 Formality of risk management in developing countries

Vissler and Joubert (2008) in their study in South Africa find that only professionals aware of formal risk management system in a company use it; competences are in risk identification and classification rather than risk instruments to mitigate/transfer risks resulting in monitoring only. The study concluded that the majority of firms did not have a formal risk management system. This is affirmed by a study done by Shunmugam & Rwelamila, (2014) in South Africa. Likewise, Perera, et al., (2014) reported that risk management in the Sri Lankan road construction projects is not done through a systematic approach. Similarly Szabo, et al., (2008) find that risk management is not systematic in Hungary.Siang and Ali, (2012)using a case study in the Malaysian construction industry find that systematic risk management is not implemented in most existing construction companies. For companies that implemented risk management there was very little evidence that performance was improved. However the application of risk management in the cases was at varying degrees with varying steps in the risk management process being followed. Companies using a more comprehensive risk management process had better performance. Zaini and Haron (2010) using questionnaire and interviews on contractors find that the risk management applied in Malaysia is unsystematic. The risk response stage were risk allocation is done is not part of RM practice. This is in line with the findings of Goh and Abul-Rahman, (2013) from their interview and questionnaire survey who find that only 17.78% (8/45) of organisations employ formal risk management processes with brain storming, checklists being the most used tools. Risk identification and qualitative risk analyisis are the most prevalent practices in Malaysia.

The conduct of risk management in developing countries seem to be unsystematic. It appears the risk management process commonly conducted is risk identification. After identification is done there is evidence of risk monitoring (Vissler & Joubert, 2008). Nevertheless, it is unclear how the monitoring is done. Various methods of analysis and allocation are utilised but there is a need to add more practices to improve management of risks and consequently project sucess.

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5. Conclusions

Risk management strategies are globally being applied to projects to improve on the delivery deficiencies; the common problems include cost overruns, time overruns, poor quality, claims and disputes. However it would appear that the application of RM is not formalised in developing countries. Systematic risk management has evidently improved project performance rather than un-formalised and unsystematic application. In developing countries, risk identification rather than allocation is done once risks are identified monitoring is done though risk monitoring methods employed are unclear. Common risk factors in developing countries include financial and payment, design risks and operational risks. Various methods for identification, quantitative analysis and risk response need to be adopted to improve risk management in developing countries. Studies in developing countries are dominated by risk identification, neglecting risk analysis and/or response. This study demonstrates a need for studies in risk analysis and risk response in developing countries to be undertaken. The future focus of this research is to study risk allocation on building projects in Zambia using interviews, questionnaires and documents.

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ISBN 978-0-86970-787-6

DII-2015-048

Bamboo Use in the Construction Industry: How Sustainable is it?

Akwada, D. R.[1], Akinlabi, E.T.[2]

Abstract

Bamboo sustainability as a construction material is paramount since it is a promising natural composite material. The use of bamboo in the construction industry in recent times has attracted increasing interest for its promising applications in sustainable construction works. The assessment of the sustainability of any material of value such as the bamboo is very critical as it will provide insight into the availability and the continuous use of such a material. However, despite a lot of literature on its impressive characteristics, bamboo's sustainability has not been critically analysed. The aim of this study is to examine, through a review of literature, how sustainable bamboo could be used in the construction industry. The work outlines the sustainable techniques that, when applied, would help in the unfolding of bamboo's potential as a sustainable construction material. Improved quality of bamboo resources, and the development of efficient, sustainable management practices, harvesting techniques, processing and preservation techniques was found to be effective for bamboo development and sustenance. Sustainability could be achieved through an appropriate management system for its propagation and harvesting, as well as appropriate industrial processing and preservation techniques. This work would provide insights to researchers, bamboo growers and industries that use bamboo as their raw material across the globe for adoption of a suitable technology for its sustainability. The study concludes that bamboo could be a sustainable material for use in construction works and other industrial uses.

Keywords: bamboo, construction industry, preservation, sustainability

1. Introduction

Due to the arising internationally awareness of sustainable development, sustainability has become an ultimate goal for worldwide industries to pursue (WCED, 1987; Finkbeiner *et al.* 2010; Klöpffer *et al.* 2009; Klöpffer, 2003). The need for sustainable development becomes urgently evident. According to Finkbeiner *et al.* (2008) and Schau *et al.* (2012), the continuously increasing consumption patterns, resulting in a rising pressure on global resources, and visible through the various financial, food and climate crises around the world are caused by human activities. At the supply side, the use of fast growing sustainably produced renewable materials such as bamboo can help to meet this increasing demand. The assessment of sustainability on the product level is an important issue but still a challenge (Schau *et al.* 2012). Sustainability includes not only the environmental pillar but the economic and social ones, as defined by the World Commission on Environment and Development (WCED), 1987). To

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

measure sustainability of products and services, constructing an integrated evaluating methodology has become extremely inevitable (Schau *et al.* 2012; Hunkeler *et al.*, 2008; Swarr *et al.* 2011; Benoît *et al.*, 2009).

The Life Cycle Assessment (LCA) is an ISO-standardized method (Schau *et al.* 2012, Iso, 2006; Iso, 2006), and is widely adopted to estimate the potential environmental impacts of products and services through the whole life cycle as supported by (Schau *et al.* 2012; Guinée *et al*. 2002; Klöpffer *et al*. 2009). It is the most advanced and experienced methodology in probing environmental burden in process or product levels, and also in preventing burden shifting from different life-cycle phases. Life Cycle Cost (LCC) is proposed for the assessment of the economic dimension of sustainability, and builds further on the traditional life cycle costing which have been used since the 1930s (Schau *et al.* 2012; Lichtenvort et al. 2008). It is still relatively a new tool in the sustainability assessment (Hunkeler *et al.* 2008, Schau *et al.* 2012).

In the contest of this study regarding how sustainable bamboo is going to be in terms of its use as construction material, it can be stated that bamboo is a remarkably versatile plant with a short growth cycle according to (Gratani *et al.* 2008; Van der Lugt *et al*. 2009). It can be harvested in three to five years, as opposed to ten to fifty years for most softwoods and hardwoods. It grows in almost any climate, and it replaces itself very quickly **(**Gratani *et al.* 2008**).** It has been used for thousands of years, and has not suffered from deforestation. It's a far more environmentally safe and sustainable option than other modern construction materials like corrugated metal, artificial plaster, and chemically treated wood and brick (Van der Lugt *et al*. 2009). It requires minimal processing before its use, and it leaves no environmental footprint afterward as it is affordability and ease of access (Yu *et al.*, 2011; Van der Lugt *et al*., 2009). According to Wooldridge (2012), bamboo can be used to construct houses, bridges, furniture, scaffolding, flooring, electrical insulators, automobile parts, flooring, as laminated plybamboo and as reinforcement in matrix composites. Hence, its sustainability needs to be addressed as a foundamental issues in order to prevent its depletion from the forest as the case of hard and softwoods.

The main focus of the study is on using LCA to evaluate the sustainability of the bamboo as a construction material from its planting stage through harvesting and processing, preservation and to its final decomposition. The study reviewed literature related to appropriate sustainable method to adopt for a high yield variety, appropriate harvesting techniques, processing techniques and preservation methods for bamboo application in construction works. An appropriate application of these technological processes would protect the bamboo and its products and hence its sustainability in the construction industry would be attained.

2. How can Bamboo be Sustainable as a Construction Material?

The construction industry in recent years has identified the potentials of bamboo in the construction of varieties of construction works. However, the big question is how sustainable is bamboo as a construction material? The high patronage in the construction industrial for its usage is in the increase. For bamboo to remain a sustainable construction material for the the industry, its sustainability needs to be tackled from the grass root which comprises of advance technological application of cultivation through harvesting, components processes and finally its preservation until its decomposition stage in the life cycle assessment process.

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2.1 Bamboo propagation and sustainability

Bamboo is abundantly found in diverse climates, from cold mountains to hot tropical regions and primarily grows on sandy topsoil to loamy mud soils. They can be found mostly across Asia, Africa, America (Gratani *et al.* 2008*)*. It belongs to the Gramineae/Procea family, and therefore it is not classified as a tree, but as a grass according to (American Bamboo Society, 2014). There are more than 60 genera divided into about 1,500 species of bamboo and is a composite material, consisting of long and parallel cellulose fibres embedded in a ligneous matrix (Kushwaha *et al.* 2013and Chattopadhyay *et al.* 2011). According to Ahmad *et al.* (2005) bamboo is an anisotropic material with mechanical properties in the three (3) principal directions vary in the longitudinal, radial and transverse directions. Bamboo grows very faster than softwood and combines this with hardwood properties. It may reach its final length of 20 meters high within a couple of months with a speed of 50 cm a day during the growing season whilst some bamboo species have been observed to surge skyward as fast as 8 inches in one-day.Bamboo is divided into 2 major portions, the rhizomes and the culms. The rhizome is the underground part of the stem and is mostly sympodial or, to a much lesser degree, monopodial. This study is concerned with the upper ground portion of the stem, called the culm as shown in figure1 and 2 accordingly. It is the portion of the bamboo tree that contains most of the woody material. It is without any bark and has a hard smooth outer skin due to the presence of silica (American Bamboo Society, 2014). The culm is complimented by a branching system, sheath, foliage leaves, flowering, fruits and seedlings. Bamboo is distinguishable from one another by the differences of these basic features, along with the growth style of the culm, which is either strictly erect, erect with pendulous tips, ascending, arched / clambering.Similarly (American Bamboo Society, 2002;, 2014, Cleaver, 1993*)* stated that culms take 2 to 6 years to mature, which depends on the species and acquires its excellent hardwood like characteristics (hardness, strength, stability) as compare to the growing years of hardwood which takes over hundred years to mature, currently they are scarce and often expensive. The bamboo plant absorbs a large amount of CO_2 out of the atmosphere by providing oxygen in return according to (Vogtländer et al. 2014a; Vogtländer, 2014)**.**

Bamboo sustainability cannot only depend on the reserves in the forest without replacement when harvested. Sustainable and advance cultivation methods must be implemented in most countries in which bamboo grows as practice in most Asian countries where bamboo cultivation is profession. Bamboo cultivation has not been given much attention as it is in China, Indian and many others countries in Asia some decades past of which depends largely on its forest for the supply of bamboo culm with few from farmlands for structural applications. Vogtländer (2014) has outlined some basic techniques which would enhance the cultivation approach of bamboo globally.

Findings show, that when one bamboo is planted it consists of several culms of bamboo as new shoots grow from the mature plant every year (Van der Lugt *et al***.** 2009)**.** It is suggested that with a good management of the bamboo resource, the harvesting cycle is normally 3 years. The growth rate of bamboo is more rapid than any other plant on the planet. Generally, if an appropriate propagation techniques and high yield species are propagated across the globe, about 40-50% of bamboo culms in the plantations and the forest would be sustainably harvested every year without decreasing the size of the plantations in the farmland and the forest. Bamboo unlike most trees does not die off after harvesting but rather by harvesting the mature culms, the yield and quality of the plantation rather increases (Van der Lugt *et al*., 2009, Vogtländer et al., 2010)**.** Similarly, bamboo has extensive root network which makes it a potential plant for reforestation on eroded and degraded lands because it can restore vegetation and water tables on degraded lands. Bamboo can be managed as an agricultural plant with an annual harvesting scheme and

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ISBN 978-0-86970-787-6

no deforestation would take place and this technological approach of its cultivation promotes its sustainability (Van der Lugt *et al*., 2009; Vogtländer et al. 2010**)**.

Figure1: Bamboo plantation Growth (Van der Lugt et al., 2009)

Figure 2: Bamboo culm after harvest and dried (Source: van der Lugt et al. 2009)

2.2 Harvesting Techniques for Bamboo

The appropriate method of harvesting bamboo in the plantation or forest plays a major role in its sustainable development.The harvesting technique of bamboo plays a major role in its sustenance both in the farmland and the forest (Vogtländer et al., 2010). In a research by Vogtländer et al. (2010), simple basic harvesting methods for bamboo were revealed. However, a satisfactory and systematic harvesting technique of wild bamboo has not yet been well established (Wong, 1995; Vogtländer et al., 2010) especially in Bamboo forest reserves. This is because mostly there is no consideration for its final intended usage when they are harvested. The high initial moisture content of bamboo may easily cause splitting when no appropriate harvesting technique is applied (Wong, 1995, Vogtländer et al., 2010). The uncertainty of age of the harvested bamboo will create problems in processing and utilization. Some of the factors that should be taken into consideration for the improvement of the harvesting technique are age, desired quality, and the properties of the enduses.

Various harvesting methods have been reported (Wong, 1995; Van der Lugt *et al*., 2009; Vogtländer et al., 2010**)**. Findings have shown that if the appropriate harvesting techniques would be followed as practiced in China, where the China Bamboo Forestry system is controlled by the Forestry Bureau of China to safeguard the sustainable exploitation of the existing bamboo resources (Van der Lugt, 2014**;**Vogtländer et al. 2010**),** then there would be high sustainability of the bamboo sector globally. For instance in China, the harvesting of bamboo is based on periodic surveys of total bamboo coverage and

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a farmer is given a "Forestry Logging Permit" for the responsible exploitation of a bamboo plot for a certain period. The farmer harvests a part of the culms and sells them to processing industries that used them to produce strips for specific products like plybamboo, flooring, panels, curtains, chopsticks, etc. These companies utilize 100 % of the bamboo resource in their final application as stated by (Vogtländer et al. 2010**)**.

The bamboo sector in Ghana can adopt China's techniques of harvesting of bamboo by educating farmers who go into its cultivation and those who harvest the lots in the forest reserves to help prevent indiscriminate harvesting methods to help prevent deforestation and its depletion of this promising plant from the earth (Van der Lugt, 2014**).** Sustainable harvesting approach of bamboo would enhance constant supply of bamboo and help prevent deforestation and serves as income generation for those who go ino its trade. Research finding have shown that this method of harvesting of the bamboo facilitates the growth of the bamboo plant because as the mature culms are being harvested, there is a stimulation for the bamboo plant to regenerate even faster (Van der Lugt, 2014; Vogtländer et al., 2010**)**. If these techniques of harvesting bamboo coupled with other modern advance and appropriate cultivation methods would be adopted across the globe, sustainability of bamboo for the construction industry would be attained as it is supply as a raw material throughout the year (Schau *et al.* 2012; Klöpffer *et al*. 2009).

2.3 Processing and preservation techniques

Processing of bamboo and its preservation in a form of varieties of products ranging from construction of buildings, furnitures, ply bamboo, textiles, pulp and papers, etc., contributes immensely to its sustainability (Vogtländer, 2011). Life cycle assessment (LCA) is the commonly accepted methodology to systematically asses the environmental impact of a product or material over its full life cycle, from the extraction of the resource until the end phase of demolition or recycling according to (Vogtländer, 2011). The LCA methodology is international standardized in the ISO 14040 series and measures the environment impact in several categories, including depletion, air quality (dust, smog), toxicity and global warming potential (GWP) (Vogtländer et al. 2014a).The environmental impact caused by products can be measured in one number, for example expressed in eco-costs. The increasing attention regarding global warming, a product's GWP is often assessed separately for its footprint. In this assessment all the greenhouse gas emissions during life cycle of products are measured in kg CO_2 equivalent (Vogtländer et al. 2014b and Vogtländer, 2014).

Finding shows that when LCA, including carbon footprint ISO 14040 and 14044 standard was conducted on the bamboo products, the LCA shows that bamboo is an important absorber of CO_2 'from the air and released a subsequently large amount of O_2 in return through the photosynthesis process during its growth and life until harvesting. In conclusion, it was discovered that after even the bamboo has been harvested, the CO_2 will remain locked in the bamboo material and will only be released when the material is discarded or burnt in the end-of-life phase.

3. Bamboo Industrial Properties and Uses

Bamboo high mechanical properties such as tensile and compressive strength, shrinkage, resistibility and elasticity make it a potential multi-functional material for structural applications. Fibres in bamboo run axial; hence the tensile strength of bamboo is in their outer edge of the culm which are profoundly versatile vascular bundle, their strength varies along with culm height, the compressive strength increases with height while bending strength has opposite pattern. Bamboo shrinks more than wood

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when it loses water. It shrinks in the cross sections to about 10–16%, in the wall thickness, which is also about 15–17%. Bamboo has an abnormal state of flame resistibility due to its high substance of silicate acid. Bamboo has an enormous elasticity which makes it a good building material and is environmentally friendly for areas with earthquake. Lastly bamboo has a relatively low weight and can be transported easily and utilized at any given distance across the globe (Klaus, 2002).

3.1 Bamboo industrial uses

According to Vogtländer, (2011),Waite (2009) and Wooldridge (2012), the utilization of bamboo ranges from foods, medicines, biomass, textiles, pulp and paper making and as a construction material for building of houses and bridges, design of furniture, application in the electronic and automobile industry, and other ranges of products like chopsticks etc. Nutritional active minerals such as vitamins, amino acids, steroids are also extracted from bamboo culm, shoot and leaves. Bamboo can also be processed into beverages, medicines, pesticides and household items e.g., toothpaste, soap, etc. (Vogtländer, 2011).

Through industrial processing of bamboo virtually anything that can be made from wood can also be developed in industrial bamboo materials. The industrial processing of bamboo and in particular the laminate bamboo strips into boards (Plybamboo), which is mostly applied in flooring, furniture board, and veneer, woven bamboo mats can be used, for example, according to (Van der Lugt and Lobovikov 2008). Examples of bamboo industrial uses are as shown in Figures 3, 4 and 5 respectively.

Figure 3: Plybamboo veneer (Source: Van der Lugt et al. 2009)

Figure 4: Coarse woven mats form the building stones for BMB (Source: Van der Lugt et al. 2009)

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Figure 5: Plybamboo is available in various colors and sizes (Source: Van der Lugt et al., 2009)

Besides the many traditional applications for local markets and low end export markets in which bamboo in its natural form (stem) is usually used, a wealth of new bamboo materials became available since the 1990s through industrial processing, such as Plybamboo and Strand Woven Bamboo, which can be used for applications in high end technological applications.

In figure 6, it can be seen how various kinds of bamboo products relate to each other in terms of production technology on the axis traditional - industrial/advanced. In the past few years, many innovations in the field of production technology have led to the development of new industrial bamboo materials with different properties and possibilities, such as Bamboo Mat Board (BMB), Strand Woven Bamboo (SWB), Bamboo Particle Board, and various experiments with Bamboo Composites. BMB is made from thin bamboo strips or slivers woven into mats to which resin has been added. Pressed together under high pressure and high temperature, the mats become extremely hard boards, which during pressing can even be put in molds to be processed into corrugated boards as shown in Figure 7.

Figure 6: Range of bamboo applications possible, based on traditional and advanced technologies (Source: Larasati, 1999)

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Figure 7: Various kinds of bamboo board material including BMB (Source: Van der Lugt et al. 2009)

Strand Woven Bamboo is a new bamboo material made from thin rough bamboo strips that under high pressure are glued in molds into beams. An interesting feature of SWB is that there are no high requirements for input strips which mean that, unlike the production of Plybamboo, a large part of the resource can be used, thereby utilizing the high biomass production of bamboo to the maximum. Due to the compression and addition of resin, SWB has a very high density (approximately 1080 kg/m^3) and hardness, which makes it a material suitable for use in demanding applications (e.g. staircases in department stores) as shown in figure 8. Recently, new higher resin content versions of SWB were developed for outside use, which could make SWB a suitable alternative for scarce tropical hardwood species.

Figure 8: Application of SWB in a stairway (Source: Van der Lugt et al. 2009)

3.2 Bamboo for construction use

In the constructional aspect, bamboo is used as a building material for decoration and as a structural member of a house. Bamboo utilization for housing has being for ages back, being used as poles, trusses, rafter, flooring, ceiling, roofing, window and door frames, foot bridges, fence posts and, wall as shown in figure 9. They are additionally used in modern-day as scaffolds to support slabs while constructing. Bamboo production is now common to the world and has been developed in China, India, Vietnam and Thailand where bamboo mat boards are manufactured. With studies observed, in Asian countries bamboo can be a valuable sustainable constructional resource.

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ISBN 978-0-86970-787-6

Figure 9: Bamboo wall (Source: Anon, 2015).

The use of bamboo in recent times as a raw material in construction works is due to its environmental friendly attributes and ready availability (Yu *et al.* 2011). Bamboo based panels are products made from raw bamboo through a series of mechanical and chemical procedures, such as spraying glue, laying up, and hot pressing. According to Naxium *(*2001*),* the bamboo-based panels have the advantages of large size, high strength, stabilization in shape and size, and its parallel and perpendicular strength and property that can be adjusted according to different demands. Bamboo based panels are relatively ideal engineering materials. The panels are manufactured under high temperature and pressure with the aid of adhesives. Ply bamboo is used in truck floors as weight of steel materials is too high. In addition, ply bamboo has a high friction coefficient and it does not rust. The bamboo culms can be developed into bamboo based panels which can be used in the construction industries in a form of Mat Plybamboo, Curtain Plybamboo, Laminated Bamboo of Strips, Plybamboo, Bamboo Particleboard, and Bamboo Composite Board. Bamboo-based composite could also be used as a suitable alternative material for prefabrication in terms of the various advantages they contain. Development of panel products based on bamboo strips and fibre polymer is gaining importance as these panel products reassemble wood when used in a particular fashion as in parallel laminates and as reinforcement in other matrices. These products have superior physical, mechanical properties and are suitable for constructional and specialized application. Moreover the requirement of resin adhesives is expected to be lower compared to bamboo mat based composites and therefore making the products cost effective which are considered to be ideal for alternates to wood and plywood for several end user applications. Bamboo laminates and fibre polymers products could replace timber in many applications such as house building, doors, windows, ceiling, furniture, and several other applications.

4. Sustainable Development of Bamboo

The increasing human population across the globe in combination with an increase of consumption per capita, more and more pressure is put on global resources according to (Brundtland *et al.* 1987), causing the three main interrelated environmental problems: depletion of resources, deterioration of ecosystems and deterioration of human health, and their effects (Van den Dobbelsteen 2004)**.** In 1987, the World Commission on Environment and Development headed by Brundtland presented the report Our Common Future (Brundtland *et al.* 1987) including the - now widely adopted - concept of sustainable development: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Hence, the term “sustainability” was first mostly interpreted in its environmental meaning.

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4.1 Impact of materials on environmental sustainability

The environmental impact of a product depends on all the life cycle stages of the product. Intuitively one expects that the environmental impact of a material has the most influence on the production phase of a product caused by raw material provision and factory production. However, the choice for a specific material in a product also has a strong and direct impact on other aspects of the product in other stages of the life cycle, such as the processing stage (e.g. energy impact and efficiency of production technology), use phase (e.g. durability during life span) and the end-of-life phase (e.g. possibility of recycling, biodegradation at the end of the life span). This shows that materials are intrinsically linked to every stage of the life cycle of a product.

Life Cycle Assessment (LCA) can be done to evaluate the environmental sustainability of bamboo. The LCA test on bamboo from cultivation to the end of its disposal systematically shows that the environmental impact of bamboo products is sustainable and it improves the atmospheric conditions of our societies. Principally, in an LCA, all environmental effects relating to the three main environmental problems occurring during the life cycle of its product are analyzed, from the extraction of resources until the end phase of demolition or recycling. The LCA-methodology used was conducted in accordance to the internationally standardized in the ISO 14040 series. The three main environmental problems are:

- Depletion of Resources: The use of materials contributes to the depletion of resources. It becomes clear that resource depletion is becoming an urgent problem for society. The raw material consumption of industrialized per capita is high according to (Adriaanse et al. 1997, Dorsthorst and Kowalczyk 2000).

- Ecosystem Deterioration: The next to resource depletion is the high raw material requirements of industrialized countries also impact ecosystems, since these raw materials need to be extracted (e.g. landscape deterioration, erosion), processed and transported (e.g. emissions of greenhouse gases causing climate change), and ultimately disposed of as waste (e.g. toxification, acidification). Depending on the material in question the influence of the extraction and manufacturing of materials on ecosystem deterioration will differ. For example, heavy metals may have a stronger environmental impact during the use and end-of-life phase due to their toxicity and the lack of biological degradability of these materials as stated by (Dorsthorst and Kowalczyk 2000).

- Deterioration of Human Health: According to Dorsthorst and Kowalczyk (2000) some materials, such as the earlier mentioned heavy metals, can be harmful to human health. Some materials such as timber can be harmful to human health, when they are impregnated with poisonous preservatives (e.g. arsenic, copper, chrome) for a longer life span of the timber. Directly or indirectly, materials have a large influence on the environmental impact of products, now and in the future.

A basic LCA provides an outcome of different effect scores; a weighing method is not included, and an overall judgment of the environmental impact of bamboo products is therefore not possible. The models to arrive at a single indicator are always subject to discussion, mainly about the weighing method applied in damage based models, but also about the environmental effects included/excluded as well as allocation issues (Van den Dobbelsteen 2002 and 2004).

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5. Recommendations for the Bamboo Industry

In order to improve the environmental sustainability of bamboo cultivation, processing and preservation of its products for construction industries, bamboo material producers are recommended to:

- Cultivate high yielding giant bamboo species suitable for the production of fibres and materials for construction industries to increase their establishment of plantations by a sustainable techniqes.
- Execute environmental impact assessments applying LCA in order to better understand which steps in the production process are most harmful to the environment and should therefore receive priority if the environmental impact of the materials is to be reduced. For example, industrial bamboo producers could use less harmful additives during the production process of their materials (preservatives, resins), either by reducing the amount of resins and chemicals used, but preferably by opting for more environmental friendly or biodegradable resins and chemicals.
- Develop take-back procedures, and recycling processes in which the materials at the end of their lifetime are 100% reusable in the same function (Cradle to Cradle strategy).
- increase the efficiency of the transformation process of the bamboo resource in semi finished materials, including the search for more high end and durable materials and applications in which bi-products of bamboo can be used to produce other wood panels.
- Develop new industrial bamboo materials, like corrugated bamboo mat boards, in which the competitive advantages and specific differences of bamboo compared to wood are utilized. For example, if the bamboo micro fibre is chosen in natural fibre based composites because of its mechanical performance, it might be worthwhile to do research into processes to extract bamboo fibres in an efficient and environmentally friendly way from the stem, including space efficient ways of transportation to the composite material production site (e.g. compressed bags through vacuum suction).

6. Conclusion

In conclusion, it can be said that an environmental impact assessment based on LCA is often lacking specific data and only provides an overview of the environmental impact (in terms of emissions and materials depletion) of a material or product as in the case of bamboo sustainability for the construction industry. LCA is a relatively new methodology which is continuously being improved, based on which new models continue to emerge on the market and this serves as a basis for the enhancement of a sustainable bamboo growth across the globe.

Furthermore, the factors time and place are not incorporated into an LCA, this is because any LCA based calculation, is full of assumptions and estimations which may differ per calculation. For example, for the factor place, even for exactly the same material or product, production data may differ depending on the country of production (e.g. regulations with regard to emissions of production facilities), or the country of consumption (e.g. transport distance). The production context may also differ, which can be best- or worst practice or something in between (e.g. recycling, waste treatment, incorporated at production site), which can cause differences in environmental impact for exactly the same product according to (Potting 2000).

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Though bamboo is a fast renewable material for production of wood products and in the construction industries, if sustainable measures are not put in place to replace its high rate of harvesting from available reserve forests and plantations globally, then this renewable resource is under a high treat of depletion and hence high yielding species cultivation should be introduced across tropical and subtropical countries where bamboo growth is sustainable.

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-001

Use of labour production rates in the Zambian road sector

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Abstract

Labour productivity has always been a key issue for project managers to improve their project results in developed countries. Currently, productivity studies are receiving special emphasis in developing countries. Thepurpose of this study was to providea framework for the development, accessibility, maintenance and use of official labour production rates specific to the Zambian road construction sector. Specifically, the study investigated how the players in Zambia set durations of their road projects; examined how other countries have developed labour production rates for the road sector; how often these rates are reviewed; and recommend an institution suited to maintain a database of labour production rates for the road sector in Zambia. The study also investigated the use of production rates as the basis of estimating tasks and consequently contract durations. Seven experts in road construction were interviewed to validate the results of a questionnaire survey conducted among twenty six key players in road construction. The United States of America was found toextensively use labour production rates in the road sectorand therefore, the study recommended the methodologyused to develop and maintain them. Findings revealed experience was largely used to determine contract duration in Zambia. However, the accuracy of the determined contract duration was average. Higher accuracy of contract duration prediction was achieved when experience was combined with company labour production rates. The study recommended that the regulatory of the road sector spearheads the development of official labour production rates reviewed every five years and establish a formal labour production rate library.

Keywords: Labour productivity, road construction, Zambian Construction Industry

1. Introduction

1.1 Background

The construction industry is one of the labour intensive industries in developing countries and its human resource covers a large amount of the project cost. Labour productivity has always been a key issue for project managers to improve their project results in developed countries. Currently, productivity studies

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

are receiving special emphasis in developing countries. Though road construction activities are similar in nature, labour productivity rates vary depending on local, political, social and macroeconomic environment of a country. Therefore, each country must strive to develop and use their productivity rates.

1.2 Rationale

There is lot of research data available regarding labour productivity of high income or developed countries as compared to developing countries. According to Yi and Chan (2013), there are 83 published research papers related Construction Labour Productivity (CLP) by US researchers, 18 by UK and 20 by Canadian researchers. As a result, developed countries have improved their construction output, whereas the developing countries lag behind even by using more human resources,(Muzamil and Khurshid, 2014).

Lack of official labour production rates make it very hard for planning engineers to come up with contract time, work schedules, costs and loads estimates and budget and cost control systems. The adage 'time is money' cannot be more relevant elsewhere than it is in the construction industry. Every second an equipment or labour spends on site has a direct cost to the whole project.

In addition, underestimating or overestimating the required amount of labour to undertake an operation is very costly.Furthermore, currently in Zambia it is very hard for engineers to identify low labour productivity on a construction site because of the lack of productivity standards. Therefore, there is no basis for dismissal due to low productive labour. Conversely, if someone was unfairly dismissed for not being productive, it would be very hard to prove otherwise without official productivity standards. Also, the productivity of labour produced by trade schools for the road sector is not standardised as there are no productivity standards to compare with.

1.3 Objectives

1.3.1 Main Objective

The main objective of this research was to provide a framework for the development, accessibility and use of official labour production rates in the Zambian road construction sector.

6.1.2 Specific Objectives

Specifically the research aimed to achieve the following; investigate what the players in the road construction industry in Zambia were using in place of the non-existent official labour production rates to determine contract duration;establish how other countries have developed labour production rates for the road sector;examine how often labour production rates should be reviewed;establish which institution was best placed to develop labour production rates for the road sector in Zambia;establish how information on labour production rates could be accessed; andrecommend the establishment of official labour production rate library.

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2. Literature review

2.1 Definitions

Construction industry is one of the oldest and largest fragmented industries of the time. The construction industry is that sector of economy which plans, designs, constructs, alters, maintains, repairs and eventually demolishes buildings of all kinds, civil engineering works, mechanical and electrical structures and other similar works, (Ofori, 1990). Productivity is an effective and efficient utilization of all resources; labour; plant; materials; and management (Prokopenko, 1987). A highway construction production rate is the quantity produced or constructed over a unit time period, (Jiang and Wu, 2004). Therefore productivity rates can be used to measure the efficiency of the sector.

2.2 Models of productivity measurements

Productivity standards provide the basis for comparing current productivity rates, and the estimation of the costs and duration of a proposed project. The main methods used in the construction industry to develop and measure productivity standards are by using historical data, or by analysing a work process and then developing a scientific standard, (Idrus, 2011).

Thomas et al (1990) identified three models of productivity measurements; they are Economic Models, Project Specific Model and Activity Oriented Model. The economic model defines total factor productivity that is the ratio between total outputs expressed in monetary terms and total inputs expressed in same currency. The total input includes labour, materials, equipment, energy and capital. The second is the project specific model that defines productivity as total productivity; that is the ratio between the outputs expressed in a physical unit and the inputs expressed in related currency. Thirdly, the activity-oriented model defines the productivity relative to project sites. In this study labour productivity is defined as output per work hour and used the activity oriented model. Accordingly, productivity is defined as:

Labour Productivity = Labour output/ Man-hours

2.3 Labour productivity rates in Africa

The only attempt in Zambia to produce official labour productivity rates was by the ILO/ASIST (2004) on behalf of the Ministry of Works and Supply, Roads Department, Roads Training School. Productivity rates were part of the contractor's handbook for labour-based road works.

However, all the productivity rates contained in the document could not be adopted and applied in the Zambian Construction Industry (ZCI) because of various reasons. Firstly, they were produced to be used as guidelines for contractors with little or no experience in road construction. Further, the basis of deriving the labour productivity rates is not clear. Therefore, they are to be used with caution. In addition, they were exclusively produced to be used on labour based road projects. However, many roads under construction in the country are not categorised as labour based contracts. Finally, these productivity rates were produced ten years ago, indicating time to review them.

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ILO earlier did similar works on labour based productivity rates in many countries in Africa such as Kenya, Zimbabwe, Botswana, Ghana, Lesotho and Tanzania (ILO/ASIST, 1998). However, literature on more comprehensive official labour productivity rates was scarce for African countries.

2.4 Labour productivity rates in the United States of America

The country which is leading in both research and use of labour productivity rates is the United States of America (USA). According to Yi and Chan (2013), there were 83 published research papers related to Construction Labour Productivity (CLP) by US researchers, 18 by United Kingdom (UK) and 20 by Canadian researchers. As early as 1995, approximately 88percent of the states and provincial Departments of Transportation (DOTs) in America used production rates to estimate contract time, (Herbsman and Ellis, 1995).

The DOTs in every state develop their own labour productivity rates to be used to determine contract duration for every road project in that state. They usually engage academicians in local state universities to evaluate and update official labour production rates. Furthermore, they also study how various factors affect labour productivity so as to improve on the accuracy of the estimated contract durations. This is because construction durations are affected by the same factors as labour production rates, (Jiang and Wu, 2004, Harber, 1988 and FDOT, 2010).

3. Methodology

The study adopted literature review, questionnaire survey and interviews for data collection. The questionnaire survey was carried out among contractors, consultants and clients. To get insight on key questions in the questionnaires, interviews were carried out among the experts in the road sector.

Only contractors, consultants and clients based in Lusaka were considered for the research because of time and cost constraints. The results could however be generalised to the whole country as both the National Council for Construction (NCC) (2014) and Association of Consulting Engineers in Zambia (ACEZ) (2014) lists of registered contractors and consultants respectively showed that at least 80 percent of the firms were based in Lusaka.In terms of the clients, RDA is the major client as it runs all large government road projects in the country, sometimes in conjunction with local councils. Therefore, the selected clients RDA and LCC were sufficient.

Stratified random sampling was used to select respondents of the questionnaire survey. This was to ensure that the different types of respondents (contractors, contractors and clients) were represented in the right proportion. Further, the sampling technique allowed for different NCC grades of contractors to be represented in a logical manner. In this study,more efficient contractors were chosen because they were more active in the road sector compared to less efficient contractors.

Thirty five questionnaires were distributed, twenty four to Contractors, nine to Consultants, and two to Clients. Out of the twenty four questionnaires distributed to contractors, eight were to NCC grade ones, six to grade twos, five to combined grade threes and fours and another five to combined grade fives and sixes. The ACEZ (2014) list of registered consultants had 21 civil engineering firms.The NCC (2014) list of registered contractors according to category and grade showed that they were 517 grade six, 277

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grade five, 128 grade 4, 38 grade three, 31 grade two and 62 grade one registered contractors in the roads category.

Interviewees were purposively sampled with the requirements that they had at least five years of experience in the road sector. Interviewees who had experience in project or construction management were most preferred.

A total of twenty six valid questionnaires were received and analysed using Statistical Package for Social Sciences (SPSS). Interviewees' responses were analysed using content analysis.

4. Results and discussion

The findings from the seven interviews carried out among road construction experts and twenty six respondents from a questionnaire survey are presented.

4.1 Survey responses

A total of twenty eight questionnaires were received, however, two of them were invalid. The response rate was 74.28percent. According to American Association of Public Opinion Research (AAPOR) (1986), the minimum response rate for a paper to be published in key journals is 60percent. In addition, seven (4 contractors, 2 consultant and 1 client) road construction experts with at least five years of experience in the Zambian road construction sector were interviewed to give insight on key questionnaire questions. Table 4.1ashows the summary of responses and majority of the respondents, 61.5 percent, were contractors.

Table 4.1a: Summary of responses by nature of company

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	consultant	8	30.8	30.8	30.8
	contractor	16	61.5	61.5	92.3
	Client	2	7.7	7.7	100.0
	Total	26	100.0	100.0	

Table 4.1b shows the experience of the experts interviewed indicating that four out of seven interviewees had more than 10 years' experience.

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Figure 4.1b: Demographic background information of interviewees

Title/ Parameter	***Frequency***	***Percentage***
Experience in the road sector		
6-10 years	3	42.86
Above 10 years	4	57.14
Total	**7**	**100**
Highest academic qualification attained		
Bachelor's degree	2	28.57
Master's degree	5	71.43
Total	**7**	**100**
Area of Expertise		
Construction management	3	42.86
Project management	4	57.14
Total	**7**	**100**

Table 4.1b shows the demographic background information of interviewees. 57.14 percent of interviewees had more than 10 years' experience in the road sector and 42.86 percent had between 6 and 10 years' experience. 71.43 percent had a master's degree in civil engineering or any related fields and 28.57 just had their first degree. Interviewees were mainly specialised in construction or project management. 42.86 were construction managers and 57.14 were project managers.

4.2 Findings

4.1.1 Official Company Labour Production Rates

Table 4.2.1: Companies that have labour Production Rates

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	8	30.8	30.8	30.8
	No	14	53.8	53.8	84.6
	Not sure	4	15.4	15.4	100.0
	Total	26	100.0	100.0	

On whether the respondents companies had official Labour Production Rates (LPR) for road construction, 30.8 percent agreed compared to 53.8 percent who did not and 15.4 percent were not sure. The low number of those that do have compared to those who don't have was expected as literature on

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LPR was scarce in the country. However, those who have would not share as the LPR are private and help them beat off competition. Table 4.2.1 shows how many firms had official LPR.

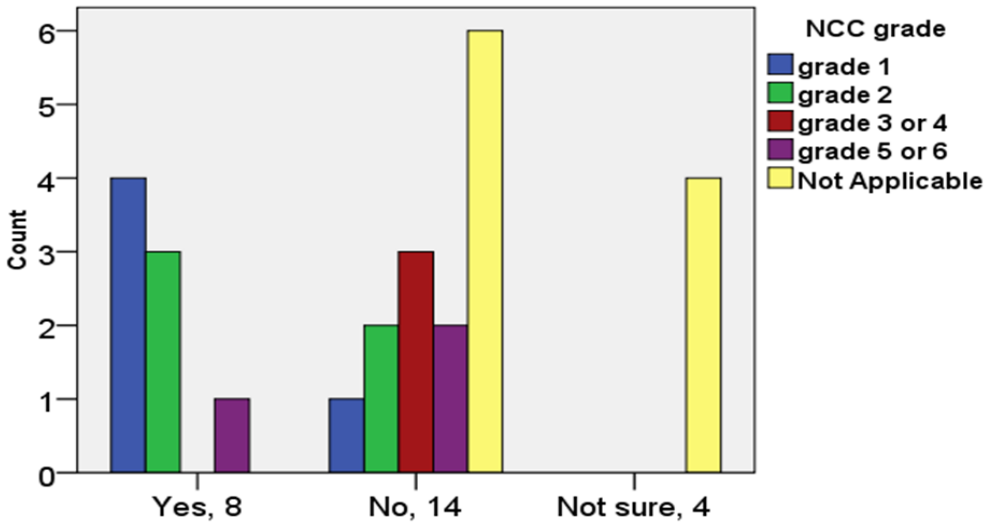

Figure 4.2.2: Respondents that had official company LPR and their NCC grade

Figure 4.2.2 shows that there is a strong correlation between companies that have official LPR and their NCC grade. Grade one and two contractors made up 87.5 percent of all the contractors that had official LPR. This would be expected as they are the most efficient and experienced contractors and therefore have the basis and resources to develop them. From the chart, it should be noted that only contractors have their own LPR. Literature reviewed showed that LPR could be used to estimate the cost of projects. This explains why contractors have taken interest in them.

9.1.2 Current practice of contract and task durations determination in the road sector

Table 4.2.2: Method used to determine contract duration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Experience	14	53.8	53.8	53.8
	Company LPR	4	15.4	15.4	69.2
	Others	4	15.4	15.4	84.6
	Experience and company LPR	4	15.4	15.4	100.0
	Total	26	100.0	100.0	

To determine contract and task durations, Majority 53.8 percent of respondents used Experience. The remaining methods namely; Company Labour Production Rates; combination of Experience and Company Labour Production rates; and neither Experience nor Company Labour Production rates accounted for 15.4 percent each as shown in table 4.2.2. Due to scare literature on LPR, it was expected that many firms resort to experience to estimate tasks and contract durations.

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4.1.3 Institution to develop official labour production rates

85.71percentof experts interviewed chose the Road Development Agency (RDA) to be the institution best placed to develop and maintain official labour production rates for the road sector. Other institutions considered during the interviews were the Ministry of labour, Ministry of works and supply, Associations of contractors and consultants and local universities. From literature review, since road projects in the USA were implemented through the DOTs, the RDA would be its equivalent in Zambia. Therefore, literature review supports the choice of RDA to be the institution to develop official LPR.

71.4percentof interviewees were quick to mention that extensive historical and present data on road construction is required to develop accurate labour production rates. In addition, primary data would have to be collected from active road construction sites and compared with historical data. Therefore, access to historical data on road construction and access to active road construction sites were cardinal to some experts choosing the RDA. Some experts (57.14percent) also mentioned that the RDA is the major stakeholder in road construction and would benefit the most from more accurate contract duration, less budget overruns due to extending contract time. In addition, 51.14percent of interviewees advised that because of the amount of research that has to be done to produce official labour production rates and create a way to predict contract duration from them, RDA should contract a local University to carry out the research. However, 14.29percent of experts interviewed recommended the National Council for Construction (NCC) to bear the responsibility of developing official labour production rates as it is the institution responsible for the development of the construction industry in Zambia encompassing road construction.

The questionnaire survey results were consistent with the interview results. The majority of the respondents 73.1percentchose the RDA and 26.9 percent chose the NCC as summarised in table 4.2.3. Among other options provided were Ministry of Labour, Associations of contractors and consultants, Central Statics Office and universities.

Table 4.2.3: Institution to develop LPR

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NCC	7	26.9	26.9	26.9
	RDA	19	73.1	73.1	100.0
	Total	26	100.0	100.0	

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9.1.4 Access to official labour production once developed

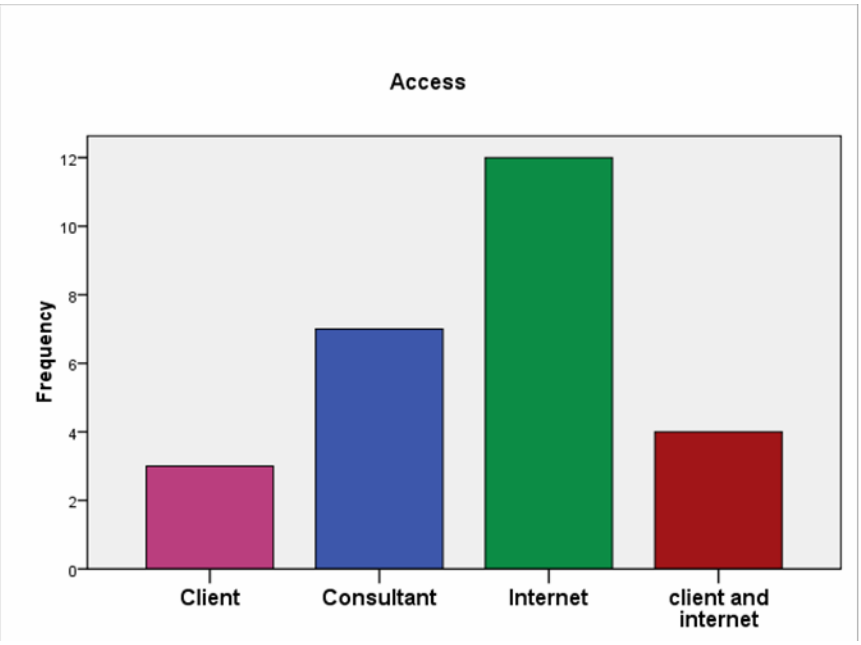

Figure 4.2.4: Access to labour production rates against frequency

46.15percent of the respondents selected the internet alone as a mode to access official labour production rates for the road sector once produced, whereas as 26.92percentpreferred access through the consultants. Figure 4.2.4 shows all the results from the questionnaire survey.

4.1.5 How often labour rates should be reviewed

Most experts interviewed 85.71percent advised that labour production rates, once developed, must be reviewed because of the continuousdevelopment of new technologies in construction methods, equipment, and materials. This makes it necessary to update the production rates to reflect the improvement in productivity and to provide more accurate input and basis for estimating contract time. 71.42percent of interviewees advised to review the rates every 5 years. Some respondents argued that it would be ideal to review the rates every year but they were quick to mention that this might not be financially feasible.

Table 4.2.5: Interval to reviewed LPR

		Frequency	Per cent	Valid Per cent	Cumulative per cent
Valid	5 years	22	84.6	84.6	84.6
	Yearly	4	15.4	15.4	100.0
	Total	26	100.0	100.0	

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Results from the questionnaire survey also strongly suggested that labour production rates should be reviewed every 5 years with 84.6 percent agreeing and 15.4 percent favoured a yearly review. Summary of the results are shown in table 4.2.5

4.1.6 Labour Production rate library

All the seven experts interviewed advised that there was need to establish a labour production rate library to store and keep track of all the necessary documents required to develop and maintain official labour production rates. Documents such as daily reports from different sites must be kept for the development and updating of labour production rates. Data could be entered into a computer program like excel for easy analysis before the physical document is filed. The LPR librarycould just be a section of the already exiting RDA library. Results from the questionnaire survey also strongly suggested that a labour production rate library was needed. All the 26 respondents recommended the establishment of a labour production rate library. Table 4.2.6 shows the results.

Table 4.2.6: LPR library recommendation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	26	100.0	100.0	100.0

5. Conclusion and Recommendations

5.1.2 Companies that have official LPR

All companies that have their own LPR are contractors and 87.5 percent belong to NCC grade one and two. Efficient contractors have the basis, experience and the resources to develop LPR.

5.1.3 Current practice of setting contract and task duration in the road sector

The common current practice of determining contract and task duration in the road sector is through experience. However, there is a decent number of those who use either their company LPR alone or combine the rates with experience and intuition.

5.1.4 Institution to develop official labour production rates

The study recommends the RDA to be the Institution to spearhead the development of official labour production rates for the road sector.

5.1.6 Countries that have developed official LPR for the road sector

Literature on LPR was scarce for African countries. However, the USA was found to extensively use labour production rates in the road sector and therefore, the study recommends the method they used to develop and maintain their labour production rates. That is to say when developing labour production

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rates, the RDA should take advantage of the expertise in the local universities to ensure quality and accurate rates are developed. Furthermore, since the construction durations are affected by the same factors as the production rates, a research should also be carried out on the factors that affect labour productivity rates in the Zambian road sector.

4.2.7 Summary of results and analysis

Table 4.2.7: Integrated results and their interpretation

objective	Literature Review	Questionnaire survey	Interviews	Interpretation/ comment
Current practice of setting tasks and contract time in the Zambian road sector	Literature was scarce	53.8 percent used experience to set tasks and contract time.	All interviewees mentioned that the major client (RDA) used experience to set contract time	Due to the lack of official LPR, contract time is estimated using experience. However, some contractors have LPR which they use to set the duration of tasks and allocate resource.
Institution to develop official labour production rates	Literature reviewed supported the regulatory of the road sector to develop official LPR	73.1 percent chose the RDA to spearhead the development of official LPR	85.71 percent suggested the RDA to be the institution to develop official LPR	The RDA would be the ultimate users of the LPR to estimate contract time and therefore should take the initiative of developing them.
Access to official labour production once developed	In the USA, LPR are accessed through the client (DOTs). However, papers on LPR are published in international journals.	46.15 percent chose the internet	All respondents mentioned that the internet would be the cheapest and quickest way of accessing information on LPR	Considering that the potential users of the LPR are many, the rates should be easily accessible to the public through the internet. The client should also make them part of the bidding documents.
How often labour rates should be reviewed	Literature reviewed stressed the need to review the LPR however, no time period was suggested.	84.6 percent suggested that the LPR should be reviewed every 5 years.	85.71 advised to review the LPR every 5 years	Ideally the LPR should be reviewed every year, but it could be an expensive exercise. Therefore, every five years would be a good compromise.
How other countries have developed labour production rates	The USA extensively researched and used LPR for the road sector. DOTs make use of expertise in local universities to evaluate and update LPR			Use of university experts was cardinal to ensure quality and accurate LPR were developed. They designed a systems that used LPR to estimate contract time

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ISBN 978-0-86970-787-6

5.1.7 Access to official LPR

Once developed, official LPR should be accessible through the internet. This is both a cheaper and quicker way of disseminating the information. However, guidelines on their use should be provided on the same platform so as to prevent potential users from using them carelessly.

5.1.7 Reviewing the official LPR

LPR should be reviewed every five years because of various reasons. The RDA can again make use of the expertise in local universities to review the rates and the contract estimating system, if need arises.

5.1.8 LPR library

A LPR library should be established to store information from different projects needed to develop a data base. Such information as daily site reports and log books should be stored carefully as they are the primary data sources of LPR.

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

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HEALTH AND SAFETY, EMPOWERMENT AND SKILLS TRANSFER IN INFRASTRUCTURE DEVELOPMENT

Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-009

Examination of Safety Performance Regulations in the Ghanaian Building Construction Industry

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Abstract

The construction industry worldwide plays a significant role in the economic growth of many countries. However the construction industry also has a poor safety record. The Ghanaian building construction industry is faced with a lot of risk due to non- compliance with the safety regulations. The objective of this paper is to examine safety performance regulations in Ghana and identify areas to improve Occupational Health and Safety (OHS). The study documents findings from published literature. The review was conducted on safety practices and challenges in Ghana. The findings showed that the Ghanaian construction industry faces a lot of challenges. These include: weak regulatory and development framework, financial, human resource and material constraints. These challenges have been attributed to lack of a legal mandate to enforce rules, regulations and professional standards. It was also noted that the Government leadership in the structuring of the OHS policy should be committed. The OHS policy adoption and development in Ghana should follow the minimum requirement of the International Labour Organisation (ILO) conventions.

Keywords: challenges, health and safety, improvement, regulations, risk management

1. Introduction

The construction industry of Ghana as indicated by the African Development Fund (ADF, 2008) is an important contributor to informal employment. The growth and development of any economy is directly or indirectly connected with the construction industry. It is linked with the economy of a country and the major contributor to the gross domestic product (GDP) of Ghana. A report from Ghana Vibe (2014) has shown that the contribution to GDP by the construction industry has increased from 8.5% to 11.8% from 2010 to 2013 respectively.

Yet, the Ghanaian construction industry is facing problems such as lack of development regulatory, limited financial resources, lack of investment in the development of human resource, lack of ability to embrace change, low technology in the industry, lack of appreciation for workforce in the industry and high movement of workers. Most of these problems are related to weakness in enforcing the rules, regulations and professional standards, largely due to the lack of a legal mandate. To solve these

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

problems, this paper will look into the institutional environment and OHS challenges in Ghana. This is followed by OHS improvement in Ghana.

2. Research Methodology

The research method adopted is literature study from various studies on OHS in Ghana. The review of literature looked into details on different views from different scholars about OHS practices and challenges in Ghana. Out of the twenty studies reviewed on Ghana, nine studies were selected which are relevant to OHS. The results from the literature study were analyzed to obtain specific issues that are relevant to the root causes of safety performance regulations. Based on the identified challenges of OHS, needs are clearly defined and strategies are proposed for their improvement.

3. The Institutional Environment

The activities of many government ministries and other organisations affect the construction industry of Ghana. The activities of construction businesses and implementation of state policy in the construction sector as indicated by Kheni et al., (2008) is under two government ministries namely, the Ministry of Roads and Transport (MRT) and the Ministry of Water Resources, Works and Housing (MWRWH).The former is responsible for the road sector of the economy and has under it, the Ghana Highways Authority (GHA), Department of Urban Roads (DUR) and Department of Feeder Roads (DFR).While the latter is responsible for policy implementation in respect of works, housing, water supply, sanitation and hydrology, and oversees the activities of building contractors. Kheni et al. (2008) asserts that the MWRWH comprises the Public Works Department (PWD), the Department of Rural Housing, Department of Hydrology, Rent Control Department, and agencies for implementing programmes deriving from government policies. Physical developments, particularly roads and housing are normally undertaken after the relevant departments are satisfied that the project meets the requirements stipulated within the planning and building regulations of Ghana. Environmental concerns have to be addressed by the client and contractor.

It was observed by Kheni et al. (2008) that the activities of other government ministries, departments and agencies impact on the construction industry as regulators. The government entities are as follows:

- Ministry of Manpower Development and Employment (MMDE) has two departments under it namely the Labour Department and Factory Inspectorate; labour issues and issues relating to employment is the responsibility of the former department while OHS issues are the responsibility of the latter.
- Ministry of Environment and Science (MES) has the Environmental Protection Agency (EPA) and Town and Country Planning under it. The EPA implements policies relating to the environment and ensures environmental regulations are complied with. Town and Country Planning is responsible for ensuring projects comply with zoning laws and building regulations.
- Ministry of Health, through its Occupational Health Unit is responsible for occupational health issues.
- Ministry of Lands, Forestry and Mines has relatively many departments and agencies under it responsible for the use of land and resources. The Lands commission, Survey Department, Office of the Administrator of Stool Lands, Lands Valuation Board and Land Title Registry, and all these have roles that could influence the construction industry.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

Danson (2005) illustrates that Class A contractors are qualified to carry out road works, airports and related works; Class B contractors are qualified to undertake bridge construction, the construction of culverts and other drainage structures; Class C contractors are qualified to carry out labour based works; Class S contractors are qualified to construct structures and Class M contractors are qualified for miscellaneous road related works. He further argues that these classes are further subdivided into categories 1-4 depending on the number and qualifications of the contractor's permanent staff, equipment/machinery holding, previous experience, and financial status. For instance, a contractor can be designated as A1B1 or A2, B2. The MWH classifies building contractors as belonging to one of the classes D1 through to D4 depending on financial standing of the contractor, equipment holding and qualification and number of permanent employees.

4. Occupational Health and Safety Challenges in Ghana

Annan et al. (2015) confirms that there are several types of OHS issues that are affecting the construction industry in Ghana. They mentioned lack of comprehensive national OHS policy as one major challenge in the implementing OHS practice. They further argued that the Ghana government is not able to partner with organizations responsible for the implementing the OHS activities and reported on its outcomes. The country has not yet ratified the ILO convention number 155, although this has been under consideration, and therefore, the international OHS requirement is not applicable in Ghana. Kheni et al., (2008) identified inefficient institutional frameworks responsible for Health and Safety (H&S) standards, inadequate government support for regulatory institutions and lack of skilled human resources in their study on impact of H&S management on safety performance of Small and Medium Sized Enterprises (SMEs) in Ghana. Studies conducted by Dadzie (2013) on perspectives of consultants on H&S provisions in the labour Act: A Study into theory and practical has shown the following as factors affecting the adherence to the H&S provisions in the labour Act of Ghana: lack of H&S training for workers, poor risk assessment, poor attitude of workers towards H&S, inadequate H&S professionals, H&S policies, inadequate data collection systems, lack of H&S education in various institutions, communication difficulties, cost of providing and maintaining H&S on sites and accident reporting shortfalls. Puplampu and Quartey (2012) asserts that there was low level of ratifications of ILO Conventions that address OHS in Ghana; lack of comprehensive international OHS policy framework; inadequate resources allocated to OHS researches; ineffective OHS inspection; OHS training and education; and OHS capacity building and monitoring. Laryea (2010) revealed that there was a serious lack of structures and procedures at all levels of the construction chain - lack of strong and appropriate H&S legislation for governing construction work and site operations in construction.

Annan et al. (2015) in their study of a call for action to improve OHS in Ghana and a critical look at the existing legal requirement and legislation concluded in their study that the large number industries in Ghana have contributed to the high risk in workplace hazards. They further argued that there is no national policy and body responsible for monitoring and ensuring OHS requirements and guidelines are met or implemented. This might be due to the existence of some fragments of OHS legal requirements under jurisdictions of different agencies. These barriers need serious attention to ensure affective OHS management.

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5. Occupational Health and Safety Improvement in Ghana

A study by Annan et al. (2014) shows that the introduction of different regulatory bodies in Ghana has not solved the problems of OHS in Ghana. The regulatory bodies as mentioned by Annan et al., (2014) are the Mining and Minerals Regulations 1970 LI 665, the Workman's Compensation Law 1987, the Ghana Health Services and Teaching Hospital Act 526 (1999), the Ghana Labour Act 2003 (Act 651), the Radiation Protection Instrument LI 1559 of 1993, which is an amendment of the Ghana Atomic Energy Act 204 of 1963, the EPA Act 1994 (Act 490), which has components that include but not limited to the Pesticide Control and Management Act 1996 (Act 528), seeking to protect not only the environment but also persons, as well as the National Road Safety Commission Act 1999 (Act 567). The concept of OHS was introduced in the Ghanaian industries before the introduction of the Factories, Offices, and Shops Act 1970 as pointed out by Annan et al., (2014). Both report from the Ghana Government (2010) and Annan et al., (2014) confirm the existence of the Factories, Offices, and Shops Act 1970 (Act 328) and the Mining Regulations 1970 LI 665 as the two major edicts that provided guidance for the provision of OHS services, practice, and management in Ghana. Annan et al., (2015) argues that the structuring of OHS policies in Ghana must start with government's commitment and leadership. They emphasised on the adoption or development of OHS policy which should follow the minimum requirement of the ILO convention by the nation.

6. Lessons Learnt

Ghana has no national policy and body responsible for monitoring and ensuring OHS requirements and guidelines. The existence of numerous types of OHS problems have led to the difficulties in the implementation of OHS practices in the construction industry. The country lacks comprehensive OHS policy, institutional frameworks for H&S standards, government support and skilled human resources. Others are low level of ratifications of ILO Conventions, inadequate resources for research, training and education.The existence of different regulatory bodies in the country has worsened the problems in the implementation of OHS practices.

7. Conclusion

Review of literature on the OHS in Ghana has shown that that there are several types of OHS issues that affect the construction industry. Implementation of OHS practiceis seen as one of the major challenges in the establishment of comprehensive national OHS policy.However, the introduction of different regulatory bodies in Ghana has not solved the problem of OHS, although the ILO convention number 155 is under consideration in Ghana but has not yet been rectified. This implies that the international OHS requirement is not applicable in Ghana. The OHS policy to be adoptedor developedby Ghana should follow ILO conventionas a minimum requirement.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-005

Assessment of Crane Safety Practices on Construction Sites in Abuja, Nigeria

Richard Jimoh[1], Sani Momoh[2], Saka Eletu[3]

Abstract

Some crane accidents could be prevented if construction managers reviewed and evaluated safety requirements, rigging equipment used, and obtained connections and operator certification for the cranes inspected. On this basis, the paper assesses crane safety practices on construction sites in Abuja, Nigeria through the use of combination of methods to collect data namely: a questionnaire survey and interviews with professionals and crane operators. Purposive sampling method was used to draw up the sample in that the respondents had to be on sites where cranes were available and were willing to be part of the study. It was discovered that the adherence level of safety practices was high and professionals know the suitable type of crane used for each project as this was ranked 1st, while "load not being moved over workers" was ranked 16th. Furthermore, results showed that the operators gained knowledge of the work based on experience. Hence, it is recommended that efforts should be made to provide avenues for the operators to be trained, whether formally or informally, so as to improve their knowledge base.

Keywords: Abuja-Nigeria, accidents, construction sites, crane, safety practices

1. Introduction

The construction industry is very important in every country. The demand for building is derived from the need for buildings in which to live, to manufacture and store goods, and in which to carry out various services. Buildings are becoming more sophisticated, larger and more complex and require plant for efficient, fast, and easy construction. Thus, the key to achieving healthy and safe working conditions is to ensure that health and safety issues are planned, organised, controlled, monitored, and reviewed (Stephen, 2006). Plant, materials, and people are the core resources on which all operations in the construction industry are successfully executed. This gives the indication that the absence of one part shall cause problems such as delays in operation, and productivity. Plant usage therefore is of great benefit to the execution of every construction activity. Transportation plant such as cranes, chutes, vans, hoists, and fork lifts have sped up construction activities over the years by transporting materials from one place to the other in various directions. Training is to be provided where necessary to reduce the risk of injury, or workers should be under the supervision of someone with such skills and knowledge (Doran, 2004). The lack of education, carelessness, overconfidence, and the trust in outmoded experiences have caused the failure, under-usage and over-usage of some plant such as cranes (Doran, 2004). The leading safety hazards on site are falls from height, motor vehicle accidents, excavation accidents, electrocution, machines, and being struck by falling objects (Ukpata, 2010).

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

2. Literature Review

Cranes are lifting devices designed to raise materials by means of rope and pulley operations and move the load horizontally and vertically within the limitations of any particular machine. The range of cranes available is very wide and therefore choice must be based on the loads to be lifted, height and horizontal distance to be covered, time period(s) of lifting operations, utilization factors and degree of mobility required. Crane types can range from a simple rope and pulley or gin wheel to a complex tower crane but most can be placed within 1 of 3 groups, namely mobile, static and tower cranes (Chudley and Greeno, 2006).

The consequences of any failure of a crane are likely to be extremely serious, with the potential for multiple fatalities. It is therefore important that mobile cranes are effectively maintained to ensure continued safe and efficient operation over time. In addition to the maintenance process, the thorough examination of mobile cranes, periodically and after exceptional circumstances is required to ensure that mobile cranes are safe to take into use and to continue in use (Philip, 2010).

The construction industry has the greatest number of deaths and accidents as compared to other occupations. In the USA, from 1992 to 2006, it was revealed that there were a total of 632 crane-related construction worker deaths. Of the total 632 crane-related deaths, 157 were caused by overhead power line electrocutions (25%), 132 deaths were associated with workers being struck by crane loads, 125 deaths involved being struck by cranes, crane booms/jibs or other crane parts (Michael, Janie and Walter, 2008).

On construction sites, crane operation is a complex undertaking that depends largely on skilled operators considering all the likely involved variables and factors affecting its safety. Safety is the opposite feeling or sense of the surrounding danger(s). It is, therefore, important to eliminate the sources of insecurity to crane users. A well designed environment is one of the key factors that contribute to users' sense of security. Safety is considered to be the most critical issue in the success of any crane operation. Crane accidents involve tragic deaths of innocent people and destruction of property. A crane as one of the most utilized equipment in construction sites can be dangerous. Statistics show that there are main hazards that occur during normal working circumstances. Most injuries and deaths from crane accidents can be attributed to several basic hazards (Zayed and Abbas, 2013).

On March 15, 2008, a crane collapsed in a densely populated area of New York City killing seven people. The tower crane became unstable and fell onto several apartment buildings (Lambeck and Eschemuller, 2009). In 2002, two tower cranes toppled from the 60th floor of a steel frame building under construction in Taipei, Taiwan, during a severe earthquake. The failures were not caused directly by the earthquake, but rather by the cranes oscillating in resonance with the building (Shapiro and Shapiro, 2011). On 30th May 2006 in Abuja, a crane collapsed during the construction of High Court Building which led to the loss of six lives. In 2012 in Benin City, a section of the Central Hospital building where construction work was still on-going collapsed. It was reported that a pail carrying materials snapped from the rope connecting it to the hook of a crane and crashed into a freshly constructed beam linking the pillars of the top of the third floor of the building, resulting in the collapse of the affected portion (Gold, 2012).

It was revealed that some of these accidents could have been prevented if project managers had reviewed and evaluated the safety requirements, rigging equipment used and had connections inspected, and operator certification for the cranes inspected. It is on this basis that this study sets out to assess crane

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

safety practices on construction sites in Abuja. To this end, answers were sought to the following research questions:

- What is the level of adherence of safety policies with regards to the use of the cranes; and
- What is the extent of the knowledge of the crane operators.

3. Methodology

Combinations of a questionnaire survey and interview methods were adopted in the study. In order to select the sample size for the questionnaire survey, a purposive sampling technique method was adopted; this is was to ensure that only active sites where cranes were used as at the time the survey was carried out. To this end, 30 sites were identified which translated to the self-administration of 30 questionnaires to the professionals' found and were in-charge of the sites (26 representing 86.7% were returned). In addition to this, 16 crane operators were interviewed.

4. Results and Discussion

4.1 Questionnaire survey findings

Figure 1 below shows the age of respondents. This indicates that 34.6% are between 20-29 years of age, 46.2% of the respondents are between 30-39 years, 11.5% represent 40-49 years and 7.7% represents above 50 years. The respondents fall within the active years and an indication with familiarity with issue under study.

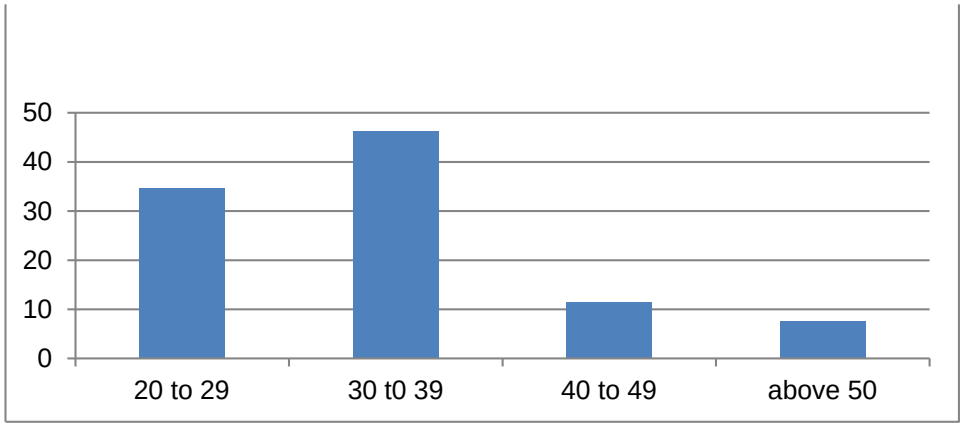

Figure 1: Age of respondents

Figure 2 indicates that 30.8% of the respondents have 1-5 years' experience, 23.3% have 6-10 years' experience, 30.7% have 11-15 years' experience, 7.6% have 16-20 years' experience, and 7.6% have more than 20 years of experience. This shows that most respondents have 1-5 years of experience. This shows that 54% of the respondents have 6-15 years of experience in the construction industry; to this end, the responses could be deemed to be reliable.

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ISBN 978-0-86970-787-6

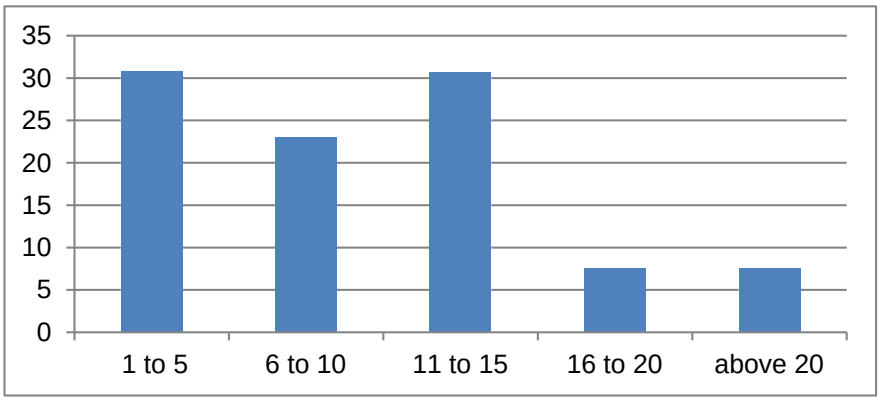

Figure 2: Years of experience in the construction industry

Figure 3 indicates that 7.7% of the respondents are architects, 30.8% are builders, 34.6% are civil engineers, 3.8% are quantity surveyors, and 23% were other. Hence they are qualified to respond to the issues raised in the paper

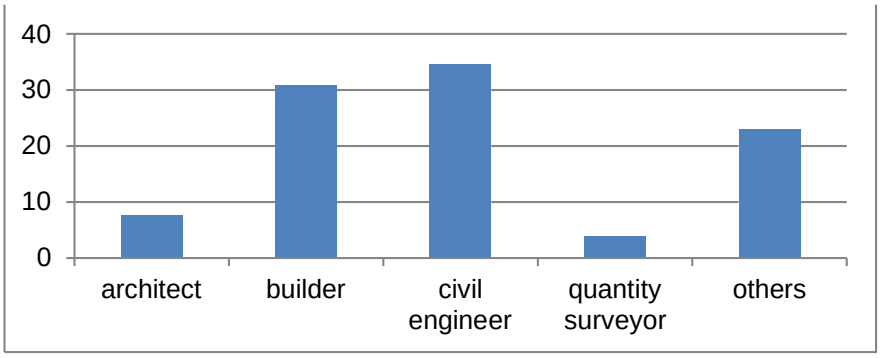

Figure 3: Respondents' discipline

From Table 1, using the best type of crane on construction sites is ranked 1st with a mean score (MS) of 4.2, watching out for electrical distribution and transmission lines which comes in second with MS of (4.15). Adequate knowledge of the operator comes third with MS of (4.00). It is followed by adequate policies and legislation regarding the operation of cranes which comes fourth with MS of (3.96); provision for maintenance of cranes which comes fifth with MS of (3.88). Provision of protection for the public by barricading accessible areas comes sixth with MS of (3.87). Crane operators participating in regular safety and health meetings comes seventh with MS of (3.84), which is followed by provision of training and orientation on health and safety issues to crane operators which comes eighth with MS of (3.76). Space available to accommodate large cranes comes ninth with MS of (3.73). The level of adherence to the policies and legislation comes tenth with MS of (3.69). Ability to apply training acquired to the work by the crane operators comes eleventh with MS of (3.60). Operators expressing their views on working procedures adopted by managers as it may affect safety come twelfth with MS of (3.57). It is followed by Inspection carried out at regular intervals which comes at thirteenth with MS of (3.50). Plant and pedestrian traffic segregation comes in at fourteenth with MS of (3.38). Adequate resources to carry out inspection for enforcement of laws come at fifteenth with MS of (3.11). Load not being moved over workers comes at sixteenth with MS of (2.80). Operator using mobile phones while operating the cranes comes at seventeenth with MS of (2.65). Operators being under influence of alcohol and drugs while operating cranes come last with MS of (2.26).

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ISBN 978-0-86970-787-6

Table 1: Level of adherence to crane safety practices

Practice	V.L 1	L 2	M 3	H 4	V.H 5	MS	RNK	RMK
Adequate policies and legislation regarding the operation of cranes	0	1	9	6	10	3.96	4th	H
The level of adherence to the policies and legislation	0	2	10	8	6	3.69	10th	H
adequate knowledge of the operator	0	2	4	12	8	4.00	3rd	H
Is the best type of crane for the work used on the project	0	0	5	11	10	4.2	1st	H
Provision of training and orientation on health and safety issues to crane operators	0	3	7	9	7	3.76	8th	H
Provision for maintenance of cranes	0	0	8	10	7	3.88	5th	H
Inspection carried out at regular intervals	0	4	10	7	5	3.50	13th	H
Provision of protection for the public by barricading accessible areas	1	3	5	6	11	3.87	6th	H
Load not being moved over workers	5	8	4	5	4	2.80	16th	M
Watching out for electrical distribution and transmission lines.	1	0	5	8	12	4.15	2nd	H
Ability to apply training acquired to the work by the crane operators	0	3	8	10	5	3.60	11th	H
Crane operators participating in regular safety and health meetings	1	1	9	5	10	3.84	7th	H
operators expressing their views on working procedures adopted by managers as it may affect safety	1	3	7	10	5	3.57	12th	H
Adequate resources to carry out inspection for enforcement of laws	0	9	8	6	3	3.11	15th	M
Space available to accommodate large cranes	0	3	6	3	8	3.73	9th	H
Plant and pedestrian traffic segregation	2	2	10	8	4	3.38	14th	M
Operators being under influence of alcohol and drugs while operating cranes	15	2	2	1	6	2.26	18th	L
Operator using mobile phones while operating the cranes	8	6	4	3	5	2.65	17th	M

VL-Very low; L-Low; M-Moderate; H-High; VH-Very high; RNK-Rank; RMK-Remark

From Table 2, it shows that 73% of the respondents stated that there is a safe means of access to all parts of the crane for maintenance. And 27% are of the opinion that there is no safe means of access.

Table 2: Safe means of access to all parts of the crane for maintenance

Response	Frequency (No)	%age (%)
Yes	19	73
No	7	27
Total	26	100

Table 3 shows that 77% agree authorities visit the site to check safety of plant while 23% do not agree and say authorities do not come to site. Though the %age may not be substantial, but operations of cranes should not be left in the hands of the contractors and clients alone as cranes accidents are known to be

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ISBN 978-0-86970-787-6

tragic. It is expected that people that are statutorily empowered to inspect the sites where cranes are used should always do so in order to ensure that proper procedures are followed. Jimoh, Ijigah and Nuah (2014) established that inspection is hampered by inadequate resources at the disposal of health and safety officers. In a related development, National Occupational Safety and Health Information Centre, Geneva in 2006 stated that the total number of factory inspectors in the Federal Capital Territory, Abuja was 1. This scenario leaves much to be desired.

Table 3: Visit of city authorities to site

Response	Frequency (No)	%age (%)
Yes	20	77
No	6	23
Total	26	100

Table 4 indicates that 96.1% of respondents post information about rated load capacities, operating speed and instructions while 3.9% do not agree. According to Beavers *et al*. (2005), the physical contributing factors leading to fatalities caused by "crane tip over" were overload, loss of centre of gravity control, outrigger failure, high winds, side pull, and improper maintenance.

Table 4: Posting of rated load capacities, operating speed and instruction

Response	Frequency (No)	%age (%)
Yes	25	96.1
No	1	3.9
Total	26	100

Table 5 indicates that 69.2% of the respondents are aware of the regulations to mounting of cranes in highly populated areas while 30.8% are not aware of the regulations. This portends serious danger as a result of the lack of awareness since many things could go wrong especially on confined sites and high populated areas.

Table 5: Awareness of regulations to mounting of cranes in highly populated areas

Response	Frequency (No)	%age (%)
Yes	18	69.2
No	8	30.8
Total	26	100

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4.2 Interview findings

Tables 6-12 are the results and discussion based on the interviews conducted with the crane operators.Table 6 indicates that 56.3% of the respondents operate tower cranes and 43.7% operate mobile cranes. This shows that most of the respondents operate tower cranes. The tower crane is a modern form of balance crane. Fixed to the ground (and sometimes attached to the sides of structures as well), tower cranes often give the best combination of height and lifting capacity and are used in the construction of tall buildings (Norman, 2008). Mobile cranes are the machines that set up the tower cranes at the onset of construction and dismantle them at the conclusion of their service on site. This is a classic demonstration of the mobile crane's main features: its capacity to be rapidly deployed and to handle heavy loads (Avid, Gunnar and Clifford, 2007).

Table 6: Type of crane used

Response	Frequency (No)	%age (%)
Tower crane	9	56.3
Mobile crane	7	43.7
Total	16	100

Table 7 shows that 93.8% of the respondents carry out daily inspection on cranes before the commencement of their daily operations, while 6.2% of the respondents do not carry out daily inspection. This is a good thing because mechanical devices such as cranes have been known to perform optimally the previous day and refuse to start the following day.

Table 7: Daily inspection of crane

Response	Frequency (No)	%age (%)
Yes	15	93.8
No	1	6.2
Total	16	100

Table 8 shows that 63% of the respondents maintained and inspected their cranes in accordance with the manufacturer's instructions while 37% do not follow them and have other ways of maintaining and inspecting cranes.

Table 8: Maintenance and inspection according to manufacturers' instructions

Response	Frequency (No)	%age (%)
Yes	10	63
No	6	37
Total	16	100

Respondents were asked how often maintenance was carried out. Table 9 presents the result. 75% stated that maintenance was carried out every 1 to 5 weeks, 12.5% indicated 6 to 10 weeks and above 15 weeks, respectively. This indicates that maintenance was mostly carried out between 1 to 5 weeks.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

Table 9: Frequency of maintenance

Response	Frequency (No)	%age (%)
1 to 5 weeks	12	75
6 to 10 weeks	2	12.5
11 to 15 weeks	0	0
Above 15 weeks	2	12.5
Total	16	100

Table 10 shows that 6.3% of the respondents confirmed that they operated cranes based on education while 93.7% stated that they operated based on experience. According to the North Carolina Department of Labour (NCDL) (2010), formal training should be provided for all crane operators, to ensure a working knowledge of crane load charts. However, on-the-job training can be adequate if the trailer is qualified.

Table 10: Operation of crane based on education or experience

Response	Frequency (No)	%age (%)
Education	1	93.7
Experience	15	6.3
Total	16	100

Respondents were asked whether they always know the weight of the load to be lifted. 100% confirmed that they do. Overloading occurs when poorly trained personnel are allowed to operate cranes. The operator must always know the weight of the load (NCDL, 2010).

Table 11: Knowledge of the weight of the load to be lifted

Response	Frequency (No)	%age (%)
Yes	16	100
No	0	0
Total	16	100

Table 12 shows that 31.3% of the respondents keep manufacturer's manual in the cab while 68.7% do not keep it. This is not a good situation as the need to refer to the manual may arise especially in an emergency situation. The consequences of this type of attitude may be dire in some cases.

Table 12: Keeping manufacturer's manual in the cab

Response	Frequency (No)	%age (%)
Yes	5	31.3
No	11	68.7
Total	16	100

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Livingstone, Zambia
ISBN 978-0-86970-787-6

5. Conclusion

The study assessed crane safety practices on construction sites in Abuja, Nigeria, by seeking answers to two research questions. It was discovered that having the best type of crane on site to perform its operations is ranked 1st meaning that at all times, stakeholders ensure that the right type of crane is used for obvious reasons, while operators being under the influence of alcohol and drugs was ranked 18th. This is an indication that operators are left at their whims and caprices to do what they like as long as their jobs are done. A substantial %age of the operators interviewed (93.7%) do not have formal education, but acquired their skills from experience.

Based on the above, it is recommended that efforts should be made to provide avenues for the operators to be trained, whether formally or informally, so as to improve their knowledge base.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-006

Assessing the influence of mentoring functions on job satisfaction and organizational commitment of construction employees: A literature review

Nkomo M. W[1], Thwala W. D[2]

Abstract

The business world has long known and relied upon mentoring as a proven technique for developing in-house talent. Previous studies proved that the implementation of mentoring programme is beneficial for enhancing employee skills and attitudes. Few researchers are devoted to exploring the impact of mentoring functions on job satisfaction and organizational commitment of new employees. This paper is aimed at examining the effects of mentoring functions on the job satisfaction and organizational commitment of new construction employees in the South African construction industry. The study is an exploratory one based on a literature review of historical data. The study indicated that career development and role modelling functions have a positive effect on the job satisfaction and organizational commitment of new employees. However, the psychosocial support function was incapable of providing adequate explanation for these work outcomes. The study recommends that construction employers should improve the career development and role modelling functions of mentoring in order to enhance the job satisfaction and organizational commitment of new employees. The study provides useful lessons for the construction industry and executives who recognize that mentoring functions are critical for sustaining future organizational performance.

Keywords: construction, employees, graduates, job satisfaction, organizational commitment

1. Introduction

Most companies have labour turnover reports that show how turnover has been trended over a period of time and this is a start. To better understand turnover of new employees, organizations will need to rely on more than an aggregate analysis. Organizations need to dissect it from a number of different vantage points.What types of employees are leaving? Losing high performers is far more damaging than average performers, and losing low performers may be seen as a good thing. What might appear to be an acceptable amount of turnover may mushroom into a significant issue if those employees that are leaving are key performers.What does turnover look like by tenure? Losing employees in their first year may suggest issues with the staffing or on-boarding process. Losing employees after 3 and 10 years

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

may indicate a compensation or career development issue. Losing employees after ten years may represent a leadership issue.

With the high turnover incidence among new employees, it is imperative that retention strategies be effective and that these strategies be examined closely. When new employees perform their duties in organizations, they often have little or no experience in the work that they are doing on construction sites, but they are required tobearfull responsibility. Owing to limited experience, and full responsibility, new employees would often bear heavy work pressure. Work pressure and new employee attitudes toward jobs have significant impact on job satisfaction and organizational commitment among new construction employees. Researches from various countries have confirmed that job satisfaction and organizational commitment are statistically significant predictors of employee absenteeism or turnover, or their intent to quit (Lee et al., 2009). Thus, in order to reduce the new employee' intent to leave, site managers should urgently address the issue of improving the job satisfaction and organizational commitment of new employees.

Mentoring relationships and formal mentoring programs have received accumulative attention in Human Resource Development (HRD) and related literature over the past several years. Studies examining mentoring involvement have showed that up to two-thirds of employees have engaged in some type of mentoring relationship and that mentoring functions may be especially beneficial for employees because of the greater barriers they often face on construction sites. Participation in formal mentoring programs has a variety of benefits for participants (Wanberg et al., 2003). Two of the most emphasized developmental benefits have been psychosocial and career advancement (Kram, 1985). In spite of increasing activity, few empirical studies have been performed examining outcomes of formal mentoring programs (Wanberg et al., 2003).

1.1 Purpose of the study

The purpose of this study is to contribute to a broader understanding of mentoring, mentoring functions and their influence on job satisfaction and organizational commitment on new construction employees.A significant %age of the workforce, within the construction sector is nearing retirement age over the next ten years where and sources. These employees have acquired a tremendous amount of knowledge about how things work, how to get things done and who to go to when problems arise. Losing their expertise and experience could significantly reduce efficiency, resulting in costly mistakes, unexpected quality problems, or significant disruptions in services and or performance source. In addition, faster turnover among younger employees and more competitive recruiting and compensation packages add significantly to the mounting concern about the organization's ability to sustain acceptable levels of performance.The relationship between mentoring and HRD can be found in the functions of mentoring and how they link to the three realms of HRD. From an organization development standpoint, mentoring can serve as a function of planned change used to improve new employee effectiveness in an organization. Mentoring can serve as a form of on-the-job training to develop key capabilities enhancing employees' abilities to perform their job functions, the defining component of training and development. In terms of career development, mentoring can be used as a strategy permitting employees to shape and perform their work to better achieve their professional goal. This study will meaningfully contributes by sharing the wisdom and knowledge of transition to retirement employees to ensure corporate knowledge does not simply walk out the door, sharing the collective wisdom and knowledge of the build environment business.

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1.2 Objectives of the study

- To examine the effects of mentoring functions on the job satisfaction and organizational commitment;
- To identify the benefits of mentoring; and
- To identify the impact of mentoring on retention of employees within organizations.

1.3 Research Methodology

The study was mainly a literature review, qualitative with a special focus on the effects of mentoring functions on the job satisfaction and organizational commitment on new construction employees within organizations. The data used in the report was mainly qualitative, based on the historical data.

2. What is Mentoring?

Mentoring can be defined as a developmental and supportive relationship between a senior, more experienced employee and a junior, less experienced employee (Kram, 1985). Mentoring has been associated with salary increase and promotion, higher job satisfaction and self-respect (Allen et al., 2004), and higher organizational commitment (Donaldson et al., 2000). Mentoring from previous studies has highlighted a positive relationship between career mentoring and all dimensions in job satisfaction such as employees, job itself, promotion and supervisors providing a way to retain employees and improve their efficiency. Reinforce mentoring power in order and guideline for the managers on ways to improve employees' job satisfaction for positive outcomes (Underhill, 2006).

Hansford, Ehrich & Tennent (2003) established that most organizations have moved towards institutionalizing mentoring not only because of the apparent benefits to those involved, but also as an affirmative action strategy intended to ensure that the previouslydisadvantaged groups in society have access to the mentoring process. Therefore, mentoring can be viewed as human resource intervention aimed at the socializing of new employees, while at the same time permitting senior employees to pass on their accumulated wisdom within an organizational setting.

Human resource management meets the discouraging tasks of employing needed employees into the organizations to match the organization's requirements and anticipations. As a result, there isa formal need to create suitable ideas, develop appropriate strategies to enhance the collaborations between supervisors and new employees, and to complete a broad insight that can support managers of human resource, increase results and enhanced performance. According to Knippenberg &Steensma (2003) suggested that the expectation of a future interaction between the supervisors and juniors would decrease the usage of hard boldness tactics as this may jeopardize the relationship and make it less attractive. Research has evidenced the impact of mentoring in professional and personal development of young employees in the organizations. Existing research has shown that mentoring is one of the best ways in organizational learning and has proved positive results with support and job satisfaction (Simmonds & Zammit Lupi, 2010). It was noted that protégé's that received mentoring support were able to exhibit better job performance and career development and decrease turnover intention among the employees in the organization mentorship .

Proenca & Shewchuck (1997) show that learning and career development opportunities are two important factors that would influence the retention of new employees. Mentors play a dynamic role in providing

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ISBN 978-0-86970-787-6

these opportunities. Furthermore, mentors can facilitate professional socialization of the new employees, entering the workplace, in the organization; facilitate their transition into the workplace and social culture of the organization; and make them feel welcome in peer groups, with co-workers and the organization . In addition, mentoring can promote the transfer of knowledgeand values that support a construction industry mission. Therefore, a mentoring program is seen as a useful method in improving the retention of new employees.

Mentoring programs in organizations can be helpful in improving performance and transferring knowledge, and lead to higher job satisfaction and retention of employees, resulting in higher business productivity.In addition to that, companies that have proper mentoring programs in place are capable to attract job seekers and retain good employees (Allen & O'Brien, 2006). The rapport between supervisors and subordinates could be strengthened through mentoring. Researchers in the past have evidenced that committed protégé demonstrated high job satisfaction and hence unlikely to look for other jobs (Iverson & Buttigieg, 1999).The use of mentoring relationships aimed at new employee development is rapidly increasing in organizations. Some benefits of mentoring relationships include career mobility and advancement, career satisfaction (Chao et al., 1992), career commitment, and career advancement (Scandura et al., 1996), more promotions and higher compensation and higher retention (Viator & Scandura, 1991). Although beneficial to personal and professional development, only a portion of the current literature examines mentoring relationships that are situated at work or in job related contexts. It is necessary to better understand how to utilize mentoring in order to enhance the growth of individuals in organizations.

2.1 Performance of the South African construction industry

Poor capacity, poor quality, low productivity and low profit margins continue to characterize the majority of South African construction firms. These shortcomings are attributable to poor cultural practices that are often associated with construction firms. Inan effort to devise strategies intended to improve the performance of South AfricanConstruction firms,the study found that there is generally a positive relationship that exists between thecorporate culture and performance of South African construction firms. The degree orintensity of the relationship is largely dependent on the size of the organization. Smalland medium sized construction firms demonstrated greater appreciation of the positiverelationship between corporate culture and business performance (Sidumedi, 2009).

Although South Africa is renowned for its infrastructure especially when compared to other African countries, underinvestment on infrastructure over the past 20 to 30 yearshas led to the considerable deterioration of the older infrastructure base (Bogetic et al.,2005). An ailing power supply, chronic shortages of housing, schools, hospitals and other social facilities, and bulking road networks serve as a constant reminder of theimmense obstacles the country has to overcome.In contrast, the construction industries of other developing nations such as India contributed approximately 8.5% to the total of India's GDP in the 2008 financial year. The industry's performance has been consistent since 2006 and has fuelled the creation of 33 million jobs (Indo Italian Chamber, 2008).

Construction firms, being project based organizations are facedwith major challenges when it comes to employee motivation as employees are usuallyfaced with additional challenges, such as peaking workloads, making it difficult to achieve a work life balance; uncertainty about future assignments, including the nature of assignment, location and work colleagues; and matching assignments to career development objectives (Turner et al., 2008).

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2.2 Mentoring functions at the workplace

Scandura (1993) did broad research on mentoring at the work environment and found that mentoring has proved that mentors provide certain functions to protégés, namely, vocational support, psychosocial support and role modelling.

Vocational support activates the protégé as an dependent, successful professional. The mentor achieves this by providingjob-related functions, such as career functions to the mentee. *Psychological* support functions are more personal trusting on an emotional bond between the mentor and protégé (Wanberg et al., 2006). *Career functions* include sponsorship, exposureandvisibility, coaching, protection and challenging assignments. Sponsorship is where the mentor uses his or her influences to support the mentee's career advancement. In the work place, the mentee, new employee is publicly supported by his or her mentor and actively selected for promotions. The coaching functions include the mentor teaching the ropes to the mentees, for example how work is done in a construction site. The mentor gives the relevant and positive feedback, which is intended at improving the mentee's performance and potential. In the protection functions, the mentor purposes to provide the mentee with support in different situations. The mentor will yield full responsibility for the mistakes made outside the control of the mentee. The exposure functions are when the mentors construct opportunities for the mentees to validate their capabilities where it counts. The mentor improves the visibility of his or her mentees by taking them to important meetings and events, which permits the mentees to develop relationships with key personnel in the organization, permitting them to show their potential for future organizational progress. Challenging work is where the mentor will give the assignments that spring the mentee's knowledge and skills in an attempt to encourage growth and develop specific capabilities in preparation for the future Burgess and Dyer (2009).

Psychological support functions improve the protégé's sense of competence, identity and effectiveness in his or her role, within the organization. Examples of psychosocial functions include *role-modelling, acceptance and confirmation, counseling, and friendship. Rolemodelling* consists of the mentor indicating appropriate behaviour and knowledge, hence earning greater respect and admiration (Lankau et al., 2005). According to Burgess and Dyer (2009), the mentor exhibits valued behaviour, attitudes and skills that help the mentee in achieving capability, confidence and a professional identity. The mentor's standards, attitudes and behaviours provide an example for the mentee, who in turn recognizes with the mentor's desirable example and in turn respects and appreciates his or her mentor. In terms of the organizational context, the mentor leads by example. The counseling functions afford helpful and confident forums for exploring professional and personal dilemmas. The mentor's advice their mentees, allowing them to talk openly about fears and concerns and to explore personal concerns that may inhibit or lessen productivity at work, where they are assigned. Acceptance and confirmation is where the mentor offers ongoing support, respect, and admiration, which permit the mentee to experiment with the new behaviour and self-differentiation. Friendship is where the mentor befriends the mentee through social communications, which will result in mutual caring and intimacy well further than the requirements of their daily work tasks.

2.2.1 Effects of mentoring functions on the job satisfaction and organizational commitment.

Organizational commitment

Organizational commitment has attracted significant attention in theory and research because of its

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attempt to understand the strength and stability of employee commitment to work organizations (Eisenberger et al., 1990). The variety of definitions for organizational commitment with all its different processes shares a mutual notion that organizational commitment is a connection of the individual employeeto his or her organization. According to Meyer & Herscovitch (2001), it is "the force that binds an individual to a course of action of significance to one or more targets". An employee's commitment is a concern to all organizations because it has been linked to reduced turnover (Mathieu and Zajac, 1990), improved knowledge sharing, better organizational citizenship behaviors (Meyer et al., 2002), higher acceptance of organizational change (Iverson and Buttigieg, 1999), ethical behaviour (Wahn, 1993) and condensed absenteeism. Usually, higher or lower levels of commitment have been exposed to be a major driver of employees staying with or leaving an organization.

People are more likely to leave their organization as the age and occupation of employees increase (Hunt et al., 1985). Further, Mathieu & Zajac (1990) expressed that those employees with higher levels of education display less commitment to their organization. In addition, job position, marital status, and length of service also clearly influence employee commitment. The degree of employee commitment has been linked with the extent to which certain employee needs have been gratified by the organization.

Job Satisfaction

Junior employees in the current trend have been given substantial independence to establish their goals and assess outcome, the role that is traditionally held by supervisors. In fact,manycompanies have reinvented themselves in becoming more capable and retiring from the predictable corporate system by giving greater decision making to the lower level of the management. Thesenew tendencies in the workenvironmentunderline the implication of creating and increasing followers' roles in organizational leadership.These tendencies also developed the new concept of leaders' openness to the idea allocating power to their junior employees. Phillips (2003) discoursedthat when a minority opinion is documented to a member from the outside of the group, this opinion could have an impact on the majority group. Practical evidence had revealed that value communication is a strong agent of job satisfaction and organizational commitment among executives at the junior level (Chatman, 1991). Job satisfaction denotes to the feelings of positive emotional as a result of the job experiences that the employees faced, within an organization. Previous studies have evidenced that there are several important causes of job satisfaction such as the reward systems in the organization, the distribution of power, individual differences, self-confidence and locus of control (Lankau &Scandura, 2002). It was also distinguished that other aspect of job personalities such as salary, promotion opportunity, clearness of the assigned task, the use of skills are also considerably contributing to employees' job satisfaction in an organization.Previous researches have revealed that junior employees would more oftencarry out favours that the managers appreciate and they would prefer to maintain a positive and balanced relationship with their supervisors (Wayne & Liden, 1994). Henceforth, proper mentoring system should be in place to ensure employees' job satisfaction.

Causes of job satisfaction

Smith, Kendall & Hulin (1969) directed extensive research on the causes of job satisfaction. They found that there are five major measurements to thisattitude that reflect affective responses to particular aspects of a job. These include:

Work itself: The extent to which the job offers the individual with stimulating tasks, opportunities for

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learning and personal growth, and the chances to be responsible and responsible for the results.

Remuneration: According toPhillips & Connell (2003) explain remuneration as the wages, salaries, orcompensation given to employees in exchange for the services the employees do for the organization. Job dissatisfaction can occur when there is too great a disproportion between what employees think they should be paid and what organizations spend on compensation.

Opportunities for promotion: According to Porter&Steers (1973) directed that the lack of promotional opportunities is a primary reason for pulling out from the job. Though Rollison *et al.* (1998) established that promotion is not desired by everybody and so satisfaction in this respect is very strongly influenced by the match between expectation and receipts, the authors emphasize that promotion brings an increase in remuneration, and for some people this is the major satisfaction compulsory, while for others it is more linked with self-image and individuality.

Supervision: The capability of the supervisor to provide emotional and technical support and guidance to work-related tasks.

Relationships with co-workers: Phillips & Connell (2003) established that teamwork is created with the purpose and understanding that productivity and effectiveness progress as a result of processing work within organized groups of employees. Satisfaction in this regard replicates the extent to which members of an individual's workgroup are perceived to be socially supportive and capable in their own tasks.

2.3 Benefits of mentoring

Mentoring saves money, retains workers, builds leadership, and growth talent. It contributes to employee growth and tenure. In the long run, a well-organized and managed program can save the company thousands of rand. Allen, Eby, Poteet, Lentz & Lima (2004) indicated that there is considerable realistic evidence to suggest that mentoring through initiation and socialization has a number of positive effects on protégés' performance. In the recent meta-analysis, they established that the mentoring functions are positively associated with compensation, number of promotions, career satisfaction, expectation for advancement, career commitment, high level of job satisfaction and low turnover intent (Allen *et al 2004*). The following were identified as benefits of mentoring:

- *Reduced turnover and recruiting costs***.** Mentoring relationships can help retain talented people because they have a stronger commitment to the organization (Jacka & Quin, 2010). Talent remains much less likely to leave if they feel supported in their work and made aware, for example, of new opportunities that their mentor suggests. It's not unusual for organizations to hear that their strong mentoring program attracted new talent.

- *Assistance in transferring knowledge from the retiring workforce to new workers***.** Many mentoring relationships help younger employees learn from those who will retire soon. Pairingjunior staff with more senior staff can reinvigorate the enthusiasm of senior employees as they transfer crucial knowledge to the next generation of workers. This reduces the loss of the tacitknowledge from seasoned veterans leaving the workforce.

- *Helping employees learn skills and gain knowledge***.** Mentoring is an excellent exampleof informal learning, which is the way people learn 80% of the time in the business world (Schooley

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et al, 2010). A mentoring program reduces training costs due to the mentor/mentee informal learning relationship, which often deals with content one-on-one that otherwise would be covered ina formal course. It also brings new employees up to speed quickly in those first few months of employment. The chief learning and development officer in a global consulting firm confirms the value of mentoring as a learning tool: "People grow more with human interaction on the job, and we are trying to bring that to all our employees. The best way to learn is from a fellow professional."

- *Assistance in career growth, building leadership capacity, and increasing bench strength.*Employees can put their learning on a fast track with mentoring. If they're headed toward management, for example, the mentoring may focus on becoming a better leader and manager. When the mentor shares her own experiences, gives advice, and suggests readings, online courses, or other experiences to help other employees move toward their goals, she builds her own leadership skills in the process. Enhanced bench strength in company leadership ensures successful succession planning and increases productivity.

- *Increasing knowledge and insights about other employees.* Mentoring allows mentors to work with employees of different ages, backgrounds, values, styles of working, and professional expertise. This relationship breaks down barriers and informs mentees about other areas of the business. Mentors increase their employee network at different levels and know more about what's going on in the organization (Schooley et al, 2010).

2.4 Impact of mentoring on retention of employees

As an outcome of mentoring relationships in workplace settings, retention is of interest in this study because of its importance to organizational performance. For decades, management researchers have emphasized the importance of retaining talentedemployees through research on turnover. If organizations invest in talented employees through increases in their knowledge, the knowledge transferred to these employees is lost if they leave the organization.

Organizations face significant challenges in retaining valued employees because of the changes in the employment relationship that promote greater job mobility. Traditional research has focused on the influence of job satisfaction on voluntary turnover (Mitchell et al., 2001). While recognizing that there will always be some voluntary turnover in an organization, retention rates should be somewhat high so that experienced workers are available to share their organizational knowledge with newcomers in the organization and to use their expertise to directly benefit their organization. Again, while the implication of such research is that workers dissatisfied with their jobs will leave and those satisfied with their jobs will remain, researchers suggest that this view is too simplistic and narrow inexplaining what influences turnover and retention (Mitchell et al., 2001). To develop alternative theoretical understandings of voluntary turnover and retention, researchers have expanded upon the initial research to explore other constructs. Recognizing that "… less turnover research has focused specifically on how an employeedecides to remain with an organization and what determines this attachment" (Mitchell et al., 2001), researchers are beginning to recognize the importance of relationships in retaining workers (Mitchell et al., 2001).

Mentoring is a type of workplace relationship that may assist in promoting the retention of knowledge

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and talented knowledgable workers. Protégés who reported receiving mentoring were more likely to indicate that they did not have plans to leave their organization to go and work in another organization. Increases in knowledge in today's dynamic workplace require organizations to focus on the retention of talented and potential employees. Knowledgeable workers are increasingly more important for organizational competitiveness today, so the knowledge transfer between employees and the retention of key employees is critically important. Organizations that have not been concerned with retentionin the past, may struggle to keep their skilled employees. In professions heavily dependent upon knowledge transfer such as medicine, engineering, and chemicals manufacturing, the pool of skilled workers is shrinking; thus, there is increased competition for available workers. Organizations with higher levels of mentoring had lower turnover; moreover, they suggested that the mentoring specifically assisted in developing protégés' knowledge and skills. Based on the above research, one may posit that the knowledge and feedback provided to a protégé by a mentor may influence the protégé's turnover intentions. Yet these studies have not investigated the potentially negative effects of mentoring on retention because of knowledge transfer.

3. Conclusion

Understanding the impact of mentoring functions on organizational commitment and job satisfaction permits organizations to make available better formal mentoring experiences to employees. Further important in the formal mentoring programmes are individuals who are chosen as mentors to signify the organization. The results of this study suggest that the organizations should be careful about who they allow or encourage to be a mentor, as having a negative relationship will poorly disturb the organization. Though it was expected that a supportive mentoring function would positively affect the employee's organizational turnover intentions through job satisfaction and organization commitment, the study reveals that the role-modelling mentoring support function has a major impact on job satisfaction and organizational commitment.

The study recommends that stakeholders and human resource managers in the construction industry should improve the career development and role modelling functions of mentoring in order to enhance the job satisfaction, organizational commitment of new employees.The early success of the initiatives described provides useful lessons for the construction industry and executives who recognize that mentoring functions on job satisfaction and organizational commitment are critical for sustaining future organizational performance. Retaining organizational knowledge in the face of changing workforce demographics is a complex challenge that requires simultaneously confronting the problems created by an aging workforce, a shrinking talent pool and increasingly restless employees. Attention must also be given to understanding the mentoring behaviours that foster a protégé's affective commitment and job satisfaction so as to mitigate the potentially negative effect of knowledge transfer on retention.The provision of mentoring functions to protégés in an organization may assist an organization in meeting two critical goals for ongoing effectiveness: knowledge sharing and retention.

The researcher expects that knowledge transfer will mediate the effect of mentoring on organizational retention. The type of knowledge transfer to protégés may influence their intentions to remain within an organization. If a mentor transfers knowledge that is specific to the organization (i.e., organizational practices and relationships), then the protégé will be more likely to remain with the organization because the knowledge cannot be applied elsewhere. Based on the above, the researcher proposes that knowledge transfer will mediate the relationship between mentoring and protégés' intentions to remain with their

organization.

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ISBN 978-0-86970-787-6

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-008

Construction Camps in Building and Civil Engineering Construction

John Smallwood[1], Claire Deacon[2]

Abstract

The establishment of construction camps needs to be addressed by contractors working outside of urban areas or in areas that are not readily accessible on a daily basis. The establishment of construction camps is subject to legislation and international recommendations. However, construction camps, medical assistance and facilities, *inter alia*, living, sleeping, ablutions, cooking, washing and recreational, impact on labour relations, health, the environment, productivity and the achievement of quality. Given the aforementioned, the establishment of construction camps should form an integral part of any health and safety (H&S) programme, and be addressed in H&S specifications and H&S plans where applicable. South African literature pertaining to construction camp practices is perfunctory. To this end, a descriptive survey was conducted among building and civil engineering contractors undertaking projects for the Eastern Cape Department of Roads and Public Works (ECDRPW). Findings include, *inter alia*: contractors provide spartan accommodation and sleeping facilities, rudimentary ablutions, minimal cooking and washing facilities; recreational facilities are marginal, and first aid constitutes medical assistance. Conclusions include, *inter alia*: the conditions in construction camps could be enhanced and such conditions impact on workers' health and wellbeing, the environment, productivity, and the achievement of quality. Recommendations include: legislation pertaining to construction camps should be reviewed; and better practice guidelines should be evolved for construction camps.

Keywords: camps, construction, facilities, health, labour relations

1. Introduction

The establishment of construction camps is subject to legislation and international recommendations. However, construction camps, medical assistance and facilities, *inter alia*, living, sleeping, ablutions, cooking, washing and recreational, impact on labour relations, health, the environment, all affect productivity and the achievement of quality. Given the aforementioned, the establishment of construction camps should form an integral part of any health and safety (H&S) programme. Studies

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

indicate that up to 30% of workers across construction organisations would be transient in nature and require rental and temporary accommodation (Chang-Richards *et al.*, 2014).

Construction work is tough, dirty and hazardous and involves high levels of manual and / or physical activity. Therefore, good welfare facilities not only improve workers' welfare, but enhance efficiency (ILO, 1995; Muiruri and Mulinge, 2014).

Transient construction sites are where work is of short duration (up to a week) or completed over a number of locations. Work of longer duration may include working over continuous geographical areas, where major road works, cable laying contracts are examples cited by the Health and Safety Executive (HSE), 2011).

2. Literature Survey

South African literature pertaining to construction camp practices is perfunctory. As such, the literature was mostly sourced from international standards, guidelines, articles, and case studies. Construction occurs in mining and general industries within their general maintenance activities, so the literature is not only confined to infrastructure development.

2.1 The effect of camps on communities and construction workers

The Western Australia development boom over the past few years led to under-developed communities being overwhelmed with a new population that would arrive with new ventures. With such development come social and economic stresses. Local resources become stretched and result in local authorities being unable to meet such demands in terms of infrastructure, transportation, and even basic supplies. While this has advantages for the local community it could lead to shortages relative to accommodation, and workers having to walk distances to shops and for basic supplies not available where the site camps have been located (Mathiesen, 2003, McKenzie, 2015).

2.2 Accommodation

The Queensland Government in Australia provided temporary accommodation for the construction workers who where brought into the Innisfail region following the devastation caused by Cyclone Larry in 2006. While this case is one of a disaster, the accommodation requirements are similar to that in South Africa, as often construction projects become fast tracked and temporary accommodation becomes an urgent requirement. Surplus government transportable accommodation was sourced in this case, upgraded, relocated and established in hotel and caravan park grounds over a number of suburbs and towns. Local residents and tradespeople also provided rooms. Fixed structures were the first choice due to existing infrastructure.

A Danish study indicated that camps created by the developers in remote areas around the construction site and lacked shops and welfare facilities. Workers could use their own caravans, ablutions were shared and conditions were noted as poor. Communal areas were available, with a privately run canteen and a bar run by the occupants (Mathiesen, 2003).

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

2.3 Long distance work commuting: fly-in fly-out

Western Australia has experienced heightened economic activity over the past few decades, resulting in a reduced unemployment rate and a high demand for labour. The results of the activity created the fly-in fly-out (FIFO) positions. The FIFO practice developed in the Gulf of Mexico, in the off-shore oil sector, and has since become pervasive across the mining world. The FIFO work-style that defined as "encompassing all those who travel to work, stay a pre-determined number of days ('roster') then return to a home location for a set break time" (McKenzie, 2010). Mathieson (2003) indicated that Danish workers had the option of staying on site, or commuting. The decision to stay on site is most often incentive related, and calculated accordingly. Nordic countries are further noted as having particular Regulations relative to travel allowances based on distance travelled, with Norway being most regulated.

2.4 Health issues, stress and working away from home

Increased stress related to working away from home has a number of possibly negative outcomes. Construction workers tend to work longer hours, drink more, do not exercise and eat badly. Loneliness is made worse where married employees are forced into a single-person status that could stretch for years (Pearson and Broughton, 2015).

Mathieson (2003) reports that those in camps regard time off on-site as being still at work. Life on site covers three distinct areas, namely work, time off on-site (at the camp), and time off at home. The time between workdays is required for recuperation for the next day's work. Workers in camp describe a typical workday as work, meals, some television, time with fellow campers, and sleep. Washing, shopping, and contacting family are additional activities.

A number of studies regarding suicide among construction workers in the United Kingdom (UK) indicate that, while not unique to the UK, is reported as being due in part to the peripatetic nature of the workforce. Many construction workers are expected to work away from family and friends for weeks on end, often alone (Pearson and Broughton, 2015). All levels of construction workers are affected. Pearson and Broughton (2015) cite Mel Pritchard, a production leader for Mace, on the Heathrow Terminal 1 project, who has lived and worked abroad, who stated "If you are on your own, it can be a miserable existence."Mathieson (2003) states that camp life is a lifestyle difficult to tackle, and the ability to withstand boredom, and resisting the temptation to have 'the bottle and get to bed on time'.

Higher levels of morbidity rates were noted where workers were on site, with the cardiovascular and digestive disorders prevalent from lack of rest, and respiratory and locomotor systems affected by general stress. Accident rates were also noted as higher risk among those living in camps (Mathieson, 2003).

2.5 Cultural issues

Cultural issues when working in different countries have an impact, for example those working in the Middle East work a six-day week, and according to Mel Pritchard, many do not make it and leave (Pearson and Broughton, 2015). McKenzie (2010) reports that many companies in the Western Australian mining sector are cognizant of the ripple effects of family breakdown caused by the FIFO form of work. As such employers provide wellness programmes, including counseling services to the employee and family. In stark contrast, in developing countries problems of low literacy resulting in

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

poor communication, unregulated construction practices, extreme weather, and a general poor culture does not promote overall health and safety (H&S) standards (Muiruri and Mulinge, 2014).

2.6 International standards for accommodation

The International Labour Organization (ILO) (1992) states that suitable living accommodation should be made available for construction workers where work is undertaken in remote areas. Remote sites are noted as where adequate transportation between home and work is not available. The ILO note that genders should have separate facilities, such as sanitary, washing and sleeping facilities. Shelters, furthermore, should be as far as practicable provide washing, eating facilities, and the storage of clothing where not available close by.

The ILO helpdesk has published a guideline as to how workers should be housed, and what could be taken into account. Minimum specifications and levels are provided. Workers housing should ensure that workers' are not affected by air pollution, surface run-off, sewage, or other waste. Provision of rest and recreation rooms, even health facilities should be available if not in the local community. Sleeping quarters should be between 7.5m^2 and 14.5m^2 where up to 4 persons share. Shifts should be separated so that workers are not disturbed. Aspects such as vermin, fire protection, emergency exits and planning, and regular inspections to ensure decent condition and that the premises are in a good state of repair (ILO, 1996).

2.7 The South African legislative framework

The South African Constitution, as the over arching legislation enshrines a number of rights that could be linked to the rights of workers in the context of this paper. Section 24 states: "Everyone has a right to an environment that is not harmful to their health", and Section 27 (2) states that "Everyone has the right to have access to sufficient food and water." (Republic of South Africa (RSA), 1996).

The Occupational Health and Safety Act (OHSA) No. 85 of 1993 requires employers to comply with the rights as stated in the Constitution, as they relate to employees. Employers have a further responsibility as it relates to those directly affected by activities and also are expected to ensure that all equipment, substances, or designed for use is safe and without risk to health (RSA, 1993). While these duties apply to the working environment, in many cases accommodation could be adjacent, within or close to the construction works. Thus the line between being separated from the work place, and 'off-duty' could be deemed blurry at best.

Should a worker be injured from activities, equipment or substances on site, there is a strong likelihood of the Compensation Commissioner accepting a claim in terms of the Compensation for Occupational Injuries and Diseases Act (COIDA). Where a contractor provides transportation to and from site, the worker is deemed to be on site should there be an accident. South African media often reports high numbers of road traffic accidents among construction workers being transported on the back of light delivery vehicles, flat-bed or tip trucks, and motor vehicle accidents in the course of employment contribute approximately 40% of fatalities in construction. The result of excessive COIDA claims for such losses could result in the loading of COIDA premiums (RSA, 1993(b)).

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

Smallwood and Wheeler (1998), state that the Facilities Regulations require a range of basic supplies for ablutions, that include soap, toilets, towels, showers with hot and cold water. Potable water, separate dining facilities and adequate tables and chairs should be available.

Regulation 30(2) 'Construction Employees' Facilities' of the Construction Regulations (RSA, 2014) states that "A contractor must provide reasonable and suitable living accommodation for the workers at construction sites who are far removed from their homes and where adequate transportation between the site and their homes, or other suitable living accommodation, is not available." In theory and in practice, this aspect should be addressed in the H&S specification and H&S plan, which in turn requires that the client must ensure that there is adequate resourcing for this aspect when it is identified.

2.7.1 South African literature

Only one previous study could be identified, conducted by Smallwood and Wheeler (1998). The study indicated that sleeping facilities were provided, and showers, wash hand basins and toilets available. Hand towels were not available and minimal availability of soap. Generally cooking facilities were available. Wash troughs were available for washing personal items and in almost 50% of cases, television and other forms of recreational facilities were provided. The provision of first aid facilities with access to a Doctor and hospital was apparent.

3. Research Findings

A descriptive survey was conducted among a convenience sample of building and civil and engineering contractors who are currently undertaking projects for the ECDRPW. The questionnaires were disseminated by a Manager of the ECDRPW in the Alfred Nzo District, by Construction H&S Agents (CHSAs) also working in the area, as well as the ECDRPW Construction H&S Manager for the province. The total number of contractors working in the district is unknown, despite requesting the information from the Managers and CHSAs who distributed the questionnaires. The purpose of the study was to determine mainstream construction camp practices. The ECDRPW master H&S Specification used to guide construction H&S Agents and Designers, makes reference to the care of workers on site (Welfare), in that 'adequate toilets, clean, safe drinking water and decent shelter will be afforded workers at all times'. No further reference is made to actual accommodation standards or requirements.

A total of 22 responses were received and included in the analysis of the data. The mean age of respondents was 42.4 years, and 90.9% male, and 9.1% female. The mean period worked in the construction sector was 17.4 years, and for current employer was 14.4 years. The respondents recorded a diverse range in terms of their level of education – thirteen in total. The highest %age was 18.2% relative to each of Grade 9 and Grade 12.

27.3% respondents indicated they are building contractors and 72.7%, civil engineering contractors. A total of 68.4% respondents indicated they use construction camps, and 10.5% provide such camps.

Table 1 indicates the mean number of people staying in construction camps. It is clear that in most cases middle and site management are not accommodated on site, however supervisors and skilled, semi-skilled and general workers are.

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Table 1: The mean number of people staying in construction camps on site

Category	**Mean No.**
Management:	
Middle	0.37
Site	0.95
Supervision	3.68
Workers:	
Skilled	5.95
Semi-skilled	6.84
General	10.11

Table 2 indicates the extent to which management, supervision, and workers are accommodated on site. Only general workers (mean score (MS) = 3.18) can be deemed to be accommodated frequently on site as the MS > 3.00. However, semi-skilled and skilled workers have MSs marginally below 3.00, namely 2.95 and 2.86 respectively.

Table 2: Extent to which management, supervision, and workers are accommodated on site

Category	**Response (%)**						**MS**
	Unsure	Never	Rarely	Some-times	Often	Always	
Management:							
Middle	0.0	89.5	5.3	5.3	0.0	0.0	1.16
Site	0.0	61.1	0.0	33.3	5.6	0.0	1.83
Supervision	0.0	38.1	28.6	33.3	0.0	0.0	1.95
Workers:							
Skilled	4.5	31.8	22.7	0.0	9.1	31.8	2.86
Semi-skilled	0.0	31.8	22.7	0.0	9.1	36.4	2.95
General	0.0	31.8	0.0	22.7	9.1	36.4	3.18

A total of 33.3% of respondents indicated that fenced-off compounds were ‘always’ provided for the construction camps, 4.8% ‘often’, 52.4% ‘sometimes’, 4.8% rarely, and 4.8% ‘never’. The resultant MS of 3.57 indicates that the practice is between sometimes to often / often.

Table3 indicates the type of living quarters provided in the construction camps. Park homes and tents predominate with MSs of 2.67, and given that the MSs > 2.60 ≤ 3.40, the provision is between rarely to sometimes / sometimes. MSs > 1.80 ≤ 2.60 indicate the frequency is between never to rarely / rarely (pre-fabs), and MSs ≥ 1.00 ≤ 1.80 indicate the frequency is between never to rarely (converted containers and caravans).

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Table 3: Types of living quarters provided in the construction camps

Category	Response (%)						MS	Rank
	Unsure	Never	Rarely	Some times	Often	Always		
Park homes	0.0	33.3	4.8	38.1	9.5	14.3	2.67	1
Tents	0.0	19.0	38.1	19.0	4.8	19.0	2.67	2
Pre-fabs	0.0	42.9	4.8	42.9	4.8	4.8	2.24	3
Converted containers	0.0	57.1	28.6	9.5	4.8	0.0	1.62	4
Caravans	0.0	76.2	0.0	23.8	0.0	0.0	1.48	5

The facilities provided by the contractors in the construction camps can best be described as limited (Table 4). Not a single MS is > 3.00, which indicates that the provision of the facilities is infrequent as opposed to frequent. A mean MS was computed for the six categories of facilities: sleeping (1.54); ablutions (1.78); cooking (1.50); washing (1.09); recreational (1.17), and medical aid (1.21).

The highest MS relative to each of the six categories is: sleeping - bed (2.18); ablutions – toilets (2.82); cooking – stove (1.77); washing – outsourced (1.18); recreational – radio (1.50), and medical aid – first aid room (1.50).

Table 4: Types of facilities provided in the construction camps

Category	Unsure	Never	Rarely	Some-times	Often	Always	MS	Rank
Sleeping facilities:								
Bed	0.0	59.1	4.5	13.6	4.5	18.2	2.18	1
Bed linen	0.0	68.2	4.5	13.6	0.0	13.6	1.86	2
Fans	0.0	63.6	0.0	31.8	0.0	4.5	1.82	3
Pillow(s)	0.0	77.3	4.5	4.5	0.0	13.6	1.68	4
Mosquito nets	0.0	81.8	0.0	13.6	0.0	4.5	1.45	5
Bunk	0.0	81.8	4.5	4.5	4.5	4.5	1.45	6
Heaters	0.0	90.9	4.5	0.0	0.0	4.5	1.23	7
Stretcher	0.0	95.5	0.0	0.0	0.0	4.5	1.18	8
Sleeping bag	0.0	95.5	4.5	0.0	0.0	0.0	1.05	9
Mean							1.54	
Ablutions:								
Toilets	0.0	40.9	9.1	9.1	9.1	31.8	2.82	1
Showers	0.0	72.7	0.0	4.5	0.0	22.7	2.00	2
Soap	0.0	81.8	0.0	0.0	0.0	18.2	1.73	3
Wash hand basins	0.0	86.4	0.0	0.0	0.0	13.6	1.55	4
Towels	0.0	90.9	0.0	0.0	0.0	9.1	1.36	5
Urinals	0.0	90.9	4.5	0.0	0.0	4.5	1.23	6
Mean							1.78	
Cooking facilities:								
Stove	0.0	77.3	0.0	4.5	4.5	13.6	1.77	1
Fridge	0.0	77.3	0.0	9.1	0.0	13.6	1.73	2

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Microwave	0.0	77.3	0.0	9.1	0.0	13.6	1.73	3
Sink	0.0	81.8	0.0	4.5	4.5	9.1	1.59	4
Canteen	0.0	90.9	4.5	0.0	4.5	0.0	1.18	5
Outsourced	0.0	100.0	0.0	0.0	0.0	0.0	1.00	6
Mean							1.50	
Washing facilities:								
Outsourced	0.0	95.5	0.0	0.0	0.0	4.5	1.18	1
Wash trough	0.0	95.5	0.0	4.5	0.0	0.0	1.09	2
Washing machine	0.0	95.5	4.5	0.0	0.0	0.0	1.05	3
Tumble dryer	0.0	95.5	4.5	0.0	0.0	0.0	1.05	4
Mean							1.09	
Recreational facilities:								
Radio	0.0	81.8	0.0	9.1	4.5	4.5	1.50	1
TV	0.0	90.9	0.0	0.0	4.5	4.5	1.32	2
CD / DVD player	0.0	90.9	4.5	0.0	0.0	4.5	1.23	3
Satellite TV	0.0	90.9	4.5	0.0	0.0	4.5	1.23	4
Pool	0.0	95.5	0.0	4.5	0.0	0.0	1.09	5
Darts	0.0	100.0	0.0	0.0	0.0	0.0	1.00	6
Drafts	0.0	100.0	0.0	0.0	0.0	0.0	1.00	7
Keerum	0.0	100.0	0.0	0.0	0.0	0.0	1.00	8
Mean							1.17	
Medical aid facilities:								
First aid room	0.0	85.0	0.0	5.0	0.0	10.0	1.50	1
Clinic	0.0	95.2	0.0	0.0	0.0	4.8	1.19	2
Occupational health nurse	0.0	95.0	0.0	0.0	5.0	0.0	1.15	3
Paramedic	0.0	95.2	0.0	4.8	0.0	0.0	1.10	4
Medical doctor	0.0	95.2	0.0	4.8	0.0	0.0	1.10	5
Mean							1.21	

4. Conclusions

The lack of information regarding the sample size is noted as a limitation of the study, and can therefore be deemed exploratory. There has been an increase in the availability of international literature since the initial South African study published in 1998, that included case studies in Australia and Denmark. The literature perused provided information and lessons learned from the mining and construction sectors. The notion of FIFO where distances are travelled that include rosters, as well as the effects on communities, recreation and the effect of stress and increased ill health and suicides were further noted. Cultures differ between countries, and it was noted that wellness programmes were available to workers who were struggling with relationships and stress.

The area in which most of the participants were noted as working could be deemed rural in nature, with very scant if any supply of running water, electricity, or community resources. The requirements set by the ILO and the OHSA and its Regulations then could be challenging when required to meet a particular level of compliance. However, the duties of the client as noted in the CRs (Republic of South Africa, 2014), are quite clear, and cognisance of the risks and availability of resources should be considered when planning for issues such as working in remote areas. The Constitution dictates the rights of the worker, and the OHSA requires employers to ensure that workers are kept well relative to the working environment. Despite the legal requirements, the level of compliance on the contracts can only be

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

deemed poor to appalling. A notable demographic finding is the length of time the respondents have been employed by their current employer, especially given the lack of resources.

The EC DRPW should be made aware of the findings of the research, as the client in this case. However, the results are equally important to other clients and employers who are likely to require their workers to work in remote areas for extended periods. The level of employees in the hierarchy should not influence the standard of accommodation i.e. it should be appropriate, adequate, and decent.

Accommodation requirements should be identified early in the design stage, and suitable accommodation identified for use by contractors. Community engagement and participation using social facilitators could enhance the level and standard of accommodation and general facilities, emergency and general local facilities noted. Bills of Quantities, tender documentation, and H&S Specifications should dictate the minimum acceptable standards to be met.

Voluntary associations, across the built environment should be made aware of the potential issues, and the need for not only legal compliance, but what standards constitutes appropriate, adequate and decent in terms of construction camps, with a view to promoting a better practice approach. The public sector is the primary custodian of infrastructure development and future studies should be expanded to cover all other provinces across South Africa.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-053

An Evaluation of Provision of Workers' Welfare Facilities and its Effects on Productivity on Zambian Construction Sites

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Abstract

Employees play an important role in any organization, as they contribute significantly to operations of any business. Therefore, ensuring employees' wellbeing through provision of welfare facilities is essential in stimulating desired conduct and performance. However, the Zambian construction industry is associated with numerous challenges in the provision of workers' welfare facilities on work site. The research adopted a non-probabilistic purposive sampling with population, with questionnaires and interviews administered to foremen, skilled and unskilled workers on targeted construction work sites. Building and civil work sites as well as road construction work sites were selected. The research established that the current levels of provision of workers' welfare facilities on Zambian construction work sites is low; with most contractors failing to provide appropriate toilet and washing facilities, rest-rooms and shelter, temporary housing, transport to and from place of work, a place to warm up and eat their food from as well as somewhere to store clothing.This research therefore recommends that contractors provide appropriate welfare and safety facilities to their employees on construction job site. Contractors should make adequate provision for safety and health when preparing bids. During tender valuations the contractors' cost allocated to provision of workers' welfare facilities and safety in the bills of quantities should be well defined and evaluated competitively by professionals responsible. Further, relevant law enforcing agencies should be proactive in conducting regular site inspections to check on contractors' compliance to workers' welfare, health and safety regulations on construction jobsites. This is important because the more the workforce is motivated, the higher will the turnover be in terms of employee output.

Keywords: construction industry, effects, productivity, welfare facilities, Zambia

1. Introduction

Employees play an important role in the industrial production of the country. Hence, organisations have to secure the cooperation of employees in order to increase the production and to earn higher profits.

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

The cooperation of employees is possible only when they are fully satisfied with their employer and the welfare at work (Parameshwaran and Shamina, 2014)

The term "welfare" proposes many ideas, meanings and connotations, such as the state of wellbeing, health, happiness, prosperity and the development of human resources (Prabakar, 2013). As a total concept of welfare, it is a desirable state of existence involving physical, mental, moral and emotional wellbeing. The social concept of welfare implies the welfare of man, his family, and his community. Welfare is called a relative concept, for it is related to time and space. In order to establish a minimum level of welfare, it demands certain minimum acceptable conditions of existence, biologically and socially (Prabakar, 2013).

In the construction industry, the work environment is characterised by its casual nature, temporary relationship between employer and employee, uncertain working hours, lack of basic amenities and inadequacy of welfare facilities. These unique characteristics of the construction industry make it distinct in implementation of labour welfare measures compared to other industries. (Nasar et al., 2013).

This research therefore, evaluated the provision of workers' welfare facilities and its effects on productivity on Zambian construction work sites. This was achieved through the use of rigorous case study approach where both qualitative and quantitative methods where employed accordingly.

2. Definition of Welfare

Welfare is a broad concept referring to a state of living of an individual or a group, in a desirable relationship with the total environment – ecological economic and social. It aims at social development by such means as social legislation, social reform social service, social work, social action. The object of economics welfare is to promote economic production and productivity and through development by increasing equitable distribution. Labour welfare is an area of social welfare conceptually and operationally. It covers a broad field and connotes a state of wellbeing, happiness, satisfaction, conservation and development of human resources (Srinivas, 2013).

2.1 Workers' welfare in general

Workers' welfare means anything done for the comfort and improvement, Intellectual or social, of the employees over and above the wages paid which is not a necessity of the industry (Lalitha and Priyanka, 2014). It covers a broad field and connotes a state of wellbeing, happiness, satisfaction, conservation and development of human resources and also helps to motivation of employee. The basic purpose of employee welfare is to enrich the life of employees and to keep them happy and conducted. Welfare measures may be both Statutory and Non statutory laws require the employer to extend certain benefits to employees in addition to wages or salaries (Srinivas, 2013).

The statutory schemes are those schemes that are compulsory to provide by an organization as compliance to the laws governing employee health and safety (Prabakar, 2013). The non – statutory services and facilities are provided beyond the provision of law to provide congenial surroundings to personal, family and social life of the employees for their physical, mental and emotional well - being. It enables betterment and growth of each and every individual (Prabakar, 2013). Ensuring welfare is a measure of promoting the efficiency of labour. The various welfare measures provided by the employer will have immediate impact on the health, physical and mental efficiency alertness, morale and overall

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

efficiency of the worker and there by contributing to the higher productivity. Some of the facilities and services which fall within the preview of labour welfare include canteen facilities, ablutions, accommodation arrangements, resting facilities, medical facilities and transportation. (Logasakthi and Rajagopal, 2013).

The basic purpose of employee welfare is to enrich the life of employees and keep them happy. (Lalitha and Priyanka, 2014). Decisions about workplace facilities and the work environment will depend on the industry the business is operating in, the nature of the work carried out as well as the size and location of the workplace and the number and composition of workers at the workplace.

3. Construction workers' welfare

Work in the construction industry is tough and involves much manual or physical activity. It is also hazardous and dirty and therefore good welfare facilities not only improve workers' welfare but also enhance efficiency (Muiruri and Mulinge, 2014). Welfare facilities such as good source of drinking-water, washing, sanitary and changing accommodation, rest-rooms and shelter, facilities for preparing and eating meals, temporary housing, assistance in transport from place of residence to the work site and back, all help to reduce fatigue and improve workers' health (Tiwari, 2014).

Construction workers need adequate toilet and washing facilities, a place to warm up and eat their food and somewhere to store clothing. The provision of appropriate workplace amenities and facilities is important for the basic health, safety and welfare of employees. The various welfare measures provided by the employer will have immediate impact on the health, physical and mental efficiency alertness, morale and overall efficiency of the worker and thereby contributing to the higher productivity (Tiwari, 2014).

3.1 Importance of the provision of workers' welfare facilities

The provision of workers welfare facilities makes the workers realise that they have some stake in the undertaking in which they are employed and so they think thrice before taking any reckless action, which might prejudice the interest of the undertaking (Bagul, 2014). Secondly, welfare facilities such as subsidised food in canteens, free medical and educational facilities etc. indirectly increase the real income of workers. If the workers go on strike, they will be deprived of all these facilities (Raman, 2007). Congenial environment as a result of welfare measures will act as a deterrent against such social vices (Prabakar, 2013). Further, welfare activities influence the sentiments of workers. When workers feel that the employers and the state are interested in their happiness, their tendency to grouse and grumble will steadily disappear. The development of such a feeling paves the way for industrial peace (Bagul, 2014)

It also helps in improving good industrial relations and industrial peace. Further employees take active interest in their jobs and work with a feeling of involvement and commitment. Consequently, employers secure the benefits of high efficiency, cordial industrial relations, low absenteeism and low turnover (Monal, 2007). Above all, employers do not have the threat of government intervention

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3.2 Challenges affecting the provision of workers welfare facilities in the construction industry

Muiruri and Mulinge (2014) noted that some of the major challenges in the management of workers welfare and safety on constructions sites include but not limited to; inadequate enforcement mechanisms, absence of safety and health committees, poor maintenance of personal protective gear, unawareness of welfare and safety matters among the workers on the construction sites as well as lack of top management support in the management of health and safety on construction sites. More so, lack of enforcement mechanisms such as site inspections to check adherence to health and safety requirements on construction work sites is another challenge (Muiruri and Mulinge, 2014).

The high competition has forced contractors to bid projects with minimum profits in order to stay in business. This has placed an added burden on contractors to construct increasingly sophisticated and risky projects with less resources and profits (Ho and Liu 2004). Similarly some site supervisors indicated that lack of adequate funds, lack of monitoring and evaluation, lack of personal protective equipment implementation programs among others as some of the factors that give rise to the above challenges.

3.3 Relationship between provision of workers' welfare facilities and productivity

Productivity is defined as outputs divided by inputs (Taylor, 1911; and Barnes, 1980). The outputs represent products and goods (and later services) generated while the inputs include key resources used for this generation, especially in the immediate factors such as labours, materials, and machines. Productivity indicates the ability of all related activity to produce.

Many scholars argue that there exists somewhat a kind of relationship between labour productivity and employee welfare benefits and facilities. For instance, Onitiri (1983) as cited in Yamwamu et al, (2012) argues that poor standards of living, bad health, lack of education, bad housing, poor transportation to and from work, bad conditions in the work place reduce workers' productivity, and low productivity in turn reduces the capacity of the society to improve working conditions, most especially housing, transportation, food and health facilities could substantially improve the workers' productivity.Furthermore, Yesufu (1984) and Ejiofor (1986) argue that employee welfare benefits and facilities are capable of attracting and retaining employees, assisting employees in meeting their needs better, helping in lowering unit cost of production, improving morale, increasing employee security and blunting these sharp edges of managerial autocracy. All these, according to these scholars, have a positive effect on labour motivation and productivity.

The concept of employee welfare has been used by many organizations as a strategy of improving productivity of employees in many industries since work related problems can lead to poor quality of life for employees and a decline in performance (Manzini and Gwandure, 2011). Priti (2009) argues that the role of the provision of welfare facilities is to promote economic development by increasing efficiency and productivity with the underlying principle being making workers give their loyal services ungrudgingly in genuine spirit of co-operation and the general wellbeing of the employee. Despite this, Mwiti (2007) as cited in Yamwamu et al, (2012) points out that naturally welfare facilities may not directly relate to an employee's job but the presence or absence of the facilities is notable through employee performance, attitude, high or low labour turnover.

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4. Methodology

Qualitative and quantitative approaches were adopted in this study for triangulation as well as effectiveness since biasness is limited (Biggam, 2008; Naoum, 2007). Definitions of workers welfare facilities and its relationship with productivity were compiled based on the literature reviewed through books, research papers and Journals.

Questionnaires and interviews were administered to foremen, skilled and unskilled workers on targeted Construction work sites. Purposive sampling was used in the selection of a representative sample from the population of interest. The population of interest were building and civil work sites as well as road construction work sites this was to avoid biasness.

The rationale for choosing this approach was that it enables the use personal judgement to select cases that can best meet the research questions and objectives (Saunders et al., 2003). More so, this sampling method is useful when working with very small samples that are particularly informative (Neuman, 2005). For the purpose of this research Building and Civil Construction works sites were classified into three categories namely; small scale, medium scale and large scale. Small scale construction work sites considered were those with projects having a contract value of less than $ 600, 000, while medium scale were ranging between $600, 000 to $1,900, 000 and lastly large scale projects considered had a value of more than $1,900, 000. As for road projects all of them were large scale.

It is also worth mentioning the limitations in the sense that due to time constraints, the research was only conducted in six provinces of Zambia namely; Lusaka, Copper-belt, Southern, Central, Northern and Eastern provinces of Zambia. Further, 60% of the contractors surveyed were Zambian owned, while 33% were Chinese and 11% South African.

5. Findings and Discussion

5.1 Provision of welfare facilities on building and civil construction work sites.

An assessment was carried out to ascertain the current levels of provision of workers welfare facilities on Zambian construction work sites. 17% of the small scale projects surveyed had provided ablution (toilet) facility. This meant workers had to look out for such facilities somewhere off site or alternatively a bush. On medium scale size projects the research revealed that 75% had toilet structures made of portable flush units, and timber make shifts. More so, 100% of large scale projects surveyed had toilets facilities made of prefabs, makeshift or portable units. Lack of adequate facilities impacts negatively on productivity due to diseases, sicknesses and time lost in answering the call of nature. The evidence agrees with proposals of Onitiri (1983) as cited in Yamwamu et al. (2012).

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Table 1: Level of provision of welfare facilities on Zambian Construction work sites

Building and Civil Construction Worksites							
Item No.	**Description**	**Small scale**		**Medium Scale**		**Large scale**	
		Provided	**Not provide**	**Provided**	**Not provided**	**Provided**	**Not provided**
1	Ablution	1 ≈ (17 %)	5 ≈ (83%)	3 ≈ (75)	1 ≈ (25%)	8 ≈ (100%)	0 ≈ (0%)
2	Kitchen	0 ≈ (0 %)	6 ≈ (100%)	0 ≈ (0%)	4 ≈ (100%)	4 ≈ (50%)	4 ≈ (50%)
3	Eating area	0 ≈ (0%)	6 ≈ (100%)	0 ≈ (0%)	4 ≈ (100%)	1 ≈ (12.5%)	7 ≈ (87.5%)
4	Change room	0 ≈ (0%)	6 ≈ (100%)	0 ≈ (0%)	4 ≈ (100%0	2 ≈ (34%)	6 ≈ (66%)
5	Transport	1 ≈ (17%)	5 ≈ (83%)	0 ≈ (0%)	4 ≈ (100%)	4 ≈ (50%)	4 ≈ (50%)
6	First aid and safety	1 ≈ (17%)	5 ≈ (83%)	2 ≈ (50%)	2 ≈ (50%)	3 ≈ (40%)	5 ≈ (60%)
7	Lodging	1 ≈ (17%)	5 ≈ (83%)	4 ≈ (100%)	0 ≈ (0%)	5 ≈ (60%)	3 ≈ (40%)
8	Smoking areas	0 ≈ (0%)	6 ≈ (100%)	0 ≈ (0%)	4 ≈ (80%)	1 ≈ (12.5%)	7 ≈ (87.5%)
9	Resting facilities	1 ≈ (17%)	5 ≈ (83%)	0 ≈ (0%)	4 ≈ (80%)	1 ≈ (12.5%)	7 ≈ (87.5%)

5.1.1 Ablution facilities for employees on Zambian construction work sites

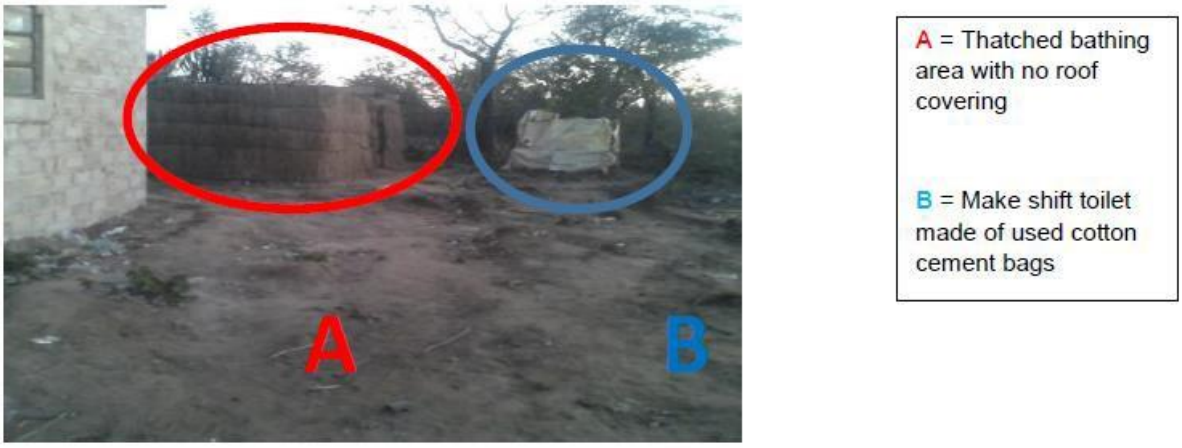

Figure1: Ablution facilities on a large scale construction site

5.1.2 Kitchen facilities on Zambian construction work sites

The findings revealed that none of the small and medium scale projects surveyed had any kitchen facility while only 50% of the large scale projects had kitchen facilities. This means that most of the workers on Zambian work sites either cook from open spaces with wood or leave the site for lunch. Among those going out for lunch others come back late or drunk suggesting that some went out for lunch to drink alcohol this negatively impacts on employees' dieting and subsequently their wellbeing.

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Figure 2: workers on site preparing lunch in an open air

5.1.3 Eating facilities for employees on Zambian construction work sites

The research established that none of the small and medium scale projects surveyed had any eating facility provided on site while only 12.5% of the large scale projects had such a facility on site. None or very low levels of provision of such facilities are on site as a result, most employees eating from site either use an office table or just anywhere they can find a shade, mostly under a tree if the site has one or behind an office block where the shade may be available.

5.1.4 Changing rooms for employees on Zambian construction work sites

The research revealed that none of the small and medium scale projects surveyed had a changing room facility provided on site while 34% of the large scale projects had such a facility on some sites. This means that some of the workers report for work with a work suit on, while others change from where ever they can find privacy though the situation is worse for sites found with female workers whose only option is to change from toilets. According to HSE (2010), washing facilities should be provided next to both toilets and changing areas. If these are far from toilets or changing areas, then they should be placed next to rest areas (HSE, 2010).

5.1.5 Provision of transport to workers on Zambian construction work sites

About 17% of the small scale projects revealed that they had transport provision for workers, none of the medium scale projects had such provisions while 50% of the large scale project work sites had transport provisions to and from site for employees. On projects with transport provisions employees where reporting for work on time and refreshed while on those project sites without transport arrangements, reports of reporting to work late and tired was the norm. Further, sites where workers had no transport facilities had workers wanting to leave the sites earlier than the knock off time to rush for the bush or catch a lift to their home. Providing of transport arrangements to and from site helps to boost workers morale thereby influencing positively on productivity. This however need to be enforced by both the clients and the principal agent for the project. The findings suggest that Muiruri and Mulinge's (2014) establishment that lack of enforcement mechanisms such as site inspections to check adherence to health and safety requirements on construction work sites is a challenge, evidence suggest that each

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ISBN 978-0-86970-787-6

site has a Resident Engineer who should be empowered to enforce minimum provision of welfare facilities.

5.1.6 First aid, safety and lodging facilities for employees on work sites

On the provision of first aid and safety facilities 17% of the small scale projects surveyed revealed that they had such facilities provided on work site with 50% and 40% of the medium and large scale project work sites having provided such facilities respectively. Provision of first aid and safety facilities boosts worker confidence and productivity. A further assessment on the provision of lodging facilities to employee working far from their home established that 17% of the small scale projects surveyed had rented lodging facilities for employees, while 100% of the medium scale projects had site camps for employees on 60% of large scale projects work sites. This Congenial environment provided for workers on site (Prabakar, 2013), paved the way for productivity, reduced site disputes, and promoted industrial peace (Bagul, 2014). As a result, evidence on site from workers indicated that workers were fresh both physically and mentally each morning when they reported for work.

5.1.7 Provision of smoking and resting facilities

The findings revealed that none of the small and medium scale projects surveyed had any area demarcated as a smoking zone with only 12.5% of the large scale projects found having a smoking zone. Despite having these zones, smoking was not forbidden on all the projects surveyed. As a result of this most of the workers on Zambian work sites smoke from wherever they wish as long as they are no flammable substances, some revealed that they excused themselves from fellow worker while others did not.With regards to resting facilities, about 17% of the small scale projects had resting facilities provided on site for workers, whereas none of the medium scale projects had such provisions. About 12.5% of the large scale project work sites were found to have resting facilities provided for workers.

The HSE (2010) opines that rest facilities should provide shelter from wind and rain. It further states that these facilities should have adequate numbers of tables, seating with backs, and access to water. According to the HSE (2010), rest areas are not to be used to store plant, equipment or materials. As a result of failure to provide for such facilities, workers on Zambian sites tended to go far from site to where they can get good rest hence resulting in late return to work and sometimes even drunk hence slowing down productivity

5.2 Provision of workers welfare facilities on road construction work sites

An assessment on the provision of workers welfare facilities on road construction work sites revealed that none of the road project works sites surveyed had; ablutions, eating areas, change rooms as well as smoking areas as shown in Table 2, therefore, to answer the call of nature workers either had to look for toilets elsewhere or use the nearby bush as no portable toilets were provided. In addition, the findings indicated that only 50% of the work sites surveyed had kitchen facilities though these were also back at camp sites. Therefore, during lunch breaks some workers had to go back to camp sites as transport was provided. More so, 100% of projects surveyed were found to have put in place enough transport arrangements, first aid and safety measures, lodging as well as resting facilities.

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Table 2: Provision of welfare facilities on road Construction work sites

Road Construction Work Sites			
Item No.	**Description**	**Provided**	**Not provided**
1	Ablution	1 ≈ (25%)	3 ≈ (75%)
2	Kitchen	2 ≈ (50%)	2 ≈ (50%)
3	Eating area	0 ≈ (0%)	4 ≈ (100%)
4	Changing room	0 ≈ (0%)	4 ≈ (100%)
5	Transport	4 ≈ (100%)	0 ≈ (0%)
6	First aid and safety	4 ≈ (100%)	0 ≈ (0%)
7	Lodging	4 ≈ (100%)	0 ≈ (0%)
8	Smoking areas	0 ≈ (0%)	4 ≈ (100%)
9	Resting facilities	4 ≈ (100%)	0 ≈ (0%)

5.3 Effects of provision of workers welfare facilities on productivity on Zambian construction work sites.

An assessment was carried out to ascertain the Effects of provision of workers' welfare facilities on Productivity on Zambian construction work sites.

5.3.1 Ablution facilities

Provision of ablution facilities enhances productivity as workers are able to answer calls of nature in a short space of time as opposed to not having a toilet on site. Where there is a lack of toilet facility, workers tend to take long to get back to work when they go to ease themselves as indicated on 59% of the projects surveyed. This because either they have to make longer distances in search of facilities further from the site or have to get to bushes away from site. Some workers spoken to revealed that it was common for them or their colleagues to use the excuse of going to the toilet to avoid work and get some rest. They usually take longer periods of time when answering the call of nature hence reducing on productive time.

5.3.2 Kitchen and eating facilities

Lack of kitchen facilities on site affects productivity. This is because there is loss of production time by the workers if allowed to go out of site for lunch as some tend to report back for work late and if that is aggregated together at month end, lost time accumulates to days. Others if allowed off site for lunch usually return back drunk. A drunk employee usually does not perform at his optimum thereby reducing on their efficiency hence affecting productivity. Therefore, good meals and environments makes the workers more refreshed and energetic to carry on with work productively as evidenced on 27% in Figure 3 of the projects surveyed.

The research further revealed that lack of eating facilitates on site impacts negatively on productivity in the sense that workers tend to give excuses of going off site to a place where they can find food hence leaving work on site hanging as opposed to projects with such facilities. More so, low levels of hygiene

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ISBN 978-0-86970-787-6

in areas where workers eat tends to be a recipe for diseases especially during the rain seasons hence affecting your productivity.

5.3.3 Transport

Provision of transport facilities impacts workers' productivity. Research revealed distances of work site from homes causes some employees to reach the work site late and even tired (from walking long distances) hence impacting negatively on productivity. On sites where transport was provided workers reported for work fresh and on time thereby enhancing productivity.

5.3.4 First aid/ safety

Lack of first aid and safety controls leads to accidents as well as interruption of works with possible sanctions by the safety inspectors, thereby impacting negatively on productivity.

5.3.5 Smoking

Smoking on construction work sites if not controlled affects productivity. Therefore, provision of smoking zones on construction work site is essential especially on medium to large scale projects; it is addictive hence many man hours are lost as smokers have to suspend the work when they want to smoke cigarette worse still hazardous when working within highly flammable areas. Employees excusing themselves to smoke meant abandoning the works. The research further revealed that smoking in presence of other co-workers who are allergic to cigarette smoke negatively impacts on their performance hence lowering productivity.

5.3.6 Resting and lodging facilities

Provision of resting facilities impacts on productivity positively; as workers are able to rest well at appropriate times as revealed on 23% of the project surveyed. Lack of resting facilities on site causes workers to go far from site to where they can get good rest hence returning for work sometimes late or drunk hence slowing down on productivity. Similarly, provision of lodging facilities for employees working far from homes enhances productivity as they are able to report for work very fresh and physically and mentally sound as evidenced on 64 % of the project surveyed. The research further revealed that where employees were not properly provided with conducive lodging facilities the morale was low thereby impacting negatively on productivity. Therefore, absence or bad housing reduce workers' productivity.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

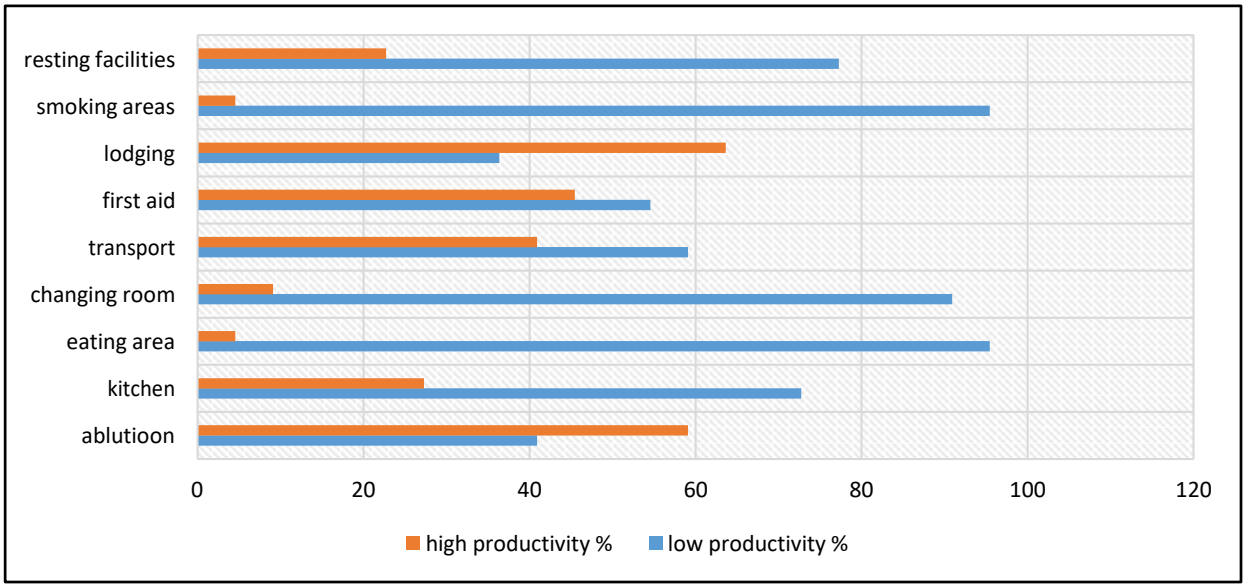

Figure 3: Effects of provision of workers welfare facilities on productivity

6. Conclusion and recommendation

Work on the construction worksite involves much manual or physical activity. It is also hazardous and dirtytherefore requiring the provision of good workers' welfare facilities.Provision of such facilities is important as it enhances efficiency. In evaluating the provision of workers welfare facilities, this research established that the current levels of provision of workers welfare facilities on Zambian construction work sites is low; with most contractors failing to provide appropriate toilet and washing facilities, rest-rooms and shelter, temporary housing, transport to and from place of work, a place to warm up and eat their food from as well as somewhere to store clothing.

To address these challenges the relevant law enforcing agencies should be proactive byconducting regular site inspections to check on contractors' compliance to workers welfare, health and safety regulations on construction job sites.Contractors should make adequate provision for safety and health when pricing bills.Furthermore,when evaluating the bids the contractors' cost allocated to provision of provision of workers welfare facilities and safety in the bills of quantities should be well defined and evaluated competitively by professionals responsible.This is important because the more the provision of adequate welfare facilities are made available to the construction workforce, the higher the turnover in productivity in terms of employee output. Lastly, employers and contractors should draw suitable programmes that are consistent with laws governing the workers Act.

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

5

ICT INFRASTRUCTURE AND MEGA PROJECTS

Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-051

Adoption of Building Information Modelling in the Zambian Architectural, Engineering and Construction Industry

Chipulu Chipulu[1], Chisanga Kaluba[2], Balimu Mwiya[3]

Abstract

Building Information Modelling (BIM) is a thriving technology and approach for the Architecture, Engineering and Construction (AEC) Industry. It facilitates, among others, the functions of planning, design, construction and operation of the project lifecycle. This paper sought to ascertain whether there is a need to fully adopt BIM as an approach to the construction projects life cycle in the Zambian AEC industry and to suggest the most effective method for the full adoption of BIM in Zambia. The research methodology involved a questionnaire survey and structured interviews. The data obtained were analysed using MS excel 2013. It was found that there was a need to fully adopt BIM in the Zambian AEC industry. It was further found that the highest usage of BIM was among the Architects and the least usage among the contractors. The organisations not using BIM expressed interest in this technology and approach to planning, design, construction and operation of the project life cycle. Apportioning separate roles between the public and private sectors could be the most effective method of BIM implementation.

Keywords: AEC industry, BIM, construction, projects, Zambia

1. Introduction

In the 21st century, every evolution in technology has been achieved with advances in computer science. The result of each evolution is to provide more information to attain objectives easily. This technical evolution is also reflected in the Architecture, Engineering, and Construction (AEC) Industry (Damian and Yan, 2008). Until the mid-nineteenth century, the general method of design did not change a lot, Engineers used simple tools (such as pen, paper and ruler) to describe their buildings. However, with advances in mathematics and building materials, the process of design changed and improved rapidly (Rabun and Blackmore, 1996). The invention of the computer, was the root of CAD, which in time resulted in the complete adoption of two-dimensional computer aided drafting (2D CAD) as a new drawing tool in the AEC industry (Phiri, 1999). At the beginning, the technology of CAD was not as popular as in current times. However, with the popularisation of personal computers, the renowned software company Autodesk developed AutoCAD and suddenly, most architects in the world started to learn and use this type of software to design their projects (Leondes, 2005). Some advantages of this approach have included standardization, ease of use, and dimension-ability. Everyone has become familiar with 2D CAD, but it has some real disadvantages. A 2D project is difficult to visualize, requires interpretation by others with the potential for misinterpretation of the design intent and replicates a manual drafting process (low-tech), which means that information may be missing, inconsistent, or

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

erroneous. The biggest disadvantage of 2D CAD is the great deal of coordination required between different members of the design team and the lack of consistent information within drawings (Sandoval, 2011).

Beginning 2000 to present, buildings have become much more complex than ever before. The numbers of people involved in producing drawings are large. With the growth of technology, the number of building systems required are also many. Today, buildings have more security, electrical, Heating, Ventilation, and Air Conditioning (HVAC), and energy requirement. Computer based technology have also been updated in order to reduce errors, but in the end, they are still collections of manually created, non-intelligent lines and text (Kumar and Mukherjee, 2009). For this reason Building information modelling (BIM) is widely viewed as the next stage in the development of AEC industry. Some of the reasons why architects, engineers and contractors worldwide are increasingly using BIM include improved visualization, improved productivity due to easy retrieval of information, increased coordination of construction documents, increased speed of delivery, reduced cost and many other reasons (Sandoval, 2011).

Building Information Modelling (BIM) is the documentation process consisting of information about different phases of any project like design, construction planning, construction, facility management and operation. It is one holistic documentation process beneficial for operational visualization and construction application such as estimating, scheduling and design coordination. The main advantage of implementing BIM application is the visual coordination of the building systems such as Mechanical, Electrical, and Plumbing (MEP) systems and it also identifies the possible conflicts between the building systems. By detecting the conflicts, problems can be resolved before actual construction which in turn saves money and time invested, (Damian and Yan, 2008). Almost 50% of the AEC North American industry is now using Building Information Modelling (BIM) and those using it are planning to increase their use significantly. The majority are also experiencing real business benefits, directly attributable to BIM (McGraw-Hill Construction, 2009).

On the contrary the Architecture, Engineering and Construction (AEC) industry in Zambia is still using 2D computer drawings (Zulu, 2013). Construction calls for team work, and BIM is dramatically reshaping the way project teams work to increase productivity and improve outcomes for all. This is driving the most transformative evolution the construction industry has ever experienced (McGraw-Hill Construction, 2010).

The Scandinavian countries are a good example of countries adopting the usage of BIM in their AEC industry. In their approach both the public and private sectors have assumed roles in order to aid this adoption of BIM. The roles of both the public and private sector are as indicated in tables 1 and 2 respectively.

1.1 Types or dimensions of building information modelling

Three dimensional building information modelling (3D BIM) is made up of software which is used to produce three dimensional representations of real objects and which also includes some information in the model or the properties about the objects beyond the graphics (Mitchell et al, 2009)

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Livingstone, Zambia
ISBN 978-0-86970-787-6

4D BIM is a 3D model linked to time or scheduling data. Model objects and elements with this data attached can be used for construction scheduling analysis and management. It can also be used to create animations of project construction processes. (Eastman, 2009)

A fifth dimension is introduced when the concept of cost over time is added to the 4D model. 5D allows one to explore what the budget/estimated cost of a project might be at any given point in time during the project. (McCarthy Building Companies, 2013).

With growing demand in the green building industry, software companies in the industry such as Autodesk, Graphisoft and Bentley, started developing new applications, modules or brand new software meeting the requirement of sustainable building design and facilitating or expediting design procedures as per new guidelines. The growing demand to the green BIM software is given as "78% of BIM users who do not currently use it for green projects expect to be doing so within three years" in a recent research done by McGraw Hill (McGraw Hill Construction, 2010).

Sustainability or green building provisions are deemed as the sixth-dimension in building/construction industry, therefore this new segment of BIM software is known as six-dimension (6D) BIM.

Table 1: ***BIM Implementation in Public Sector of the Scandinavian Countries (Source: Wong et al. 2010)***

	Countries		
	Finland	Denmark	Norway
Organization	Senate Properties	The Palaces and Properties Agency The Danish University and Property Agency Defence Construction Service	Statsbygg
Projects	Pilot projects	To implement BIM and IFC in public work	Pilot projects
BIM adoption Policy	To adopt BIM in all projects from 1St Oct 2007	Since January 2007, the architects, designers and contractors would follow the format set by"Det Digitale Byggeri" (the digital construction)	BIM to be used for whole life-cycle of Buildings. Complete implementation by 2010
Information exchange policy	IFC is desired	IFC is recommended	

Table 2: ***BIM Implementation in Private Sector of the Scandinavian Countries (Source: Wong et al. 2010)***

	Country		
	Finland	Denmark	Norway
Organisation	Skanska	bips Rambøll	Selvaag – Bluethink
Projects and main function	Integration of Project Specific Building Information Model in Industrialised Building Process	BIM Guidelines Rambyg - IFC collaboration	BIM Guidelines Rambyg - IFC collaboration

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1.2 Building information modelling benefits

The key benefit of BIM is its accurate geometrical representation of the parts of a building in an integrated data environment (CRC Construction Innovation, 2007; CIFE, 2007 and McGraw-Hill Construction research, 2009). Other related benefits include:

- Faster and more effective processes– information is more easily shared, can be value-added and reused;
- Better design– building proposals can be rigorously analyzed, simulations can be performed quickly and performance bench marked, enabling improved and innovative solutions;
- Controlled whole-life costs and environmental data– environmental performance is more predictable, lifecycle costs are better understood;
- Automated assembly – digital product data can be exploited in downstream processes and be used for manufacturing/assembling of structural systems;
- Better customer service– proposals are better understood through accurate visualization; and
- Lifecycle data– requirements, design, construction and operational information can be used in facilities management
- Competitive advantage

BIM is seen as a way to get a leg up on the competition. This is particularly true among less experienced users who are promoting a new service. Some of these new users have cited the following benefits.

- Marketing new business to new clients is the top rated business benefit of BIM;
- Half of users say offering new services with BIM is a significant business benefit; and
- Two-thirds of users say BIM's ability to help a company maintain repeat business with past clients, brings at least a moderate level of value

1.3 Obstacles to Building information modelling adoption

The technology to implement BIM is readily available and rapidly maturing. Yet, BIM adoption is much slower than anticipated (Fischer and Kunz, 2006). The two main reasons are, technical and managerial. The technical reasons can be broadly classified into three categories (Bernstein and Pittman, 2005):

- The need for well-defined transactional construction process models to eliminate data interoperability issues (Interoperability here refers to the ability of two separate systems or software programs to communicate and exchange data with each other);
- the requirements that digital design data be computable; and
- the need for well-developed practical strategies for the purposeful exchange and integration of meaningful information among the BIM model components.

The management issues cluster around the implementation and use of BIM. Currently, there is no clear consensus as how to implement or use BIM. Unlike many other construction practices, there is no single document or treatise on BIM that instructs on its application or usage (AGC, 2005).

Researchers and practitioners have to develop suitable solutions to overcome these challenges and other associated risks. Since there are a number of researchers, practitioners, software vendors and

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professional organizations working hard to resolve these challenges, it is expected that the use of BIM will continue to increase in the AEC industry (Azhar et al., 2008).

1.4 Purpose of the study

The purpose of this study is to ascertain whether there is a need for Zambia to fully adopt BIM. This is so because there is a growing focus of current project management (PM) practices in the AEC industry on integrated project delivery (IPD) and large organizations are adopting such tools which facilitate IPD. BIM by its design facilitates IPD (Hardin, 2009) and, therefore, has tremendous growth potential for PM practices in the AEC industry. Furthermore, Construction is a team sport, and BIM is dramatically reshaping the way project teams work together to increase productivity and improve outcomes for all. This is driving the most transformative evolution the construction industry has ever experienced (McGraw-Hill Construction, 2010).

1.5 Objectives of the study

The main objective of the study is to ascertain whether there is need to fully adopt BIM as an approach to the construction projects life cycle in Zambia and to suggest the best or most efficient way to implement BIM in Zambia. The specific objectives are as follows. To:

- investigate the merits and short falls of the current approach to the construction life cycle in use in Zambia;
- investigate the types of BIM software being used in Zambia;
- establish the benefits that would be associated with BIM in Zambia;
- establish the extent to which BIM can be adopted;
- investigate the barriers to the adoption of BIM in Zambia; and to establish the best way of implementing the BIM in the Zambian construction industry considering countries where is has already been implemented

1.6 Research methodology

A questionnaire survey was conducted from 10th March to 3rd April 2014. This survey targeted locally practising Architects, Engineers, contractors and quantity surveyors. The designed questionnaire was composed of four parts namely A, B C, and D. Each part addressed one or more specific objective. Structurd dintervies were also conducted. Key personnel in governing organisations for the Architects, Contractors Engineers and quantity surveyors were interviewed. The data collected were thereafter analysed using MS excel 2013 and presented as in the findings.

2. Findings

2.1 Current approach to the construction life cycle in use in Zambia

The merits of 2D CAD as opposed to manual drafting are shown in the figure 1. From figure 1, it can be noted that there are several merits 2D CAD has over manual drafting, among them are its ease of use, dimension ability and standardisation.

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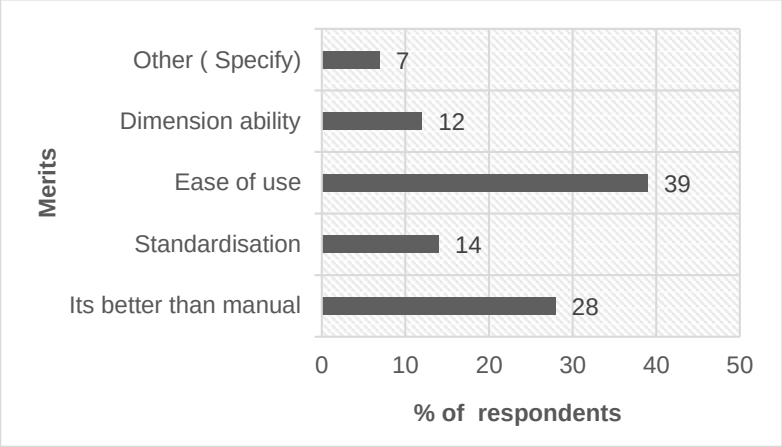

Figure 1: Merits of two dimensional CAD

The demerits of 2D CAD which is the current method of drafting were assessed and figure 2 presents the findings. 39% of the respondents felt that 2D CAD had no demerits. This can be attributed to the fact that most of them had not used BIM software before though they might have heard about it. While 30% of them indicated that 2D CAD required a great deal of coordination which was difficult because of how the professionals work when using this approach of design and drafting. There seemed a general willingness to explore the new design and drafting method (BIM).

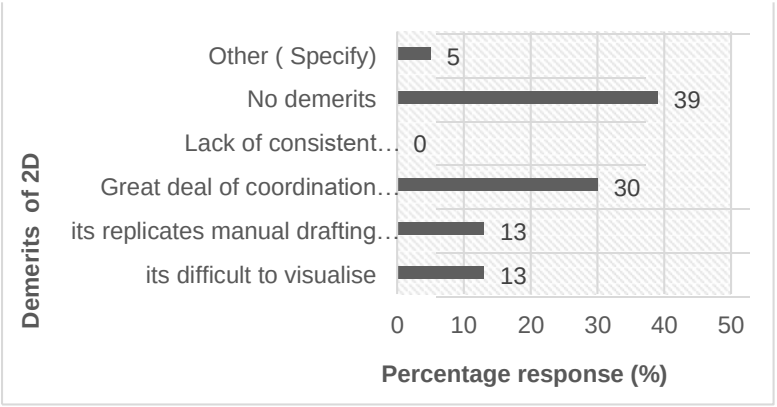

Figure 2: Demerits of two dimensional CAD

2.2. Current building information modelling adoption in Zambia

2.2.1 Usage of building information modelling in the Zambian AEC industry

Currently the majority of Zambian firms are not using BIM software, only 44% of the respondents (figure 3) most of them architects indicated that they used some BIM software. This usage of BIM is however smaller compared to other countries such as the Scandinavian countries.

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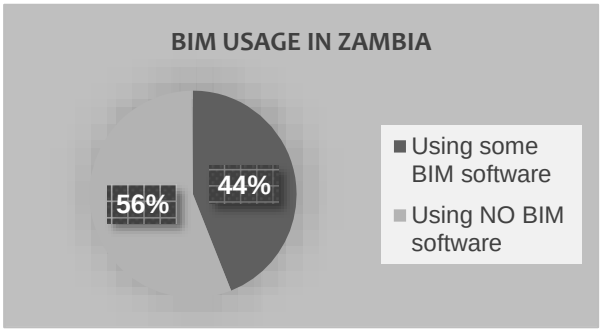

Figure 3: Usage of BIM in the Zambian AEC industry

Architectural firms in Zambia seem to be leading in the implementation of BIM as can be seen in figure 4 .This is so because most clients like to see how the building will appear once completed.

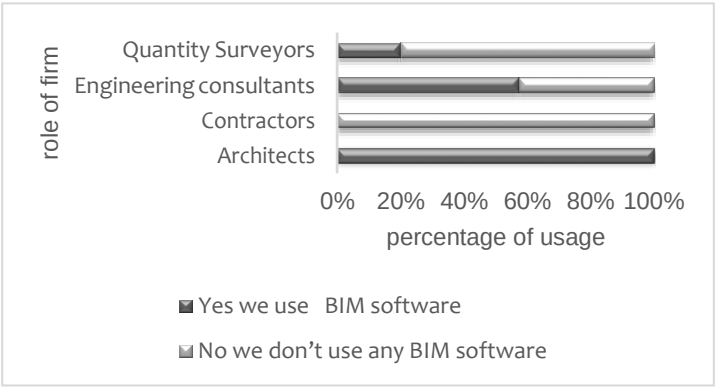

Figure 4: BIM usage in organisations in the Zambia AEC industry

2.2.2. BIM software usage among firms in the Zambian AEC industry

There are number of BIM software packages currently in use in Zambia. Autodesk software are the most commonly used as is shown in figure 5. This can be attributed to the fact that Autodesk software is easily accessible and also because of a 30 day trial which is given to clients. It can further be noted that the most used BIM software are architectural inclined such as Autodesk Revit architecture, Autodesk architecture desktop and Graph iSOFT Achicad.

Other BIM software in use were excel format, plan shift and Bentley watergems. Respondents were permitted to indicate the usage of more than one type of BIM software. The extent of BIM software usage in projects among firms was also assessed, the results are as presented in figure 6. It can be noted that the usage of BIM in projects undertaken by firms in Zambian is still on a very small scale. For instance only 1% to 25% of the projects undertaken by these firms usually have a component of BIM software used. This maybe be attributed to the fact that software or hardware upgrades are too expensive and the fact that most clients are not willing or even ready to pay for the extra cost. The other reason may be the resistance to change from 2D to BIM.

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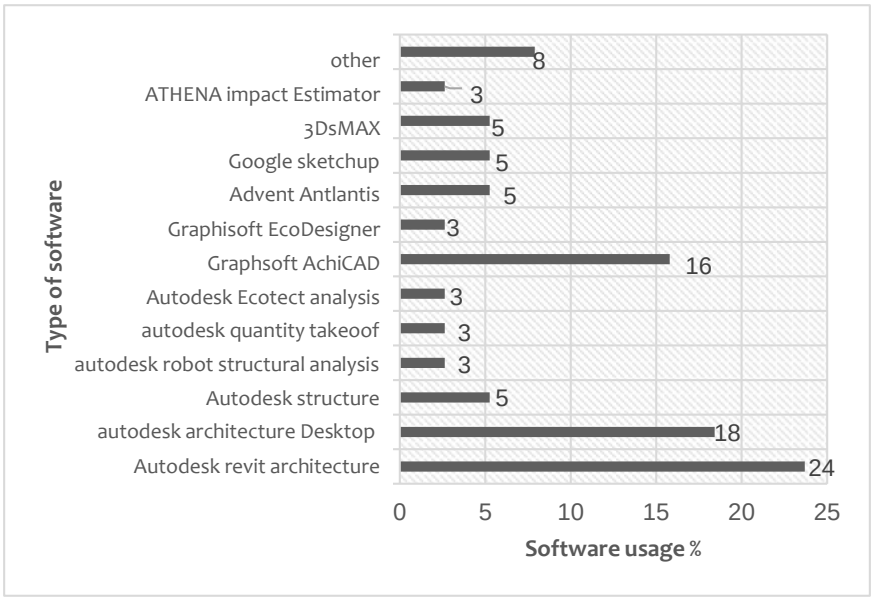

Figure 5: Type of BIM software and frequency of usage

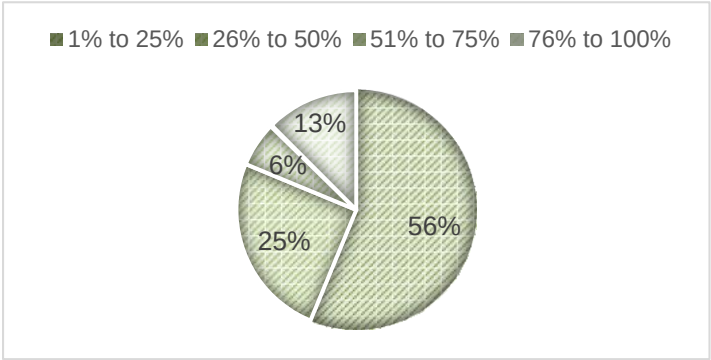

Figure 6: Percentage of projects developed using BIM software

2.2.3. Reasons for BIM usage

The reasons for BIM usage among some respondents were assessed. 33% of the respondents using BIM in some of their projects indicated that the automatic creation of views and schedules were their reasons for using BIM as shown in figure 7. The reasons given or specified by respondents who used BIM were that:

- it was more efficient to work in 3D software as it allowed more exploration and detailed design;
- it was easier to create artistic impressions using 3D views; and
- it gave a clear perception to others such as clients as to what the designer was intending to achieve.

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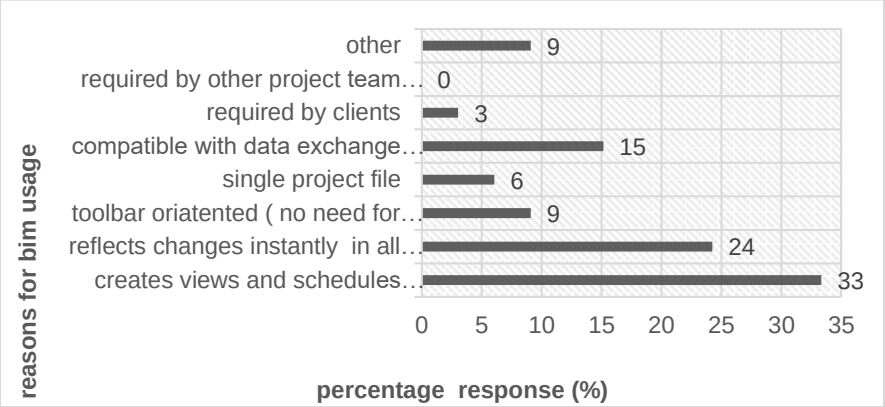

Figure 7: Reasons for BIM usage

2.2.4. Assessment of the Respondents from Firms/ Companies Not Using BIM

The essence of this section was to assess the reason why some firms were not using BIM and whether they felt they needed to adopt BIM. About 55% (figure 8) of firms not using BIM agreed that they needed to start using BIM; while rest of these firms were not for the idea of adopting BIM in their firms. Most of respondents who were not for adopting BIM were contractors. This information is as presented in figure 8.

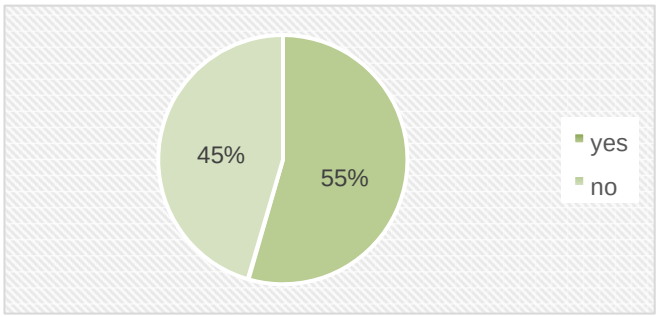

Figure 8: Need to adopt BIM

There are currently three main reasons why most firms are not using BIM in the Zambian AEC industry as presented in figure 9. The first main reason is lack of training as indicated by 19% of the respondents. This is a barrier to BIM adoption because from literature reviewed, training people in BIM is an extra cost and if the firms/ organisation do not train its professionals, then employees who understand BIM need to be found. This in itself is an obstacle as time and money will be spent. Furthermore, at present, there are few to no institutions in Zambia that teach the use of BIM software. This therefore implies that anyone intending to embark on the use of BIM has to train or learn on their own, which is difficult and usually takes time. In addition, 19% of the respondents stated that BIM is expensive. This is in agreement with literature which indicated that software and hardware upgrades are too expensive .The third barrier to BIM adoption is the view from 18% of the respondents that feel that existing 2D CAD systems fulfil their need to both design and draft. This could be attributed to minimal use of other design and drafting method apart from 2D CAD by most of the respondents in this category.

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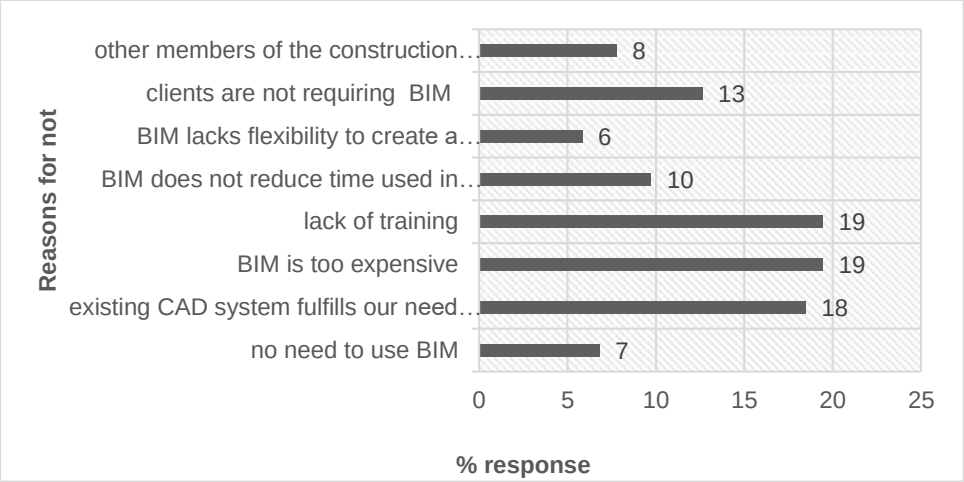

Figure 9: Factors leading to non-adoption of BIM.

As there is always a reason that impels people to adopt a certain technology, in this light the reasons that would lead to the start of BIM usage in certain firms currently not using any BIM software were assessed. According to figure 10, the ranking of reasons for full adoption of BIM are: client's requirement of BIM; its requirement by other project team members; large productivity gain over conventional entity based CAD system; knowledge of downstream applications of BIM; and when more support in form of training from BIM software vendors is accorded.

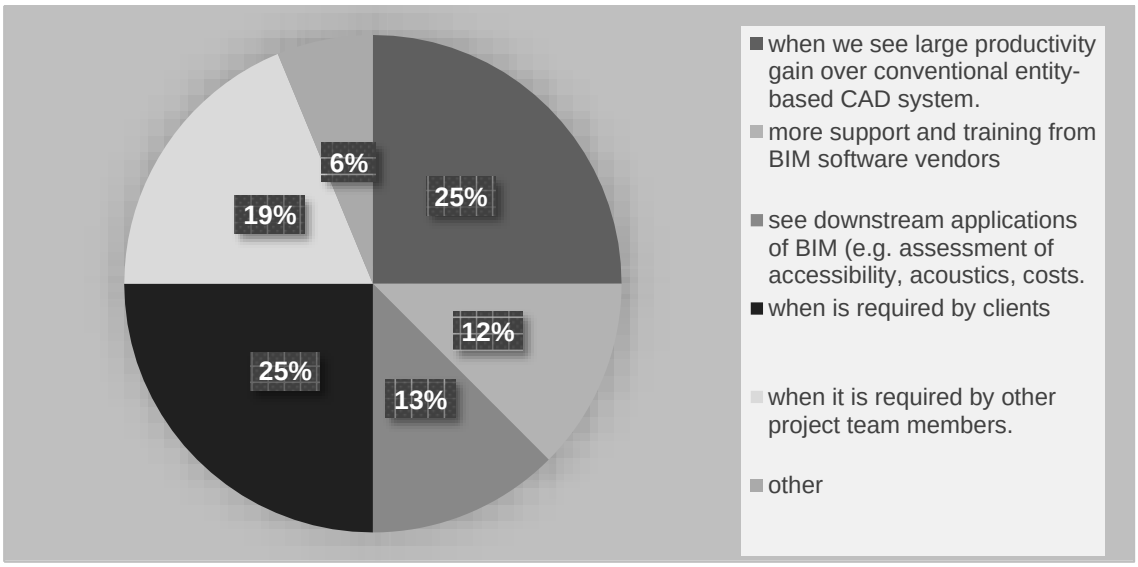

Figure 10: Reasons which would impel firms not using any BIM software to begin

2.3. Adoption of building information modelling in the Zambian AEC industry

Once the need to implement BIM in Zambia had been established, this study further investigated the extent to which BIM should be implemented in Zambia. This was divided into two parts in terms of dimensions and project life cycle.

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2.3.1 Extent of BIM adoption in terms of its dimension

Figure 11 shows that 37% of the respondents indicated that BIM should be adopted only up to three dimension. This means that BIM should only be used in the design phase only, and thus cannot be fully be adopted to its sixth dimension. This entails that BIM should not be fully adopted because full adoption implies implementation up to the sixth dimension. On the other hand about 30% were for the idea of adopting BIM up to the sixth dimension. Adopting BIM only at third dimension cannot be very beneficial considering the fact that its full advantages and capabilities cannot be experienced.

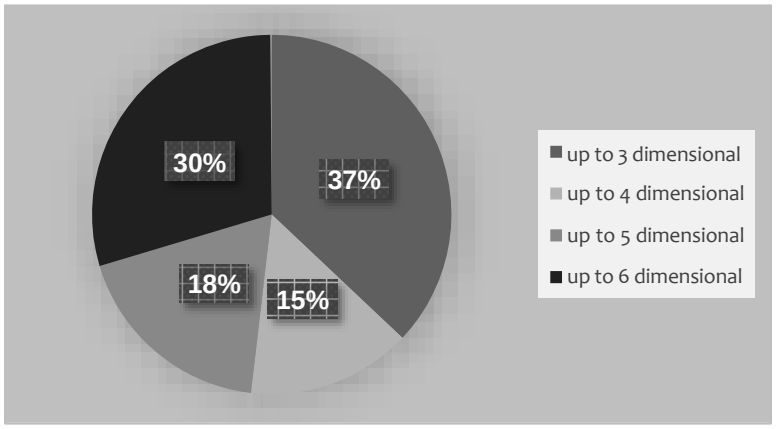

Figure 11: Extent of BIM adoption in terms of dimensions

2.3.2 Extent of BIM adoption in terms of the project life cycle

The responses to the adoption of BIM in the project life cycle are presented in the figure 12. In terms of the adoption of BIM in the project life cycle, 48% of the respondents indicated that BIM be adopted in the design stage and as compared to 33% who indicated that BIM be adopted up to the construction stage as this would lead to the production of real time schedules, enhance quality control and cost estimation.

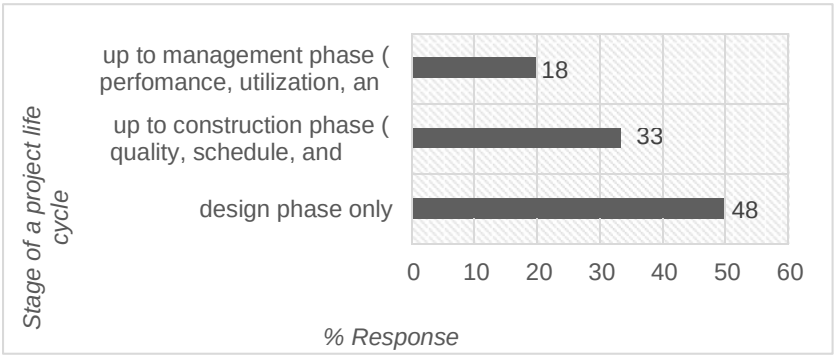

Figure 12: Extent of BIM's full adoption in terms of the project life cycle

According (Snook et al., 1995; Gavilan and Bernold, 1994; EPD, 2002) as quoted by (Shen et al, 2002), the best way to deal with material wastes is not to create it in the first place. The adoption BIM at least up to the construction phase would help release this dream. This is so because, The greatest advantages of BIM according to literature, is its capability to facilitate progress monitoring by using 4D

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phasing and trade coordination. In fact the essence of BIM adoption to improve quality of completed projects, to reduce wastage and to increase the delivery speed of projects.

Considering the adoption of BIM in countries where it is currently extensively used such as in North America and Scandinavian countries combined with the results obtained in this study, it is recommended for the Zambian AEC to adopt BIM up to 5D in terms of dimensions and up to the construction phase in terms of the project life cycle. This is the minimum level of adoption that would help curb the problems of quality, wastage and delivery

Figure 13 shows that among the benefits that could be associated with BIMs' full adoption are: increased delivery speed of project as stated by 23% of the respondents, better coordination which leads to reduced errors, decreased cost, greater productivity, higher-quality work, increased revenue and business opportunities. Furthermore, BIM has the benefits of providing controlled whole-life cycle cost and environmental data hence satisfying life cycle data-requirement and making available operational information for the facilities constructed. Controlled whole-life costs and environmental data imply that environmental performance would be more predictable and lifecycle costs would be better understood using BIM.

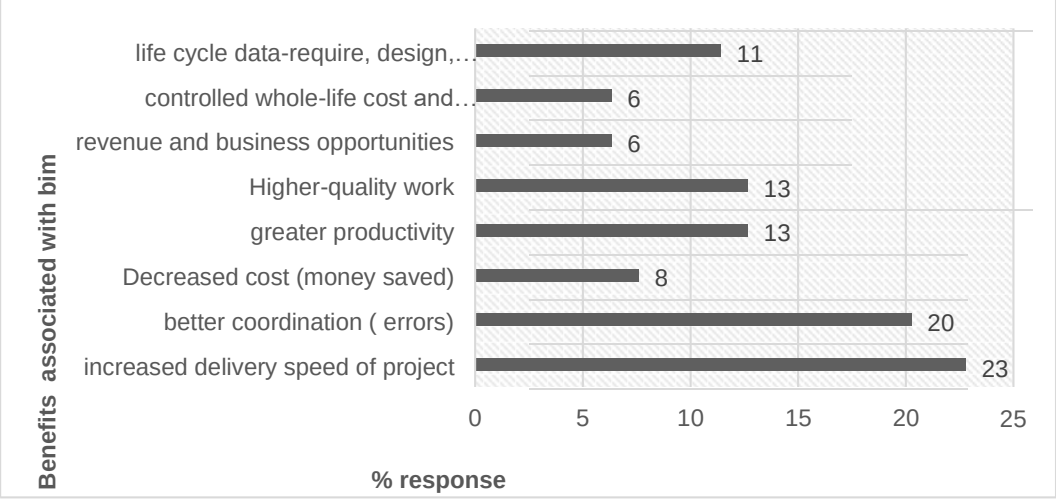

Figure 13: Benefits of BIM adoption in Zambia

2.4 Full adoption and implementation of BIM in the Zambian AEC industry

From Literature and the results obtained in the survey, it can be noted that the government has a major role in the adoption of BIM. Among the ways of encouraging the adopting of BIM are making it a policy in schools (i.e. universities) that students are taught at least two BIM software before they join the industry and that short training courses be offered to AEC stakeholders. Further there should be a requirement by the government to use BIM to carry out major public projects. This will force stakeholders to adopt BIM. This implies the government specifying the type of BIM software to be used and on what type of projects. This could be accompanied by restricting and limiting the use of 2D software to preferably small projects. Measures to make the BIM software packages affordable and readily available should be put in place. This can be by subsiding some software packages which are very expensive.

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In countries like Norway, Denmark, Finland, the governments through relevant bodies have established BIM guidelines which are based on experiences from other projects. These guidelines acts as a manual to BIM implementation on any project (Wong et al. 2010). This approach of making guidelines can be one of the major roles the government can take to spear head the full adoption of BIM in Zambia.

Finally the roles of the private sector in this process of fully adopting BIM according to literature review and interviews include organising of workshops through the various professional bodies to sensitize and educate professionals on the merits of BIM. Secondly, there should be standardization of all projects with at least a component of BIM in the design stages. The professional bodies should offer advice to the government as client on the merits of BIM and the effects to the growth of the AEC industry in terms of project delivery. In addition, professional bodies should encourage member firms to include in their budgets an allocation for BIM training and software. These firms should come up with an initiative of provision of student and trial BIM software to its members.

Considering how the BIM adoption process has been conducted in other countries such as, the Scandinavian countries, the United States of America, Singapore and United Kingdom with information obtained from this study, full adoption of BIM must also be a gradual process. The recommended way to fully implement the usage of BIM in the AEC industry in Zambia is through apportioning separate roles between the public and private sectors.

3. Conclusion

The purpose of this research was to ascertain whether there was a need to fully adopt Building information modelling (BIM) as an approach to the construction projects life cycle in Zambia and to recommend the most efficient way to implement the adoption of BIM in Zambia.

Findings indicate that there was a need and a necessity to fully adopt BIM information modelling in the Zambian AEC industry. This was because the current 2D CAD approach to design, drafting, construction and documentation had a lot of limitations such as difficulty to visualise and the immense coordination required when using it

The full adoption of BIM must be a gradual process over a stipulated period of time. The best way of implementing this adoption is by apportioning separate roles between the public and private sector. This process can only be successful only if both the public (government) and private sectors takes active roles.

Findings further highlighted that BIM should be adopted in the design and up to the third dimension, but adoption up to the fifth dimension is recommended. This should also be accompanied by adopting BIM up to the construction phase in the project life cycle. This recommendation is put forward because cost estimation is an important part of the design and construction project life cycle and is one of the major problems that the AEC industry in Zambia is facing. Furthermore, this recommendation is based on consideration of the implementation of the adoption of BIM in other countries reviewed in this study.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-036

Urban Growth Analysis for Lusaka City using Remote Sensing and GIS

Lameck Phiri[1], Edwin Nyirenda[2]

Abstract

Quantification of urban growth is cardinal for urban planning. This paper seeks to explore and analyse satellite images for the purpose of detecting the spatial and temporal variations of urban growth for Lusaka City, the Capital of Zambia. Two Landsat images were processed so as to quantify urban growth and, thereafter, a post classification comparison was carried out to provide the details of urban growth from 1986 to 2015.

The temporal and spatial characteristics of urban growth were extracted from satellite images. The results show that urban growth increased, from 1986 to 2015, by 1,080% whilst cropland and forest decreased by 60% and 92% respectively. Urban growth gravitated towards the western side of the city where most of the industries are located. To reduce on the loss of groundwater recharge in the face of urban growth the Local Authority should prescribe pervious materials for car parks, sidewalks and drainage channels.

Keywords: groundwater recharge, impervious surface, Lusaka city, satellite image classification, urban growth

1. Introduction

Infrastructure development, if haphazardly or not properly done, can lead to high surface runoff and loss of groundwater recharge. This is so because infrastructure development has an impact on urban hydrology and climate. The spatial extent of infrastructure development can increase impervious surface which reduces infiltration rate and increases surface runoff, thereby influencing ecosystem processes and biogeochemical cycles (Keller, 2012; USGS, 1998; USGS, 1983 and Subramanya, 2010). Stemming from the impacts of infrastructure development, a lot of research has been on quantifying impervious surface and its effects (Brabec, et al., 2002; Zha, et al., 2003; Dougherty, et al., 2004; Xu, 2007; Wu & Yuan, 2007; Yuan, et al., 2008 and Dams, et al., 2013).

Quantifying urban growth is required for optimal planning of land and natural resources, zonal and regional planning, service allocation and designing urban drainage infrastructure (Jat, et al., 2008). In many studies of quantification of landcover, satellite images from Landsat Program are used because the Landsat Program routinely gathers land imagery from space (USGS, 2012) and provides images freely (Beck & Headley, 2008). This study also takes the advantage of satellite images captured by

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

Landsat Program. The objective for the study was to explore and analyse satellite images for the purpose of quantifying urban growth for Lusaka City.

2. Study Area

This study focuses on Lusaka City, the Capital of Zambia. The City has a spatial coverage of about 45,000ha and a population of around two (2) million (CSO, 2011). Being the Capital City, Lusaka is a central hub of transportation as well as a centre of political and financial administration. The City greatly depends on groundwater mostly from unconfined aquifers for water supply. Groundwater accounts for more than 50% of water supply for the City (Ndogwe, 2015). The elevation for Lusaka City (fig. 1) ranges from 1100 to 1400 m above sea level, with most of the land being above 1200m.

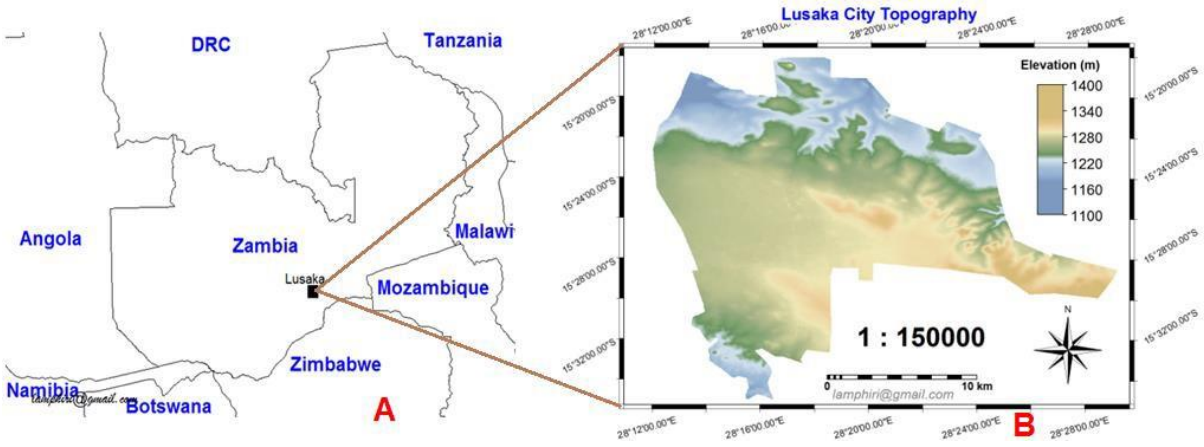


Figure 1: Location (A) and topography (B) of Lusaka City

3. Material and Methods

3.1 Data

Population data was gathered from Central Statistics Office (CSO), Zambia, reports (CSO, 2003 and CSO, 2011). The population of Lusaka was around 800,000 in 1990, one million in 2000 and 1.8 million in 2010.

The digital elevation model for Lusaka was acquired from Global Data Explorer, an online Data Pool, courtesy of the NASA Land Processes Distributed Active Archive Center (LP DAAC), USGS/Earth Resources Observation and Science (EROS) Center. Landsat Satellite images for this project were acquired from the NASA/USGS Landstat program. Level 1 Product Landsat data of zero % cloud cover and spectral bands of spatial resolution 30m were downloaded from "Earth Explorer", a USGS website. The images include a Landsat 5 Thematic Mapper image captured on 17th November, 1986 and Landsat 8 OLI_TIRS image captured on 7th June, 2014. (**OLI** means: Operational Land Imager and **TIRS** means: Thermal Infrared Sensor)

3.2 Satellite image classification

Integrated Land and Water Information System (ILWIS) Remote Sensing and GIS software was used to analyse and process satellite data. Bands were combined to identify dominant landcover for Lusaka

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

City. Identifiable landcover themes included water, forest, cropland, shrubs, savannas, grassland and built-up area (Table 1). The definitions of landcover themes were adapted from International Geosphere and Biosphere Programme (IGBP) DISCover Data Set Land Cover Classification System (Loveland & Belward, 2000).

A supervised classification was carried out based on the land classes in Table 1. Representative cells for each Landcover theme were selected and used as a basis for the classification. Theme selection was done in such a way as to minimize the standard deviation of sample selection. Two sets of theme selection groups were created for classification and validation.

The images were classified using classifiers available in ILWIS: The Box classifier, The Minimum Distance classifier, The Mahalanobis Distance classifier, and The Maximum Likelihood classifier (Gorte, 1998). These classification methods were carried out for each satellite image and the best classified images were selected and validated. Classified images were validated by crossing with independent data themes for each satellite image. Summary statistics, from the above operations, were extracted and interpreted.

Table 1: Landcover classes' description adapted from Loveland & Belward (2000)

No.	Class name	Description
1	Water Bodies	Lakes, reservoirs, streams and rivers
2	Built-up areas	Land covered by buildings and other man-made structures
3	Forest	Lands dominated by trees with a % canopy cover >60% and height exceeding 2 meters
4	Shrub land	Lands with woody vegetation less than 2 meters tall and with shrub canopy cover between 10-60%. The shrub foliage can be either evergreen or deciduous
5	Savannas	Lands with herbaceous and other under-storey systems and with forest canopy cover between 10-30%.The forest cover height exceeds 2 meters
6	Grasslands	Lands with herbaceous types of cover. Tree and shrub cover is less than 10%.
7	Cropland	Lands covered with temporary crops followed by harvest and a bare soil period (e.g., single and multiple cropping systems). Perennial woody crops will be classified as the appropriate forest or shrub land cover type.

3.3 Urban growth

Urban growth from 1986 to 2014 was quantified by generating statistics of Built-up areas for the classified images. The dynamics of urban growth were identified by generation of a landcover conversion matrix, created by crossing classified images.

$$Ur\text{}Gr\text{}th = \frac{Tot\ alarea\ (2014) - Tot\ alar\ ea\ (1986)}{TotalArea(1986)}\text{}100\% \qquad \text{eqn. 1}$$

4. Results and Discussion

From the classified images, the Minimum Distance classifier produced more reliable results than the others. The overall User Accuracy of classified images ranged from 87% to 91% while the Producer's Reliability ranged from 88% to 90%.

The analysis reviewed that Built-up area has increased. This can be is seen from the two classified images in figure 2. Urban growth (built-up area) has gravitated towards the western side of the City. This is so due to the high presence of industries on the western side of the City as well as the preference of workers

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

to stay closer to industries so as to reduce on transportation costs. The expansion of built-up area is also along main roads and around the Central Business District.

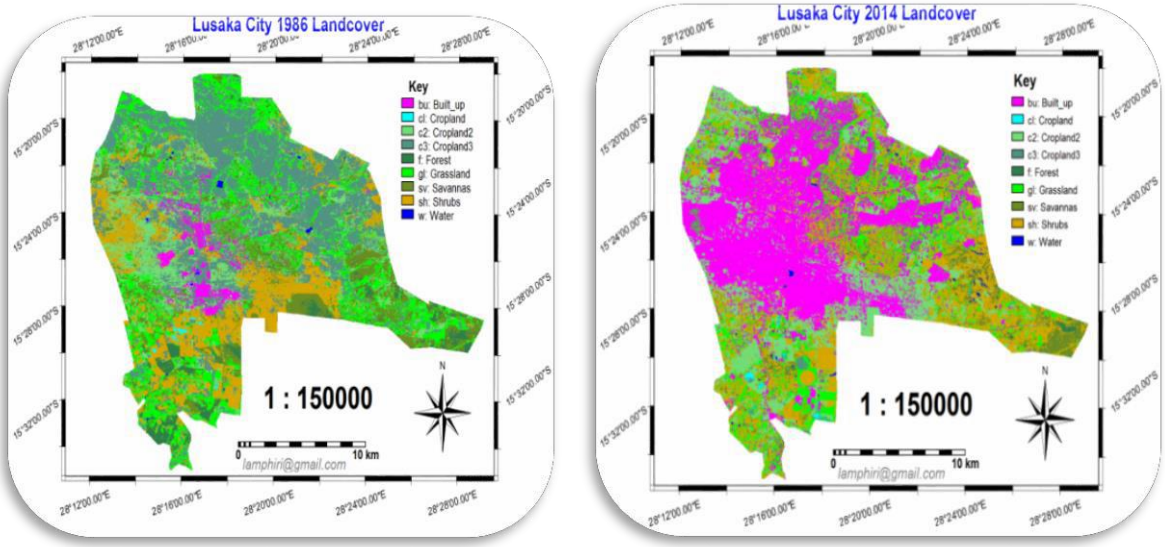
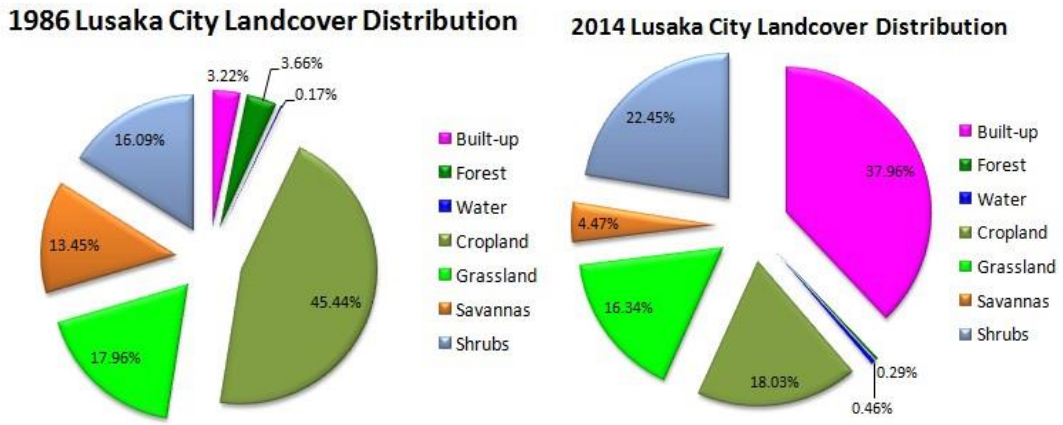


Figure 2: Lusaka City Landcover Maps

Population increase has led to urban expansion and this is confirmed by the data collected from the Central Statistics Office of Zambia (CSO, 2003 and CSO, 2011). The data shows that the population has increased from around one million in 1990 to around two million in 2010. Land parcel variations in terms of %age are displayed in figure 3.

It can be seen that the spatial coverage of urban area (Built-up) increased from below 4% (in 1986) to above 35% (in 2014) of the total area of the City. While the urban area is growing, forest area, cropland and savannas are decreasing. This is likely to reduce groundwater recharge due to increase in impervious surface area which reduce infiltration. Built-up areas create impervious surfaces – a threat to groundwater recharge – through which water cannot infiltrate into the soil, thereby increasing the volume, duration and intensity of surface runoff. Areas with an increase of impervious cover will eventually have a reduction of groundwater recharge.



16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

Figure 3: Landcover comparison for 1986 and 2014

The %age coverage values in figure 3 quantify spatial coverage of landcover but do not indicate the transformed land parcels. The complexity of change can be reviewed by analysing the conversion matrix (Table 2). From table 2 it can be seen that, from 1986 to 2014, built-up area increased by 1080%, whilst cropland and forest decreased by 60% and 92%, respectively. The major contributing landcover to built-up was cropland (10,737ha), grassland (1,474ha) and shrubs (2,478ha). The spatial coverage of water and shrubs increased. Of all the land parcels, the savannas contributed greatly (81ha) to increase in surface water coverage. Cropland, grassland and savannas contributed substantially (above 2,500ha each) to the increase of shrubs. Most of the forests were converted into shrubs (580ha) whereas 36ha of cropland was converted into forest. All in all it can be seen from table 2 that transformation of landcover is dynamic and complex.

For the year 2014 urban land parcels are likely to be under estimated while vegetation and surface water are likely to be overestimated, as the cloud free image analysed was captured a few months after rain season.

Table 2: Lusaka City landcover conversion matrix, from 1986 to 2014

		Lsk2014 Area (Hectares)							
		Water	**Built-up**	**Cropland**	**Forest**	**Grassland**	**Savannas**	**Shrubs**	**Total**
Lsk1986 Area (Ha)	**Water**	**34.56**	1.98	0.63	0.36	13.05	0.54	27.09	**78.21**
	Built-up	7.29	**1,308.24**	57.06	0.27	12.87	0.81	58.77	**1,445.31**
	Cropland	27.09	10,737.09	**3,013.83**	36.27	3,518.91	209.25	2,878.92	**20,421.36**
	Forest	23.49	99.54	240.66	**32.76**	225.99	444.06	579.96	**1,646.46**
	Grassland	18.18	1,473.57	1,177.74	24.84	**2,070.99**	392.22	2,915.55	**8,073.09**
	Savannas	80.55	963.18	866.52	22.68	649.62	**913.59**	2,551.05	**6,047.19**
	Shrubs	14.58	2,478.15	2,748.15	12.96	851.04	49.14	**1,079.37**	**7,233.39**
	Total	**205.74**	**17,061.75**	**8,104.59**	**130.14**	**7,342.47**	**2,009.61**	**10,090.71**	**44,945.01**

Growth	**163.06%**	**1080.49%**	**-60.31%**	**-92.10%**	**-9.05%**	**-66.77%**	**39.50%**

5. Conclusion

Considering the availability of data and the limitation of classifiers, it can be safely concluded that urban growth for Lusaka City is evident. Using 1986 as the reference year, urban growth for the City increased by 1080% in 2014. In terms of spatial coverage, urban area grew from below 4% (in 1986) to above 35% (in 2014) of the total area of the City. The major land parcels that were converted to urban were cropland (10,737ha), shrubs (2,478ha) and grassland (1,474ha). Urban growth gravitated towards the western side of the City. To reduce on the loss of groundwater recharge in the face of urban growth, especially on the western side of the City, the Local Authority should prescribe pervious materials for car parks, sidewalks and drainage channels.

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

6. Acknowledgement

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-055

Using digital mobile GIS tool for occupancy audit, beneficiary administration and maintenance of data base to improve human settlements in Ekurhuleni metropolitan

Molatelo Mabaso[1], Innocent Musonda[2]

Abstract

A perception exists that the Human Settlements Department in most municipalities are unable to meet the increased demand for delivering sustainable and integrated Human Settlements. The many service delivery protests that are experienced in the previously disadvantaged areas/townships in South Africa are an indicator of the underlying problem of not being able to meet the commitments to eradicate or upgrade all informal settlements. Despite some of the achievements in delivering subsidised housing by the Department of Human Settlements, the housing backlog still remains at more than 2, 1 million housing units. The other indicator is the number of informal settlements. This research assesses the benefits of using digital mobile GIS tool for occupancy audit, beneficiary administration and maintenance of data base to improve Human Settlements in Ekurhuleni Metropolitan Municipality. The study has revealed that the use of the digital mobile GIS tool is beneficial for addressing issues related to data required for conducting Occupancy Audits, beneficiary administration and House Inspections in Informal Settlements upgrading projects.

Keywords: data base, GIS, housing backlog, occupancy audit, South Africa

1. Introduction

The new South African constitution addresses and enshrined housing as a basic human right. Section 26(1) of the South African Constitution; stipulate that every person has the right of access to adequate housing. Equally Section 26(2) of the Constitution entrusts the state with the responsibility to realise this (Constitution of the Republic of South Africa, 1996). Consequently the Constitution places a great responsibility on the huge demands on the state to provide housing.

The provision of housing is tasked to the national department of Human Settlement. Documented reports show that the housing supply falls far short of the demand. (National Department of Human Settlements,

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

2010). The demand in the subsidised housing has been growing and will continue to grow making the housing backlog to equally grow.

In view of the increasing housing backlog, the Government of the Republic of South Africa, conceptualised the Breaking New Ground (BNG) plan to address the problem of human settlements and also to address the housing backlog (National Department of Human Settlements 2010). The BNG was designed for the delivery of subsidised housing, schools and roads, and emphasised the creation of communities as opposed to numbers (Lombard 2004). In essence it emphasised development of sustainable settlements and quality housing (Julyan, 2011). As a result, under the BNG, the quality of the housing unit improved in terms of size, materials used had electrical connection and water services as opposed to the previous housing units which in some instances did not have even partitions (Julyan, 2011).

The other aim of the BNG strategy was to try and eradicate the informal settlements which had become prevalent. Unfortunately the increase in the housing backlog has not been reversed as there are more families still living in informal settlements (Hutchinson, 2006).

It appears therefore that one of the main reasons for the delayed backlog eradication is the inefficiencies in the resettlement of the people in the informal areas. The inefficiencies and barriers can be attributed to the difficulties in data capture and cost associated with it. The current study therefore looked at the benefits of using digital mobile GIS tool for occupancy audit, beneficiary administration and maintenance of data base to improve Human Settlements in the Ekurhuleni Metropolitan area.

2. The Study

The purpose of the article was to illustrate how the GIS system is being used to address the administration problems associated with the delivery of and the eradication of housing backlog within Ekurhuleni Metropolitan Municipality, Human Settlements Department.

The paper will attempt to describe the use of the Mobile GIS tool being used by the Department of Human Settlements in the Ekurhuleni Metropolitan Municipality, process of data capturing and the associated benefits.

Therefore the objectives of the paper include inter alia to:

- Analyse the use of the Mobile GIS tool in conducting Occupancy Audits, Beneficiary Administration and house Inspections in Ekurhuleni Metropolitan Municipality;
- Identify the benefits of the Mobile GIS tool in collecting and capturing data for Occupancy Audits and Beneficiary Administration in Ekurhuleni Metropolitan Municipality;
- Identify the challenges of the Mobile GIS tool in conducting Occupancy Audits, Beneficiary Administration and house Inspections in Ekurhuleni Metropolitan Municipality.

The study therefore followed a case study that used a qualitative method of data collection. Qualitative research, broadly defined, is any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification (Golafshani, 2003).

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

The case study looks documents the management of Balmoral Extension 4 which has been identified for Human Settlements Development by the Ekurhuleni Metropolitan Municipality Human Settlements Department.

Ekurhuleni Metropolitan Municipality has over 114 informal settlements which need to be developed and therefore contribute to the achieving of the BNG goals. The plan for Balmoral Extension 4 was to develop an integrated sustainable Human Settlement and achieve the projected yield of 1150 housing opportunities. The occupancy audit was therefore needed in order to assist the Ekurhuleni Metropolitan Municipality achieve the relocation strategy for the informal settlement.

At the end of the project, a total of 3092 households were captured in 17 days in the Balmoral Extension 4 area. With such an unexpected yield of over 100% in terms of households captured namely from a targeted 1150 to 3092, the current study was conceptualised to compare the common method of collecting and capturing occupancy data to the method of using a web based Mobile GIS tool. The comparison was in terms of cost and time implications of the two methods. The other comparison related to data capturing and occupants' interaction issues.

2.1 Web based GIS solution Data Capturing process

The initial process of data capturing when using the web based GIS solution followed in the Balmoral Extension 4 area before the work of conducting the Occupancy Audit, Beneficiary Administration and House Inspections could commence was to get a buy-in from the Ward Councillor, the Local Political Structures and the Community. This process was considered to be critical to the success of the project.

The second step was to collect data from the designated area using the web based GIS Solution. The tool has been configured to collect information on occupancy audits, beneficiary administration and house inspections. The software architecture with GIS functionality is based on two platforms namely:

- On-line application (Oracle Apex Web Based Application) and
- Off-line application (JAVA application on mobile device or tablet with Android Operating System).

The fieldworkers are able to access the off-line capturing module (JAVA application) on the mobile device (tablet with Android operating system) and record the GPS coordinates household information and photographs of supporting documents from the occupant.

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

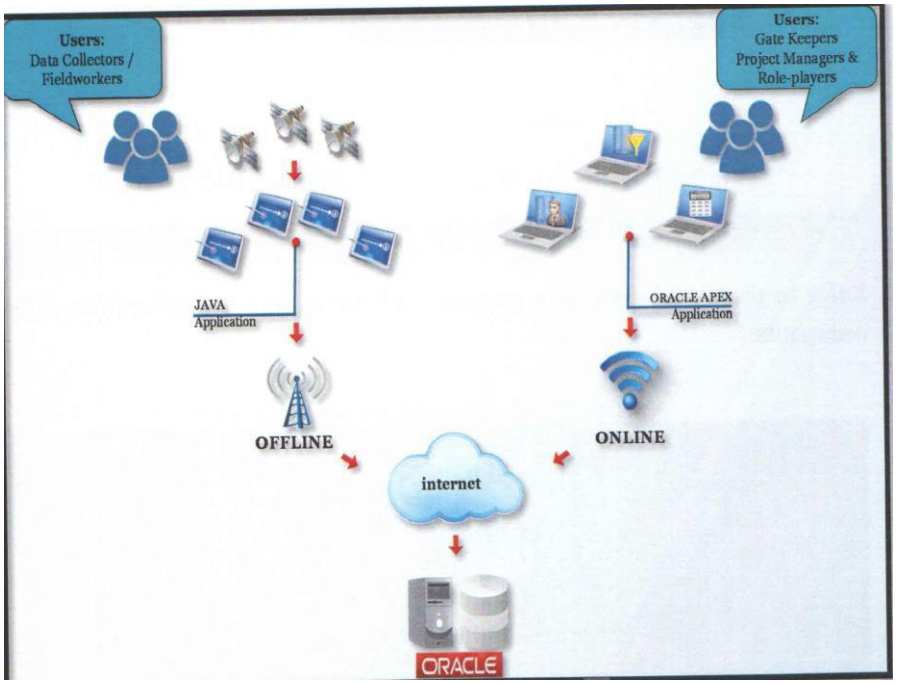

Figure 1: Software architecture.

The On-Line Oracle Apex Web-based application is accessible to all the role players where information is immediately available (real-time reporting). The module allows for the role players to view geographic data, attribute data, supporting documents and reports.

The set-up of the GIS Database at project phase, serve to ring fence the working area, where the families currently reside informally on the site, to set boundaries to ensure that only occupants residing within Balmoral Extension 4 Settlement were included for the data collection, beneficiary administration and the household inspection phases.

Dynamic Reporting techniques make data come alive. Data may be exported in digital form for transfer to other software packages to allow statistical analysis, desktop publishing or further analysis. However, most GIS output is in the form of maps to illustrate trends. GIS is an excellent application for visual and progress reporting. Spatial analysis distinguishes GIS from other types of information systems. All attribute data and images of supporting documents are accessible via the web in real time.

The electronic shape file (ring-fence) served as the backdrop on the mobile device (tablet) and the application only opened when the data collector was within the pre-created ring-fence of the area in order to continue with interviews of the occupants. The pre-created electronic ring fence was loaded onto the mobile devices and fieldworkers were not permitted to conduct data capturing outside of the identified area boundaries.

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Figure 2: Pre-created electronic ring fence loaded to the mobile devices

The Mobile GIS tool enabled 13 fieldworkers to conduct occupancy audits for 3092 households within 17 days.

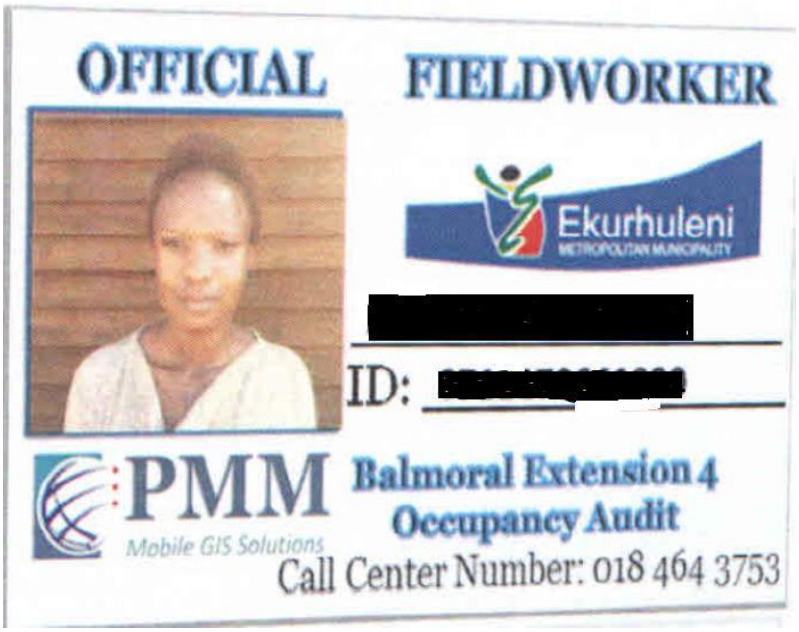

Figure 3: Fieldworker ID card

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

Figure 4: Fieldworkers appointed on the project

3. Findings

The differences in using the web based solution and the traditional method of data capturing methods were appreciable. It was immediately notable that more housing units were documented and the web based system also attracted a significant amount of questions from the occupants. A breakdown of the differences on the above mentioned factors are elucidated upon in the following sections.

3.1 Cost Implications of using the two systems

The cost implication of using the traditional method of resettlement data management, which methods are currently being used by the Ekurhuleni Metropolitan Municipality is illustrated in Table 1.0 below. The traditional method entails performing three distinct operations namely; occupancy audit, beneficiary administration and maintaining of a beneficiary database. The estimated cost for each of these activities is as tabulated in table 1.0. The costing information was obtained from the Instructions to Perform Work (IPW) issued for work on other similar projects. The estimated cost of settlement data management for the Balmoral Extension 4 was estimated to be a total of R1, 443,720.00 (Table 1) if they had used the traditional method of data management.

On the other hand, the number of activities required to be performed reduced from three to one when compared to the traditional system. The resulting cost for using the Mobile GIS tool was also found to be far much less when compared to the traditional methods. The actual cost incurred for the data management, was R504, 621.00 (Table 2).

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Livingstone, Zambia
ISBN 978-0-86970-787-6

Table 1: Estimated cost- Traditional data management method

IPW	Amount	Total Cost
Occupancy Audit	R 350,000.00 per project	R 350,000.00
Beneficiary Administration	R 285-00 per @ 3092 units.	R 881,220.00
Maintaining of a Beneficiary Data Base	R 212,500.00 per project	R 212,500.00
	TOTAL	**R 1,443,720.00**

Table 2: Cost – Web based GIS Data management solution

IPW	Amount	Total Cost
Occupancy Audit, Beneficiary Administration, Maintaining of a Beneficiary Data Base and House Inspections.	R 504,621.00 per project	R 504,621.00
	TOTAL	**R 504,621.00**

3.2 Findings on time implications

From the study, it was found that the entire exercise of conducting an occupancy audit, beneficiary administration, maintain of the beneficiary data base and house inspections using the web based Mobile GIS tool, took 17 days for 3092 housing units. The activities included the collection of household data including the capturing of documents and reporting. In addition, when using the web based GIS solution, access to information is in real time.

At the moment records from the Ekurhuleni Metropolitan Municipality show that traditional methods of data collection, document capturing and reporting take up to four months for a similar number of households.

3.3 Beneficiary administration issues

Although the benefits are clear in terms of cost and time as illustrated above, a number of challenges were observed during the deployment of the tool. The challenges included inter alia:

- Households refusing to participate in the programme and to provide the information to fieldworkers;
- The proof of income was not always available - the information was sometimes taken down but the photo of the payslip was not;
- Identification document were not readily available at all households for spouses or dependants- the occupancy audit is still recorded with the information but the photo of the supporting document is omitted.

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

The challenges associated with the traditional method of occupancy data collection, and reporting were gleaned from data obtained in the Moleleki Extension 1 project, an existing informal settlement in Ekurhuleni Metropolitan Municipality which used the traditional beneficiary data management method. The occupancy audit was conducted in April 2014 and the following challenges were observed:

- Difficulty in appointing capable fieldworkers. The project experienced difficulty to recruit fieldworkers from the area who could read, write properly and fully understand the questionnaire in order to avoid duplications and misinformation;
- Numbering of the housing units (shacks). The numbering on the documents needed to correspond to the physical numbering of the existing housing units;
- Managing the expectation of the occupants. Most of the occupants wanted to know when their houses would be constructed;
- The records of the occupancy audit are only available on hard copies. This constituted a major risk and could impede the process of eradicating the housing backlog.

4. Conclusion

The study identified that the use of the Mobile GIS tool has the ability to improve the methods and efficiency which Ekurhuleni Metropolitan Municipality in general and the Human Settlements Department in particular are using to conduct their occupancy audits, beneficiary administration and maintenance. The benefits of using the Mobile GIS tool have been appreciable and include:

- Cost saving;
- Time saving;
- Accurate data capturing and
- There is no need for trained personnel

The unreliable data that is obtained through the old system can lead to and perhaps has led to poor service delivery. Use of the GIS tool which does not need overly trained people can eliminate this problem and contribute to the eradication of the housing backlog currently being experienced in South Africa.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-046

Strategies for Implementing Value Management in the Construction Industry of Ghana

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Abstract

Construction enterprises in Ghana are increasingly being criticized for works that fail to meet stakeholders' expectations, thus achieving project delivery within a reasonable amount of time; within budgeted amounts whilst ensuring quality. Seemingly, Value management (VM) presents a solution to these problems via the generation of a wide variety of innovative alternatives. However, the concept of VM is in the route of finding a niche in the construction industry in Ghana. Hence, this study presents the strategies for implementing VM in the construction industry in Ghana. To do so, a structured questionnaire survey was used to elicit data from architects, civil engineers, quantity surveyors, project managers, and contract managers belonging to construction and consulting firms in the Ashanti region of Ghana. The results revealed that, development of a successful application model in the context of construction, clarifying clients' perceptions about VM, creation of VM workshops for construction professionals, creation of local guidelines and data on VM techniques, and application of effective techniques and tools in VM as the most significant strategies for implementing VM in the Ghanaian construction industry. The findings of this study may be beneficial to construction professionals who are in quest of innovative ways to implement VM on construction enterprises. A way forward is recommended for future development of VM in the Ghanaian construction industry.

Keywords: construction enterprises, Ghana, implementation strategies, VM, VM process phases

1. Introduction

Presently, Ghana seeks to become a middle income nation in 2015. And with the recent discovery of oil in commercial quantities, the duty of the construction industry is absolutely important (Fugar and Agyakwah-Baah, 2010). However, Ghana like any other developing economy requires a sound construction faculty to sustain economic growth. Thus, the construction industry offers ways of production for most industries. Nevertheless, there are numerous ways for a project to fail. Most often reported is the failure to meet the deadlines, deliver within budget and to the specified quality. In Ghana, most public projects are either delayed or halted due to poor stakeholder management, financial constraints or inadequate regulatory frameworks. Consequently, VM can help alleviate constraints in

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

delivering projects in Ghana via scrutinizing their functions to improve cost savings and clarifying project objectives. The concept of VM is synonymous with terms such as value analysis and value engineering. Subsequently, the Society of American Value Engineers (SAVE) international treats these terms as synonymous (see Fong and Shen, 2000), hence the use of term 'VM' throughout the study. Value management is a structured, flexible, organized team approach to determine the link among projects/products and their function, cost and worth (SAVE International, 2001). Due to the fact that no two projects are the same, VM supposes that with such complexity, unnecessary costs are inevitable. Hence the need to identify unnecessary costs and eliminate them. In 1947, Lawrence D. Miles of General Electric Company in the USA developed VM. In order to achieve a smooth production line at a time of material shortage, Miles developed a system of techniques called value analysis. Due to Miles break through, Dell'Isola also introduced VM in the construction industry in 1963. This paper describes a survey regarding the implementation of VM in the construction industry of Ghana. The paper commences with a review of the VM process phases. This is followed by a description of the research method. Survey results are illustrated and discussed. Lastly, conclusions are drawn and recommendations are made.

2. Value Management Process Phases

2.1 Orientation phase

Primarily, elaborates the problem and prepare the value study (Chougule and Kallurkar, 2012). Coetzee (2009) indicates that during the orientation meeting, the aim is to establish an appropriate understanding of the project and the clients' objectives. During the meeting, other schematic issues are concisely talked over. Consequently, this phase is of prime importance so as to assess the information needed for the study.

2.2 Information phase

At this phase, the VM team gathers information to a feasible extent about the scheme requirements, project design, background, restrictions, and forecasted costs (Jariri and Zegordi, 2008; Sharma *et al*., 2011). According to Chougule and Kallurkar (2012), this phase embraces settling the range of issues to be addressed, targets for improvement, and evaluation factors while building unity among team members.

2.3 Function analysis phase

Functional analysis is an essential part of VM (*cf.* Norton and McElligott, 1995). According to Coetzee (2009), function analysis system technique (FAST) is another way of structuring this phase. Moreover, a technique like FAST has been globally applied in this phase of VM study. Norton and McElligott suggest that function analysis influences a panoptic comprehension of the project by inducing concentrated discussion and stimulating team members to view aspects they might be seldom regarded.

2.4 Creative phase

During this phase, all the team members are provided the opportunity to suggest their ideas for favorable change without panic of blame or slander (Thomas, 2005). Consequently, to aid determine these ideas for effective execution of each function, a group interaction process and brainstorming can be adopted by the VM team. Shen and Liu (2004) add that, open discussion technique is usually adopted in this phase.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

2.5 Evaluation phase

Subsequently, the ideas determined from the creative phase are analyzed and evaluated by the VM team. The best ideas are refined and chosen for advancement into peculiar value improvement recommendations (Jariri and Zegordi, 2008; Sharma *et al.*, 2011; Chougule and Kallurkar, 2012). Nevertheless, Coetzee (2009) indicates that the team members should be objective in the evaluation of the suggestions. Merits should be regarded and demerits of each suggestion should be considered without refusing or consenting a suggestion ahead of time. Developed from suggestions by Norton and McElligott (1995) is a typical evaluation criteria that can be used and are infinite to *Cost*: savings, maintenance cost, life cycle cost, implementation cost, etc.; *Function*: aesthetics, safety during occupancy, serviceability, etc.; *Time*: impact on design time, construction programme, liability periods, etc.; and *General:* political factors, idea buildability, environmental impact, etc. (figure 1).

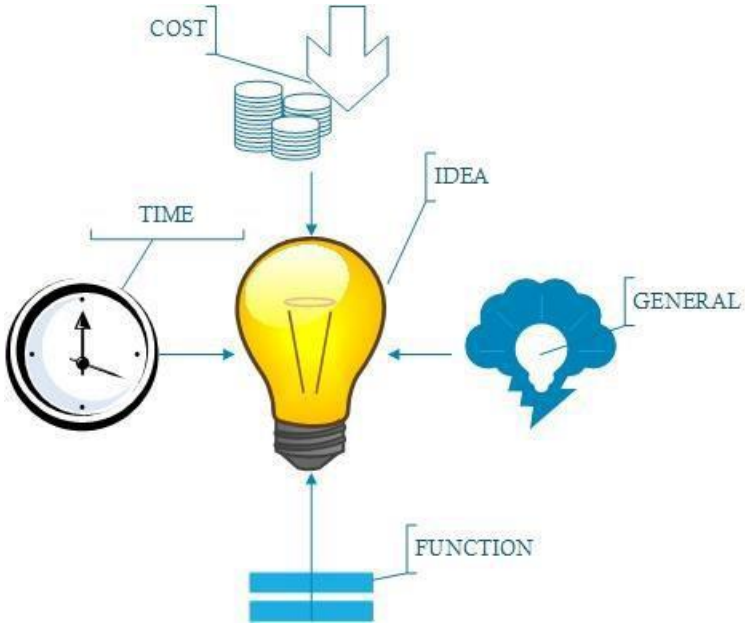

Figure 1: A typical evaluation criteria

2.6 Development phase

At this phase, the analyzed ideas required for implementation are determined. Furthermore, the team investigates the chosen ideas and creates descriptions, sketches, and life cycle cost estimates to support the VM proposal recommendations (Jariri and Zegordi, 2008; Sharma *et al.*, 2011).

2.7 Presentation phase

Primarily, the team presents the VM proposal to the client during an oral presentation at the conclusion of the workshop (Sharma *et al*., 2011). A detailed report must be prepared immediately after the workshop, and the workshop report must then be distributed to the workshop participants (team

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members) to reassert their responsibility in the implementation of the workshop proposals (Male *et al*., 1998; Liu and Leung, 2002).

2.8 Implementation phase

Finally the ideas accepted to be worthy are implemented. Concisely, this phase comprises acquisition of a final approval of the proposal and ease of its implementation (Chougule and Kallurkar, 2012). Though at this phase VM study lessens, Smith (1993) posits that, feedback from the sponsors of the VM should be relayed to the VM team to complete the learning cycle.

3. Research Method

A structured questionnaire survey was conducted among construction (irrespective of financial class) and consulting firms in the Ashanti region of Ghana. Similar questionnaire design was adopted by Bowen *et al.* (2010). Such a survey was appropriate for gathering the scaled opinions on VM implementation strategies. Formulation of the questionnaire was preceded by a literature review on VM process phases and the strategies for successful implementation.

Industrial practitioners were identified in assistance with the building directory of the Registrar General of Companies whilst simultaneously merging with the data obtained from GhanaWeb.com building directory. The survey was achieved by delivering hard copies of questionnaires by hand. The targeted groups were (a) architects, (b) civil engineer, (c) quantity surveyor, (d) project managers and (e) contract managers.

International Business Machines Statistical Package for Social Sciences (IBM SPSS) version 21 was used to analyze the survey results. Respondents were asked rank their opinions on VM implementation strategies on a five-point Likert scale (from 1 – not significant to 5 – very significant). Also, respondents were not obliged to provide the firms details, hence the opinions given can be regarded to be unbiased.

4. Analysis of survey results and discussions

4.1 Profile of the respondents

A total of 80 target respondents were identified and survey questionnaires were administered to them. Effectively, a 100% response rate was achieved. The high response rate can be attributed to the fact that questionnaires were administered personally to respondents and successive follow-ups thereafter. 81% of the respondents were from construction firms whilst 19% of the respondents were from consulting firms in the Ashanti region of Ghana respectively. The questionnaires were completed by architects (30%), civil engineers (25%), quantity surveyors (11%), project managers (26%) and contract managers (8%). Over half of the respondents have more than 11 years of public projects experience. This high level of experience gave relevance to the kind and quality of information that was given out. This illustrates that the respondents have significant experience in the field of the study. On the other hand 36% of the total respondents have public projects experience between 6 and 10 years, with 9% of the total respondents having below 5 years of experience in public projects. The profile of respondents therefore assures the value and reliability of responses.

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Table 1: Summary of VM implementation strategies for developing economies

VM implementation strategies	Literature source
Development of a successful application model in the context of construction	Kermode *et al.* (2000); Abidin (2005)
Clarifying clients perceptions about VM	Male *et al.* (1988); Al-Yami (2008); Alazemi (2011)
Creation of VM workshops for construction professionals	Connaughton and Green (1996); Abidin (2005)
Creation of local guidelines and data on VM techniques	Sigle et al. (1999); Mohammad e*t al.*(2000); Tohidi (2011); Arnautovic and Svetinovic (2012);
Application of effective techniques and tools in VM	Blytheway (1965); Kelly (2004); Abidin (2005)
Synchronizing clients expectations with VM outcome	Kelly and Male (2002); Shen and Liu (2003); Abidin (2005); Al-Yami (2008)
Selection of well-equipped team members	Male *et al.* (1998); Abidin (2005); Al-Yami (2008)
Strong teamwork spirit	Simister and Green (1997); Woodhead and Downs (2001);Abidin (2005)
Law to enforce the use of VM on public projects	Thiry (1997); Daddow and Skitmore (2005);
Enhancement of communication with the outside world	Abidin (2005); Behncke *et al.* (2014)
Continuing government support	IVM (2001); Ramazan and Ali (2006)
Enhancement of publicity about VM achievements and benefits	Sigle *et al.* (1999); Daddow and Skitmore (2005)
Broad acquisition of knowledge by VM facilitators	Green (1992); Woodhead and Downs (2001)
Increase in VM education in higher institutions	Daddow and Skitmore (2005)
Involvement of key stakeholders in VM study	Abidin (2005); Al-Yami (2008)
Inclusion of VM clauses in the design contracts	Daddow and Skitmore (2005)

4.2 Ranking of strategies for implementing value management

Many researchers have adopted the "mean score" method for analyzing data. For instance, Fan *et al*. (2010) adopted the mean score ranking technique to establish the significant levels of critical success factors for using group decision support systems in VM studies. Similarly, Mohamad *et al*. (2014) used mean score ranking techniques to determine the significant critical success factors for VM workshops in the Malaysian construction industry. In this present study, the data collected from the questionnaire survey were analyzed with mean score ranking technique. In establishing the relevance of the variables on the five-point Likert scale, a success criterion was deemed significant if it obtained a mean value of equal to or greater than 3.0 (*cf.* Shen and Liu, 2003; Field, 2005; Ahadzie, 2007). Where two or more variables have the same mean, the one with the lowest deviation is assigned the highest significance ranking. Similarly, the significance level was set at 95% in accordance with orthodox risk levels (*cf.* Ahadzie, 2007). This approach was adopted by Cha *et al*. (2006) in a similar study. Field (2005) suggests that with a sample size of more than 50, the sampling distribution will most times approach normal distribution. Seemingly, this study's sample size (N = 80) is in accordance with Field's recommended.

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In Table 2, the mean ranking of each strategy is tabulated to help elucidate the consensus reached by the respondents.

The mean for each variable including the associated standard deviation is presented in Table 2. Standard deviations less than 1.0 indicate consistency in agreement among the respondents. For this study, the 11 significant strategies in Table 2 report that, only 6 strategies had their standard deviations below 1.0. Suggesting that there might be differences to how these variables were interpreted by the respondents. This could be due to the low awareness and application of the VM methodology. This was evident in the preliminary survey conducted during this study. Respondents were asked to indicate if their company undertakes internal VM studies within the construction project process and if they provide VM services. From a cross-tabulation, 10% of the 80 respondents indicated that their company undertakes internal VM studies within the construction project and 8% also indicated that their firms do provide VM services. As pointed out by Ellis *et al*. (2005), VM in developed economies like the UK has its construction industry developed to become "an established service with commonly understood tools, techniques and style". Although this may be so for developed countries, the situation is definitely blur for developing countries (*cf.* Bowen *et al*., 2010). And Ghana is no exception.

As described earlier, the five point Likert scale (1 – not significant to 5 – very significant) was used to assess the mean score for each of the strategies. Thereafter, the mean scores were used to establish the significant strategies in descending order. See Table 3. The descriptive statistics were computed using the formula:

$$\mathrm{MS} = \frac{\Sigma(f_N X\, s)}{\quad}, (1 \leq \mathrm{MS} \leq 5),$$

Where S is the score given to each strategy by the respondents, ranging from 1 to 5, f is the frequency of each rating for each strategy and N is the total number of responses concerning that challenge. Subsequently, the high rate of response ensured statistical robustness.

4.3 Discussion of survey results

Development of a successful application model in the context of construction (M = 4.538) ranked first by the respondents. Currently in Ghana, the construction industry lacks the required practice model to implement VM in the industry. As pointed out by Kermode *et al*. (2000), the acceptance of such a model should be rigorously planned and developed to ensure maximum benefits from the project. However, an unaccepted model should be analyzed to ascertain what went wrong for future benefit (Abidin, 2005). Consequently, such a model would aid in unraveling difficult technical problems.

Clarifying clients' perceptions about VM (4.063) ranked second. Clarity can be a significant tool for breaking existing perceptions to convince stakeholders to adopt improved and advanced problem solving techniques such as VM, which would tend to set out tasks and objectives with value for money at the forefront of their thinking (Male *et al*. 1988). Nevertheless, some perceptions like VM is cost cutting tool should be repulsed. Rather, Al-Yami (2008) suggest that, VM should be viewed as a medium to address the most difficult features linked with attaining the best value for money into a project by considering both internal and external requirements. Eventually, this will equip all stakeholders to achieve their objectives with the competent use of resources.

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Table 2: Respondents' overall ranking of strategies for implementing VM in the construction industry of Ghana

Significant	Development of a successful application model in the context of construction (4.538, 0.693).[a]
	Clarifying clients' perceptions about VM (4.063, 1.011).
	Creation of VM workshops for construction professionals (4.025, 0.968).
	Creation of local guidelines and data on VM techniques (3.913, 0.889).
	Application of effective techniques and tools in VM (3.900, 0.587).
	Synchronizing clients' expectations with VM outcome (3.675, 1.123).
	Selection of well-equipped team members (3.650, 1.192).
	Strong teamwork spirit (3.538, 1.067).
	Law to enforce the use of VM on public projects (3.338, 0.826).
	Enhancement of communication with the outside world (3.200, 0.770).
	Continuing government support (3.138, 1.220).
Less significant	Enhancement of publicity about VM achievements and benefits (2.738, 1.064).
	Broad acquisition of knowledge by VM facilitators (2.588, 1.015).
	Increase in VM education in higher institutions (2.450, 0.953).
	Involvement of key stakeholders in VM study (1.838, 1.195).
	Inclusion of VM clauses in the design contracts (1.775, 1.369).

[a]Figures in parentheses are the arithmetic mean and standard deviation. Test value = 3.000, significance level at 95% confidence interval. M = Mean, SD = Standard Deviation.

The third significant strategy scored by the respondents is the c*reation of VM workshops for construction professionals* (4.025). Usually, VM studies tend to be distinct at various phases of the project in terms of the duration, scope and objective of the studies and the range of participants (Abidin, 2005), hence the need for a VM workshop. Consequently, the best chance for evaluating needs and challenging critical design choices before they are made can be offered by the creation of VM workshops (Connaughton and Green, 1996). However, workshops should be closely knitted in crucial phases in project development so as to achieve best outcomes. More so, distinct techniques in producing best results are adopted from the workshops.

Fourth among the strategies is the *creation of local guidelines and data on VM techniques* (3.913). Tohidi (2011) indicated that, the provision of required relevant data on VM techniques could be safely relied on for flexibility in its business plan, along with the increasing use of project management leads to improved outcomes. Consequently, such data will aid achieve value for money via optimizing costs, time and quality. According to Arnautovic and Svetinovic (2012), the data provided on VM techniques will aid in the early life cycle, and hence significant to minimize risks. Unfortunately, there is no standard method and formal certification of VM in Ghana. The purpose of a standard method as identified by Sigle *et al*. (1999) is to offer clients and other users of VM with guidelines for its application. The introduction of such guidelines and data on VM techniques will promote the implementation of VM in the construction industry of Ghana.

Application of effective techniques and tools in VM (3.900) ranked fifth. Globally, techniques like Function Analysis System Technique (FAST) diagram has been applied the function analysis phase of VM study. According to Abidin (2005), the tool is useful to comprehend what is being prospected to accomplish in a manner that moves away from preconceived ideas. Another effective technique is the Simple Multi Attribute Rating Technique (SMART), which is part value tree diagram and part matrix analysis method (Kermode *et al*., 2000). SMART is used to determine the best alternative for clients. Values for each branch and its twigs are multiplied (Kelly *et al.*, 2004). After the scores are computed,

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thus producing an aggregate utility rating for each alternative (Green and Moss, 1993). The most suitable alternative can be arrived at by comparing the total scores of the various alternatives.

Ranking sixth by the respondents is the strategy, *synchronizing clients' expectations with VM outcome* (3.675). One of the critical success factors for VM as identified by Shen and Liu (2003) is having uncluttered objectives. Hence it is imperative to rationalize clients' expectations on the outcome of VM to prevent dissatisfaction that would undermine client interest for VM in the future (Abidin, 2005). More so, the clients' needs, demands or projections needs to be open and clear to aid foster mutual understanding in VM proposals. According to Al-Yami (2008), such cooperation will aid identify specific measures to effectually analyze a project so as to improve the maximum number of alternatives to please the stakeholders' needs, requirements and expectations and further make clients seek to attain better value in the project.

Selection of well-equipped team members (3.650) ranked seventh. In every discipline, it is expected to select team members who in the end produce outstanding decisions within the constraints of the available resources. And the VM team is no exception. The findings here confirms that of Al-Yami (2008) who stated that, the VM team engaged in the study mush be highly qualified and experienced to bring forth proper findings. Also the VM team should consist of various disciplines.

In VM, there is the need for members to work in unison. According to Abidin (2005), this will encourage active participation, better communication and information dissemination. This strategy, *strong teamwork spirit* (3.538), ranked eighth by the respondents. For instance, research by Woodhead and Downs (2001) and Simister and Green (1997) identified the significance of a strong teamwork spirit in VM. Accordingly, a strong teamwork spirit could transform human behaviour. As observed by Abidin (2005), this will propel the endeavors and involvement by members in birthing ideas, offering and sharing information, developing proposals, and giving constructive criticisms which will improve the entire performance of VM.

Law to enforce the use of VM on public projects (3.338) ranked ninth. Although, Daddow and Skitmore indicated that the application of VM is becoming a requirement in the development and assessment of projects. For instance, in 1997, Thiry revealed that incentive provisions, or a system of rebates in the USA referred to as VM incentive clauses are massively being welcomed into contracts to formalize the arrangements among the parties for sharing the costs involved in applying VM. However, over a decade, the situation has not been so for Ghana. Hopefully, it is probable that VM will finally become an obligatory requirement in a similar way to quality management in the 1980's (Daddow and Skitmore).

Respondents altogether ranked *continuing government support* (3.138) as the eleventh. According to Tohidi (2011), places countries like the USA, Japan, India and even Saudi Arabia have special attention in this field. Also, VM in the Australian construction industry has receives attention and support from the Australian State and Federal Governments since the early 1990's (Institute of Value Management, 2001).

Earlier discussions in this study reveal the benefits and opportunities of implementing VM and hence needs to be giving the necessary recognition. Though *Enhancement of publicity about VM achievements and benefits* (2.738) was ranked twelve by the respondents, Daddow and Skitmore (2005) argue that the positive effects of VM demand to be better 'sold' to the industry. This will foster VM implementation in the Ghanaian construction industry.

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4.4 Perceptions regarding significant VM strategies: Kruskal-Wallis test

The Kruskal-Wallis test is significantly useful to compare means of more than two groups of samples on an independent variable with relatively small sample size and also to avoid the violations of assumptions under ANOVA (Coates, 2001; Field, 2005). For example, Yu (2007) conducted the Kruskal-Wallis test to examine the difference among the groups (Hong Kong, UK and USA) in her study on "a value management framework for systematic identification and precise representation of client requirements in the briefing process". In this study, the significant variables were subjected to the Kruskal-Wallis test. Here, scores are converted to ranks and the mean rank for each group is compared. The Kruskal-Wallis test was used to examine the significant differences in the mean scores of the dependent variables across the five groups (architect, civil engineer, quantity surveyor, project manager, contract manager). Where the significance level is a value less than 0.05, then it can be concluded that there is a statistically significant difference in the continuous variable.

Table 3 explains that most respondents have different perceptions about the strategies associated with the adoption of VM except 'clarifying clients' perceptions about VM', 'synchronizing clients' expectations with VM outcome', and 'strong team work'. Significance value of these three VM implementation strategies is more than 0.05, which means that respondents have given similar ranking to these VM implementation strategies. However, the eight strategies in Table 3 with their alpha levels below 0.05 indicates the diversity in agreement to the variables. This confirms the high standard deviations recorded in Table 2. Earlier discussions in section 4.2 clearly certifies why such differences in perceptions about the associated variables. As discussed in the said section, this could be attested to the fact that, VM awareness in the Ghanaian construction industry is low. Hence knowledge of the VM methodology in the industry is weak. An inspection of the mean ranks for the five groups (architects, civil engineers, quantity surveyors, project managers and contract managers) presented in Table 3 indicates which of the groups had the highest overall ranking that corresponds to the highest score on the continuous variable. For example, in Table 3, the mean ranks for the groups on the variable 'creation of VM workshops for construction professionals' suggest that, civil engineers (55.95) had the highest score in ranking the continuous variable, with project managers reporting the lowest (30.88).

5. Conclusion and Recommendations

Currently, the state of VM adoption in Ghana is not satisfactory. As this was evident in the preliminary survey of the study, 10% of the 80 respondents indicated that their companies undertake internal VM studies within the construction project and 8% also indicated that their firms do provide VM services. These meagre figures call for concern. The implementation of VM in other countries like Hong Kong, UK, USA, Saudi Arabia and Australia has cultivated enormous benefits such as the increase performance and reduction in costs at all stages of projects. This has led to maximum proficiency in carrying out projects and hence made optimum value for their projects. Not surprising, the Royal Institution of Chartered Surveyors (RICS) named VM as one of the ten 'critical success factors' in seeking to improve value for money. Hence this study sought to explore the significant strategies needed to implement VM in the construction industry of Ghana.

The Kruskal-Wallis test confirmed that, the awareness of VM and its application in the Ghanaian construction industry is low. In descending order of ranking, the significant strategies as indicated by all the respondents are; development of a successful application model in the context of construction; clarifying clients' perceptions about VM, creation of VM workshops for construction professionals, creation local guidelines and data on VM techniques, and application of effective techniques and tools in VM.

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Table 3: Kruskal-Wallis test of VM implementation strategies

Strategies	Architect[a]	Civil engineer	Quantity surveyor	Project manager	Contract manager	Asymp. Sig.	Chi-Square
Development of a successful application model in the context of construction	43.29[b]	27.55	46.61	44.71	48.58	0.017	12.097
Clarifying clients perceptions about VM	48.29	36.15	41.67	33.83	45.42	0.187	6.162
Creation of VM workshops for construction professionals	38.29	55.95	34.67	30.88	40.25	0.004	15.175
Creation local guidelines and data on VM techniques	31.33	53.95	40.11	44.79	17.92	0.000	20.562
Application of effective techniques and tools in VM	52.08	41.00	40.61	22.83	54.17	0.000	28.345
Synchronizing clients' expectations with VM outcome	45.77	38.50	48.89	33.12	39.33	0.281	5.066
Selection of well-equipped team members	50.10	30.20	49.56	30.81	56.75	0.002	17.220
Strong team work spirit	33.75	42.95	41.33	43.93	46.08	0.510	3.295
Law to enforce the use of VM on public projects	48.23	33.95	47.67	32.79	47.67	0.041	9.967
Enhancement of communication with the outside world	49.58	38.03	41.28	31.05	44.33	0.017	12.097
Continuing government support	39.29	25.95	43.28	53.86	42.92	0.003	16.400

Figures in table represent mean ranks by respondents' views and test statistics. [a]Architects: n = 24. Civil engineers: n = 20. Quantity surveyors: n = 9. Project managers: n = 21. Contract managers: n = 6. [b]Mean ranks of variables for respondents. df = 4.

In addition, the findings of this paper suggest that strategies such as; synchronizing clients' expectations with VM outcome, selection of well-equipped team members, strong team work spirit, law to enforce the use of VM on public projects, enhancement of communication with the outside world, continuing

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government support are significant in the fostering of VM in the construction industry of Ghana. Practically, the findings of this study may be beneficial to construction professionals who are in quest of innovative ways to implement VM on their construction enterprises. Considering the empirical discussions in this paper, the significant strategies for implementing VM in the construction industry of Ghana are potent.

Some limitations need to be acknowledged. First, the concern of generalizability is realized by the geographical location. Due to nearness in proximity of respondents, the survey was conducted in only one region out of the ten regions in Ghana. Hence the implications made from this study should be considered suggestive. Future works on VM in Ghana can expand the survey to other regions to further validate the outcomes of VM implementation strategies. Second, like ANOVA, the Kruskal-Wallis test alone does not tell us which of the groups differ regarding the level of agreement of the continuous variables, hence the need to conduct post-hoc tests in future studies. Another limitation of this study is the differences in agreement by respondents regarding the strategies. This is evident in the Kruskal-Wallis test, with alpha levels below the significant 0.05 level. However, to develop expertise in VM, higher institutions in Ghana should embrace the inclusion of VM in their core curriculums. Moreover this will increase relevant knowledge on value for money issues among construction practitioners.

Future research will be carried out to examine the pedagogy of teaching VM in higher institutions in Ghana especially postgraduate construction studies. Also, it would be highly remarkable to investigate further into the creation of VM workshops for construction professionals as this will aid foster the implementation of VM in the construction industry of Ghana.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-011

Application of Value Management Methodologies to Project Selection in the Nigerian Construction Industry

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Abstract

Previous studies have proposed that efficient project selection is one of the critical factors that determine project success. Current realities indicate that end users do not accept certain projects despite attempts by these projects at meeting targets of quality, cost and time. Such is the case of certain government-sponsored projects in Nigeria which gets abandoned or fails to attain full utilization. Policy makers assume they know what the people need without consulting them. The value question is hardly adequately answered and agreed upon across the spectrum of stakeholders. The senario above created the need for this research which explores how value management methodologies can be applied to project selection processes in Nigeria. The study adopts mainly the review of literature of value management. The findings showed that a more inclusive, benefits-oriented, value-laden project selection process will lead to a decrease in unused and underutilized public projects in Nigeria, and thus, improving end user satisfaction. This supports the position of established literature and scholarly position in the field of value management which emphasized team-oriented, stakeholder-inclusive processes.

Keywords: construction industry, project selection, project success, stakeholders, value management

1. Introduction

Studies on value management (VM) by Thiry (1997), Kelly et al. (2004) and Stewart (2005) focused on its use as a methodology to improve value of construction projects. Thiry (2004) set the pace for this research. The writer argues for the use of VM methodologies as means of achieving stakeholders' expectation in the most effective way. More recently, Olanrewaju and Khairuddin (2007) and Oke and Ogunsemi (2011) advocated for the use of VM as a tool for value delivery in the Nigerian construction industry (NCI).Therefore, this paper reviews the current level of VM applications in the NCI, evaluates the applicability of VM methodologies in project selection and proposes VM methodologies for enhanced project selection.

According to the Central Intelligence Agency (CIA), 2015), Nigeria is a country with a population of over 180 million. Infrastructure deficit is one of its current challenges. It is of utmost importance that the government use its limited resources to meet the need of its ever increasing population in the most efficient manner. Delivery of projects is a major means of achieving infrastructure development (Construction Industry Development Board (CIDB), 2011).The Government has to determine which of

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Livingstone, Zambia
ISBN 978-0-86970-787-6

these proposals is best for the society while achieving economic and social benefits. Thus, for these projects to be successful there must be continuous support by all the stakeholders as well as the availability of adequate resources (Association for Project Management, 2006). Therefore, embarking on a project that lacks the support of major stakeholders and most importantly end users is futile. All stakeholders must be involved in the process of project selection (Pinto, 2010). Value Management promises an all-inclusive, team-based approach in the delivery of optimum value to the clients.

2. Literature Review

2.1 Value management

There is a consensus among researchers that what is currently known as Value Management has its roots in the works ofMiles of the General Electric, United States o0f America (USA) (Stewart, 2005). Value management was then described as Value Analysis. This approach which was developed as a problem-solving method sought to substitute materials in existing designs. The earliest application of Value Analysis was in 1940's and was in the manufacturing sector.

Yan (2012) defines value engineering, also known as value analysis, as function analysis of a product or job in other to increase the value. He argued further that value projects involve three basic units; the value, the function and the life cycle cost. Thus:

$$\text{Value (V)} = \text{Function (F)}/ \text{Cost (C)}.$$

He posits that on application of this concept to construction projects the following holds:

$$\text{Value (V)} = (F + Q)/ (C+ T) \qquad \text{where F = Function, Q = Quality, C= Cost, T= Time.}$$

Some authors argue that Value Engineering is a process that can be applied all through the product development phases or project lifecycle (Yan, 2012).

According to Kelly et al. (2004), VM is the process in which function benefits of a project are made explicit and appraised consistent with a value system determined by the Client. The Client is required to explicitly and implicitly establish a value system for the project.

The United Kingdom (UK) Construction Industry has adopted VM tools, techniques and methodology (Thiry, 1997 and Kelly et al. 2004). It has since been adopted by many countries such as New Zealand, Germany, France, India, Japan, Saudi Arabia, Hong Kong, Australia, France and Malaysia to mention a few (Jaapar et al., 2011, Kelly et al., 1998, Fong ,1999). The initial reason for theadoption of VM by most countries is itscost saving benefits.

Value management has become a well-established tool in the UK Construction Industry mainly benefitting from a strong case made for its continual use by reports such as Latham (1994), Egan (1998), National Audit Office (2001) and other recent enquiries.

The use of VM has moved from manufacturing to construction, strategic planning, process re-engineering, organizational change and concurrent engineering. To this end, modern applications of

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ISBN 978-0-86970-787-6

value management continue to emerge making it a powerful tool for entrepreneurial development (Jay and Bowen, 2013).

Value management as practiced in the United States (US), has design teams separated from the audit team that perform VM. This situation allows for professional rivalry, design responsibility and some legal complexities. Value management as practised in the UK in recent time has the design team being integral part of the audit unit even though certain scholars argued this has its demerits such as the design team insisting the old design is the best possible outcome (Jay and Bowen, 2013).

2.1.1 Progression in the development of value management

The flow diagram in Figure 1 represents the ideological emphasis in the development of VM. At the beginning, the emphasis was on the cost reduction advantages of the Value Methodology. As its application in manufacturing increased, it became a quality tool. Further, its use deepened in Construction, it was used to achieve time and performance objectives. In recent time, the application of VM has increased to other areas of human endeavour and hence its use in attaining a variety of articulated measures (Akram et al, 2011).

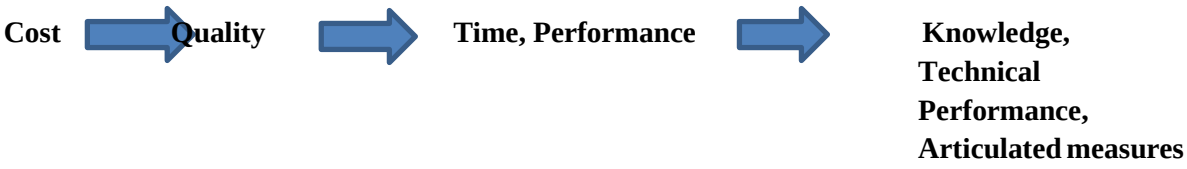

Figure 1: Development of value management (Source: Akram et al., 2011)

2.1.2 Advantages of value management

According to Akram et al. (2011) and the Institute of Value Management (2015), the benefits of adopting the VM approach on projects are as follows;

a) Value definition: It helps in understanding what value meant to the owners and users of the project.
b) Balancing expectation: It serves as a means of optimising the balance between different stakeholders' needs and expectations.
c) Enhancing project brief: It forms the basis for improving the project brief that reflects the sponsors priorities and expectations expressed as a function.
d) Communication tool: It provides anopportunity for communication so that all stakeholders are aware of constraints, limitations, and requirements for making appropriate trade-offs.
e) Design Development: Allows for theimprovement of design and performance enhancement in a collaborative environment.
f) Value Measurement: Provides a functional mechanism for measuring value by considering monetary and non-monetary benefits. A good way to evaluate value for money.

This paper explores how these benefits can help achieve better project selection in the NCI. It has been argued that VM can achieve these key elements that have also been linked to successful projects (Thiry, 2004). Thus, it is desirable to seek its use in the NCI.

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However, since its introduction into construction projects VM has faced challenges that impeded its successful application argues Green and May (1990). Some people misconceive VM as solely a cost reduction process (Jaapar, 2000). Hence, claiming VM is only about lowering the cost of construction projects. This proposition shows a narrow perspective of VM and provides a restrictive use of its methodologies.

In a recent research, Hamid et al. (2011) propose an Integrated Value Management model. The model seeks to integrate Value Engineering, Risk Management and Partnering into the existing VM framework. The study argued that if justified by further research the model stands to deliver better results in the Malaysian Construction Industry rather than justvalue for money by addressing key stakeholders need, handling uncertainties and fostering collaborative relationships. Also, Leung et al. (2003) argue that consideration of the human dimension/behaviour in VM workshops is very vital in obtaining a holistic view of the entire management process.

2.2 Project selection

Today, the challenge of project selection is a real one. To choose the best among several alternatives and competing demand for scarce resources is challenge for most organizations and clients (Pinto, 2010). However, selecting a novel project is not fulfilling in itself if it doesn't meet the greater aspirations of the major stakeholders (APMBOK, 2006). Identifying the needs of the owners of a project, balancing expectations from different stakeholders and enhancing the project brief so that the project is the best option for the client has been identified as one of the key functions of value management in construction (National Audit Office, 2001 and Akram et al. 2011).

Traditionally, Project selection is made after considering which of the proposed projects meet the client's needs most after comparing with certain pre-determined requirements. Several analysis methods have been applied to project selection based on decision models.

The Comparative Approach adopts the benefits measurement methods. The approach chooses the best from a pool of alternatives using; Cost/Benefits Analysis, Internal Rate of Return, Net Present Value analysis, Scoring Models, Economic Models, and Discounted Cash Flow. This is essentially the use of financial models(Pinto, 2010).

The Mathematical Approach adopts the Constrained Optimization Methods. This approach uses Analytical Hierarchical Process(AHP) and Analytical Network Process (ANP).Cheng and Li (2005) argue that ANP can be useful in dealing with inter-dependent relationships in a multi-criteria decision making environment. This process adopts a five-level project selection model which analytically prioritizes the projects under review. This position is supported in the study by Ebrahimnejah et al. (2002) which integrates a modified ANP and an improved compromise ranking method known as VIKOR for optimal selection of projects.

2.3 Nigeria construction industry in context

The construction industry in Nigeria is a collection of loosely integrated sub-sectors that collectively construct, alter and repair buildings and civil engineering works. The uniqueness of the industry is

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derived from the type of physical products, demands patterns, novelty and varying site conditions it operates (Andawei and Nyeke, 2001). Arguably, the Construction Industry in Nigeria is also one of the biggest employers of labour in the country after governments at the federal, state, and local levels (Nwaogu, 1988).
The Industry makes asignificant contribution to the country's gross capital formation and gross domestic product (National Bureau of Statistics (NBS), 2015).The real GDP for the country for 2010 was ₦54,612,264.18 million in which construction sector's contribution was N1,570,973.47million. This implies a share of 2.88%. The construction sector grew by 21.30% to reach ₦1,905,574.90 million in 2011. A reduction in growth rate of the construction sector by 14.86% resulted in the sector closing at ₦2,188,718.59 million in 2012. Hence, the share of construction to GDP that same year stood at 3.05% (NBS, 2015).

The delivery of services and works to prospective clients in the construction Industry follows a variety of processes. It is often the case that the mostly used procurement option in the country is the traditional one or two stage method (Ogunsanmi and Bamisile, 1997). This method emphasizes the separation of the design and the construction stages of a project. Recent developments have shown the adoption of more integrated systems such as Management Contracting, Construction Management, Build, Operate and Transfer (BOT) and Public Private Partnerships, Private Finance Initiatives and Partnering which are at their infancy in the country
(Babatunde et al.,2007).

2.4 Challenges of project delivery in the Nigerian construction industry

Projects delivered by Governments at all levels (Federal, states and local governments) in Nigeria have suffered set back due to lack of adequate inclusion and rigourous consultation with major stakeholders amidst other factors such poor choice of location, improper needs analysis, project imposition, lack of finacial analysis, wrong choice of procurement route, inadequate social analysis and corruption(Hanachor, 2012; Ingwe et al., 2012).Projects like the Tinapa Business Resort,Calabar((Eja and Eni, 2014) and Eyo C. (2011)); The Gateway International Market, Owode Yewa (Punch, 2012), Gateway International Market, Sagamu are examples of projects where inadequate consultations with key stakeholders at inception have led to near failure of the projects after delivery. Otherprojects were not delivered at all as they fall under the category of abandoned projects (Ingwe et al, 2012).

The senario above occassioned the need for better project selection becausethe projects were built at great cost to the people of the country as enormous public funds were committed to the projects.

2.5 Current value management applications in Nigeria

From literature, it is affirmed that the subject of VM and its applications in Nigeria is poorly researched. Studies by Olanrewaju and Khairuddin (2007) indicated that the knowledge and practice of VMis just gaining ground in the country. Likewise, in their study,Oke and Ogunsemi (2011) interviewed a sample of professionals in the construction industry on the subject of VM. Their findings indicatedthat less than 40% of the study population have knowledge of the subjectarea. Only a small %age actually admitted participating in any form of VM workshop. The study suggested that the following factors have impacted negatively on the adoption of value management in the country; unstable economy, government policies, professional incompetence and poor management.

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The use of VM in the country is still at its infancy. However, this does not prevent the use of its established methodologies which has improved the way projects are delivered in other countries of the world such as Germany, Japan, Malaysia and South Africa.

1. Methodology

This paper employs an exploratory review of literature through desktop study of leading journals and academic repositories on the subject of VM. The paper examined literature from peer reviewed articles, journals such as IEEExplore, Emerald, ScienceDirect, textbooks, government websites and online resources.

2. Lessons Learnt

Most of the models and tools used in project selection are based on the assumption that the Clients'/Stakeholders' needs are known. This assumption of knowledge of client's need forms the basis for drawing criteria against which projects are ranked or weights created for evaluating the various options (APM, 2006). The gains outlined as the benefits of VM indicate that VM is veritable tool in aggregating the desires of Clients/stakeholders. This researcher argues that only when the needs of a client/stakeholders are well established can the established models of project selection yield expected results.

The existing reality is that VM practise in the form of Charette, The Forty Hour Study, Value Engineering Audit and Contractor Change Proposal are new in the country (Japaar 2000; and Olanrewaju and Khairuddin, 2007). There is little documented evidence that VM methodologies are applied to construction projects not to talk of documented VM workshops. However, this does not mean that it is not existing and does not prevent scholarly research and raising legitimate argument with policy makers on the subject due to its anticipated and proven benefits in South Africa, Malaysia, United States of America and England.

The literature suggests that VM could be legislated as a requirement by law in the Procurement Act just as it is in the US since the 70's where it is a legal requirement for certain level of public contracts (Jay and Bowen, 2013). Also, addition of value engineering contract as integral part of construction contract is one of the ways of ensuring that the benefits of value adoption are distributed in ways agreeable to all the parties to the project (Zhao et al. 2010). At the construction stage, increasing the value of building products and reducing production costs mainly depends on the contractor. Hence, there must be sufficient motivation for the contractor to buy into the value concept.

Also, this paper shows that though the use of Value Management is still at its infancy in the country, benefits-oriented and value-laden process of VM would help ensure better project selection by mitigating the challenges of the construction industry identified most especially stakeholder involvement. This is because stakeholders' needs and expectations would have been aggregated in the VM process.

3. Conclusion

Value management and its methodologies are not new, however the application into several fields of human endeavour has emerged over time. What is new according to this research is the application of

ISBN 978-0-86970-787-6

VM to project selection in a developing economy like Nigeria. In light of the above, an exploratory

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literature research technique was adopted in this research to determine the extent to which application of VM methodologies can be applied to project selection in the NCI in such a way that the needs of the stakeholders are met.

This study concludes that VM methodologies can be applied to project selection in Nigeria and it stands to deliver on the promise of better project selection that meets the aspirations of the stakeholders. The study also establishes that the benefits of Value management will lead to stakeholders owning delivered projects and ensuring their success.

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ISBN 978-0-86970-787-6

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Livingstone, Zambia
ISBN 978-0-86970-787-6

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INFRASTRUCTURE LEADERSHIP AND GOVERNANCE

Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-014

Challenges of joint ventures in the construction industry: Literature review

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Abstract

New opportunities are constantly emerging as a result of globalization which allows local firms to enter into international construction markets. As a result, joint venture (JV) construction projects are becoming common place which results in increased exposure of organizations to worldwide business markets. The formation of JVs between construction companies has become one of the recent efforts in combating contractors' problems as they are confronted with multiple challenges. Therefore, the current study sought to identify challenges or risks encountered by JVs in the construction industry. A literature search relative to challenges and risks of JV projects in the construction industry was conducted. Thematic analysis was conducted to establish the various categories of risks and barriers to JVs in the construction industry. Key findings reveal that challenges encountered in JVs formation are: inadequate staff training, the number of parties involved as well as collaboration of people from different cultures. Other challenges encountered by joint ventures that are less significant relate to the lack of clarity of the JV partner, unequal sharing of risks and benefits and an irregular pattern of operation as well as unstable relationships. The study highlights potential challenges involved in JVs. Consequently, by addressing these challenges, interested and concerned parties (contractors, consultants, owners) could improve the JV relationships before contracts are signed.

Keywords: challenges, construction industry, joint venture, projects

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

1. Introduction

According to Fitzpatrick, Hecker and Hazard (2011:1), JVs have become increasingly common in the construction industry. Issues related to the formation and operation of JVs for construction projects have been the subject of considerable commentary. The Construction industry development board (CIDB, 2004:1) indicated that, the creation of joint venture will mainly depend on: the size of the project, where the project requires specialist skills or abilities, where the skills and expertise of emerging firms can be developed through their association in JVs with well-established experienced companies. Therefore, the use of JVs is a crucial weapon to alleviate projects issues particularly related to delays and disruptions, poor site management, time and cost variations, skills and competence issues.

Knowing that JVs are a useful vehicle for collaborative housing development and future private rented sector projects, it is regarded as a speculation for profit (Umunna, 2014:1) where the risks and rewards (benefits) are shared by two or more parties (Construction industry development board, 2004:1). Yet, Talman (2009:180), in his study undertaken in Swaziland, made an important observation, where, JVs make for a thought-provoking paradox as the popularity of joint ventures is as high as the %age failure of its operation. Similarly, Govindan, (1995:2) supported this previous argument by highlighting the fact that international construction firms have extensively used JVs as a vehicle to enter new construction markets, yet, the failure rate of such ventures has been quite alarming.

Indeed, risks are innate in JV construction projects and include the agreement of the contract, partner selection, potential financial distress, improper project feasibility study, project delay, inadequate forecast about market demand, loss due to bureaucracy for late approvals and design changes have been identified worldwide (Kwok et al., 2000:4; Shen et al., 2001:77). Thus, the main objective of this study is to identify the key issues that contribute to the successful delivery of JV construction projects. Observing these key issues or challenges will influence the increasing success of the JV construction projects performance.Hence, the researcher has decided to first highlight important aspects of JV and progressively identify the possible challenges faced by JVs.

2. Overview of joint venture

2.1 Definition of joint venture

A JV is the most common form of organizational structure where the partners wish to establish and operate a jointly owned business (Kale et al., 2013: 60). Thus, a JV, unlike a partnership, will have a distinct legal entity and also have a certain time limit. Kolbehdari and Sobhiyah (2014:373) further highlight that JV is a specific type of long-term alliance among the partners which creates an exceptional opportunity for combining distinct merits and complementary resources. Thus, it can be said that JV is a prospect to share the risks and costs in order to advance knowledge, to enter new markets, and economic saving. Moreover, JV provides strength in terms of achieving goals of construction companies, whilst offering a unique opportunity to combine the distinct competencies and the complementary skills of participating firms (Kale et al., 2013: 60).

In the same way, JV is commonly named partnering as it is a relationship between two or more companies or organizations which is formed with the express intention of improving performance in the delivery of projects (Azlan-Shah et al., 2010:328). Similarly, Matschulla and Rittmann (2012:6) emphasize that a JV takes place when two or more parties come together to take on a combined task

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Livingstone, Zambia
ISBN 978-0-86970-787-6

which can be a project or a series of works for a specific operation only or it can become a continuing business relationship. A JV is therefore, the commercial agreement between two or more companies in order to allow superior work quality and cooperation towards achieving a common aim, through the management of the appropriate resources.

2.2 Types of joint ventures in construction projects

Indeed, the selection of an appropriate legal form of JV needs to take into account the goals of the JV operation, as it would limit problems and thus reduce the exposures faced in such corporation. It is important to discover that there are numerous types of JVs encounter during the course of construction projects which include three common legal forms of JV, i.e. contractual or consortium joint venture, partnership joint venture and corporate joint venture which is the incorporation of joint venture as a limited company (Kwok, 2006:3). However, according Zhang (2011:21), there are three types of consortiums: non-equity joint venture (non-integrated joint venture/ Project-based), equity joint venture (integrated joint venture/ Traditional type) and combination joint venture (Contractual type).

2.2.1 Non-integrated joint venture

This type of JV, on the contrary to the integrated joint venture, has as primary characteristic, not to be a partnership in that there is no sharing of profit and losses and each member is taken for a specific scope of work and is responsible for the profit and losses associated with that specific scope of work (Kale et al., 2013: 62). Furthermore, Hong and Chan (2014:5) and Zhang (2011:21) highlight that, the non-integrated JVs are usually used when parties to a JV each have isolated scopes of work and the JV is being formed simply to satisfy a particular requirement demanding a joint bid, where responsibility for the contract habitually has to be assigned to a JV board. The work and obligations making up the contract are broken down into discrete elements usually on the basis of locality, the nature of the work, or the capabilities and resources required where each element is assigned to a specific member of the JV who assumes full responsibility for its execution, under the direction of the JV (Construction industry development board, 2004: 63).

2.2.2 Integrated joint venture

Integrated JV according to Kale et al., (2013: 63) has as primary characteristic to represent a true partnership, in that the parties share profit and losses and the interest may be 50:50 and there may be two or more members. However, the integrated JVs may otherwise refer to jointly managed JVs (JMJ) where the parties fundamentally agree to perform their work as if it was performed by a distinct corporation having numerous stakeholders (Hong & Chan, 2014:5). In other words, the integrated JV is adopted when the parties to the proposed joint venture expect to perform their work on an incorporated basis. This type of JV is used in projects which are of an immense size and the task of splitting the work is very difficult (Kale et al., 2013: 64). As a result planning and programming can become complicated and requires highly structured and authoritative central management (Kale et al., 2013: 64).

2.2.3 Combination joint ventures

In addition to the types of JVs encountered in construction projects, there is the combination joint venture type which is used in larger and complex projects. It is a combination of an integrated and non-integrated joint venture (Kale et al., 2013: 64). According to Kale et al. (2013: 65), each member takes

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ISBN 978-0-86970-787-6

on specified scope of work and is responsible for the profit or losses associated with that scope of work. But the member also agrees to act as a partner with respect to a portion of the necessary work, which may include sharing the preliminaries and general conditions necessary for each member's separate scope of work, as well as the actual performance of the portion of the work of the project (Kale et al., 2013: 65).

2.3 Reasons for forming joint ventures in construction projects

Zhang (2011:20) states that, a JV is constantly used as an essential means to conjoin contractors in construction industry. However, the motivations of entering into JVs in construction industry depend on the area of operation. For instance, in Japan, construction JVs are used to develop the chance of acquiring projects by small and medium-size companies. Moreover, in China, construction JVs are means for foreign companies to evade government policy. Just as in manufacturing industry, JVs are also used to expand market, to share risks, to reduce cost or access cheaper materials and resources as well as to transfer technology in construction industry (Zhang, 2011:20). Moreover, the motives of JVs formations are further summarized by Zhang (2011:21) in Table 2.1 as follows:

Table 2.1 Reasons for the formation of joint ventures (Zhang, 2011:21)

1	To partake in overseas project or to undertake the major project
2	To develop market
3	To spread financial risk
4	To reduce cost by accessing the cheaper manpower, materials and resources
5	To transport outside expertise/technology
6	To acquire management skills
7	To evade government policy about foreign investment constraints

3. Challenges or Risks of Joint Ventures

In general, JVs help firms in accessing new markets, knowledge, capabilities, as well as other resources. Yet, these operations could be challenging to achieve as they are owned by two or more parent companies (Beamish & Lupton, 2009:75). These companies may have opposing or dissimilar objectives, variances in management style as previously discussed in the previous sections of this paper. However, those challenges can be clustered under the following points when it comes to the challenges of JVs:

3.1 Ambiguity in each partner`s responsibility

Lack of clarity of partner implies defining the extent of authority of each of the key individuals in the JV project (Kolbehdari & Sobhiyah, 2014:13). Some ventures require the active participation of both parents to be successful, while others do not (Kale et al., 2013:65). In the case of a 50-50 JV, which is the case of an integrated joint venture, matters are more complicated when the minority partner wishes to participate actively in the decision-making (Kale et al., 2013:65). To be more precise, the parents of a proposed partnership must articulate their assumptions and involve key people during the negotiations to define the contributions the partners will make and the benefits they expect (Kale et al., 2013:65).

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ISBN 978-0-86970-787-6

3.2 Unequal sharing of risks and benefits

Indeed, it is very important to resolve issues dealing with the values generated by the venture before finalizing the project (Kale et al., 2013:64). Therefore, ensuring an equitable risk-benefit ratio is fundamental to the longer-term health of the alliance (Kale et al., 2013:64). As in a JV, the partners should cooperate to achieve the JV desired objectives and hence complete the desired value creation (referred here as: growing the pie) (Talman, 2009:188).

On the other hand, Talman (2009:188) emphasized that partners will almost obviously compete to share the anticipated benefits (referred here as 'getting the largest slice of the pie'). And thus, the competitive perspective would mean that, all partners would perform in order to learn from the other partner which would therefore have a damaging impact on the JV performance.

3.3 Irregular pattern of operation and unstable relationships

Kale et al. (2013:64) puts forward the idea that a JV will get off to a successful start as long as it settles into a normal pattern of operation and stable relationships. As a result, effective day to day routines need to be established and problems arising from the activities will be predictable (Kale et al., 2013:64). Conversely, it is further articulated by Talman (2009:188) that, the management of JVsis about creating good relationships between partners as well as enhancing trust; yet, the most difficult events in JVare those that have the potential to put the parties against each other (Kale et al., 2013:64).

However, there should be exit mechanisms so that when conflicts escalate beyond a certain threshold and the parties no longer feel they can work with each other, this exit mechanism will be in place, thus avoiding costly and time-consuming litigation.. Therefore, to avoid having to exit a venture that has by one measure or another failure, the partners need to step around the minefields.

3.4 Inadequate staff training & misunderstanding of partnering concept

In fact, inadequate staff training is the essential reason for JV failure, where the participants do not fully understand the concept of a JV and consequently are not able to implement partnering successfully (Kale et al., 2013:64). This problem causes further issues to the formation of joint venture construction projects according to Kale et al. (2013:64) which is the misunderstanding of the partnering concept as participants failed to understand how the partnering relationship could provide a competitive advantage. According to Minja et al. (2012: 34), limited experience in the partnering approach affects the understanding and knowledge of project participants.

3.5 Collaboration of people from different cultures & the number of parties involved

Indeed, the collaboration of people from different cultures with different attitudes may cause improper communication, which will result in conflict and may cause the collapse of the JV (Kale et al., 2013:65). Kolbehdari and Sobhiyah (2014:13) as well as Beamish and Lupton (2009: 85-86) emphasized that, it is important for the partners to be aware of cultural differences as it can affect the successful performance of the JV. In other words, the prospective conflicts in any JVs exists due to the differences of partners involved, which may be further amplified as a consequence of the different cultural backgrounds of partners (Hong & Chan, 2014:12). Moreover, with the issue of difference in cultures,

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Livingstone, Zambia
ISBN 978-0-86970-787-6

compatible objectives are difficult to inaugurate between partners who come from different cultures (Govindan, 1995:51).

It follows then that, the number of parties may be another challenge to the success of the JV construction project since the decision-making is normally slowed down (Kale et al., 2013:65). Moreover, Julian (2008:4-5) argued that the number of partners involve in JV operations may result in conflicting desires of parent firms for cooperation and their autonomy. As a consequence, there is considerable evidence to suggest that there is a significant inverse relationship that exists between the level of conflict and the performance of joint ventures.

Similarly, García-Canal et al. (2003:743) highlighted that the number of partners participating in a JV represents a dimension of complexity that may disturb its effectiveness, which is, the extent to which a main partner's goals for the alliance are fulfilled. In other words, García-Canal et al. (2003:743-744) expresses that the number of partners conditions the proper management of joint ventures as it could result in conflicting interests, operational asymmetries, poor coordination of the activities that would make it problematic for the firm to accomplish their full potential in the joint venture.

4. Methods

In the present paper, the theory regarding JVs and their general challenges are assessed and identified. Journals, theses, books and government reports which included authors such as Kwok et al. (2000), Kale et al. (2013) as well as Shen et al. (2001) were reviewed. The researcher then conducted a systematic thematic analysis. A thematic analysis is a systematic approach to the analysis of qualitative data that involves identifying themes or patterns of cultural meaning, coding and classifying data, typically textual, according to themes; and interpreting the resulting thematic structures by looking for commonalties, relationships, overarching patterns, theoretical constructs, or explanatory principles (Boyatzis, 2008:1; SAGE Research Methods, 2013:2). Thus, the researcher reviewed the data, took notes of challenges of JVs in construction projects and sorted them into specific categories or points with the objective to identifying the key issues that are encountered by JV partners when entering JV agreement.

5. Findings

Joint venture operations may encounter challenges during the course of execution of JV projects. Indeed, these challenges have repercussions on the JV operation and therefore they should be strategic in order to avoid collapsing of the JV agreement. Results from the existing journals, theses, books and government reports revealed that the highly perceived challenges in joint venture operations include: unequal sharing of risks and benefits; irregular patterns of operation and unstable relationships; as well as misunderstanding of partnering JV concept. However, the lack of clarity of your JV partner seemed to be considerable and finally, inadequate staff training; the number of parties involved; as well as collaboration of people from different cultures are considered not to make significant impact when it comes to the formation of JVs.

6. Conclusion

ISBN 978-0-86970-787-6

The objective of this study was to identify the possible challenges underlying the JV process. The literature review produced a list of those challenges. Indeed, the most important risks or challenges

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Livingstone, Zambia
ISBN 978-0-86970-787-6

influencing the formation of JVs were found to be unequal sharing of risks and benefits; followed by irregular patterns of operation and unstable relationships; as well as misunderstanding of partnering JV concept. Even though, the main purpose of JV operations remains the spreading of risk inherent in large projects and to pool resources in a way that permits the execution of projects, it becomes crucial for the partners to be aware of the possible risks or challenges and thus set procedures to resolve such problems as they could occur in the course of the execution of the contract.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-019

A Technical Framework for assessing Higher Education e-Learning Readiness – Ensuring benefits from e-learning infrastructure investments

Teressa Chikohora[1], Thulaganyo Dimakatso[2], Edmore Chikohora[3]

Abstract

E-learning is one of the fast growing technologies in Higher Education which has seen institutions adopting a platform to enhance their traditional teaching, learning and assessment methods. Most institutions use already established platforms like Blackboard and Moodle, where they pay a fee for using the facility. However institutions are limited by the Service level agreements with the service providers such that they may not use other environments effectively. The study is motivated by the challenges that institutions face after investing in this e-learning infrastructure. Institutions tend to under-utilise the implemented platform yet the implementation costs are high. A thorough analysis on the technical readiness of the institution is therefore required so as to inform the decision on whether to invest or not. A survey was conducted to identify the hardware, software and networking resource requirements for an e-learning platform. Questionnaires and interviews were used as data collection instruments. The study defines a framework that may be used to assess the technical readiness of a university to implement an e-learning platform. The framework also uses the e-LRS model to inform the readiness levels. The defined framework will be useful in ensuring that universities benefit from the huge investments in e-learning infrastructure.

Keywords: e-learning, framework, higher education, readiness

1. Introduction

An e-learning platform is the software that provides the technical infrastructure on which e-learning activities can take place, (Piotrowski, 2010). E-learning platforms are enabled or supported by the use of electronic technologies and involves online interaction between the learner and teacher or peers. The platforms support activities such as access to learning content, assessments, communication, collaboration tools for students, course management and assessment facilities for instructors.

Al-Amer and Al Soufi (2011) described e-learning as learning that is enabled by the use of digital tools and content, usually accessed via the internet. Given the challenging economic environment, it is

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

important for institutions to evaluate their e-learning readiness first before embarking on the high investment costs (Schreurs et al, 2008). Many institutions of higher learning have adopted the use of e-learning in an effort to reach out to a larger student base which may otherwise be limited by geographical location. The e-learning platforms have made it possible for learners to enrol in programs without the need to physically attend classes in the far away campuses. For example, students are able to take up a degree with the Amity University (India) from anywhere in the world, without having to travel there. The introduction of e-learning has seen many students even those who are disabled to access education. For example people with disabilities, who would not benefit much from the face to face mode of instruction, are catered for by these e-learning platforms, (Piotrowski, 2010).E-learning allows students with different backgrounds and learning styles to learn at their own pace. A high fee is paid to access these services and if there are other features that the institution is not using, the institution may lose out. An informed study is therefore important so as to benefit from the huge investment.

So as much as universities in Africa may want to be in line with international trends/ universities, they cannot afford to make uninformed decisions which would squander the little resources available. Researchers have defined techniques and ways of evaluating e-learning readiness from a hardware, software and network requirements perspective. Given that many authors have suggested various assessment tools, this study seeks to define a framework that may be used by universities to standardise the evaluation process for universities, based on their technology. The rest of the study is organized as follows; section 2 reviews the literature in order to identify the requirements of implementing a successful platform, section 3 provides the methodology that is, describing how the study was conducted, section 4 looks at data analysis and interpretation, section 5 looks at results discussion while section 7 and 8 provides some conclusion and recommendations on how universities may use the proposed framework to evaluate their e-learning readiness respectively.

2. Literature Review

2.1 E-learning platforms

E-learning is a learning platform that is enabled or supported by the use of electronic technologies and involves online interaction between the learner and teacher or peers. The e-learning platforms normally includes access to curriculum learning content, tests, communication, collaboration tools for students, and course management and assessment facilities for instructors (Piotrowski, 2010). Higher learning institutions are using e-learning platforms to enhance their teaching and learning process. The platforms are used right from the admission point to manage admissions and enrolments, by instructors for course management and more oftenly by students to access their learning materials and assessments. E-learning places today's university at an advantage by allowing easy interaction between students and their instructors. Most universities in the world are using the tool to improve the student-teacher interaction in the learning and teaching process. Robust technical infrastructure is required to support the implementation of e-learning and involves huge amounts of investments, in terms of resources, infrastructure and time. An inappropriate system would impact negatively on the institution hence the need to assess readiness prior to the implementation decision (Graham, 2006). Institutions need to analyse their technological infrastructure among other factors in order to establish whether adopting an e-learning system would be beneficial and cost effective. The e-learning systems usually involve big investments in terms of resources, infrastructure and time. There are platforms which may be rented by institutions to access e-learning services. Examples include Moodle, Blackboard, Desire2Learn and Sakai.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

2.2 Requirements for setting and e-learning platform

The successful implementation of an e-learning platform must be coupled by acquisition of adequate technological infrastructure and adequate educational content for those using and administering the platform. Apart from the technical perspectives there are other attributes that characterize an e-learning environment, such as policy, financial, human resources and pedagogy (Govindasamy, 2002; Psycharis, 2005).Building the e-learning system may consider technological, pedagogical and managerial issues, (Madar and Willis, 2014).Borotis and Poulymenakou (2004)suggested the categories/dimensions to be considered when setting up an e-learning platform as policies on the operations of the platform, the technology, financial and human resource requirements as well as the infrastructure are important in successfully implementing a platform.

An e-learning system is best implemented after ensuring that the needed components have been identified and established with their maintenance carefully planned. Institutions should avoid a system that does not meet users' needs and end up not being used, so they must consider the strategic issues before either outsourcing a tool like Blackboard which may not allow proper customization or developing a tool that is not useful. The study will focus on the technological, with other dimensions left for further work.

2.3 Technical requirements

There is no standard model of implementing e-learning (Madar and Willis, 2014) .Different authors have their own perspective and idea of how the e-learning platform may be implemented. Generally no special hardware or networking hardware requirements are required for e-learning today; theoretically a computer with a web browser and internet access is necessary. Other e-learning applications use client side scripting while others provide a single consistent user interaction for all aspects of a course.

Factors such as hardware, software and network may be considered as the key technological indicators of an organisation's e-learning readiness (Aydin and Tasci, 2005).Schreurs, et.al (2008) mentioned that the infrastructure, internet connectivity, flexible LMS, student's portal and a system to track and connect learners' activity are technological features essential for the implementation of an e-learning platform. Internet Students Teaching Centre (ISTC) is an e-learning system whose implementation is based on internet technologies; a relational database connected to an internet browser and manages course materials in Microsoft Office formats (Howard Community College, 2012; Guminska and Madejski (2007). In other words, to implement an e-learning platform, the Internet, a database, a web browser and Microsoft Office are the basic requirements that an institution must meet.

Institutions of higher learning have adopted the standards like SOAP, java and PHP to implement an effective e-learning environment. Table 1 shows the adopted standards that are used by different frameworks. They rely on open standards for information exchange and component integration (Leal and Queirós, n.d.). E-learning frameworks use adapted standards and they have common standards that are found in all the frameworks.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

Table 1: Some adopted Standards (Leal and Queirós, n.d.)

	LTSA	OKI	IAF	OUSS	SIF	e-F
Content Format	-	-	IMS CP SCORM	-	SCORM	IMS CP SCORM
Metadata	LOM	LOM	LOM	LOM	LOM	DC LOM
Service Description	WSDL	WSDL	WSDL	WSDL	WSDL	WSDL
Web Service	SOAP	SOAP	SOAP REST	SOAP	SOAP REST	SOAP REST
Language Bindings	-	JAVA, PHP, MS. NET, C#	JAVA	JAVA	JAVA	JAVA

2.4 How to measure the readiness levels

E-learning readiness is how ready the institution is on several aspects to implement e-learning. E-learning readiness is the mental or physical preparedness of an institution for an e-learning experience (Ouma et al, n.d). An institution must have the physical infrastructure for it to successfully implement an e-learning platform. Readiness assessment is done to help institutions to design and implement effective platforms. Schreurs et al (2008) emphasized the importance of establishing readiness first before rushing to implement a platform given the prevailing challenging economic competition. Okinda (2013) suggested the readiness assessment from various dimensions such as users, technology, institution's culture and the environment with many models that may be adopted. Examples of such models include Engholm's, Bakry's STOPE, Bekim Fetaji and Haney's models .The popularly used model is Engholm's model which captures respondent's perceptions along five dimensions on a five point Likert scale and the aggregating the individual readiness levels.

Aydin and Tasci (2005) suggested that e-learning readiness can be measured on a scale of 1-5 and each component level of readiness assessed on a five point liker-type scale. The mean and standard deviation for all components is calculated and rated on the e-Learning Readiness Survey (e-LRS). Table 2 shows the scale and interpretations of the calculated means.

Table 2 The Scale and Indication of mean (Aydin and Tasci, 2005)

Means	Scale
0-2.6	Not ready, needs lot of work
2.6-3.4	Not ready, needs some work
3.4-4.2	Ready but needs a few improvements
4.2-5	Ready to go ahead

According to Aydin and Tasci (2005), the readiness level would be benchmarked as not ready with a lot of work to be done for scores between 0 and 2.6, scores ranging from 2.6 to 3.4 means that the institution is not ready and some work still need to be done, 3.4 is the expected level of readiness which translate to ready but needs improvements and 4.2 to 5 indicates thatthe institution is ready to go.

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Research shows that there are a number of models and frameworks that may be adopted to assess an institution's readiness level. No one model is appropriate but for an informed decision, a researcher may adopt several models and compare the outcomes.

3. Methodology

A literature survey was conducted to identify the technical requirements and how their availability may be measured. The main sources for this information were books, journal publications, research papers and research conference proceedings. Document analysis was done to gather requirements for various platforms as specified by the developers. The targeted platforms were the commonly used ones, some of which are open source like Sakai. Interviews were conducted and questionnaires administered to a sample consisting of 9 support analysts selected from the ICT departments of 3 universities, one in Botswana and 2 in Zimbabwe. Purposive sampling was used to select the respondents who are actively involved and responsible for maintaining and supporting the e-learning platforms at their universities. A questionnaire designed to establish whether the proposed checklist of requirements was complete, was distributed to the technical department representatives. The interviews and questionnaire were focused on establishing the components of the infrastructure on which their platforms are hosted.

4. Results and Discussion

The reporting of results and discussion is organised into three sections. The first section shows the mean scores for the most basic basic technical components of an e-learning system. Although the e-learning systems in use were different, the basic hardware, software and networking resources used were almost similar, with differences on their finer specifications and configurations. Variations may occur depending on the nature and operating environment for each institution. The second section describes how the e-LRS Assessment Model (Aydin and Tasci, 2005) was combined with the framework in assessing the readiness level of each technical component. The third section outlines the framework that institutions may use to assess e-learning readiness.

4.1 Mean scores

The information gathered from the survey was used as a basis to design a questionnaire which was distributed to the support analysts selected from the universities' ICT departments so that they could identify which components were more relevant in the universities environment. The requirements in the questionnaire were a summary of the technical aspects identified in the literature survey. The technical components were grouped into hardware, software, network and other for purposes of representing the results. Table 3 shows a summary of the calculated mean and standard deviation for the components for each institution.

The table shows the mean scores for each category of requirements as evaluated by each university. The hardware and software requirements scores were almost of the same value, ranging between 3.33 and 3.43, across the three universities with very minor deviations for the network and other requirements. A mean score for network requirements was calculated as 3.59, 4.08 and 3 for the respective institutions.

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Table 3: Mean and standard deviation for each category by university

	Hardware	Software	Network	Other
University 1	3.33	3.92	3.59	2.78
University 2	3.27	3.67	4.08	3.06
University 3	3.43	3.67	3	3.89
Mean	3.34	3.75	3.56	3.24
standard deviation	0.07	0.12	0.44	0.47

Figure 1 shows the mean measure of relevance of each category of attributes as calculated for each university.The calculated mean scores show that the basic hardware and software requirements for setting up an e-learning platform are generally similar for most institutions. All universities scored a mean of 3.34 for hardware with a standard deviation of 0.07.

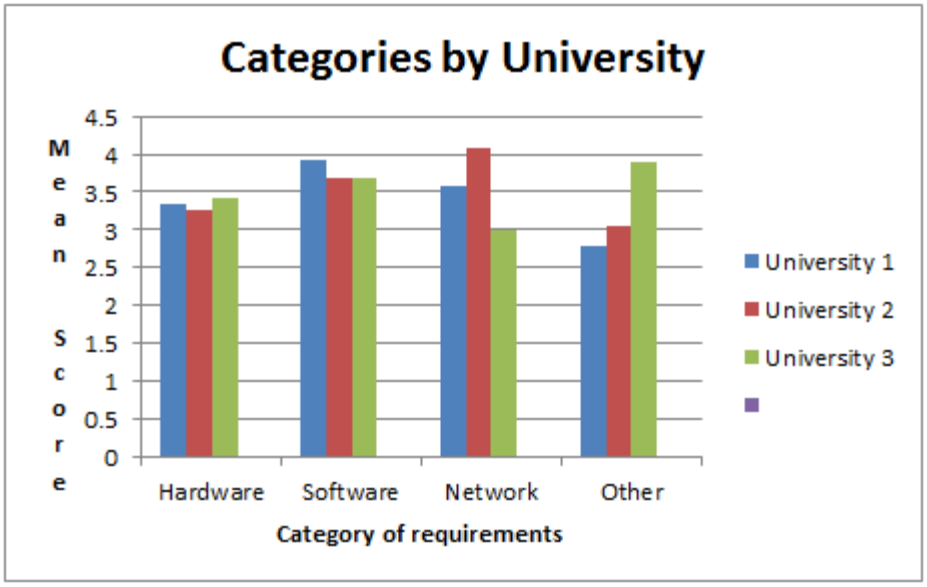

Figure 1: Meanscore per category per university

This means that the individual university scores were almost similar on the identified hardware requirements. The network requirements had a slightly significant deviation which given the sample, may be attributed to the differences in location of the institutions. Two universities had an almost similar score and are located in the same country.

4.2 Using the e-LRS assessment model

To measure the extent of relevance for each attribute, the e-LRS model by Aydin and Tasci (2005) was used. The model requires that a mean and standard deviation for each attribute be calculated, and then placed on the e-LRS scale to determine the extent of its relevance. Attributes scoring a mean value between 0 and 2.6 were deemed not to be of importance, 2.7 to 3.4 may be required depending on the environment, 3.5 to 4.2 considered as required and those scoring 4.3 – 5 were considered to be a pre-requisite. Table 4 below summarises the model. Those attributes with scores between 3.4 and 5 were captured into the framework as the basic technical requirements. A mean score for each technical

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ISBN 978-0-86970-787-6

component was computed and analysed against the e-LRS Assessment Model designed by Aydin and Tasci (2005).

Table 4: The Scale and Indication of Means (Aydin and Tasci, 2005)

Means	Scale
0-2.6	Not ready, needs lot of work
2.6-3.4	Not ready, needs some work
3.4-4.2	Ready but needs a few improvements
4.2-5	Ready to go ahead

With reference to the mean scores calculated for each university (Table 4), the e-LRS scale shows that for hardware and other dimensions, the universities are not ready and need some work. Given the technological advancements, the institutions are still using the desktops in their laboratories with some still running on Windows XP. The economic constraints in the region may also explain this result. The scores of 3.75 and 3.56 for software and network requirements respectively show that the institutions under study are ready but need a few improvements.

The evaluation committees must consider this framework in an effort to make informed decisions on whether to invest in e-learning or not. It is important however to note that it is not only the technological perspective that requires evaluation, other dimensions as discussed in our literature review need to be considered as well. An evaluation of all dimensions will better the chances of making an appropriate decision.

4.3 Suggested framework

The suggested framework is presented in figure 2. As explained earlier, they can be grouped into hardware, software, network and other dimensions. Table 5 presents the observable variables for each group. The components were identified as the basic technical requirements that universities may consider when assessing its e-learning readiness. Availability or sufficiency of the technical component may be rated on a scale of 1 to 5, where 1= not available; 2= very little available; 3= adequate; 4=sufficient to sustain current number of users; and 5= more than sufficient for current users. Additional comments clarifying the exact resource available could be provided.

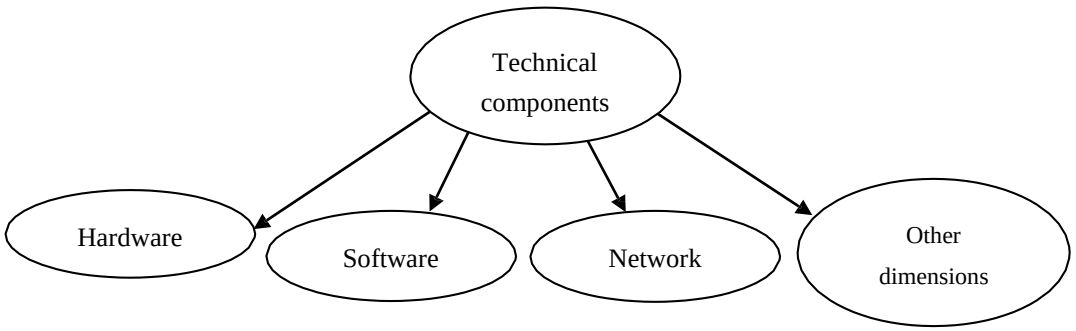

Figure 2: Framework for assessing higher education e-learning readiness

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5. Conclusion

The study focused on the technological dimension which we deemed key for e-learning implementation. Results show that despite the variances in universities' curriculum and location, the hardware, software and network requirements have the same extent of importance in the success of e-learning platforms. The sample institutions have already implemented e-learning systems and are utilised to an extent that policies to force teachers and students to use the platforms have been implemented. Perhaps a thorough analysis of their technical readiness could have influenced the decision of whether to invest or not. It is like they have made huge investments whose benefits are not being realised.

6. Recommendations and Future Work

Our research looked at proposing a framework that might be applied to assess the readiness of institutions that want to implement e-learning infrastructure. We hope this will reduce situations whereby e-learning implementations fail before completion. The availability of the technical infrastructure at a University is not the only requirement for an effective e-learning platform. Successful implementation of e-learning involves adequate educational content for those using and administering the platform. This means that a university must evaluate the content development skills in their staff and provide training wherever necessary as a way of ensuring the effectiveness of the implemented platform. However, like any other system, the maintenance of the platform must be carefully planned to avoid a situation where the platform's usage is discontinued due to inadequate resources to keep it running.

Table 5: Framework components

Technical component	**Observable variables**
Hardware	Application Server
	Servers
	Recent Computers
	UPS in classrooms, labs and offices
	Communication Infrastructure
	Mobile Devices
	Physical Security infrastructure
	Computer-Student ratio
	Computer-staff ratio
Software	Database Management System
	Web & File Services
	Learning Management System
	Web Browser
	Antivirus software
	Students Portal
	Offsite Backup
	Content Development Software
	Multimedia Support
Network	Internet availability
	Internet speed, quality
	Campus-wide backbone networks

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ISBN 978-0-86970-787-6

Technical component	**Observable variables**
	Website
	E-mail services
	Infrastructure to multicast
	Extent of Online interaction
Other Dimensions	ICT experience level
	Frequency of upgrades in qualification
	User Training on ICT
	Support for learners using ICT infrastructure
	Students' basic computer skills & internet skills
	Instructors basic computer & internet skills
	Students' literacy on Software applications
	Instructors literacy on software applications
	Availability of Technical support
	Defined security privileges
	Availability of Computer room/lab/classroom

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-025

Contextualizing Global Mindset: The case of Multinational Construction Firms in Ghana

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Abstract

The ascendency of global markets has created a need for organizations to search for new sets of competences to enable them to survive. Whether they operate regionally or internationally, global challenges are felt in every business especially in the area of adaptation. This paper aims to explore the concept of global mindset and its challenges and strategic opportunities for Multi-National Construction (MNC) firms in Ghana. The study utilized a structured survey questionnaire administered to top management professionals such as Project managers, Quantity Surveyors, Architects, Site Engineers and Services Engineers of selected multi-national construction firms. Data gathered from respondents were analysed using descriptive statistics and relative importance index rankings to establish significant levels of the various challenges and strategic opportunities of the global mindset. The findings from the research work disclosed the strategic gains/opportunities of global mindset as improvement in performance; ability to understand global and local markets; global positioning and outlook and early identification of emerging opportunities. The challenges of the global mindset were revealed as difficulties with socio-cultural adaptation; distress in new settings and limitations in performance. While the study is regionally specific, the findings are equally applicable to other countries worldwide. Further research is recommended to researchers to conduct a study into the strategies for developing a global mindset.

Keywords: construction, Ghana, global mindset, multi-national, performance

1. Introduction

As a concept, the term globalization refers to an increasing worldwide interdependence, and involves integration of economies, countries and people (Gupta and Govindarajan, 2002; Dean, 2005). It relates to internationalization and the sharing of ideas, knowledge, cultures, history and doctrines. Scholars agree that the process of globalization has been proceeding, with some disruptions, for many centuries

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

(Yergin and Stanislaw, 2002; Friedman, 2005). On the contrary, the world has become a global village where every individual can move and conduct business with little or no hindrances.

In the past decades, a global mindset has gained the attention of international business scholars and is a multidisciplinary concept comprised of cognitive and cultural dimensions which both influence the international behaviour and decision making of firms (Akyol and Akehurst, 2003). Accordingly, Evans *et al.,* (2002), describe the global mindset as a set of attitudes that predispose individuals to cope constructively with competing priorities (for example global versus local priorities) rather than advocating one dimension at the expense of others. Nummela*et al*., (2004), also argue that a global mindset has been cited as a necessary competence and pre-requisite for successful Multi-National Companies (MNCs). However, an increasing number of companies are 'born global' from inception (Nummela*et al*., 2004). Furthermore, researchers and practitioners alike suggest that managers who have developed a global mindset are better equipped to deal with the complexity wrought by multiple organizational environments, structural indeterminacy and cultural heterogeneity - all of which characterize contemporary MNCs (Doz and Prahalad, 1991).

The construction industry and its activities form an essential role in any economy in terms of socio-economic development goals of providing shelter, infrastructure and employment (Anaman andOsei-Amponsah, 2007). Indeed, the interdependence of the construction sector and economic development has been addressed by various writers and there is strong evidence between investment in construction and economic growth. For instance, Lopes (1998), revealed that countries that invested a minimum of 4% into construction industry are likely to grow faster in their Gross Domestic Product (GDP).

The Ghanaian construction industry plays a vital role in achieving socio-economic development goals, providing shelter, infrastructure and employment, and above all, contributing significantly to the country's GDP. For instance, between 2003 to 2008, the industry provided an average GDP growth of 6.1% to the economy. Indeed, the industry was the third largest growing economic sector out-stripping the manufacturing industry in 2004. In 2008, the industry's GDP contribution peaked at 7.3% in 2008 (Institute of Statistical, Social and Economic Research, ISSER, 2005;International Youth Foundation, IYF, 2009;International Monetary Fund, IMF, 2009). These trends demonstrate the industry's inherent ability to regenerate the economic development of developing countries such as Ghana. Thus in specific terms, the Ghanaian construction industry could be the instrument for achieving the infrastructural guidelines of the Millennium Development Goals (MDGs) and The Ghana Poverty Reduction Strategy II (GPRSII) agenda. One of the main agendas of MDGs and GPRSII is to address human development issues such as the provision of infrastructure for services and employment (Cotton *et al.,* 2005).

Multi-National Construction firms that ignore the global mindset do so at their own peril. The ones that most effectively develop this quality in their employees will have a distinct advantage over their competitors (Beechler and Baltzley, 2008). Global mindset is a pre-requisite for multi-national construction firms in order to provide a competitive advantage.Although various academic works have sought to define and cultivate a global mindset (Gupta *et al.,* 2002; Arora*et al.,* 2004), existing literature fails to provide evidence of the challenges and strategic gains to be made from such for Multi-National Construction firms. Therefore, it is imperative that the challenges and strategic gains from adopting a global mindset are explored within the context of Ghanaian Multi-National Construction firms.Pires*et al.* (2006) found that Multi-National Construction firms may experience stress-induced reactions when completing international assignments and the associated day-to-day cultural discrepancies of the host country. However, the global mindset is not weIl defined within the extant literature and indeed, many

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Livingstone, Zambia
ISBN 978-0-86970-787-6

inconsistencies between definitions exist (Levy *et al.*, 2007). According to Morrison (2000), a global leadership mindset should be a requirement for all Multi-National Construction firms and not just American, European or Asian firms. Julien (2006) explained that no empirical research has been conducted on the global mindset of Multi-National Construction firms in developing countries like Ghana. The protracted neglect by researchers to champion the global mindset in the construction industry could have contributed to its unpopularity in most developing countries.

Therefore, this paper aims to contribute to resolving such issues by conducting an empirical study on the global mindset of Ghanaian construction contractors. This research is articulated through the specific lenses of challenges and strategic gains available to said contractors.

2. Definition of the Global Mindset

Evans *et al.* (2002) explained the global mindset as a set of attitudes that predispose individuals to cope constructively with competing priorities (for example global versus local priorities) rather than advocating one dimension at the expense of others. In contributing to this discourse, Nummela*et al.* (2004) defined the global mindset as the necessary competence to possess and a pre-requisite for successful internationalization of companies and are built gradually over time by most Multi-National Companies (MNCs) in their quest to enter and succeed in foreign markets. Whilst Maznevski and Lane (2004) defined the global mindset as the ability to develop and interpret criteria for personal and business performance that are independent from the assumptions of a single country, culture or context and to implement those criteria appropriately in different countries, cultures or contexts. Gregerson*et al.*, (1998) stated that a global mindset, in its simplest form will allow a manager from one part of the world to be comfortable in another part and perform well on account of knowledge and skills that are based on understanding and awareness.

Gupta and Govindarajan (2002) defined a global mindset as: *"one that combines openness to and awareness of diversity across cultures and markets with a propensity and ability to synthesize across this diversity."* Arora*et al.*(2004) did not offer a definition of a global mindset but cited Rhinesmith's view on a global mindset as: *"one that scans the world from a broad perspective"*, which alludes to the fact that people with a global mindset are able to adapt to their environment and view the world from different outlooks. Whilst and Blonski (2010) also defined a global mindset as one that: *"enables people to embrace complexity and paradox"*.Boyd*et al.*, (2011) offered a definition of a global mindset linked to the work of Javidan*et al.*, (2010) that focuses on i) intellectual capital which covers knowledge of international business and an individual's ability to continue learning; ii) psychological capital which ensures one is open to exposure to different cultures and change; and iii) social capital which is the ability to build relationships with different stakeholders.

3. Internationalization of the Construction Industry

International business is characterised by any form of transaction taking place across national borders for the purpose of satisfying the needs and demands of individuals and firms (Rugman and Collinson, 2009). A number of construction firms already operate in international markets, trading their design services and construction products (Reina and Tulacz, 2010). However, internationalising a construction business is a complex process involving decisions on what international region, country or market to enter and how to succeed.

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Livingstone, Zambia
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Construction firms could exploit international markets in at least two forms: i) out-source their selected core or non-core business functions or operations to an international operator; and/ or ii) offer the firm's products or services in the international market. Construction firms can choose to internationalise their business through an import or export mode or foreign direct investment mode (FDI) (Menipaz and Menipaz, 2011). Furthermore, construction firms can reckon their business as being reigned by design, production and assembly. It can also be dominated by a hybrid of the aforementioned processes. Teece (2007) explained that construction businesses could internationalise by being innovative in understanding their potentialities. This would enhance their sustained competitive advantage in the industry. However, Lambert and Cooper (2000) affirmed that the most significant paradigm shift of contemporary business management is that construction companies no longer compete as single sovereign entities, but rather as supply chains. Supply chains fundamentally aim at ways of delivering products and services to clients through efficient and effective flow of materials, plant, people, finances and information.

The most important barrier against trade is distance. Distance could constitute a barrier against the transportation of goods safely, on time, securely and with acceptable prices. However, globalisation has made the construction industry feasible with technological developments and trade agreements that enhance sustainability in the construction industry. Globalisation further enhances cross-border civilisation which enable Multi-National Construction firms to operate without boundaries in various locations.

4. Developing Global Mindset Capabilities of Multi-national Construction Firms In Ghana

The basic features of a global mindset are the use of wide and numerous views as well as the ability to balance between contradictions, value diversity, foster teamwork and exhibit receptiveness. Regarding global virtual teams, cultural intelligence teaches employees and managers ways to effectively work across cultures. Interestingly, Thomas and Inkson (2009) noted a paradox of cultural intelligence. That is, in order to acquire cultural intelligence one must practice by working in culturally different environments and with culturally different people. Unfortunately, in order to work effectively with these different people in different environments, one needs to first be culturally intelligent. Indeed, a variety of experiences and training involve strategies for developing cultural intelligence and facilitating the global mindset in Multi-National Construction firms' managers and employees. Furthermore, international transfers and assignments, membership in cross-border project teams and task forces, international coordination roles can all be considered in developing global mindset. Distinctively earmarked for leaders of Multi-National Construction firms, international transfers and assignments are the strongest propellers for growing global mindset.

However, contemporary Multi-National Construction firms require managers who would easily embrace multiple cultures and work effectively within a global team. Training of managers using the conventional approaches of cultural training involves only country-specific noesis which insufficient and requires the cultural intelligence approach. Cultural intelligence involves assessing an individual's specific competencies to render training in various ways.

According to Gupta and Govindarajan (2002), the global mindset within Multi-National Construction firms can be acquired formally and informally. The formal path involves learning of new language skills and building knowledge about diverse cultures and markets where the MNC firms operate. The latter

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can also be acquired through informal means such as expatriate assignments; and cross-border collaborations.

5. Performance Implications of Multi-national Construction Firms

The universal principle underpinning the global mindset embodies the ability of individuals to integrate diverse geographical and cultural cognitive filters into new hybrid perspectives (Mansour, 2009). A construction firm is considered to have a global mindset when it has insights of diverse markets and cultures and can integrate across this diversity to gain new markets and products emerge (Mansour, 2009). Four keycharacteristics of a global mindset for a construction manager are: a genuine connection with people throughout the entire organization; the capacity to manage under ever changing circumstances; the ability to strike a balance between global integration and local responsiveness; and the ability to exhibit business intelligence and organizational intelligence (Kedia and Mukherji, 1999). Kedia and Mukherji (1999) further explained that intimate knowledge of the firm's capability and the skills needed to put knowledge into action are the two most fundamental attributes any Multi-National firm. The core competencies of management are very critical in the realisation of global mindset maturity which would enhance performance.

Performance is the accomplishment of a given task measured against predetermined standards of accuracy, completeness, cost and speed. In a contract, performance is considered to be the accomplishment of an obligation, in a manner that discharges the performer from all liabilities under the contract. The Baldridge National Quality Programme (BNQP) (2008) describes performance as: *"outputs and outcomes from processes, products and services that permit evaluation and comparison relative to goals, standards, past results, and other organisations."* In order to achieve performance improvement, the actual performance should be measured relative to a specified benchmark**.** Managers of construction firms who are open to acquiring the global mindset are: more tolerant of other peoples and cultures; consider cultural diversity an asset; thrive on ambiguity; balance contradictory forces; and rethink boundaries which result in performance improvements. According to Gregerson*et al.*, (1998) the global mindset, in its simplest form will allow a construction firm's manager from one part of the world to be comfortable in another part and perform well on account of knowledge and skills that are based on understanding and awareness.

6. Challenges and Strategic Gains of Global Mindset in Multi-national Construction Firms

Clashes in cultural orientation can have a major influence on the success or failure of a MNCs but understanding the culture of the host country is only one part of orientation process (Varner and Palmer, 2006). An introspective understanding of a manager's own cultural orientation and how they influence acceptable behaviour within that cultural context is an important factor that must be considered (Maddi, 1999). Furthermore Maddi (*ibid*) affirmed that it is crucially important to learn to overcome the belief that MNCs own cultural mindset would be the same in every other country and thus, avoid judging culturally different behaviours negatively. One issue is that the majority of people are not consciously aware of their own cultural mindset which is perceived to be 'normal'. This phenomenon occurs because people adopt certain cultural traits from infancy- so called 'learnt behaviour' (Varner and Palmer, 2006). In a construction context, managers who know their individual and company priorities will improve their performance and that of their company (Varner and Palmer, 2006).

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A potential pitfall to the success of MNCs is the problem of adaptation to the new country. MNCs experience an emotional cycle and typically hit a low between six and twelve months after starting a new venture (DeLollis, 2007). Difficulties connected with socio-cultural adaptation have been identified as the main source for many stress-induced reactions experienced by contractors on international assignments in confronting the day-to-day culture and norms of the host country (Pires*et al.,* 2006). The inability to perform effectively in the new environment typically results in lower than expected performance, poor management, low productivity and failure to meet corporate objectives. Moreover, meeting the construction firm's objectives is dependent upon the MNCs successful sociocultural adjustments. However, Oberg (1960) explained sociocultural adaptation as the anxiety that results from losing all our familiar signs and symbols of social intercourse. This adjustment phase refers to the subjective well-being or mood of the MNCs and means that the ability to adjust is related to stress and grappling contexts. Black *et al.,* (1990) suggest that the new unfamiliar setting upsets old routines and creates a feeling of uncertainty in everyday life. At the same time, sociocultural adjustment is connected to foreign contractor's behavioural competence in social interaction. Earlier studies by Barhem (2008) have identified several factors that influence sociocultural adaptation, such as: language fluency, length of residence in the new culture, cultural knowledge, amount of interaction, identification with host nationals and acculturation strategies of the company. Failing to meet these factors during sociocultural adaptation process can produce stress and even depression in the MNCs which may result in reduced productivity or even premature withdrawal from the new country.

7. Research Methodology

This paper adopted a quantitative approach of enquiry for its data collection and utilised both primary and secondary sources. An intensive literature review was undertaken which discovered the academic paradigms supporting the subject which helped to identify the benefits and challenges relating to creating the global mindset. After the literature review, survey questionnaires were designed using five-point Likert items for the various questions, where: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree. The questionnaires were administered to management professionals in the various MNC firms who were sampled for the study. Literature revealed that most Multi-National Construction firms were located in the Greater Accra region of Ghana and for that reason, Accra as the capital was chosen for the study. The occupations and frequency of respondents involved in the study were: Project Managers (eight), Quantity Surveyors (ten), Site Engineers (seven), Services Engineers (six) and Architects (four).

Due to the difficulties encountered in assessing the population size, snowball sampling technique was adopted to arrive at the sample size. Kumar (1996) describes the snowball sampling technique as a process of selecting a sample by networking. The snowball sampling is an approach for locating information on rich-key informants. De Vos*et al.,* (2002), affirms that snowball sampling is valuable in research since it is directed at individuals that are difficult to identify. Using this approach, a few potential respondents were contacted and asked whether they know any other respondent with the characteristics that you were looking for in your research. This technique was adopted to reach hard-to-get respondents. A total of ten MNC firms were contacted with 35 self-administered questionnaires asking respondents to rate the relative importance of identified challenges and strategic gains of MNCs due to global mindset. Data was analyzed using the Relative Importance Index (RII) for the ranking of the challenges and strategic gains identified. Relative Importance Index method was used by Kometa*et al.* (1994) to determine the relative importance of the various causes and effects of delays in the

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construction industry. The same method is adopted in this study within the various groups (i.e. management professionals). The five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree) was adopted and transformed to relative importance indices (RII) for each of the challenges and strategic gains as follows:

$$\text{RII} = \frac{\sum W}{\text{A}*\text{N}}$$

Where, W is the weighting given to each challenge or strategic gain by the respondents (ranging from 1 to 5), A is the highest weight (i.e. 5 in this case), and N is the total number of respondents. The higher the value of RII, more important was the challenge or strategic gain and vice versa (Megha and Rajiv, 2013). The RII was used to rank (R) the different challenges and strategic gains. These rankings made it possible to cross-compare the relative importance of the challenges and strategic gains as perceived by the five groups of respondents. Each individual strategy's RII perceived by all respondents should be used to assess the general and overall rankings in order to give an overall picture of the challenges and strategic gains of MNCs due to a global mindset. RII is deemed necessary for the study because it takes into account the size of the population and the relative disadvantage experienced by the different management professionals.

8. Results and Discussion

8.1 Strategic Gains of MNCs due to Global Mindset

The respondents were asked their opinions on the strategic gains of MNCs due to a global mindset. Table 1 shows the ranking in descending order of these strategic gains using the method of relative importance index. The table reveals the index rankings ranged between 74.9% - 89.7%.

Table 1: Strategic gains of MNCs due to Global Mindset

Strategic Gains	RII	Rank
Improvement in performance	0.897	1
Ability to understand global and local markets	0.863	2
Global positioning and outlook	0.851	3
Early identification of emerging opportunities	0.846	4
Promote internationalism	0.834	5
Development of cultural awareness and openness	0.817	6
Sharing of best practices	0.811	7
Anticipation of change long before it occur	0.806	8
Help to identify priorities	0.800	9
Inter-cultural adaptation	0.789	10
Cultural orientation adjustment	0.754	11
Efficient cross border collaboration	0.749	12

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It can be inferred from Table 1 above that respondents' identification of the strategic gains of MNCs due to a global mindset was grounded in to *improvement in performance, ability to understand global and local markets, global positioning and outlook, early identification of emerging opportunities, promote internationalism, development of cultural awareness and openness and sharing of best practices.* However, respondents ranked cultural orientation adjustment and efficient cross border collaboration very low (11^{th} and 12^{th} respectively).

8.1.1 Improvement in performance

Managers with a global mindsetachieveimprovement in their performance wherever they find themselves (Kedia and Mukherji, 1999). It is however not surprising that respondents in the study named *improvement in performance* as the most significant strategic gain of a global mindset to MNCs. This strategic gain was the highest ranked (0.897, 1^{st}) in Table 1. This is in confirmation with Levy *et al.*, (2007) that multi-national companies with a global mindset concepts operate profitably and improve performance across different countries, cultures and contexts. Moreover MNCs with global mindset operate comfortably perform well other countries on account of knowledge and skills developed.

8.1.2 Ability to understand global and local markets

In this study respondents ranked a*bility to understand global and local markets* (*0.863, 2nd as in Table 1),* as the second most relevant strategic gain of a global mindset to multi-national construction firms. Put simply, this infers that MNCs with global mindset would be able to understand each market of operation being it global or local markets.

8.1.3 Global positioning and outlook

Merton (1957) explained that global consumers of products and services are within the reach of local context; they require globally accepted standards and are thus very demanding. Possessing a global mindset would enable firms to meet the ever demanding preferences. Moreover the global mindset gives firms that global outlook that helps them to meet client needs. This strategic gain acquired an RII of 0.851 and was ranked 3^{rd} from Table 1. The study revealed that MNCs acquiring a global outlook through the possessing of global mindset is a very relevant strategic gain.

8.1.4 Early identification of emerging opportunities

Respondents indicated that MNCs' identification of emerging opportunities in time is very relevant to the retention in business. This affirms the assertion of Gupta and Govindarajan (2002) that one of the benefits of global mindset to MNCs is being able to identify emerging opportunities early and a faster roll-out of new product concepts and technologies. Furthermore, early identification of emerging opportunities (RII=0.846, ranked 4^{th} in Table 1) has been revealed in this study as a significant strategic gain to MNCs with global mindset.

8.2 Challenges faced by MNCs due to Global Mindset

The respondents were asked their opinions on the challenges faced by MNCs. This was carried out on a five point Likert item ranging from 1 (Strongly disagree) to 5 (Strongly agree). Table 2 shows the ranking in descending order of these challenges using the method of relative importance index. The table reveals the index rankings ranged between 70.0% - 80.0%.

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From Table 2, the respondents identified that challenges faced were anchored on difficulties with socio-cultural adaptation, distressed in new setting, limit performance, uncertainty in everyday life and stressful situations. However, respondents ranked strain on contractor due to new setting and premature return to home country very low (9th and 10th respectively).

Table 2: Challenges faced by MNCs due to Global Mindset

Challenges	RII	Rank
Difficulties with socio-cultural adaptation	0.800	1
Distressed in a new setting	0.800	2
Limits performance	0.800	3
Uncertainty in everyday life	0.800	4
Stressful situations	0.800	5
Depression due to new environment	0.800	6
Prisoner of differences in another culture	0.700	7
Inability to perform in different settings	0.700	8
Strain on contractor due to new setting	0.700	9
Premature return to home country	0.700	10

8.2.1 Difficulties with socio-cultural adaptation

Socio-cultural adaptation is essential to the business environment of MNCs as it enables them to operate effectively across the globe. On arrival in different locations globally, most MNCs find it initially difficult to adapt to the socio-cultural practices of their host locations. Difficulties connected with socio-cultural adaptation have been identified as the main source for many stress-induced reactions experienced by MNCs (Pires*et al.*, 2006). It was not surprising when respondents in this study identified *difficulties with socio-cultural adaptation* as the most relevant challenge faced by MNCs.

This challenge was top-ranked (0.800, 1st) in Table 2. This finding supports the work of Tung (1981) who suggested that meeting the firm's objectives is dependent upon the MNCs successful socio-cultural adaptation. Oberg (1960) explained socio-cultural adaptation as the anxiety that results from losing all our familiar signs and symbols of social intercourse. This adjustment phase refers to the subjective well-being or mood of the MNCs and means the ability to fit in and is associated with stress and coping contexts.

8.2.2 Distressed in a new setting

Distressed in a new setting relates to distress within the company with its individuals exhibiting low hardiness in the form of increased depression and anxiety (White *et al.*, 2001). However hardy individuals are upbeat, optimistic and view challenges in a positive light. Hardy individuals are also able to view activities as attractive and pleasant, as being a matter of personal choice and as important stimulus for learning. This challenge obtained an RII score of 0.800 and ranked 2nd in Table 2. Therefore, distressed in new setting is a significant challenge to MNCs who wish to develop a global mindset.

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8.2.3 Limits performance

Limitations on performance were emphasized as a key challenge. The finding revealed that MNCs upon arrival in their new settings, face situations that limit their performance. This affirms the assertion of Kedia and Mukherji (1999) that MNCs on assignments in other countries take a long time to settle in order to improve upon their performance. Limits performance of MNCs was ranked 3rd with a corresponding RII value of 0.800. MNCs must find constructive ways in order to adapt to survive, and the most adaptable organizations will be best positioned to explore the possibilities hidden amid the chaos and to respond with innovative solutions to the complex challenges they face in order to improve their performance.

9. Conclusion and Recommendations

Despite the numerous strategic gains identified when a global mindset is adopted with a company, there are still limitations and challenges to contend with. A key obstacle to the success of MNCs is the adaptation to the new country. Difficulties connected with socio-cultural adaptation have been identified as the main source for many stress-induced reactions experienced by MNCs on international assignments in confronting the day-to-day culture and norms of the host country (Pires*et al.*, 2006). However, this study is the first to explore the challenges and strategic gains that a global mindset offers to Ghanaian MNCs.Furthermore, this study is also amongst the pioneering researches conducted in the area of global mindset from the Ghanaian perspective.The findings of the study support the argument that developing a global mindset enhances the MNCs performance and success.

Recommendations advanced from this study are that MNCs must devise a training 'policy' to train its workforce on cultural-intelligence. Such training is based on individual weaknesses in order to help individuals adjust fully into their new settings when they are on assignments. In addition, MNCs must be proactive in dealing with the challenges presented by the global mindset in order to improve their performance. Being proactive will prepare the MNCs to provide contingency plans to cater for these challenges.

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ISBN 978-0-86970-787-6

DII-2015-037

Investigating Government's Experience with Regard to the Effectiveness of Public Private Partnerships in Meeting Black Economic Empowerment Policy Aspirations

Kagiso Sekgothudi[1], Nolwazi Ndlovu[2] and Rudzani Radzilani[3], Nthatisi Khatleli[4]

Abstract

Black Economic Empowerment (BEE) has been one of the strategies used by the African National Congress (ANC) government since 1994 to correct the imbalances bequeathed by the apartheid regime. BEE has largely been implemented through normal traditional procurement as the government is using its massive buying power to bring redress, but the policy has been bedevilled by a myriad of practical impediments. The ANC has consequently identified Public Private Partnerships (PPPs) as an appropriate alternative for delivering its BEE aspirations. However PPPs are relatively new in the South African context and the institutional memory with regards to their effectiveness in attaining government's BEE goals has not been properly collated. This paper articulates the government's experiences with regards to this procurement method and the effectiveness thereof in BEE delivery. A review of literature on the Gautrain project and a comparative document analysis on traditional and PPP procurement methods were conducted to extract any PPP methodological benefits. The results of the study revealed that with regards to PPPs, the government is successfully fulfilling its stated BEE goals due to the rigorous and progressive monitoring mechanisms applied in this procurement method. This procurement method appears generally to be mitigating the endemic problems bedevilling the BEE implementation in traditional procurement in South Africa.

Keywords: BEE, effectiveness, Gautrain, monitoring, PPPs

1. Introduction

The South African government post-1994 employed BEE (Black Economic Empowerment) as a strategy to deracialise the country's economy and realise racial redress. This strategy has been implemented through traditional procurement of public infrastructure "where the public sector body may enter first into a Design-Build (DB) contract, engaging a private sector firm to design and build a facility in accordance with requirements determined by the government. After the facility is completed and paid for, the government assumes responsibility for operating and maintaining the facility. It may then use a

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Livingstone, Zambia
ISBN 978-0-86970-787-6

service or management contract to outsource all or part of operations and maintenance" (Grimsey & Lewis, 2007: 171). Due to the superficial scrutiny of the players and the dearth of monitoring exacerbated by the brevity of most of these contracts opportunistic behaviours of fronting, window dressing and fraud abound. These have hampered the effective implementation of the policy to redress the racial economic imbalances. This resulted in the government sourcing alternative vehicles that could better deliver the BEE mandate effectively and to this end, the government identified PPPs as an "excellent vehicle for achieving BEE" (National Treasury, 2004). This research therefore, investigates the government's experiences with regards to PPPs in order to interrogate the efficacy of this procurement method in delivering the BEE mandate.

2. Literature Review

BEE is regarded by the African National Congress (ANC) government as a policy to redress the socio-economic imbalances bequeathed by the apartheid government. The government defines BEE as "an integrated and coherent socio-economic process that directly contributes to the economic transformation of South Africa and brings about significant increases in the numbers of black people that manage, own and control the country's economy, as well as significant decreases in income inequalities"(Department of Trade and Industry, 2003: 12). The BEE policy aims to address issues such as human resource development, employment equity, enterprise development, preferential procurement, as well as investment, ownership and control of enterprises and economic assets as outlined in the BEE strategy (Ibid). This initiative provided platform for the publishing of legislative frameworks such as the Broad-Based Black Economic Empowerment (B-BBEE) Strategy, the B-BBEE Act and subsequently the BEE Codes of Good Practice to facilitate the transformation of South Africa's economy (Department of Trade and Industry, 2004)

Public Private Partnerships on the other hand have a relatively brief history in South Africa. They have been implemented and regulated since the year 2000 and to date; this method of procurement has spread over to many sectors within the country (National Treasury PPP Unit, 2007). PPPs have long been advocated as organisational solutions to pressing societal problems because they maximise the comparative advantages of government, business, and civil society" (Brinkerhoff and Brinkerhoff, 2011: 2); the corollary to that is that the purported efficiency would in turn empower the impoverished and economically marginalised.One of the important characteristics of PPPs is the dynamic of the multi-stakeholders involved in these projects (Tang et al., 2013), this is particularly important to South Africa because the main interests of the public and private sectors can both be utilized to further the interests of the South African general populace (National Treasury, 2004). The seemingly divergent objectives of social upliftment by the government on one hand and profit maximization by the private sector on the other; can be harnessed for a greater good if the government's interventionist strategies are well structured. The focus on PPPs is to harness the private sector's innovation acumen, financial and managerial resources to benefit the ordinary citizens during the project implementation. This relationship is deemed to work as it is of mutually benefit; where the government is able to provide improved, cost effective services and products whilst the private sector is able to profit and acquire new fruitful long-term business opportunities, both of which are in the interest of advancing the South African economy.

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2.1 Black economic empowerment in public private partnerships

Mahlangu and Lenepa state that "the increasing demand for services and the backlogs that have been spawned by years of infrastructure neglect, misguided colonial policies and racial exclusivity of blacks, are some of the reasons why policy makers have found PPPs more appealing and attractive" (Mahlangu and Lenepa, 2011: 3). PPPs in South Africa have been made uniquely peculiar because of the BEE requirement. There are special stipulations regarding BEE delivery in PPPs, and this is governed by the Code of Good Practice for Black Economic Empowerment in Public Private Partnerships.The benefits that make PPPs so attractive are the long-term nature of the projects, clearly established risks within the contracts, the formation of private consortia which provides a platform between new black enterprises and the experienced and well-resourced companies to allow progressive engagement and opportunities for growth. PPPs furthermore provide a stable line of income which is vital for the development of new companies; they provide a vast reach for BEE through the requirement for contractors and their subcontractors to abide by BEE in PPP contractual obligations (National Treasury, 2004).

2.2 Impact of black economic empowerment implementation on public private partnerships in South Africa

Identifying the quality of impact that BEE implementation through PPPs has had on the impoverished is essential in highlighting the difference between BEE implementation in PPPs as compared to other procurement methods. The BEE in PPP process is multifaceted rather than one-dimensional. Firstly, there is a concerted effort to find a fit between BEE and PPPs in social upliftment. Secondly, PPPs bear the biggest potential to deliver BEE because of imbedded benefits occasioned by the rigours of competition and longevity; which benefits are Skills Transfer, Professionalism, Innovation and Managerial Acumen among others. The World Bank (2014: 1) supports this statement by highlighting that PPPs can be used as a way "of developing local private sector capabilities through joint ownership with large international firms as well as sub-contracting opportunities for local firms in areas such as civil works, electrical works, facilities management, security services, cleaning services, maintenance services, amongst others".

Mahlangu and Lenepa (2011) stated that South Africa has received much praise with the legislation on the implementation of BEE in PPPs. They further continue to mention that in comparison with other developing countries, this is one way in which South Africa has attempted to avoid the inequalities that are generally accompanied by PPP's. However, there have been numerous claims made against the policy that even though the Codes provide a framework for advancing BEE implementation through PPPs, black companies are still largely disadvantaged when bidding due to "limited pool of black equity, a lack of experience and skills, too little capital and high transaction costs" (Fombad, 2013: 15) . Fombad (2013) continues on to proclaim that some of the deals that have been awarded have been subject to "fronting", this is when companies have pseudo black directors or shareholders to win bids although the companies are in essence owned and directed by white people. Khatleli (2009) confirms this by stating that theeffectiveness of BEE implementations has been hampered by the opportunistic behavior of well established companies, which is manifested through strategic misrepresentation of the true BEE beneficiaries. This practice continues despite the guidelines defined by the Codes on combatting fronting.

With BEE troubled by such judgment, this research will establish whether BEE has been effectively delivered when implementing the infrastructural development of South Africa through PPPs. In order to

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ISBN 978-0-86970-787-6

understand the impact of BEE implementation in PPP's, on the public sector front, it is important to understand the government experience with PPPs and whether compliance with the government's main policy goals have been met. This is going to be vital in reducing disadvantageous asymmetric lock-in arrangements whereby the government is involved in contractsthat are not improving the overall quality of life of the previously marginalized South Africans.

3. Methodology

This is a qualitative study which aims to explore and understand the experiences of participants (Creswell, 2009: 4) and to present their views and perspective (Yin, 2011: 8) concerning the empowerment phenomenon. This method was used to interrogate the relevant stakeholders in order to examine their experiences in implementing BEE policy through PPPs and to further analyze the effectiveness of this method in realizing the government's objectives with regards to BEE

The study adopts a phenomenological perspective which follows a constructivist epistemological paradigm. It was carried out through an examination of the Gautrain PPP as a primary case study andrunning a comparative analysis of another case conducted onInkosi Albert Luthuli Central Hospital (IALCH) PPP (Khatleli, 2009) as a secondary case to corroborate the findings of the primary case. This is consistent with what Heaton states as the complementary secondary data analytic method(Heaton, 2000).Critical case sampling as explained by Patton (2002: 243) was used to select the two cases as they are one of the biggest PPPs in their respective sectors and this allows for generalization. The two cases also meet the criteria of the research as they are exemplarily compliant PPPs and were both used as vehicles for BEE delivery.

4. Findings

4.1 Gautrain project

Gautrain is recognized as the largest transport infrastructure PPP project not only in South Africa but in Africa as a whole (Gautrain Management Agency, 2013). The 80 kilometer Rapid Rail Link is a state-of-the-art rapid rail network for the GautengProvince of South Africa, which has two links that connects Tshwane (Pretoria) to Johannesburg and the Oliver Reginald Tambo International Airport to Sandton (ibid.). The Gautrain PPP is structured around a concession agreement (CA) between the concessionaire, Bombela Concession Company, and the Gauteng Provincial Government (Province) which was signed and concluded in September 2006 and the concession period ends in September 2026. The relationship between the Province and the concessionaire is managed by the Gautrain Management Agency (GMA) which is mandated to ensure that the interests of the Province are protected in term of the CA through the monitoring and reporting of the activities of the concessionaire to the Province (Gautrain Management Agency, 2013). At the time this research was conducted (2014), the project was on the 4th year of its 15th year operation period.

4.1.1 Case analysis on Gautrain

The implementation of BEE and how it was monitored in the Gautrain project is largely considered to be exemplary. This is claimed to be due to the independent monitoring aspect incorporated within the concession agreement. The appointment of the Independent Socio Economic Monitor (ISEM) is deemed

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to have played a critical role in ensuring the achievement of the Socio Economic Development (SED) objectives set in the concession agreement. The independence of the ISEM is said to be ensured through its joint employment by the Gautrain Management Agency (GMA) and the concessionaire. The ISEM's role, which is to independently verify, monitor and report the SED deliverables as the project progresses, has resulted in the successful achievement of the SED goals which include the participation of BEE beneficiaries which are black people in verity, black women, black youth and disabled people through the employment of BEE companies inclusive of Small, Medium and Micro Enterprises.

The participation of BEE companies has been brought to fruition through the provision made in the concession agreement obligating the concessionaire to ensure the companies' participation by providing funding for their establishment and continuous support. The black companies however still had to rely on the funding provided by other developmental financial institutions. Another opportunity provided for BEE beneficiaries' participation was presentedthrough the provision for entities referredto as Special Purpose Vehicle/Group (SPV/G) within the consortium established for the Gautrain project. The SPV is a black entity given a 25% stake in the shareholding of the consortium which qualifies itto certain rights to exercise in the project. This provided a platform for the participation of black people in management as provided in the socio economic objectives of the project. The concept of black people in management was not only evident in the above mentioned platforms but was carried through the entire supply chain through the provisions made in the concession agreement.

Like any other project, the Gautrain project also experienced its own challenges. These were in relation to tokenism, fronting and fraudulent activities. These challenges were expressed through accounts given by the respondents of incidents where these practices were identified. At management level, incidents of fronting and tokenism where identified. These incidents include the appointment of inappropriate people in management level to increase BEE credentials of companies employed by the concessionaire; the replacement of black women in management with white women to reduce the participation of black people in management as white women are also recognized as previously disadvantaged individuals so the replacement would not affect their BEE credentials; and the use of blind trusts entities in order to hide company related information as these are protected by law in terms of which information can be provided. At the employee level, these incidents were associated with; the misrepresentation of documents such as BEE credentials of some of the companies which came on board and fraudulent identity documents of the people employed by the contractors.

The ISEM has also identified areas in which the implementation of BEE has been successful and where it has failed. The consensus is that; job creation, skills training and transference, black ownership, disabled people participation, women empowerment, enterprise creation and development; have all been somehow attained in the Gautrain project. However the extend and quality to which these are achieved becomes could not be ascertained. The ISEM attest that black ownership, skills training and transference have not been well attained whereas women empowerment, enterprise creation and development have been attained well above targets. The one area that the GMA attest to have been and still is a challenge with PPPs is the long periods between the signing of the concession agreement, the development and operation phase of the project. These open door to issues of risk transfer as it is affected with the change in legislature and economic state. Another common issue is the lack of awareness by the beneficiaries to both the financial and legal obligations that come with participation in PPPs. Most of the BEE companies are more than happy to sign the agreement without proper understanding of the consequences which leads to their participation being withdrawn.

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4.2 Inkosi Albert Luthuli Central Hospital (IALCH)

The Inkosi Albert Luthuli Central Hospital (IALCH) PPP stands as one of the largest PPPs to be implemented in South Africa, and was named in honour of former president of the African National Congress (ANC), Chief Albert John Luthuli Located in Durban, KwaZulu Natal, the construction of the 846 bed hospital began in 1996 and was still undergoing completion when the PPP legislation was promulgated in 2000 (Malao, 2011). However once the physical infrastructure was completed (without equipment), it was converted into a PPP agreement which was concluded in December 2001 for the provision and maintenance of medical equipment and certain hospital upgrades and Facilities Management (FM) services over a 15-year concession period.This project follows the British model of privately financed hospitals, where supporting services such as laundry, security or catering are provided by the private sector and clinical services and care are provided by the public sector.This meant that the non-core functions of health-care facilities were to be undertaken by the private sector, freeing health departments to focus on core clinical and medical functions. (Malao, 2011: 63).

4.2.1 Analysis of case study in literature: Inkosi Albert Luthuli Central Hospital (Khatleli, 2009)

The following are the themes that emerge from the deliberations had with PDIs involved in the Inkosi Albert Luthuli Central Hospital.

4.2.2 Reflection on the deal

The respondents on this study were asked to reflect on the deal and give an objective assessment of the contract after its 7th year in operation (Khatleli, 2009: section 5.7).

Proper involvement of PDIs

A strong feeling amongst the respondentswas that it is important for the PDIs to participate in all 3 tiers (1st tier = SPV, 2nd =main sub-contractors, 3rd is sub-sub-contractors) of the arrangement and most importantly in the 2nd tier which the women (a special company established and run by women) PDIs were not involved in and realized later that this level has more responsibility and financial benefit. Another pertinent issue was that there was one strong PDI (the sponsor) who might have compromised the other PDIs due to the others'lack of experience in PPPs as he was able to gain more from the deal at a higher level at the expense of the others.

The Commitment of the Private Sector to BEE

The collective opinion of the PDIs and the government officials was that the established companies were not embracive of the spirit of BEE and they were just concerned with meeting the minimum requirement in order to obtain the contract and any further involvement of BEE was not entertained. The PDIs felt exploited by the established companies due to their lack of experience in the PPP environment.

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PDIs' under-preparedness and lack of capacity

The PDIs emphasized on the need to have appropriate capacity and proper preparation prior to participating in PPPs as a BEE beneficiary. They reflected on the need for one to know what they are getting themselves into and the importance of resorting to professional assistanceshould one be uncertain. The input of lawyers who are not only experienced in the commercial side of contracts but who also know BEE extensively was also considered to be crucial. The PDIs also decried the need for capacitation to make appropriate business assessments and to be accorded an opportunity to play a meaningful role in the management of these contracts.

Challenges at independence

The PDIs gave an account that there is still a lack of independence of BEE companies in this deal even after 7 years; the PDIs generally felt that the established companies continue to have over-bearing control over the BEE companies. The PDIs further gave a view that future PPPs should be structured in a way that allows the PDIs to be able to gradually take over the operations to produce a pool of experienced PDI operators in the country.

Empowerment assessment of PDIs and contracts managers

The PDIs gave a positive view in the empowerment brought by this deal. They attest to having gained substantial experience and skill through this deal which has resulted in the overall positive molding of their business acumen and growth in professionalism. They now confidently see themselves as empowered business people. The contracts managers also attest to having being empowered through their experience in this deal as they mostly feel like they can start their own businesses as they have learned significantly in this deal.

4.3 Discussion of cases

There are four main areas that surfaced in both the cases that were examined with regards to the delivery of BEE in PPPs. These four main areas are discussed below and a conclusion is given at the end to synthesize the findings in line with the aim of this research.

4.3.1 Monitoring

The element of project monitoring in PPPs plays an important role in the effective delivery of BEE as it can be seen in the Gautrain PPP through the independent monitor. This has resulted in a successful implementation of BEE objectives which in this project have exceeded the initial targets. This is verified through the IALCH PPP as there was also a self-monitoring mechanism incorporated in the project. Although this did not yield the greater results compared to the independent monitoring employed in the Gautrain PPP, the self-monitoring element in IALCH resulted in a high standard of BEE delivery in that context.

4.3.2 BEE beneficiary participation

Participation of BEE beneficiaries was evident in both the cases. The question is that of the extent at which this participation was experienced. In Gautrain, the concession agreement allowed for the

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participation of BEE beneficiaries in the concession agreement and this participation was evident in all tiers of the partnership and throughout the supply chain through employment of the PDIs. This was also the case in the IALCH PPP as participation of PDIs was seen throughout all tiers except in the second tier where the SPV encountered challenges which resulted in their commercial exclusion in this level due to their lack of knowledge of the PPP arrangement.

4.3.3 Epowerment

Empowerment in a form of skills development and transfer, black ownership, job creation, disabled people participation, women empowerment, enterprise creation and development were also realized in some way or the other in both PPP projects. Although the same questions of the extent at which these were achieved is still a common denominator, this does not take away the fact that these elements were achieved in line with BEE policy aspirations in one way or the other. This can indicate an efficacy element of PPPs in delivering these BEE objectives.

4.3.4 Challenges experienced

The challenges which were experienced in both these PPP projects reflect mutual association in relation to the PPP platform which suggests that PPPs, like any other procurement method faces their own unique challenges that are not comparable to traditional procurement methods. However these challenges are minimal as they don't impact on the delivery of BEE as it is demonstrably better with PPPs than the traditional approaches to procurement.

5 Conclusion

This research has established that BEE can be effectively implemented in PPPs, if the government prescribed process is followed properly. The study's interrogation of the government experience dealt with level of satisfaction of policy makers and implementers. This was determined by looking at whether the problems frequently associated with BEE are prevalent when BEE is implemented in PPPs and the result was that; the transparent nature of PPPs together withprescribed meaningful stakeholder involvement, rigorous and independent monitoring mechanisms lead to effective BEE implementation which is congruent with the government's aspirations. Khatleli (2009) attests to this statement as he states that PPPs tendering mechanisms are more rigorous than traditional procurement methods.

The robust monitoring protocol in PPPswas also found to make BEE more defined, traceable and transparent due to the independence of the monitoring, and the monthly reporting on socio-economic progress of the projects. Thus the method of monitoring of BEE in PPPs is effective in comparison to that of traditional procurement. This is consistent with the study done earlier by Khatleli (2009) where this following conclusion was made; "in comparison to traditional procurement methods, substantial BEE compliance in PPPs is largely due to clarity in the articulation of project outcomes, unambiguous performance measurements and effective self-monitoring mechanisms".

The final objective of the research was in assessing the value PPPs have added to the South African society, in order to ascertain whether the implementation of BEE in the procurement procedure was a successful endeavor inproviding sustainable empowerment. The measurement utilized was to look into whether the outcomes of the Gautrain and the IALCH projects reflect the objectives as set out in the Codes for BEE in PPPs. Both projects substantially achievedthe set objectives in the respective

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Livingstone, Zambia
ISBN 978-0-86970-787-6

concession agreements congruent with the government's overall empowerment aspirations. The government is therefore making a successful effort in providing sustainable empowerment that establishes PPPs as a prospective leading contributor to BEE commitments.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-038

Evaluating Claims and their Impact on Project Delivery in the Zambian Construction Industry

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Abstract

The construction industry in Zambia has been a major contributing sector to economic growth and national development. However, it is also the most fragmented industry as it involves multidisciplinary parties working together in achieving successful project delivery. Yet more, because of its multidisciplinary nature any lack of cohesion or synergy among key project stakeholders may result in claims. Claims are costly and detrimental in construction project delivery therefore demanding necessary control measures. Through the use of qualitative and quantitative approaches this research identified changes in design, errors in contract documents, changes in specifications, poor workmanship, change in schedule, inadequate design, unforeseen ground conditions as well as poor communication to be the common causes of claims on construction projects in the Zambian construction industry. This research recommends that reasonable time and investigation be allocated by the employer in choosing the consultants or a contractor for project execution. More so, appropriate contracts which indemnify parties to a contract need to be employed in reducing and managing claims with its adverse effects on successive project delivery in the Zambian construction industry.

Keywords: claims, construction industry, project delivery, Zambia

1. Introduction

Construction projects are complex in nature involving the integration of human and non-human factors and variables. The non-human factors and variables include such things as plant, material and equipment; while human factors entails parties from different disciplines temporarily joining together to execute a construction project. Each party's responsibility within the construction process is intertwined with others, either as a prerequisite for another party's work or as an integral part of such work. Where one of the parties in the construction process fails, the others are adversely affected. When a problem faced by one party is ignored or recognized late, the problem may escalate into disputes and claims. Claims are costly and detrimental on a construction project demanding necessary control measures.

Semple et al. (1994) as cited in Mitkus (2013) defined a claim as a request for compensation for damages incurred by any party to a contract. Construction claims are considered by many project participants to

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

be one of the most disruptive and unpleasant events of a project (Hesham, et al., 2012). Claims during the course of construction can be due to among other things variation orders or site instruction.

This research identified and evaluated some of the causes and effects of claims on Construction projects in general as well as in the Zambian Construction Industry, before subsequently suggesting some of the possible cost effective claim management techniques. This was achieved through the use of both qualitative and quantitative approaches involving various relevant procedures, statistical tests and analysis.

2. General Definition of a Claim

Over the years, various authors have attempted to define the term "claim". Others have defined a claim in terms of its relation to the original contract. Semple et al (1994) as cited in Mitkus (2013) defined a claim as "an assertion to the right to remedy, relief or property" or as "a failure to fulfil obligations under the contract". Further, Chappell (2011) defined a claim as "an application by the contractor for payment and extension of time (EOT) for changes which arise outside the ordinary contract provision". More so, Cunningham (2014) defined a claim as "requests for the reimbursement for additional cost resulting from certain employer or employer's agent's act which delay or disrupt the contractor's progress and which otherwise would not be recoverable under the contract". However, for the purpose of this research a claim has been defined as application by a party to the contract for payment that may arise other than that under the ordinary contract payment provisions.

2.1 Claims in construction industry

The term "claim" has become a commonly used word in the construction industry around the world. Claims are a significant concern in the construction industry especially with increasing magnitude of complexity of modern day projects (Ramachandra, 2014). The cost of a construction project right from inception to completion bears great importance in the construction industry. However, due to many reasons, the total cost of a project can significantly vary from the initial estimated cost consequently leading to variations which are sometimes inevitable on construction projects.

2.2 Classification of construction claims

Construction related claims have been classified severally by various authors depending on their relevant legal basis. This research however adopts the categorisation of construction claims by Ashworth, Hogg and Higgs (2013) and Mohammed (2012), into three divisions, namely: contractual, extra-contractual and ex-gratia claims.

2.2.1 Contractual claims

Contractual claims are the claims that fall within the specific clauses of the contract. In well-accepted standard contracts, there are a lot of provisions which entitle both the contractors and the employers to claim for the appropriate compensation such as ground conditions, valuation, variations, late issue of information, and delay in inspecting finished work.

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2.2.2 Extra-contractual claims

This type of claims has no specific grounds within contract but results from breach of contract that may be expressed or implied, i.e. the extra work incurred as a result of defective material supplied by the client.

2.2.3 Ex-Gratia Claims

Ex-gratia claims are the claims where there is no ground existing in the contract or the law, but the contractor believes that he has the rights on the moral grounds, e.g., additional costs incurred as a result of rapidly increased prices. Ashworth, Hogg and Higgs (2013) comment that a sympathetic client may on rare occasions, make such a payment if there has been a long-standing relationship, or because a contractor has provided a particularly satisfactory performance and has completed the contract on time, to the required standard within the agreed price, but has incurred a loss through misfortune, or no fault of its own.

2.3 Causes and effects of claims on construction projects

2.3.1 Causes of claims on construction projects

The factors that cause claims either as variation orders or change orders on construction projects vary from one project to another. Several authors highlighted the following as some of the common causes of claims on construction projects (Abedi et al., 2011; Harvey and Donna, 2011, 2011; Rizwan et al., 2014; Hymes 2010).

Change of schedule -- A change of schedule during the project construction phase may result in delay as well as major reallocation of resources. Delay is costly and often times results in claim; disruption of work, loss of productivity, late completion of project, increased time related and third party claims (Abedi, et al 2011).

Change in scope - The scope of work (SOW) is typically a written document that defines what work will be accomplished by the end of the project—the deliverables of the project. The project scope defines what will be done. The scope of work is the basis for agreement by all parties. A clear project scope document is also critical to managing change on a project. Since the project scope reflects what work will be accomplished on the project, any change in expectations that is not captured and documented creates the opportunity for claims. Harvey and Donna (2011) established that change in scope was considered to be the among the most common cause claims on infrastructure projects.

Financial challenges - The owner's financial problems can affect project progress. Inadequate financial strength on the part of the client is leads to disputes and claims (Rizwan et al., 2014). This problem often leads to change in work schedules and specifications, affecting the quality of the construction.

Change in design - A change could necessitate contractor's claim for increased cost of additional material, labour, supervision and equipment. The contractor may also claim for would be loss of productivity. The inefficiency may lead to damages because it forces the contractor out of his initial plan. This loss of productivity subsequently results in claim.

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Errors in contract documents **-** Errors entail different meaning and usages depending on how it is conceptualized (Sunday and Afolarin, 2013). Errors in contract documents are a source of claims and disputes. Errors in construction documents have had serious effects on construction projects and these are mostly manifested at construction and post construction phases of project's cycle. Contract documents among other things include; drawings, design specifications, quality control reports and bills of quantities. These errors maybe as a result of slips, lapses, mistakes, omissions, violation, errors in drawings, poor communication, inadequate design and documentation (Love et al., 2011; Sunday and Afolarin, 2013).

Design complexity **-** Complex designs require unique skills and construction methods (Arain et al., 2004) as cited in Memon et al. (2014). Complexity affects the flow of construction activities, whereas simpler and linear construction works are relatively easy to handle hence less disputes

Change in specification **–** Specification are part of contract document hence any change in specification during project execution has effects on the project delivery. Change in specifications results in variations to the project, leading to delay and increased overall cost (Hymes 2010).

Equipment **-** Equipment unavailability, breakdowns, shortage, and low level of equipment-operator's skill, low productivity and efficiency of equipment, lack of high-technology mechanical equipment causes of delays on construction projects which subsequently results in claim (Muhwezi et al., 2014).

Contractor's financial difficulties **-** Construction is a labour intensive industry. Whether the contractor has been paid or not, the wages of the worker must still be paid. Muhwezi et al. (2014) identified contractors financial difficult to be the cause of delay (dispute) and therefore claims. If a contractor experiences financial difficulties during the course of a project, it may affect resource availability. Consequently, affecting the progress of the project works.

Poor workmanship **-** Similar to the rights of the contractors, the employers are also entitled to claim from the contractors, any payment which they consider is due to them by virtue of certain defaults under or in connection with the contract such as: rejection and/or retesting of the works, remedial works for defective works International Federation of Consulting Engineers (IFCE), (2014). This results in delay and increased cost.

Lack of strategic planning **-** Proper strategic planning is an important factor for successful completion of a building project. The lack of strategic planning is a common cause of variations in projects where construction starts before the design is finalized (e.g., in concurrent design and construction contracts).

Inadequate design **-** Inadequate design can lead to errors in the preparation bills of Quantities (Sunday and Afolarin, 2013), errors in contract document leads to claims and dispute during project execution. Inadequate design also affects project technical Implementation

2.3.2 Effects of claims on construction projects

In the construction industry, claims are common and can happen as a result of several reasons as articulated during the review of the common causes of construction claims. Claims exert various effects on the projects (Memon et al., 2014; Ismail, 2012; Sunday, 2010; Ramabodu and Vester, 2010) highlighted the following as the significant effects of claims (variation orders) on project performance;

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Schedule Delays **-** Claims on construction projects can lead to schedule delays especially if it is disputed by one of the parties to a contract. This is so because in certain instances the affected part may not agree to proceed with the works unless a common ground is met.

Late engineering and design information, numerous and late design change, late approval of contractors submittals, late response to contractor request for information and untimely approval of valid contractors request for changes are the common factors that affects and leads to schedule delays (IFCE, 2014)

Cost Overrun **-** Increase in project cost is regarded as the most common effect of claims. Any alteration or addition to the design and schedule during project execution may results in claims. Ramabodu and Vester (2010) identified critical factors that causes cost overruns on construction projects among them include contractual claim (extension of time with cost) as well as changes in scope of work on site and inadequate design.

Quality Compromise **-** Claims affect the quality of work adversely. Construction Industry Institute (CII), (1995) as cited in Memon et al. (2014) reported that the quality of work is frequently affected by frequent variations because contractors have to compensate for the losses by cutting corners this is more pronounced especially if the claim has not be adequately addressed.

Rework **-** Variations which are a source of claims often results in rework and demolition. This effect is to be expected due to variations during the construction phase while variations during the design phase do not require any rework or demolition on construction sites (Memon et al, 2014)

Logistics delays **-** Variation which leads to claim may cause requirement of new or additional amount of material and equipment which results in logistics delays (Memon et al., 2014). Late approval of contractors submittals affects planning resulting in shortages of resources (Akinsiku et al., 2012) thereby leading to logistic delays. Most disputes under construction contracts relate to the issue of payment. Such disputes can sour relationships and pose a major threat to the effective delivery of materials and consequently projects, on time and on budget

3. Methodology

Qualitative and quantitative approaches were adopted in this study for triangulation as well as effectiveness since biasness is limited (Biggam, 2008; Naoum, 2007).Common causes of claims and their effects on construction projectswerecompiled based on the literature reviewed.

It is also worth mentioning the research limitation in sense that it did not survey any road project but rather building projects only. Questionnaires and interviews were administered to contractors working on both public and private projects. Purposive sampling was used in the selection of a representative sample from the population of interest. The population of interest were public and private projects this was to avoid biasness. The rationale for choosing this approach was that it enables the use of judgement to select cases that can best meet the research objectives. More so, this sampling method is useful when working with very small samples that are particularly informative(Neuman, 2005). Therefore, ten (10) projects based on a case by case were purposively sampled andthe claims considered in this study were those that occur at project execution phase.

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4. Findings and Discussion

The following information was obtained from the research study and analysed so as to draw conclusions and recommendations for the research. The presentation of findings and discussions is aimed at meeting the overall objective of the research study which is to evaluate claims and their impacts on projects delivery in the Zambian construction industry.

4.1 Causes of claims in the Zambian construction industry

An assessment was carried out to ascertain the causes of claims based on their frequency in the Zambian construction industry.

4.1.1 Change in design

The findings revealed that the most prominent cause of claims on construction projects surveyed was change in design necessitated by the client through the consultants. This was evident as the results showed that 80% of the projects were affected by this factor. Unforeseen site conditions also contributed to design changes.

4.1.2 Errors in contract documents

60% of the projects surveyed revealed errors in the contracts documents namely; the Bills of Quantities, drawings and consequently specifications. Architect's failure or lack of familiarisation with the site conditions at design stage was a major contributing factor identified as well as making of wrong specifications.

4.1.3 Varying site conditions

Varying site conditions were identified as a factor leading to claims as evidenced on 30% of the projects surveyed. The varying conditions were due to Engineers or Architect's lack of familiarization with site conditions at design stage. It was also found that contractors were sending unqualified staff during site visits.

4.1.4 Poor communication

The research found that poor communication was another factor which caused claims as evidenced on 30% of the projects surveyed. Getting timely feedback between the contractors and consultants had been a challenge on most projects surveyed; this consequently resulted in claims and cost escalations.

4.1.5 Inadequate design

The findings revealed that most projects surveyed had challenges with the architectural drawings. In 40% of the projects surveyed drawings had to be revised twice due to unrealistic details andomissions.

4.1.6 Changes in specification

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The findings revealed that 30% of the projects surveyed had situations where client had to change the specification during the course of actual construction process; this led to alterations in contract documents subsequently leading to claims

4.1.7 Change of schedule

The findings revealed that 30% of the projects surveyed experienced time overruns due to delay in receiving payments, lack of interface as well as changes in design. The extension led to the increased cost of preliminaries and general items.

4.1.8 Poor procurement process

10% of the projects surveyed revealed that the purchase of materials was not well coordinated as evidenced by delay which consequently affected the project delivery in terms of time overruns.

4.1.9 Workmanship

10% of contractors surveyed revealed the quality of workmanship as another factor contributing to claims on construction projects. On 20% of the project surveyed the nominated subcontractor failed to execute the works. This consequently led to the works being transferred to the main contractor during the course of actual construction at a higher rate.

Table 1: Causes of claims on construction projects

Item No	Descriptions	Projects affected	% of projects affected
1	Change in design	8	80
2	Error in the contract documents	6	60
3	Varying site conditions	3	30
4	Poor communication	3	30
5	Inadequate design	4	40
6	Change in specifications	3	30
7	Change of schedule	3	30
8	Poor procurement process	1	10
9	Poor workmanship	1	10

4.2 Effects of claims on project delivery cost

An assessment was carried out so as to ascertain the effects of claims on construction projects cost in the Zambian construction industry. The findings, as shown in table 2, revealed that 100% of the projects surveyed had cost variances between the initial contract sum and final sum. The average %age cost variance between the initial contract and a final sum was at 18.92%.

These cost variances were due to alterations or addition to; the design, scope of works and schedule during project execution. Poor procurement process and communication also contributed to cost overruns. Poor procurement process was through contractor's failure to order materials on time thus leading to delay and subsequent cost escalations. Poor communication resulted from late and inadequate responses to contractors request for information as well as late approvals of valid contractors request for payments and changes this also led to delay and eventual cost overruns. Therefore, this clearly shows that the problem of claims on Zambian construction projects is costly hence requiring cost effective control measures.

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Table 2: Impact of claims on construction project delivery Cost

Item No	Project Details	Contract sum	Final sum	Variation	% variation
1	Project 1	4, 282, 615	4, 785, 328	502, 713	11.74
2	Project 2	9, 260, 041	10, 154, 647	894, 606	9.66
3	Project 3	1, 412, 665.98	1, 510,124.65	97, 458.67	6.90
4	Project 4	1, 802, 310.11	1, 974,731.71	172,421.6	9.57
5	Project 5	624, 520.00	902, 7199.6	278, 199.6	44.55
6	Project 6	3, 100, 936.01	4, 121, 726.71	1, 020, 790.7	32.92
7	Project 7	3, 232, 206.64	4, 727, 333.00	1,495, 126.36	46.26
8	Project 8	5, 710, 346.00	6, 100, 400.86	390, 054.86	6.83
9	Project 9	6, 482, 711.00	6, 582, 320.00	99, 609.00	1.54
10	Project 10	1, 946, 001.00	2, 320, 100.01	374,099.01	19.22
11	**Average**				**18.92**

4.3 Effects of claims on project duration

An assessment was carried out so as to ascertain the effects of claims on construction project time in the Zambian construction industry.The research findings as shown in table 3 revealed that 90% of the projects surveyed experienced some variation between the scheduled and actual duration with an average %age variation of 20.41%. The variations were due to claims resulting from delays in getting timely feedback between the contractors and consultants; this consequently stalled the work progress. Furthermore, the purchase of materials was not well coordinated as evidenced by delay in delivery to sites. More so, delays in receiving payments, lack of interface as well as changes in design were other factors identified as causes of time overruns.

Table 3: Impact of claims on construction project delivery Time

Item No	Project Details	Planned duration	Actual duration	Variation	%age variation
1	Project 1	8 Months	10 Months	2 Months	25
2	Project 2	16 Months	19 Months	3 Months	18.75
3	Project 3	7 Months	8 Months	1 Month	14.29
4	Project 4	8 Months	8.3 Months	0.3 Months	9.38
5	Project 5	6 Months	7.2 Months	1.2 Months	25
6	Project 6	18 Months	21 Months	3 Months	16.67
7	Project 7	16 Months	26 Months	10 Months	62.5
8	Project 8	20 Months	29 Months	9 Months	45
9	Project 9	12 Months	12 Months	0	0
10	Project 10	16 Weeks	14 Weeks	2 Weeks	-12.5
11	**Average**				**20.41**

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Livingstone, Zambia
ISBN 978-0-86970-787-6

5. Conclusion and Recommendations

In the construction industry, claims are common and can occur as a result of several reasons as earlier mentioned. The research established that the most common causes of claims in the Zambian construction industry are changes in design, inadequate design details as well as errors in contract documents. Further, Engineers or Architect's lack of familiarisation with the site conditions at design stage is another major cause of claims in the ZCI as evidenced in this study.

Therefore, in reducing and managing the costly effects of claims in the Zambian Construction Industry; the client needs to allocate enough time to the design team and the consultants to produce more elaborate, adequate drawings, specifications, Bills of Quantities and required documentations. Secondly, certain public infrastructural projects need to be opened up for design competition, which would allow for the selection of the best designs. This strategy can aid in addressing the issues of; errors in design, inadequate designs, omissions as well as incorrect specifications. Lastly, reasonable time and investigation in choosing the contractor as well as an appropriate contract which indemnifies parties to it accordingly should be considered.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-017

Provincial Roads CAPEX Programme in South Africa: Payment Claims and Reporting Gaps

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Abstract

As a developing region, the management of infrastructure programmes is important in sub-Saharan Africa. Road projects under Capital Expenditure (CAPEX) programmes fall into this category of infrastructure. To assess the issues, a study with the overall aim of identifying remedial actions that can mitigate the challenges in the roads CAPEX programme (RCP) in a provincial Department of Public Works (DPW) was conducted in South Africa. This paper reports on the unfavourable effects of improper payment mechanism and report administration encountered in the RCP. A mixed methods research design was used in the study. The exploratory sequential mixed methods design, which allows the collected qualitative data to build into the quantitative data for a broad interpretation of the findings, provides salient insights. Late payment for work done by contractors due to employer' internal procedures are a major problem experienced on the projects. Another significant concern of the programme actors is the fact that reports seldom reflect the actual status of the progress of projects in the programme. The research findings suggest that the DPW should revisit mechanism for payment and reporting currently used for the 10-year RCP, which is meant to contribute to the socio-economic development of the province through the upgrade of existing roads and the construction of new roads.

Keywords: construction, programme management, roads, South Africa

1. Introduction

Infrastructure projects, such as schools, hospitals and roads, consume almost 18% of the national budget allocation in South Africa (Department of Treasury, 2008) because of the need to address the effects of a past policy of separate development. The South African government have steadily embraced the practice of increased investment in areas that were previously under-developed (Fisher, 2008). However, the question is how to spend the allocations properly for the realisation of the anticipated benefits. This question is crucial as infrastructure development would not only boost the economy, but it will also correct the separate development of the country (Gorghan, 2012). The premise is the rationale for the implementation of CAPEX infrastructure programmes through the DPW at various level of governance in South Africa. Such CAPEX programmes enable the execution of projects that can uplift under-developed areas in South Africa. The problem is that though the government invests

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Livingstone, Zambia
ISBN 978-0-86970-787-6

a lot of resources into such programmes functional infrastructure that can be shown for the effort is limited. This is a major concern to stakeholders. The management of the CAPEX programme at the provincial level has been a concern to all stakeholders. For instance, Molewa (2008) note that a large proportion of government projects have failed due to ineffective project management practices. The observations of Molewa (2008) highlight the fact that management structures seem to be ineffectively utilised; and protocols were bridged in some cases. Such problems leads to misinformation that leads to errors in reports as government bureaucratic structures hinder swift and timely processing of information. The mainstream media have made case examples of several provincial programmes.

This study therefore focuses on the problems by looking into the programme in a single province in South Africa. According to the strategic plan of the case province, the Chief Directorate Roads Management at a Head Office (HO) and District Offices (DO) implement the RCP. The HO focuses on planning, design, and the implementation of capital projects, whereas the DO is mainly concerned with routine maintenance. This study therefore focuses on the roles and responsibilities under the HO. The RCP is a ten-year strategic development initiative that caters for the development of additional paved roads, and the rehabilitation of existing paved and unpaved roads in the province.

The case of this particular province is unique as most projects fail to achieve their goals due many implementation problems that affect the payment and reporting mechanisms in the programme (Molewa, 2008). Therefore, this particular paper reports on the payment and reporting hiccups witnessed in the RCP. As such, the objective of this paper is to present responses to two research questions:

- What are the payment problems of an RCP in a South Africa province?
- What are the inadequacies relative to reporting mechanism used in an RCP in a South Africa province?

2. What is Construction Programme Management?

While project management is oriented toward the goals of a single project by focusing on the management of finance, progress and quality, programme management is oriented towards strategic goals involving more than one project. However, project and programme management focus on integrated planning, control and coordination of required activities. Just like projects, the lifecycle of a construction programme include initiation, planning, bidding and tendering, implementation and termination. In contrast to project management where the team participates in all areas of management of the particular project, the programme management team does not play direct roles in daily administration of projects that make up the programme (Chen et al., 2013). As a result of these descriptions, Shehu and Akintoye (2010: 27) define construction programme management as ..."an integrated, structure-framework to co-ordinate, align, and allocate resources, as well as plan, execute and manage a portfolio of construction projects simultaneously to achieve optimum benefits that would not have been realised has the projects been managed separately."

6 Research Rationale

The literature acknowledged a range of implementation barriers related to programme management. Such barriers encompass the lack of clarity and understanding (Shehu and Akintoye, 2009), lack of proper risk management (Shi et al., 2014), and bureaucracy (Jia et al., 2011). For instance, excessive

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ISBN 978-0-86970-787-6

bureaucracy and control creates increased overheads for reporting requirements and a culture of blame within the team (Lycett et al., 2004; Shehu, 2008). The challenges of programme management is evident in late delivery of projects, which can be due to poor risk and financial management, lack of cross-functional communication, and the lack of required resources to assign and analyse various constraints (Shehu and Akintoye, 2010).

These reported challenges mirror the experience of the RCP in South Africa where performance problems adversely affect public sector service delivery. According to Consulting Engineers South Africa (CESA) (2012), inadequate delivery capacity within government has contributed to slow pace of infrastructure development in the country. The gaps in delivery capacity are evident at the design and implementation stages, especially in relation to constant scope changes, increased project cost, delayed hand over dates, and associated rise in service delivery protest nationwide. Thus, the premise of this research is to gain insights into the challenges of construction programme management in South Africa. Notwithstanding evident barriers, successful programmes are designed to meet the expectation of stakeholders. In order to do this, Donaldson (2001 cited by Xaba, 2011: 32) advocates elements, which include:

- Establish a programme management office and appoint a programme director or coordinator;
- Recruit and develop a qualified and technically diverse team of employees;
- Develop an annual work plan containing specific, measurable, time phased and realistic goals, as well as objectives, activities and performance measures for each programme component;
- Develop an accurate budget request that corresponds with the programme's work plan and meets the administrative requirements and guidelines;
- Establish a sound fiscal system that tracks and monitors programme expenditures and ensures the accurate and timely reimbursement of services contracted by the programme;
- Prepare and submit required progress reports and financial status reports to clients in a timely manner, and
- Develop mechanisms for consultation with stakeholders.

7 Research Methodology

This study emerges through the analysis of reviewed literature, semi-structured interviews and questionnaire research. The data collection was conducted with the use of mixed methods to provide broader perspectives on claims and reporting issues in the RCP (Tashakkori and Teddlie, 2010). The approach enabled the collection of both qualitative and statistical data, which were used to substantiate evidences (Creswell, 2009). One-on-one interviews were used to explore the problems, and a survey among the actors involved in the programme was conducted to confirm the views of the interviewees. This approach is called "exploratory sequential design" by Creswell and Plano Clark (2011: 69) as the interviews builds into the survey so as to engender broader interpretation of the findings. In particular, the study collected textual data about the RCP through interviews so as to identify the claims and reporting gaps in the programme. Relying on the themes that emerged from the textual analysis, the researchers developed a survey questionnaire and used it to assess the prevalence of these inadequacies within a larger sample of the RCP participants.

The purposive sampling technique was used for selecting the participants in the study as the fieldwork focused on a single department in a province in South Africa. The participants in the study were affiliated

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with the RCP in the DPW. Although the participants have various job titles, they can be categorized under clients, consultants, and contractors.

When the review of the literature was concluded, the interview protocol was then compiled and piloted among three principal actors in the programme. After the finalisation of the protocol, fourteen programme actors were invited to take part in the study, although only nine interviewees were eventually conducted. Prior to the scheduled date and time of each face-to-face interview, the protocols were sent to the programme actors that agreed to take part in the study. The interviewees include three DPW employees, four project management consultants, and two contractors involved in the programme. The interview questions were open ended, and each session was almost an hour in duration. The venue for each interview was the designated office of interviewees.

After the interviews, a survey was conducted among an enlarged sample of actors in the programme. Through the information retrieved from the DPW, 83 survey questionnaires were circulated to obtain possible confirmatory data for the study. The structured questions of the questionnaire were based on the findings of the interviews. At the end of the survey period, 39 completed questionnaires were returned and processed. This constitutes a 47% response rate for the survey. In terms of demographic data, 94% of the survey respondents have post-secondary school qualification, 72% of them have construction related job titles, 69% offer project management as a core service in their forms, and most importantly, 13% of the respondents have executed seven or more projects in the RCP. The data also show that 56% of the respondents have done 1-3 projects, whereas 31% of them have concluded 4-6 projects in the programme. The survey thus provides the platform for obtaining confirmatory data from the programme actors. It should be noted that the interviewees were not included in the survey.

8 Research Results

In broad terms, the interviews sought responses to implementation issues related to both payment and reporting on the programme. To obtain information related to general perceptions of the CAPEX programme, responses were sought to:

Question G1: what necessitated the practice of Roads CAPEX programme management in the Department?

Question G2: how is the Roads CAPEX programme assisting the DPW to achieve its objectives and goals?

Based on the textual data, it was clear that the interviewees agree that the DPW has infrastructure projects, which must be coordinated, so that limited resources can be appropriately allocated. It was cited that the management of the RCP has helped in the formulation of policies and resource budgeting. Beside policy and budgetary requirements, the interviewees noted that the programme is also expected to assist the DPW to align its projects with government policies, especially the preferential procurement policy. In response to the second question, the interviewees were of the view that the periodic programme management reports show a clear financial and physical progress on the various projects in the programme. These reports enable decision makers to know the state of infrastructure projects in the province, and assess the infrastructure needs of communities so as to plan and budget towards them. The data further show that the management of the RCP, places and aligns, projects within the strategy of the DPW. The alignment allows appropriate actions to be taken where projects are becoming rogue. Rogue

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projects in this context refer to the start and implementation of projects, which have complete separate socio-economic benefits from the projects in the programme. In addition, all the nine interviewees observe that projects are coordinated, monitored, controlled and managed successfully by the programme management consultants. The use of the consultants has stemmed the tide of rogue projects in the programme. For instance, it was reported that more projects are successfully completed within the programme than when managed individually; and projects within the programme are prioritised and executed in accordance with the resources dedicated to the programme.

The opening questions posed to the programme actors about broad perceptions provide the opportunity to inquire about the payment and reporting issues. According to the interviewees, the most conspicuous payment problem on the programme pertains to processing (Table 1). The interviewees also note that payment delays lead to cash flow problems in projects within the programme, and this is evident in many changes that are effected at the construction stage. In particular, the interviewees note that:

- Payment certificates and invoices for the programme do experience constant template changes, which makes it difficult for contractors to prepare. Certificates prepared on out-dated templates need to be returned to contractors and put on the required templates before processing can be done;
- Most payment certificates and invoices are found to have errors that must be corrected and signed off before payment can be done;
- The certificate and invoice payment processes in the department are lengthy and complex. Certificates need to go through complex bureaucratic processes, which delay their payment, and
- The department has insufficient capacity and skills to process large volumes of certificates and invoices in time.

Table 1: Overview of major payment and reporting gaps in the RCP

Aspect	**Comments of interviewees**
Payment claims	Processing of payments constantly run into brick walls
	Payment delays leads to cash flow problems for projects
	Capacity and bureaucracy affects timely payment
Reporting	Reports fail to show clear programme / project status
	Reports tend to be complex and technical
	Reporting template constantly undergo revisions
	Reporting does not follow the programme timelines

The effects of the payment claim issues are evident in the delay in the progress of both projects and the main programme due to cash flow constraints. Once the cash flow problem occurs, unnecessary extension of time and escalation claims often become the order of the day. On the social economic front, the empowerment programmes for subcontractors and emerging contractors in the programme are affected and various stakeholders would flag reduced profit margin as possible reason for disputes.

Another issue mentioned by the interviewees is that of bureaucracy. Bureaucracy occurs in terms of the number of signatures on documents / invoices before payment can be effected. Given the first hand experiences of the interviewees on the subject matter, most of them were quick to advance possible interventions. They mention that:

- Though payment certificates and invoices must be upgraded to meet new policies of the departments and evolving technologies, the frequency of their updates should be minimised.

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This will allow those who prepare payment certificates and invoices to get accustomed to the templates in order to minimise inconsistencies;

- Invoices and payment certificates should be scheduled such that their submission dates are evenly spread throughout the month, contrary to the monthly 25th day deadline currently used. This will reduce certificates and invoices piling up and consequently enhance timely payment, and
- The department should build adequate capacity to process the large volumes of these invoices and payment certificates. This may be done by recruiting more hands, training employees to improve efficiency and putting necessary systems in place to enhance the payment processes.

At the administrative level, the programme has been vulnerable to reporting issues in its management. To this end, the interviewees mention that reports in the RCP do not always reflect actual project status. This may be due to the lengthy reporting lines; starting with Contractor – Consultant – Implementing Department (DPW) – Client Department – Government. It is obvious that, by the time this information reaches the major decision makers, a lot of changes might be done to the programme. For example, skill development and employment generation figures, which are key concerns to policy makers, are difficult to determine from reports. And the technicalities in the reports make them difficult for a non-technical reader. In this turn leas to misrepresentations and misinterpretations among programme actors. The reports also demands a lot of time to compile, and the submission protocol is rather lengthen due to the bureaucratic nature of government organisations. As such, it is important to remedy the situation in line with the comments of the interviewees, which include:

- Reporting lines should be streamlined such that, information is not distorted on reaching the receiver. Unnecessary bureaucratic processes, which delay reports and make it out-dated, should be eliminated. The reporting channel should be programmed and managed in order to minimise time spent at each reporting point in the channel, and
- Junior level workers, from task leaders – gang leaders – foremen – general foremen on projects, where reports are generated, need to be equipped with reporting skills and techniques. Information provided by contractors on the various projects in the programme should be accurate and relevant. Training programmes such as workshops on the reporting template should be given to contractors before the contract commences.

The survey, which was conducted after the analysis of interview data, confirms the veracity of the views of the interviewees. The survey data are herein shown in Table 2 and Table 3. The survey used a 5-point Likert scale to collect, analyse, and interpret the data. A scale of 1= strongly disagree to 5= strongly agree, was used. In order to determine inferences, Chi–square tests were conducted in accordance with the decision rule in Bagdonavicius and Nikulin (2011: 32). A confidence level of 95% was set for hypothesis testing. Two complementary statements, the null hypothesis, which is a claim of no difference and an alternate hypothesis, which is a claim of a difference in the population (Bagdonavicius and Nikulin, 2011: 34) were specified for this study. In brief, the null hypothesis is accepted if $p \leq \alpha$ whereas the alternative hypothesis is accepted if $\alpha \leq p \leq \beta$. Where p is the significance level, α is the pre-determined threshold probability (5%), and β is confidence level (95%).

It is notable that the general perception of the programme obtained through the survey was not dissimilar from the views obtained in the interviewees. The perceptions related to payment / claims as shown in Table 2 indicate that late payments negatively influence outcomes of the RCP and its constituent projects. This appears to be the foremost payment problem encountered on the programme. Improved

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software for payment and the reduction of the impact of bureaucratic steps would constitute a step forward in the RCP. The mean responses to the various statements in Table 2 are notably greater than 3.00, which indicate that the respondents agree that bureaucratic processes and software matter impact on payments in the RCP. The Pearson Chi-square test revealed significance level ≥ 0.63. The findings in Table 2 thus corroborate the views of the interviewees (Table 1) in term of the payment related problems of the RCP.

Table 2: Inferences related to payment claims related gaps in the RCP

Statement	Mean	Rank	Chi-square
Late payments of certificates negatively influence the delivery of projects	4.74	1	0.63
Payment system software needs to be improved to enhance early payment of certificates	4.10	2	0.52
Bureaucratic processes hinder early payment of certificates and invoices	3.97	5	0.62

Table 3 shows that the respondents opine that reporting channels are not well defined on the RCP, and reports are prepared by inexperienced and unqualified employees in the DPW. The respondents also flag the view that the time lines for submission of reports are not observed on projects and the RCP as a whole. In other words, the survey data show that there is a positive relationship between 'in-house capacity' and 'reporting standard' of the RCP. The Pearson Chi-square test results revealed significance level ≥ 0.72. The findings in Table 3 also corroborate the views of the interviewees (Table 1).

Table 3: Inferences related to reporting related gaps in the RCP

Statement	Mean	Rank	Chi-square
Reporting channels are not well defined on the programme	4.10	1	0.72
Reports are prepared by inexperienced and unqualified employees in the DPW	3.86	2	0.90
Time lines for submission of reports are not observed on the project	3.25	4	0.60

9 Discussion

Within the construction industry context, the implementation of a new system, such as programme management, is a challenging task (Shehu and Akintoye, 2010) because infrastructure projects are implemented in a socio-technical context in which events occur (Van Gils et al., 2009). Major challenges have been encountered in the practice of construction programme management. Reported categories include strategic focus, human and communication, finance, leadership and commitment (Shehu and Akintoye, 2010). Under these categories proposed by Shehu and Akintoye (2010), the lack of cross-functional working (among projects), lack of coordination between projects, lack of training, people constraints, lack of knowledge of portfolio management techniques, lack of resources / poor allocation of resources (human and finance), lack of knowledge to evaluate risks, frequent scope changes (especially in projects), late delivery of projects (which was almost endemic), and lack of cross-functional communication; are the major challenges experienced on the case programme of this study.

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Both the interview and the survey data confirm the impact of late payments and poor reporting mechanism in the RCP. Going forward, the programme would have to take address these issues by ensuring that at the implementation phase, all stakeholders reach a notarised agreement concerning major deliverables of the RCP (Chen et al., 2013). The findings of this study, which resonate with the findings in the literature, demand that the problems in the RCP must be mitigated as Todorov (2014) contends that best project and programme tools and methods are able to positively impact the economic and social development of communities and countries that effectively implement them. Todorov's contention is based on the measureable positive socio-economic benefits that have accrued to Bulgaria through implemented European Union programmes.

10 Conclusion

This exploratory study shows payment and reporting challenges in the management of a CAPEX programme in South Africa. The assessment of the RCP through the lived experiences of actors in the programme confirms that payment and reporting mechanisms have often impact on the progress of the work at different stages of implementation.

To some extent, the results of the study answered the two research questions mentioned at the introductory section of the paper. In particular, the response to the payment question shows that poor payment processing mechanism appears to have been exacerbated by lack of capacity in the responsible department and the required number of steps taken to release funds based on valid certificates and invoices. The response to the second question highlights the impact of complex reporting templates and again, the bureaucratic steps incidental to reporting deliverables. These problems tend to compromise the timeliness and usefulness of reports in the RCP.

There is resonance with the literature on construction programmes on some of the issues uncovered in this particular study. In relation to payment for claims, it is imperative to expedite it in a manner that cash flow problems do not manifest in the RCP and reporting template can be further improved for readability.

Although a single RCP has been examined in this study, similar on-going infrastructure programmes in South Africa should avoid the challenges documented in this paper. There are some limitations associated with this study. One of such limitations pertains to replication. The replication of the suggestions made in this paper would however carry more validity with a future study that addresses more than one CAPEX programme.

10.1 Note

The dissemination of other aspects of this research reported upon in this paper would appear in an accepted conference paper detail below:

Emuze, FA, Norgbey, W & Smallwood, JJ (2015) Provincial roads CAPEX programme in South Africa: planning and management inadequacies. In: Proceedings of the 31st Annual Association of Researchers in Construction Management (ARCOM) Conference, 7-9 September, Lincoln, UK

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Livingstone, Zambia
ISBN 978-0-86970-787-6

7

SOCIAL INFRASTRUCTURE AND SUSTAINABILITY

Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-012

Stakeholders and Sustainability Consideration for Mega Infrastructure Projects: A case of Accra Airport City Project, Ghana

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Abstract

Studies have revealed that stakeholder management and consideration of sustainability principles are essential for mega construction projects success. This research was necessitated by the fact that though there is stakeholder dissatisfaction and lack of studies on the sustainability of the Airport City Project (ACP) in Accra, there is a proposal for a second phase development. This paper evaluates stakeholders' and sustainability measures considered for the ACP's long term sustainability. A mixed method approach using purposive sampling was adopted. The data were analysed using relative importance index (RII), grouped into high, medium and low impact and validated using semi-structured interviews. Key findings indicate that peer review of designs, project stakeholder meetings, project approval in principle and development monitoring were the measures instituted for stakeholder and sustainability considerations rather than the entire stakeholder management process. The research concludes that the ACP may only be sustainable in the medium-term due to low level stakeholder consideration, services infrastructure development, high vehicular traffic congestion, high rental values, socio-economic and cultural factors which are challenges for long term project sustainability.

Keywords: Airport City Project, management, stakeholders, sustainability

1. Introduction

Accra, the capital city of Ghana has seen major infrastructure development during the past decade becoming a modern city in realization of the 'Gateway to West Africa concept.' The physical manifestation is the sprouting of splendid architecturally-designed high rise glass buildings, magnificent structures and road networks developed as the Accra Airport City ACP(Modern Ghana, 2013). ACP unlike many urban city projects small in scale, sprawling or isolated high rise, has about 40 high rise projects of competing height and architecture conspicuous along the airport and airport by pass road. The ACP enclave at 80% completion stagehas large and complex projects to be considered as mega construction projects MCP (Ruuska et al., 2009; Grun, 2004; Flyvbjerg, et al., 2003). These huge investment projects aimed at achieving social and economic development objectives (Othman, 2013), attracting public and political attention due to the substantial impacts on communities, environment and budgets (Van Marrewijk et al., 2008; Capka, 2004). MCPs are usually complex in nature hence

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

evaluating and understanding these complexities becomes critical to the stakeholder management SM and project success (Othman, 2013; He et al., 2015).

The ACP has hotels, shopping malls, residential apartment, corporate office blocks, multi storey rental tower buildings, restaurants, banks. The numerous stakeholders involved in these projects leads to several factors impacting on the project success namely, technological, organizational, environmental, cultural, goal and information complexities (He et al., 2015) numerous and disgruntled stakeholders (Eyiah, 2015a). Guangshe et al. (2011) suggests that MCPs have close connections with globalization and could be the outcome of social conflict hence Stakeholder satisfaction and needs(PMI, 2013) is essential for project sustainability. MCPs often fail to meet expectations and agreed goals notably deadlines and budget (Morris and Hough, 1987;Flyvbjerget al., 2003). Considering stakeholders concerns,roles and responsibilities, interest (Freeman, 1984), legitimacy, power and urgency (Mitchel et al., 1997) and impact on the project outcome is useful for the execution of the phase 2, meet users need and sustainability(Frame, 1987; Kreiner, 1995), failure may be attributed to poor SM (Eyiah, 2015a).Yang et al.(2011)states that in MCPs, project managers often face challenges in the processes of identifying stakeholders, their needs, assessing stakeholder impacts and their relationships, and formulating appropriate engagement strategies to meet their needs. Stakeholders' dissatisfaction and the call for stakeholder consideration assessment are justified.

Further studies have shownMCPs undertaken in developing countries impact on the environment, culture, social and economic growth of the nation. Ugwu and Haupt (2007) suggest project management and resource utilization involves project key stakeholder roles. Designresponsibility includes considering environmental impacts, innovative solutions to construction, optimised usage of resources including, design durability, constructability, material reuse, recycle and waste management.Projects are temporary endeavours (PMI, 2008) butcarrying out project as planned does not guarantee success especially if project managers ignorestakeholders requirements (Eskerod and Jepsen, 2013). Research has confirmed consideration of sustainable principles such as clean atmosphere, efficient energy utilization and sustainable sites as necessary for project success, effective management of these relies on three key concepts including stakeholder communication and project controls integration, and continuous improvement (KPMG, 2013). The lack of studies in stakeholders' and sustainability consideration in MCP delivery and long termsustainability for developing countries together with less emphasis on SM poses a problem to project managers. This paper therefore assesses stakeholders and the long term sustainability considerations of ACP development by exploring (1) key project stakeholders, roles and consideration process in the project development; (2) sustainability considerations; and (3) the project sustainability in relation to stakeholders and sustainability considerations.

2. Literature review

2.1 Airport City Project, Accra

The Gateway to West Programme was a major government of Ghana policy to create the enabling environment to attract investment in the late 90's. The Ghana Civil Aviation Authority (GCAA) in 1999 stated that the ACP, is one of the many projects government is embarking to enhance the Accra-Tema area in 1998 as part of the Ghana Vision 2020 plan to encourage quality business away from the central business district (Forbes, September 1999). The GCAA plans as landowners wasto develop the 40 plus acre site as the 'Airport City Project' by developing the roads, communication facilities, power

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distribution, lighting, water supply, sewage treatment, parking lots, landscaping, drainage, walkways, utilitiesas site and service scheme only, due to financial constraints vonfirming Othman et al, (2013) assertion that government development interventionsare constrained by financial resources. The site is bordered at the north by the Airport road, east by airport by-pass road, south by the north liberation road and the west by the liberation three-lane carriage road with only two exits from the airport single lane by-pass road. The ACP has complex of hospitality industry, hotels, shopping malls, offices, parking and recreational areas (GCAA, 1999) and linked to other MCPs (Othman, 2013; Mok et al, 2015). Hannan (2012) raises the question of the long lasting benefits of such MCPs in the interest of the entire citizen, its conception as part of urban redevelopment scheme. Mok et al., (2015) state that such mega projects have numerous stakeholders with diverse interest and cultural influence raising the questions of "Who are the project stakeholders and their interest?" "How are the project stakeholders, interest and influences managed?" "What are the project sustainability considerations?"

2.2 Stakeholders

According to Freeman, (1984) stakeholders are "groups or individuals who can have effects on, or are affected by, the objectives of an organization or those who are, or could be, influenced by an organization (Kolk and Pinkse, 2006). Stakeholders have vested interest in the success of a project and the environment within which the project operates (McElroy et al, 2000) and most important is the widely acceptance that stakeholders have a claim or interest in a project and its activities (Nguyen et al., 2009). Considering the initial 100 interested investors alone (GCAA, 1999) gives an indication of a high stakeholder interest. Project stakeholders include the government, GCAA as client, client organization, project sponsors, developers, project team, project managers, consulting architects, engineers, quantity surveyors, specialist designers, contractors, sub-contractors), facility users (financial institutions, office staff, shoppers, holiday makers), suppliers, statutory bodies, utility service providers, road users, air travelers, investors and pedestrians (Newcombe, 2003; Olander and Landin, 2005; Atkin and Skitmore, 2008; Yang, 2010, Heravi et al, 2015). Though there are several stakeholders, some are primary and others secondary related to the project hence have different levels of impact and consideration (Clarkson, 1995; Calvert, 1995; Winch and Bonke, 2002). Newcombe (1996) suggests that project managers usually will consider the project client or developer as the only stakeholder of importance though there is the tendency of a negative impact by others if considered not beneficial. This paper therefore assesses the SM process and impact on the project sustainability

2.3 Stakeholder management and mega construction projects

Stakeholder Management is a process which entails several activities and stages. Bourne and Walker (2005), state that SM is an effective approach of bringing stakeholder concerns to the surface and developing robust stakeholder relationships in complex project environments. Young (2006) agrees and suggests that SM should include identifying stakeholders, gathering information about stakeholders and analysing the influence of stakeholders which should consist of a systematic approach (Lock, 2007). Making conscious effortis an essential part of MCP management considering the objective of SM which seeksto ensure a successful project delivery by considering stakeholder interests, needs, influence, and conflicts while enhancing stakeholders' contribution and roles. Cleland (1986) and Jergeas et al. (2000) stress the need for efficient management of the relationships between the project and its stakeholders as an important key to project success". SM therefore has a major role in the long term sustainability of the Accra Airport City project. According to scholars, the challenges to project managers are the identification of all stakeholders involved and the best approach to stakeholder management for effective

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impact on mega construction projects with stakeholders of diverse interests (Chinyio and Akintoye, 2008, Yang, 2010, Mok et al, 2015).

Researchers have identified tools for analyzing effective management of stakeholders to include Stakeholder Matrix (Chinyio and Olomolaiye, 2010; Newcombe, 1996), Stakeholder Circle Tool (Bourne, 2005), Social Network Analysis (Bourne and Walker, 2006; Rowley, 1997) which is necessary for sustainable project development in developing countries since MCPs impact by contributing to value addition to society economically, culturally, socially and environmentally (Barrett and Barrett, 2006). Earlier research has shown that some stakeholders in developing countries only consider aspect of SM, rather keeps mental record than documentation of the process (Eyiah, 2015). The paper assesses stakeholder consideration and impact on long term sustainability.

2.4 Mega construction projects and sustainability

The Airport City Project by virtue of the site coverage of 40 acres, over 40 projects being developed, complexity and cost qualifies as a mega project (Othman et al, 2013). Research has identified that MCP's development can be controversial, raising severalquestions on the long term benefits to the people and community as envisaged (Hannan, 2012; Robbins, 2014; Scott et al., 2006) due to the diverse interest including political. Since the Bruntland Commission Report, 1987, there have been several researches because construction projects such as roads, dams and housing developments by their scale and site coverage naturally causes environmental damages and ecological instability. Sustainabilityhas emerged as normative concept to address environmental crisis. Sustainable development promotes the integration of economic, social and environmental concerns within policies and strategies, paying to the integrity of nature, well-being of the people and environment (Gibbs et al., 1998; Hopwood et al., 2005). Environmental Protection Agency is the body responsible for environmental sustainability and is a major stakeholder in this project realization.

According to Othman, (2013),studies and analysis carried out has confirmed challenges identified in literature relating to MCPs and sustainability impact on developing countries which are classified under (1) engineering design and technical challenges, (2) environment, society, economy and policy, (3) client performing organisation and (4) project nature and objectives. The Leadership in Energy and Environmental Design LEED advocate for sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality as measures necessary for building sustainability. Sustainability can be achieved as a long-term solutions to meeting community needs but requires involving multiple community partners in the planning process, using local materials equipment and technology when possible, identifying a local funding source, providing training and education, motivating beneficiaries to take ownership, monitoring and evaluating project objectives (Rotary, 2012). Barrett, (2006) suggests that sustainability can be achieved through constraints driving, collaboration and creativity which eventually lead to community benefits. These factors are critical when considering stakeholder management role for enhanced MCP sustainability hence the assessment of sustainability considerations and impact on ACP long term sustainability.

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3. Research Design

To achieve the research aim and objectives, a mixed-method research survey was considered which consisted of literature review, quantitative survey and semi-structured interview.A purposive sampling involving key stakeholders involved in the ACP was used. 100 key stakeholders were consideredand administered with questionnaires comprising of 25 questions and grouped under 7 thematic areas (table 1) with a 70% return rate which was followed with semi-structured interview of six key stakeholders. The seven thematic areas and objectives were developed around the three research questions formulated as; "who are the project stakeholders and their role in ensuring sustainability of the project?", "what are the sustainability principles considered by the key project stakeholders?" and "whether the airport city project is sustainable in Ghana?"

Firstly, there was a comprehensive background buildup of the research topic including (1) stakeholder, stakeholder management (2) ACP and developing countries nature and characteristics (3) MCP and sustainability approach. This approach mainly through extensive literature review on stakeholder management, MCPs and developing countries from academic journals,text books, conference papers and news articles assisted the researcher with information on various stakeholders involved in MCPs, SM processes, sustainable principles and sustainability considerations used in preparing the 25 set of questionnaire. Six project types were also used (plates 1-6).The 70 returned questionnaires were analysed using RII. These were grouped into High, Medium and Low Interviewing further six key stakeholders; two project managers, architects and developers each validated or otherwise key stakeholders' perception of the sustainability of the project from literature and the responded questionnaire analysed.

4. Findings and discussion

4.1 Airport City Project development

An interview with the Ghana Airport Company Limited (GACL) architect revealed the company's satisfaction with the project development and the plan underway to develop a business center. ACP is 80% over all complete, others at various level of completion except the airport city hospital complex yet to commence. One each of the different types of projects developed at the enclave namely: hotel, office tower, shopping mall, bank and mixed-use development in relation to stakeholder management and sustainability principles namely the Silver Star Tower, 3-Star Holiday Inn Hotel, exquisite UT Bank, One Airport Square (a mix commercial), Marina Shopping Mall, SSNIT Emporium adding to the elegant spectacle of the Airport City and the13-storey complex with a revolving restaurant at the summit, cinema halls, retail outlets and offices selected due to their complex architectural design, availability of information or public interest.Stakeholder and sustainable development considerations for the overall project, individual projects, and needs of interested or affected individuals, groups and simultaneous devotion to economic, social and environmental goals for sustainability were explored.

The Marina Shopping Mall (plate 1) is a dual commercial development with 9000sqm area, has over 45 outlets, spread across three floors and one of the four shopping malls in Accra managed by Broll Ghana, the others A&C Square (10,000sqm) Accra Mall (20,000sqm) and the West Hills Mall (27,000sqm) in Weija-Accra. The mall opened in 2012 at the Airport City enclave, serves as a hangout, meeting place during weekends and the success of it attributed to the growing middle and upper class income group in Accra as a result of the economic growth of 14% in 2007 and desire for people to shop in a modern

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environment (modernghana.com/news). The Holiday Inn (plate 2) is part of the African Sun group well located for the business traveller or adventurous tourist with 168 appointed rooms. It has the Wiase Restaurant, overlooking the sparkling pool and the La Cabona Pool Bar. The SSNIT Emporium (plate 3) on the other hand is a corporate ultra-modern office complex, has a main building and a tower with about 15,400sqm, biggest commercial office space in Accra, well sited, aesthetically pleasing designs and greenery and belongs to the Social Security and National Insurance Trust with several estate developments in Ghana.

Plate 1: Marina Shopping Mall

Plate 2: Holiday Inn Hotel

Plate 3: SSNIT Emporium

The ACP cannot be mentioned without the One Airport Square project (Plate 4), which has an outstanding architectural traditional character, nine floors of office space and 2000sqm retail space designed by the award winning sustainability architect Mario Cucinella.The Silver Star Tower (Plate 5) has been the banking halls for Ecobank Ghana and Stanbic Bank for several years. In addition, there are commercial office spaces, showroom for Japan motors, owners of the property and restaurant. The UT Bank (Plate 6) is located in one of the Manet twin towers at the Airport city arena with a box-like glass curtain wall, double volume columns with arches and open floor office design.

Plate 4: One Airport Square

Plate 5; Silver Star Tower

Plate 6: UT Bank, Manet Towers

4.2 Stakeholders and stakeholder management

The study identified ACP with numerous stakeholders, different cultural backgrounds, had interest or their interest affected by the project outcome which agrees with literature (Mok et al., 2015). There were notably Italian, German and South African as well as local Ghanaian architects as clients, sponsors, designers, partners, project managers and contractors with their cultural backgrounds impacting on the design concepts. The project supply teams were not different with several individual and stakeholder firms involved in the project. All questionnaires respondents agreed to these stakeholders involvement and were confirmed by the interviewees. Project managers had hectic task identifying these several individual and groups with stake in the project development:project managers, project teams, consultants, site personnel, contractors, subcontractors, supply chain, statutory approval bodies, end-

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users and professional bodies (Newcombe, 2003; Ward and Chapman, 2008; Chinyio and Akintoye, 2008).

The questionnaire further revealed that, stakeholdersconsidered by project managers and designers were the project team members, primary stakeholders who had interest in the outcome of the project. The interview confirmed project client, land owner, project sponsor and identified end-users interests were the main consideration with the client as the top most priority (Newcombe, 1996).Significantly missing was consideration for stakeholders affected by the project; public and politicians (Mittelman, 2000) and those who were benefitting from the undeveloped land; vegetable farmers, labourers (squatters), road users, individuals and businesses firms daily using the adjacent Air Cargo warehouse affected by the project outcome but had little legitimacy and power (Mitchell et al, 1997) though literature suggests the need for theirconsideration. Equally, the media, politicians, and local community were less considered as interviewees believed that considering all interest will imply compromising design. Beyond the project team the other stakeholder mainly considered were the statutory bodies responsible for approval, the Accra Metropolitan Authority (Building Permit), Town and Country Planning (Development Permit),stakeholder committee set up for approval in principle (AIP) and the utility providers as and when their services were needed (Chinyio and Olomolaiye, 2010). This was confirmed by interviewees. Stakeholder identification for the ACP was not rigorous, entirely consideredat the project planning stage, largely client and known end-user consideration, confirmed by the absence of stakeholder identification register (Smyth, 2008).Stakeholder identification process was compromised as approach was in contrast to SM process suggested by scholars that all stakeholders should be identified at the beginning of the project and their interest considered (Olander, 2007).

Effective SM process requires that stakeholders are systematically identified, engaged, analysed, planned, monitored (Lock, 2007, Yang, 2010) formally (Cleland and Ireland, 2002). In the absence of formal identification process, interviewees confirmed that project managers adopted different approaches to managing the project team members mainlyclient and identified end-users with SM process not fully considered. The approach seems to agree with the suggestion by Karlsen (2002),Chinyio and Akintoye (2008) that no formal approach exist(Yang, 2010) hence selective consideration and different approaches are adopted. It is not surprising that some stakeholders are dissatisfied with ACP. The research further identified that stakeholder types and influences were not considered rather project team members and stakeholder engagements were in the form of project site and progress meetings with the client as confirmed by interviewees as traditionally known (Newcombe, 1993) regarding power, legitimacy and urgency (Mitchel et al, 1997), mostly monitored and well informed by the project team. Three things were evident: (1) some key stakeholders like the local community and government agencies were not considered, (2) SM consideration was only at the initial stages of the projects and that (3) there was absence of records showing SM process for the entire project development except the project teams' individual informal approach for their key stakeholders and the specific projects. A careful SM consideration for the entire project could have created the necessary stakeholder needs such as common landscaped open spaces for vibrant culture,diversity of social, recreational and economic activities, safety, security and car park provision to meet stakeholders' needs confirming SM approaches for a projectas subject to national context (Mok et al., 2015).

4.3 Sustainability principles considerations

The research explored sustainability principles considerations (SPC) for the ACP as mega construction project with sustainability implication requiring simultaneous attention, devotion to economic, social

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and environmental goals(De Brucker et al., 2013).Sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality as measures necessary for building sustainability were in addition considered, with these factors seen as critical for mega projects due to their impact on the environment. The ACP site, until its development, had water bodies, greenery and was eco-friendly.

4.3.1 Creation of an urban regenerated city

Respondents and interviewees agreedthat the objective of amodern urban development concept, expansion of the airport business portfolio for economic growth such as promotion of trade and employment generation has been achieved however the objective appeared to have overshadowed the need for consideration for sustainable principle as the ACP is seen as an arena with brisk business, social and economic opportunities created by the presence of the Vodafone Offices, Silver Star Tower, 3-Star Holiday Inn Hotel, UT Bank, One Airport Square, Marina Mall and the SSNIT Emporium. Economic and social activities mainly banking, financial transactions, telecommunication, hotel business and shopping are brisk.One interviewee asked "which other modern environment is needed" except the lack of vibrant culture. The ACP serves residents in the central and north eastern suburbs of Accra, visitors and airport staff but lacks vibrant culture though Hannan (2012).

This high rise development is in response to the liberal urbanism with characteristics of globalization, strong effect on urban densities and environment (Roberts et al., 2009) however uncharacteristic of urban design as it lacks open spaces and greenery. There is no outdoor recreational spaces provision for the local community and the general public, a situation which hinders local community ownership of the development. The green ecological area has become brown with paved grounds for car parks and the sprawling development suddenly vanished, a situation which has become a major concern to stakeholders.

4.3.2 Environmental, cultural heritage consideration and sustainability

Respondents agreed that environmental and cultural heritage consideration necessary for the project sustainability are virtually missing. Office blocks, shopping mall, hotel and the mixed commercial high rise buildings lack the traditional architectural character and concepts that enhances social interaction, usually considered for the tropics except the One Airport Square project which has outstandingarchitectural character and environmental consideration adopting the traditional courtyard concept with raised floors on columns to enhance airflow and create space for social interaction. The Una Mall, ground floor of the UT offices also depicts some traditional architectural characters. Interviewees agreed with respondents that the usual courtyard designs with long overhangs, provision of terraces and balconies were missing together with the lack of attempts to preserve any cultural heritage in the form of buildings (Gounden, 2010). The design and the environment created exclude the benefits of the poor in society though developers have benefitted from the government resources by not providing for social infrastructure for the poor, a cultural heritage which is found in the local communities (Hannan and Sutherland, 2015). Corner shops, local eating areas, playing fieldsfor recreation pedestrian access are just not available which was attributed to the non-engagement and participation of city residents in the planning and design. Conspicuously missing is the use of local materials such as bricks both for walls, as facing material, clay roofing and wall mural found in parts of the country northern.

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4.3.3 Mega construction projects and sustainability

Research participants agree with the researcher that the Airport City Project can be assessed as a mega construction project considering the scale, complexity, size, cost, site coverage, linked infrastructure development and stakeholder involvement (Othman, 2013). As MCP it impacts on the environment, society, local resources and the community having several stakeholders and national cultures. In addition, the need for high design knowledge, technical skills, managerial capabilities, political and economic stabilities, coupled with sustained business environment are all sustainable challenges for Ghana as a developing country and therefore the project. Research participants further mentioned lack of matching infrastructural development as a major challenge. Power, water, sanitation, transport, telecommunication are some of the major utility services lacking and threatens the sustainability of the project. In the opinion of respondents, economic and political stability are prerequisites for MCPs sustainability not to mention convenience in accessibility and proximity.

4.3.4 Efficient transport systems and sustainability

A project architect at GACL interviewed agreed that transport system and integration to the urban transport network is ill-considered Africa. The project is not accessible from the three lane Liberation road linking the Tetteh Quashie interchange from the Tema motorway and the Legon high income residential areas. The two vehicular accesseswith exits to the project site; airport by-pass and the north liberation road remains single carriage lanes with high vehicular traffic unprecedented throughout the day and very difficult to exit or join. Project managers agree and continue to advocate for the airport by-pass which links the trade fair site, aviation village and the cantonments area to be developed as a dual carriage.

The research identified ACP as having no bus terminal for urban commuters using public transport. In addition the site has no links with the proposed rapid transport network, no parking spaces designated for buses for group tour. Least to mention is the pedestrian consideration which though bordered by roads at all sideslacks properly designed pedestrian walkways and bicycle lanes advocated by urban transport designers to ease traffic jams. Respondents agreed that with the current terminal three airport expansion proposal in that direction, road traffic will increase, aggravating the existing situation. Research participants were of the view that absence of multi-level car parks at the site has created a major deficiency in the car parking provision and poor access to the facility and integration to the urban transportation system.Key stakeholders agreed with the suggestion of reducing vehicular dominance and encourage large buses and streets in favour of the pedestrian as for better air quality which encourages cycling, walking and sustainability.

4.3.5 Sustainable design considerations

The Holiday Inn and Marina shopping malls designs have little maintenance capacity for ecological system unlike the SSNIT Emporium in the enclave. The airport city project to a large extent promotes integration of economic, social and environmental concerns without nature consideration and the well-being of the people and environment (Gibbs et al., 1998; Hopwood et al., 2005). Sustainable principles advocates by LEED; sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality as measures necessary for building sustainability were not fully considered . There is no balance between greenery and brown areas, materials used and design are not water efficient. No single project recycles complete waste water generated in the building for re-use. The large curtain walls design with no consideration for solar orientation for the UT Bank and Vodafone

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ISBN 978-0-86970-787-6

offices raises major energy conservation concern. The One Airport Square and Holiday Inn however had design consideration for reduced heat generation within indoor spaces. Day lighting and natural ventilation cannot be adequately relied on hence the heavy dependence on artificial lighting and ventilation. Stakeholders agreed with the researcher that sustainable principles were not well considered but sacrificed for modern and stunning architecture. The volume of vehicular traffic has created noise and air pollution depriving the environment of quality air. The high and rising cost of local produced building materials, fast degradation of sand sites coupled with lack of innovation for recycling or re-used materials can be attributed to demands by these MCPs which are not sustainable. Stakeholders suggested the need to reduce Greenfields development for preservation in the city but rather the redevelopment of previously developed land (Brownfield sites).

Sustainability can be achieved as a long-term solution to meeting community needs but requires involving multiple community partners in the planning process, using local materials equipment and technology when possible, identifying a local funding source, providing training and education, motivating beneficiaries to take ownership, monitoring and evaluating project objectives (Rotary, 2012). Barrett (2006) also suggests that sustainability can be achieved through constraints driving collaboration and creativity which eventually leads to community benefits. The need for stakeholder management role for enhanced MCP sustainability and project delivery cannot be over emphasized.

6. Conclusion

This paper evaluated the ACP as a MCP, considered SM, SPC and their impact on infrastructure sustainability as a developing country. It addressed the questions of (1) who the project stakeholders were and their roles in the project development (2) what sustainableprincipleswere considered, (3) the extent of stakeholders and SPC on project sustainability using seven (7) thematic areas (table1). It concludes that the ACP was necessary for socio-economic development and has achieved its objective of creation of vibrant economic environment.Further, as MCP, there was a positive impact on the economy and business culture but negatively on the socio-cultural and physical environment.

The project failed to consider effective SM process hence the failure to meet stakeholder needs and satisfaction except the project clients. Failure to consider the local community and other stakeholder impacts negatively on the project hence the dissatisfaction by the local community and end-users. Key stakeholders were identified and roles considered but without the entire SM process and the positive impact, the reason for scope changes, lack of needed infrastructure and negative impact on project targetsand future sustainability.

It further emerged that project key stakeholders were aware of sustainable principles but were not fully considered as attempts were not made forcultural heritage preservation such as building conservation, traditional architecture, creation of open spaces for social activities and integration. The lack of guidelines and tools for measuring and ensuring adherence to sustainability principles contributed to the negative impact on sustainable sites, energy efficiency, resources effective usage, recycling of waste materials and components.
Designers aimed at meeting clients need rather than sustainability considerations hence the absence of green areas provision, pedestrian walkways, open spaces and efficient transport systems impacting negatively on sustainability of the infrastructure development. As part of contribution to knowledge, SM, SM process and sustainability has been considered as two areas that can be convergent and explored to improve MCPs sustainability.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-018

Conceptual Framework for Sustainable Affordable Housing Construction in South Africa

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Abstract

Housing is a basic human need and is a key factor in the sustainable development of a nation. Worldwide, demand for affordable housing has grown in recent decades and it is expected to continue to grow due to the problem of rural-urban migration which is affecting both developed and developing nations. With the growing demand for affordable housing, the need for a sustainable solution in the construction of housing cannot be over-emphasized. Previous research has shown that the affordability of urban housing in South Africa is usually measured using a housing cost to income ratio, which is an unsustainable way to view affordability. Due to this fact and governments determination to upgrade the "informal settlements" there is a need to critically examine and investigate the scenarios affecting affordable housing construction, towards building homes that are cost-effective to the occupants over the building life-cycle. This research intends to bridge the gap in the literature by providing an effective strategy by which housing can be made affordable and sustainable, through efficient management of construction resources to enhance sustainability in affordable housings constructed for the poor population in South Africa. This strategy could be applied to analyse housing situation of the poor in developing economies.

Keywords: construction strategies, housing affordability, informal settlements, South Africa, sustainability

1. Introduction

Sustainability is currently one of the most argued ideologies of as everyone recognises that it must occur but there is no agreement on what needs to change in response (Sutton, 2004; Arman*et al.*, 2009). This is unsurprising because challenging the goal of sustainability is like objecting to other fundamentally good goals like peace or freedom (Arman*et al.*, 2009). However, the term sustainability is used indifferent contexts in different fields of study and such usage is geared towards the process of keeping something to meet the needs of the present and the future, without compromising the ability of coming generations to meet their needs (WCED: World Commission on Environment and Development, 1987). The concept of sustainable development is centered on efficient allocation of resources, reduced energy consumption and reuse and recycling to ensure effective short and long term use of natural resources (Ding, 2008).Hence, the need for improvement in the performance of buildings (housing) with regard to

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

the environment should encourage greater environmental responsibility and place greater value on the welfare of future generations (Ding, 2008).

Du Plessis (2002) opines that developing nations have little time left to decide the future of its settlementsand that although large scale development is needed to address issues of adequate housing, rapid urbanisation and lack of infrastructure. Sustainablehousing has not been widely developed in affordable housing markets, instead focus has been on displaying architecturally well designed green housing (Arman *et al*., 2009).

To achieve sustainability in the construction of affordable housing, there is need for an all-inclusive approach to integrate sustainability principles into management of construction resources during the construction stage of a building project. Although, there are hosts of related research in this area, a wide research-gap still exists in integrating sustainability issues in construction of housings. The framework presented in this paper structures the goals of stakeholders in housing construction under the pillars of sustainability concepts to define the problem.

1.1 Significance of housing in sustainable development

Housing activities are significantly linked to the macro-economy, as investments in this sector not only improve and add to the existing stock of housing units, but improve the working and living conditions. Buttressing these, Ferguson and Navarrete, (2003) state that housing generates a significant share of employment (around 9% globally) and often helps to lead national economies out of recession. Furthermore housing has a crucial role in the development of human settlements and like all other developmental activitiesitalso has a monetary and subsistence component. Even if it is a self-help or family activity in rural areas, it needs building materials, tools and skilled labour as input factors. Besides creating an individual product, the new or repaired shelter and the combined input factors also contribute to the national product and increase the overall national wealth.

It is worth noting that, improving housing delivery requires a better understanding of the mechanisms governing housing availability. These require better data and policy-oriented analysis, so that housing delivery policy can be formulated in a more holisticway, which include using sustainable affordable construction techniques, selection of building materials and efficient management of construction resources during the construction process.

1.2 Background of the research problem

There has been great demand from stakeholders forthe need to minimise the negative threat posed by construction activities on the environment. As a matter of urgency sustainable strategies and actions in the entire building process needs to be adopted.The tendency towards urban sprawl in developing countries isacknowledge, and it is projected that 70% of the world's population will be living in cities by 2050 (World Bank, 2006). This trend is basically driven by the perception of cities as centers of wealth and prosperity that attract people from rural areas in search of a better future (Dumreicher & Kolb, 2008). This upsurge in the global urban population predictably has resulted in a very sharp increase in the demand for housing. Unfortunately, the current housing sector cannot cope with the demand for living space (Jenkins *et al.*, 2007). This gap between demand and supply creates a very complex problem, driving the housing sector towards less efficient and more-expensive solutions and new city inhabitant towards informalself-help construction of buildings (Arman *et al.*, 2009). Self-help

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

construction has become a prevalent phenomenon in emerging economy countries. It has driven a corresponding sense of urgency to promote socially responsible housing solutions (Wallbaum *et al*., 2012) that do not unreasonably impact the environment and that can be acquired by low-income family groups in a reasonable period and cost.

Addressing all of these issues highlighted in the background and solving housing problem in South Africa, requires an all-encompassing strategy towards building a house that is not just affordable but equally sustainable to both the building provider and the end-users.

2. Affordable Housing

Affordable housing is that which takes into consideration the well-being of the community for which the housing is provided. The process takes into account accessibility measures for intending occupants, adequacy and quality, availability measures and lastly affordability measures. According to Noble (2007), the process of affordable housing construction starts with the identification of housing as a problem, which is generally derived from a census taken which is prompted by citizen outcry or a visual view of homelessness within a community.

There are a number of ways through which investment potential of housing projects are appraised, but many are still based on traditional and fixed ways of using payback as the yardstick. Traditional accounting systems generally rely on initial capital to finance the project, which means that projects need the total cost as up-front capital. Financing a sustainable housing project could be hinged on the issue of bringing corporate social responsibility (CSR) into the financial accounting system, which is often referred to as the triple bottom line: environmental sustainability, social sustainability and financial sustainability. Summarily, provision of sustainable affordable housing has linkages with several social issues that impact directly on the severity of housing shortfalls.

2.1 Sustainability and sustainable construction

2.1.1 Sustainability

Sustainability is a broad and complex concept, which has grown to be one of the major research focuses of experts in the construction industry. The concept of sustainability has become a major issue of concern due to recognition of an impending and assured global disaster as a result of depleted world's resources (Vallero & Braisier 2008). Sustainability concept has been defined from different perspectives depending on the author's field of research but what is common in all is ensuring a better quality of life for everyone, now and for future generations.

Diesendorf (2000) describes sustainability as the goal of 'sustainable development' or 'ecologically sustainable and socially just development' which enriches the natural environment and human well-being. Gibberd (2005) views sustainability as a complex interaction between 'environment, society and economy'.The author stress further that these characteristics (environment, society and economy) are generally accepted as the important contributor to sustainability. Conversely,the concept is based on the interaction between the "triple legged concepts" that surrounds human existence as shown in figure 1. Sustainability definitions can be summarised with the definition given by ISO (2008) as "state in which components of the ecosystem and their functions are maintained for the present and future generations".

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

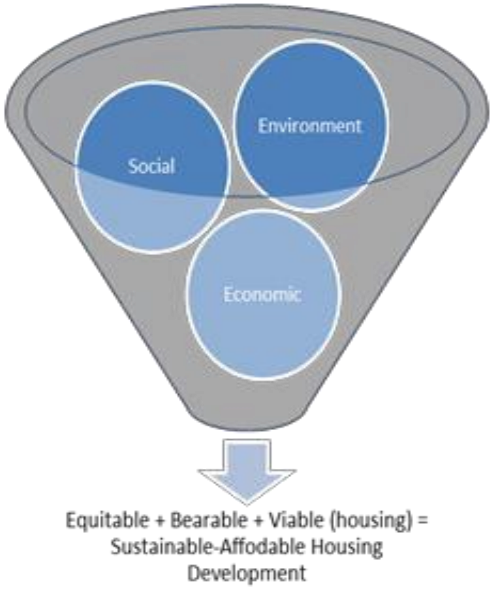

Figure 1: Products of interaction between tripod stand of sustainability

2.1.2 Sustainable construction

Sustainable development is the founding principle towards ensuring a decent quality of life for future generations. The United Nation (UN), in recognition of this fact and the impending and assured global disaster, commissioned the WCED to conduct a study of the world's resources. The WCED in their 1987 report titled "*Our Common Future*" introduced the term Sustainable Development and defined it as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (WCED, 1987).

Sustainable development requires meeting the basic needs of all and extending to all the opportunity to fulfill their aspirations for a better life (WCED, 1987). Conversely, sustainable construction covers a broad interaction between construction stakeholders and the entire construction process. Construction implies all activities from client briefing, site-activities to creation of a building. The International Council for Research and Innovation in Building and Construction (CIB) defined sustainableconstruction as construction which is set to reach the goal of sustainable development (CIB, 1999). TheCIB Agenda 21 explained further that sustainable construction is achievable through:

- Management and organisation of construction processes;
- Material selection and construction methods; and
- Resources consumption.

Ding (2008) in a study conducted in Australia states that lack of sustainability index developed using multiple criteria of ecological, social and economic growth in the society have posed serious challenges to sustainable design solutions and building operations.Further to these, clients' unwillingness to share burden, lack of clear knowledge on the concept of sustainable construction and its benefits, regulatory constraints and inconsistent government policy and lack of fiscal incentives also hinders progress in the adoption of sustainable construction (Adetunji *et al.*, 2003).

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Livingstone, Zambia
ISBN 978-0-86970-787-6

Similarly, Shen*et al.* (2010) suggests that contractors and suppliers should be engaged during the early stages of construction projects due to their knowledge of the environmental issues associated with construction activities, building materials and plants. The green material supply chain presents another challenge to green construction. Green materials are often expensive and the conflict of interest among stakeholders can result in uncertainties and inadequate trust relationships (Love*et al.*, 2002; Shi *et al.*, 2012). Conversely, Pearce and Vanegas (2002) were of the view that green or sustainable materials were not available from standard distribution networks, hence a reliable and flexible supply could not be ensured.

11 Enhancing sustainability in affordable housing: conceptualised framework for housing construction

Achieving sustainable and affordable housing has a strong link to the tripod stand of sustainability. This is due to the fact that house building forms the basic unit of a human settlement which is a crucial component for social development. Previous studies notably (Gibbard, 2005; Nair*et al*., 2005; Ding, 2008) have shown a clear correlation between economic growth (consumer income), the level of urbanisation, the quality of shelter and basic services provided, and social indicators.The socio-cultural factors determine the individual's primary requirements of housing.

Economic factors define the limit of cost commitment which an individual has to transform his needs into a sound reality. Construction cost has been the most important consideration for implementation of any construction project. In the same vain, cost plays a prominent role in decisions on implementation of sustainable construction (Kunzlik, 2003; Meryman & Silman, 2004). Ofori and Kien (2004) posited extra cost required as the main constraint for implementing sustainable construction. Heravi and Qaemi (2014) believe utilisation of sustainable techniques such as high performance insulation protection, water and energy saving equipment often escalate construction capital cost. However, the cost savings on energy consumption and other service charge overtime are believed to offset part of the increased capital cost (Chang *et al.*, 2011).

The environmental constraints encompass various technological means through which natural resources used for construction can be efficiently utilised and managed to accomplish present demands without compromising the needs of the future generations. Apparently, sustainability of affordable housing falls within this context. It brings together inter-dependent aspects: environment, socio-cultural and economy to achieve sustainable housing.

3.1 Environmental aspects

In the construction industry, the environmental management system (EMS) has little influence on the contractual issues which play important roles on the green performance of projects. Despite implementing EMS, building contractors may not deliver affordable housing based on sustainability concepts because of environment-unfriendly contracts. However, no matter how the operations carried out by contractors are complying with their EMS, the projects may still have a negative environmental impact because the specified materials and practices in the contracts are not conducive to sustainable construction.

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

Environmental sustainability aspects (Appendix) comprise environmental sustainability criteria for selection and management of building materials, as it affects design of buildings, selection of building materials, choice of construction methods and management of construction materials wastage. The environmental sustainability is influence by the following:

- Design consideration: This includes factors considered at developmental stage of building design to ensure occupants' comfort and enhance sustainability in the building.
- Building material selection: This describes the materials and components used in the construction of the building.
- Construction concepts: This assesses the willingness of industry practitioners to change the conventional way of specifying existing methods and processes.
- Management of construction materials wastage: This relates various construction concepts in relation to efficient use of construction materials.

3.2 Socio-cultural sustainability aspects

A sustainable house is one that provides safe and healthy living to the occupants notwithstanding the cultural and religious believes. Hence, the requirements of a shelter differ from one individual to another. A sustainable house should respond to the socio-cultural needs and practice of the occupants and community. It is focused on housing developments that promotes social interaction among individuals and ensures equal participation of different groups of people in a community. Socio-cultural sustainability involves different dimensions such as:

- Cultural beliefs: This describes the way of living, tradition and household size of the inhabitants of the housing;
- Stakeholder engagement or beneficiary participation: This describes involvement of the beneficiary in the planning and developmental process and ensures direct participation of the community in providing labour and other construction inputs;
- Infrastructure development or available social amenities: This describes social services available in the community. Available social services affect social relationships and day-to-day living and ultimately the prospects of future generations.

3.3 Economic sustainability aspects

Economic growth is the key to provide the means to meet basic needs and ease poverty. Although, housing problems arise as a symbol of poverty, mere financial assistance alone does not help the poor to meet their housing needs. To ensure economic sustainability of housing, emphasis must be beyond financial assistance and include using construction materials and methods that reduce the total cost of construction, operating cost, and considering various housing-financing options to determine the individuals' affordability. The economic sustainability aspects of housing construction thus include:

- Cost of construction: Assess user needs with various construction concepts, to ensure the building is realised at affordable cost to the beneficiary.
- Cost-in-use or operating cost: This describes the cost incurred by the user when the building is in normal use. It captures cost gain to the user for energy, water and maintenance.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

- Life cycle costing analysis: Assessing total cost performance of building in relation to construction, operation and maintenance.
- Housing financing strategies: These enhance the abilities of beneficiaries to assess finances for housing construction.
- Affordability: The actual cost during construction and various savings to inhabitants during the operational stage of the building.

Integratingthe sustainability criteria identified under each of the aspects (see appendix) is intended to assist in formulating strategies for sustainable affordable housing construction.At the decision-making level, sustainable development principles should be integrated into policy strategies and into the planning process as well as construction phase of housing delivery. An uncompromising policy framework is thus inevitable for the efficient working of the policy, which can optimise the limited resources and integrate the various stakeholders. It is important to drive provision of housing based on user's demand, rather than it being an imposition by the authorities.

12 Conclusion

Evidence from literature revealed that understanding the concept of sustainability and its application in construction industry remains one of the fundamental areas that attractresearch efforts in the construction management field. Succinctly, the frameworks have brought together different aspects of sustainability which when applied during construction of housing has considerable potential to produce building that is energy-efficient, cost-effective to maintain and affordable to all income groups.

13 Acknowledgement

The authors acknowledged the Cape Peninsula University of Technology (CPUT) Research Directorate for proving financial support through University Research Fund (URF) award to undertake this study. We also acknowledged the CPUT Conference Committee (ConfCom) for providing finances required to attend the conference.

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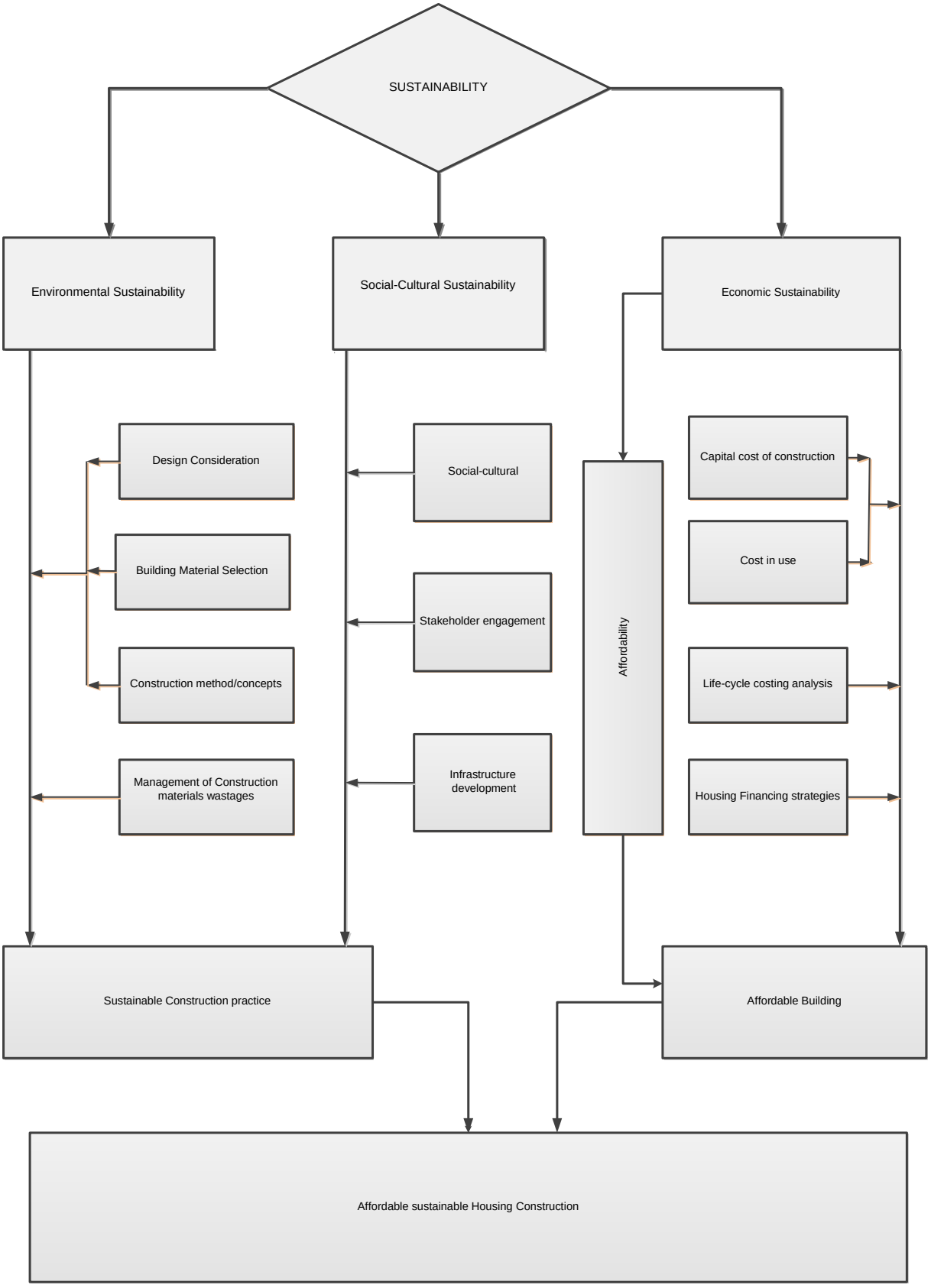
16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

APPENDIX

CFEssentials of sustainable affordable housing construction



Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-021

Improving Social and Urban Infrastructure in Zambia's Slums through Urban Renewal and Regeneration

Daniel Apton Phiri

Abstract

Zambia faces the challenges of rapid population growth, rural-urban migration and urbanization which have contributed to the proliferation of slums Characterised by inadequate housing, urban and social infrastructure. An estimated half of all urban residents in Zambia live in slums in substandard housing without adequate services, water, sanitation, accessibility, drainage systems and secure tenure. This study aims to demonstrate the potential of urban renewal and re-generation in improving the social and urban conditions in slum areas. Using literature review, the paper provides a brief contextual analysis of slum conditions, highlights some of the causes and responses to slum growth and the concept of urban renewal and regeneration as an alternative to conventional slum upgrading. It also shows that urban renewal has potential negative effects such as gentrification and so should be cautiously implemented.

Using a case study of the Chibolya Pilot Urban Renewal initiative in Lusaka, the study demonstrates an approach that could result in sustainable provision of social and urban infrastructure. The objectives, key elements and process of the pilot project are highlighted including settlement re-planning, provision of new housing; public spaces and access roads; commercial and industrial facilities. Urban renewal could result in provision of clean water and sewage, improved drainage, access roads and waste disposal and storage, with positive impacts on slum communities. The paper concludes that achievement of urban renewal and regeneration objectives requires not only the collaboration of municipal governments, employers, communities and the private sector working together in public private partnership arrangements but also a huge financial outlay. Municipal governments therefore need to have the capacity for resource mobilization and political will to successfully embark on such initiatives.

Keywords: infrastructure, regeneration, renewal, social, urban

1. Introduction

This paper presents the findings of a review of the Chibolya Pilot Urban Renewal and Regeneration project. This study aimed to demonstrate the potential of urban renewal and re-generation in improving the social and urban conditions in slum areas. Using literature review, the paper provides a brief contextual analysis of slum conditions, highlights some of the causes and responses to slum growth and the concept of urban renewal and regeneration as an alternative to conventional slum upgrading. It also

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

shows that urban renewal has potential negative effects such as gentrification and so should be cautiously implemented.

1.1 Country context

Zambia, a landlocked Central Southern African country with a total land area of 752,600 km^2 has an estimated population of 13.05 million and population density of 18 peopleper km^2. Population grew at a rate of 2.7 % per annum during the 2000-2010; 3.0 % during the 1980-1990 period and 2.6 % during the 1990-2010 period. Population is projected to increase to 24 million by mid-2025 and 45 million by mid-2050 (Population Reference Bureau, 2012). Urban population grew at 3.8 % per annum in the 2000-2010, reflecting an increase from the 1.3 % per annum recorded during the 1990-2000 period. In 1963, only 20.7 % of the Zambians lived in urban areas but the proportion almost doubled to 39.8 % by 1980 and increased to 39.0 % or about 5.07 millionin 2010 (CSO, 2010). Zambia's urban population is mainly concentrated in Lusaka and the Copperbelt which together account for 69% of the total population. A major effect of this demographic transformation has been the growth of unplanned settlementsor slums.*Slums and unplanned urban settlements* are used synonymously. A slum household is defined by UN Habitat (2002) as a group of individuals living under the same roof lacking one or more of the following conditions: - access to improved water; access to improved sanitation facilities; sufficient-living area, not overcrowded; structural quality/durability of dwellings and security of tenure. Lusaka, Zambia's capital city has 2 million inhabitants of whom 70 % live in 37 slums on 10 per cent of the total land area. At least 35 out of a total of 37 of Lusaka's slums have been declared "Improvement Areas" which can be officially upgraded and provided with services and infrastructure. The World Bank (2002), estimate that Lusaka's slums have been growing at a rate of 12 per cent per annum.

The expansion of urban areas has not been well balanced with population growth and economic growth resulting in inadequate supply of land for residential development leading to illegal occupation of public and/or private land and the growth of slums. Poor people's land rights are thus not legally recognized by Government and so they live in constant fear of eviction. Payne (1997) suggests that the reasons for the creation and persistence of slums vary from place to place, butrange from rural to urban migration, rapid urbanization, urban poverty, socio-economic and spatial inequalities, and institutional and governance failures to lack of affordable legal options,unequal access to land and insecurity of tenure, intense demand for urban land, inappropriate standards and investment.Hari (1991) on the other hand posits that lack of collateral assets and savings, and other financial assets; semi-permanent or temporary daily wage/low-income jobs and the high cost of land and other housing services; apathy and anti-pathy on the part of the government to assist squatters; high "acceptable" building standards and rules and regulations; lopsided planning and zoning legislation are the major causes of slums.

Slums are characterized by poor, inadequate housing and infrastructure (such as water, sanitation, access roads and drainage systems, waste management, energy) and lack of basic services (such as health, education, social and recreation facilities). Slums are also prone to high crime rates, unemployment, disease burden including high prevalence of HIV/AIDS, social exclusion and anomie. Lack of secure tenure and corruption in land allocation; inefficient land administration and development control mechanisms; lack of enforcement of planning and building regulations; insufficient manpower and capacity; ineffective land use planning and failure to acquire land for low cost serviced housing; inappropriate standards imposed by the authorities (World Bank, 2002); long and cumbersome processes of obtaining planning permits and limited participation of the urban poor in decision makingare major challenges.

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2. Global and Local Responses to Challenges of Slum

Government authorities are aware of processes that lead to the growth of slums but often turn a blind eye to such developments due to incapacity to deal with the problem, lack of funds to compensate and relocate the people and for political reasons as slums provide an electoral/power base. Despite this inertia, there have been several attempts to regularize, upgrade and merge the slums into the city fabric. However the responses have been reactive and not proactive while progress has been slow and hampered by financial and human resource constraints. Conventional upgrading approaches have addressed slum challenges in a piecemeal fashion, for instance by providing individual land titles to the poor, who in turn sell their land to higher income groups and move further out thus creating new slums in the process. Upgrading projects have resulted in increasing land values thus putting additional pressure on the land being occupied by slum dwellers. Any city- wide or national approach to upgrading, therefore, must come to terms with land issues in a way that ensures an adequate supply of land for all income groups (UN Habitat, 2009).

Slum upgrading is a process of intervention in the physical, social, economic and juridical structure of an existing human settlement (Acioly, 2007).The process is supposed to lead to economic, organizational and environmental improvements undertaken cooperatively and locally among citizens, community groups, businesses and local authorities. Actions typically include: installing or improving basic infrastructure; water reticulation, sanitation/waste collection, rehabilitation of circulation, storm drainage and flood prevention, electricity, security lighting,and public telephones.Upgrading or slum improvement is package ofbasic services: clean water supply and adequate sewage disposal to improve the wellbeing of the community. But fundamental is legalizing and regularizing the properties in situations of insecure or unclear tenure.

Globally, there have been shifts in upgrading policy and doctrine since the 1970's from emphasizing on repression, resettlement, eradication and evictions which emphasized land acquisition, land banking and conventional housing projectsmoving to integration into housing policies in 1980s providing for land tenure regularization, sites and service and housing finance and to the 1990s, that heralded combinedapproaches along programme designs endeavouring to deliver infrastructure improvements, services, physical and layout restructuring and legalisation of tenure through integration into programs in citywide policies with localgovernance and urban management at the forefront. In the 2000s housing delivery systems include adaptive and proactive measuresimplemented to tackle the urbanization of poverty and multisectoral, partnership approaches involving external actors who plan and implement slum projects, successfully engaging with the community and facilitating participation.

Many slum upgrading projects are standalonepilot, innovative practice projects which are not always scalable or sustainable since they involve high delivery costs, technologies, processes and institutional structures and on-going resources.Current best practice requires community participationand integratedapproaches as vital elements for long term project success and the generation of livelihoods alongside physical improvements while reforming government capacityto repeat or scale up projects. When generalised most slum upgrading approaches are either 'top-down or centralised' or 'bottom-up or decentralised'. Every approach has an alternative delivery method but require investigation of the longer term sustainability since after project completion, external actors may leave the site, community groups may break up and poor people's priorities may change with time.Clearly the failure to improve living conditions in slum areas through upgrading projects imply the need for more innovative approaches to deliver social and urban infrastructure.

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2.1 Urban renewal as an alternative to conventional slum upgrading

One approach that has not been tested in Zambia and other developing countries is urban renewal or urban regeneration. Urban renewal is an old concept and refers to a process where an urban neighbourhood (or slum) is improved or rehabilitated through demolishing of old or run-down buildings or undesirable houses in which the poor live, the construction of new housing either for rent or social purposes and the provision of new social facilities and amenities such as schools, health centres, play parks and so on.

Palenand London (1984) contend that it is not easy to find a satisfactory definition of urban renewal which embodies the complexity of issues involved in the process. They argue that some of the existing theoretical and ideological disagreements about urban change are thought to come, in part, from the fact that the terms used by different scholars reflect different perceptions of the phenomenon and its significance. There are several terms used in reference to urban renewal such as urban regeneration, urban revitalization, gentrification, neighborhood renewal, rehabilitation, and renovation. In this discussion, however, the term urban renewal is used to refer to the general process of transforming the urban environment.Urban renewal is often presented as a natural process through which the urban environment, viewed as a living entity, undergoes transformation. In the words of Treister (1987: 57)" as the years pass, transformations take place, allowing the city to constantly rejuvenate itself in a natural and organic way".

Historically the concept of urban renewal emerged in England in the 19th C as a method for social reform in response to urban blight caused by the increasingly cramped and unsanitary conditions of the urban poor. Renewal was imposed in poor areas of cities not only for aesthetics and efficiency achieved after re-development but a way to reform the urban poor morally and economically. This progressive doctrine and agenda for the provision of better housing conditions for the urban poor assumed an intense phase in the late 1940s and 1950s and the rubric of urban reconstruction. Experts present at the first International Seminar on Urban Renewal, held in Den Haag in August 1958, agreed that the main purpose of urban renewal is to deliberately change the urban environment and to inject new vitality through planned adjustment of existing areas to respond to present and future requirements for urban living and working (Miller, 1959). For them, the fundamental objective of urban renewal is the application of several principles resulting in the revitalization of any or all portions of the urban structure which are not fulfilling the functions for which they were designed (Miller, 1959). Urban renewal generally applies to inner-city areas, centrally located in historical districts including non-residential as well as residential land uses (Grebler, 1964).

In developing countries like Zambia urban renewal has often been overlooked by urban planners and municipal governments as an option for solving the incipient problems presented by slums. This is because of the complexity of the processes involved and often the huge financial outlay that is required to undertake such initiatives. Urban renewal and regeneration is, however, one approach that can assist urban actors to turn urban development problems into solutions; manage complex large-scale urban development projects; maintain progress within a continuously shifting political and institutional environment; establish an integrated area based urban development and deliver urban development benefits targeted at the poor (Robinson et al, 2004). The process has a significant impact on urban landscapes and in demographic transformation of cities as it entails demolition of structures, relocation of people and businesses and the application of eminent domain (or government purchase of property for public purpose) as a legal instrument to take private property for city led development projects.

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The process may be seen as an economic engine and a social reform mechanism of blighted areas or slums when it enhances the existing communities but may be construed as a means of political control when it results in demolition of entire neighbourhoods and their social fabric. On large scale renewal may result in urban sprawl as when areas of cities are extended further through complex transport networks. Urban renewal is suitable for densely populated areas especially those with complex and challenging issues of unplanned settlements. On a positive note renewal may lead to the revitalization of the central business district and gentrification of blighted residential neighbourhoods or slums. It can significantly improve the conditions in and rehabilitate slum areas through settlement re-planning, provision of new housing, public spaces, commercial and industrial facilities, clean water and sewage, drainages, access roads and waste disposal and storage, which may have a positive impact on the health of slum communities. Improvement of accessibility, for example, may have multiple benefits for the slum communities as it makes transportation easier and increases the mobility as residents can travel to and from jobs more quickly, increasing their productivity and potential for economic gain. Services like police and ambulances can react quickly to emergencies as they happen. The urban renewal process involves land re-development in areas of high density urban land use such as slums which on one hand may attract private investments and result in increased land values.

Other positive effects of renewal and redevelopment are that replenished housing stock might be an improvement in quality; it may increase density and reduce sprawl; it might have economic benefits and improve the global economic competitiveness of a city's centre. It may, in some instances, improve cultural and social amenity, and it may also improve opportunities for safety and surveillance. Developments such as London Docklands increased tax revenues for government. Urban renewal has been responsible for the rehabilitation of communities—as well as displacement. Replacement housing – particularly in the form of housing towers – might be difficult to police, leading to an increase in crime, and such structures might in themselves be dehumanising. Urban renewal is usually non-consultative. Urban renewal continues to evolve as successes and failures are examined and new models of development and redevelopment are tested and implemented.

On the negative side urban renewal may result in gentrification and the displacement of the urban poor. Gentrification refers to shifts in an urban community lifestyle and increasing share of wealthier residents and/or businesses and increasing property values. Many theories that have been espoused about gentrification fail to explain where and why gentrification occurs but in large cities, like Lusaka it’s a common phenomenon due mainly to industrialization. It is mainly the result of citizens who are not residents to an area coming to live in a certain area. It occurs in stages with early gentrifies who may belong to low income groups but this is followed by increased investments in a community by real estate development businesses, local government or community activities and more economic development and attractiveness of business and lower crimes rates. Gentrification can also lead to population migration. In a community undergoing gentrification the average income increases and the poorer pre-gentrification residents who are unable to pay increased rents or property taxes are forced out. This results in a negative change of status of the existent population.

Urban renewal requires that municipal governments, employers, communities and the private sector work together in public private partnership arrangements. Urban renewal has to be undertaken in combination with small and big business incentives. It has to be carried out cautiously as it is politically sensitive to demolish slums and relocate people who constitute the electorate and power base of most politicians. In Zambia, like other developing countries, local governments do not have adequate capacity to attract big private investments to give impetus to the urban renewal process. Notwithstanding these

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limitations, urban renewal is emerging as a policy based less on demolitions (and destruction of property and lives), but more on urban reconstruction, renovation and investment.

2.2 Case Study: Chibolya Pilot Urban Renewal Project

2.2.1 Settlement characteristics

Chibolya is an unplanned settlement with an estimated population of 25,000 people in 4,500 households and lies within 5 km of the Lusaka City CBD on prime land. Chibolya is a term which in the local language refers to an "abandoned area" or "dump site" and which was established by people who came to look for employment in Lusaka in the 1970s. The settlement has a total area of 116.7 Ha of which 52.1 Ha is the original area; 49.9 Ha is the extension area and 14.8 Ha is the Market zone. An estimated 63.2 % of Chibolya is residential use while 35 % is non-residential use. At least 60.1 % of the owners live within Chibolya while 39.1 % live outside the settlement. At least 95.8 % of residents in Old Chibolya hold land records given by the LCC while 0.4 % has Occupancy Licenses and have to pay land rates.

Over half of the residents of the extension area have no legal papers. Most houses are built using concrete blocks with corrugated iron sheets on the roofs. Water is provided by the Lusaka Water and Sewerage Company through communal while most residents depend on pit latrines for sanitation. Waste disposal is a major challenge as many residents dump waste anywhere. Social services are inadequate with only two schools located some 2 kilometres away, a market, football ground and shopping centre. Chibolya, notorious for its high levels of social anomie, is one of the most socially and politically contested urban localities in the history of Zambia.

2.2.2 Chibolya pilot urban renewal project

In 2009 the Lusaka City Council finalised the preparation of the Comprehensive Urban Development Plan (CUDP) for Lusaka (JICA, 2009). The CUDP proposes two different approaches to improve the living environment of slums (and low income areas) in Lusaka. The first is to improve the living environment by providing infrastructure and other services by engaging community people while the second is largely dependent on land readjustment (or market approach) involving new subdivisions, creation of commercial plots and selling the land to investors and use the financial proceeds to improve the living environment and provide infrastructure and services.

The CUDP proposes implementation of the*ChibolyaPilot Urban Renewal project*whose objectives are: i) to materialize efficient and practical land provision mechanism for unplanned settlement residents; ii) secure quality of life of unplanned settlement as an inner city area by provision of liveable environment (infrastructure and urban services); iii) enhance an urban function by maximizing land values with economic development and efficient land use of Chibolya's proximity to the CBD; and iv) promote sustainable urban community through the Public Private Partnership mechanism.The basic approach of the pilot project is to improve in an integrated manner the living environment through the provision of basic human needs (BHN) in Chibolya which lack infrastructure and services. The pilot project will be implemented by the Lusaka City Council in partnership with private investors and civil society and if successful the project will be replicated to other slums in Lusaka and the country.

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TheChibolyaUrban Renewal projectwill have five key components or programs including:*i) a Land Subdivision Program with provision of legitimate land title, ii) Infrastructure Improvement Program for the entire Site, iii) a Housing Arrangement Program, iv) a Compensation Program; and v) a Development Measure and Institutional Arrangement Program. The land subdivision program will involve giving legitimate Title Deed, creating feasible lot areas of at least 180m^2/lot, securing community business and public/community spaces (lots).* The Housing Arrangement Program will involve provision of transitional housing as people wait to be allocated social or rental housing units, phased movement rotation and provision of a core-house and building materials. Theinfrastructure improvement programwill involve provision of paved access road, tapped water supply by the LSWC), securing drainage system and appropriate septic tank/sewer while the Compensation Program which will entail compensation for owners who live outside of Chibolya while renters will not be compensated but be assisted through mediation and other financial means. The last component will be theDevelopment Measure and Institutional Arrangement Program which will involve the creation of a project implementing unit(that will also include the local WDC) and establishing a technical, financial and legal advisory board.

Once fully implemented Chibolya, which is adjacent to the Lusaka CBD, will be transformed into a modern mixed land use precinctwith a commercial and business zone; an integrated neighbourhood and commercial zone; a public/communal zone; a residential zone and a retail and wholesale market zone. Other facilities will include a parking area and a park and recreational zone as shown in figure 1.

Within Chibolya access and local roads, drainages, housing, utility and social services will be upgraded to ensure an acceptable living environment. Public private partnerships will be used to build homes (both rental and social housing), renovate environmental facilities, improve and provide social and utility services. The pilot project will be implemented through community consensus building, securing and arrangement of property rights, land tenure delivery, funding arrangements, housing construction, provision of infrastructure and public services and related administrative services.

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Figure 1: Chibolya Urban Renewal and Redevelopment Project (Source: JICA Study Team, 2009)

2.2.3 Challenges of implementing the Chibolya urban renewal project

Urban renewal has previously not been considered a good and viable option for upgrading of slums. The feasibility of the Chibolya Pilot Project has thus been questioned by many stakeholders especially regarding the financial mechanisms to implement the project and the issues around the relocation and compensation of residents. The project will require an estimatedUSD 2000 million additional funding to be mobilized through the private sector yet potential private investors and mechanisms has been identified or developed (UN Habitat/UPDB, 2013).

There are several shortcomings in design and implementationmechanisms of the project since a huge gap exists in present institutional settings and capacity of LCC. For example only USD 7 million is allocated for capacity development and institutional strengthening while the LCC is expected to meet USD 1600 million of the cost of the proposed plan by 2030 (ibid, 2013). No major follow ups have been made regarding the proposals relating to city densification and urban renewal although the former is taking place piece-meal and organically through initiatives of parcel owners who are subdividing their lots while the Chibolya Urban Renewal Project, which, is supposed to be a flagship demonstration project for the CUDP, has lacked progress. Only a few of the planned activities involving consensus building have been achieved since the CUDP was approved in 2009.

Within the CUDP, detailed zoning regulations have been outlined for Chibolya area on the premise of classical rather than contemporary mixed zoning concept. Detail design and regulations are considered for different types of Unplanned Urban Settlements (UUS) and only the case of Chibolya is illustrated while strategies for other types of areas have not been illustrated with detail designs. Different types of UUS require different strategy for living environment improvement and different implementation mechanisms and investment plans need to be outlined for future directions and implementation. The space allocated for streets is not sufficient as only 10 % of land is allocated where it should be 30-45 % according to theprinciples of Neighbourhood Planning. The street lay out is also not very clear and specific and no bike lane and foot-path for safer pedestrian movement are provided. The proposed residential density is 300 person/ha but density is not proposed for the commercial zone which holds 57% of total land area. A number of issues regarding the direction of growth and dimensions of Chibolya have yet to be clarified. For example the density concepts should be reviewed to allow less difference to allow a mix of uses(UN-Habitat/UPDB, 2013).

Details of the grid and public space (increase of share, layout of the super-block or at least some regulations for public space and plots and the phasing of the plan should be articulated. The average residential plot size is 180 sqm/lot (for 1,359 individual households) which are quite big and difficult to keep such low density and to enforce such zoning in such a central area (UN-Habitat/UPDB,ibid.).No specification for social mix and affordable housing units is designed for the existing landowners. However, 2,740 new dwellings are foreseen (274,060 sq m floor-by considering 100 sqm/dwelling units) for 15,000 populations for 2030. The Chibolya Plan supports the principle of mixed land use (57.2% land allocated for economic/business/commercial use) but the mix function block area theory is not followed in this plan given that 56% of land use is fully dedicated for commercial or for sale to the private sector. The Plan does not follow the principle of mixed use concept of for example UN-Habitat's sustainable neighborhood planning concept (i.e. 100% mono functional)(UN-Habitat/UPDB, ibid.).

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3. Conclusion

In concluding, it is clear that urban renewal focuses on improving upon and extending social and urban infrastructure in areas that are already settled albeit unplanned and informal in the Zambian case. It can be synthesized from the case study and prior discussion that for urban renewal to occur a public agency has first to acquire the land for such an initiative to occur. In the Zambian case, this implies that the local authority should have full control and development rights of slum areas. This can only be achieved by apply the appropriate legislative requirement of regularizing an unplanned areas using the Housing (Statutory and Improvement Areas) Act of the Laws of Zambia.

Secondly, once the land has been acquired or appropriated for renewal or re-development it has to be to be cleared for re-development. Herein lays the major challenge since much of the land is already occupied by residents, most of whom are unwilling to move or due to political reasons (as the residents constitute an important electorate and power base of local politicians) cannot easily be moved. Considerable political will is required to engage the communities and political leaders to accept the urban renewal initiative.

Thirdly, once the people have been convinced they have to be relocated, land has to be identified and compensation given for the residents to move and build new homes in permanent overspill areas. In the proposed urban renewal project transitional homes will be provided within the settlement. It is very difficult to obtain land for relocation within town since much of it has already been used up for other developments. There is however plenty of vacant land on the peripheral areas though much of it is under traditional authorities. The latter can be convinced to surrender part of their land but a major challenge is that the urban poor are generally unwillingness to relocate to peri-urban areas due to long distances to work and other sources of income. It can also be argued that the option of relocating the urban poor to peripheral traditional land has not been seriously discussed or attempted.

Fourthly, once the relocation has been agreed upon and compensation paid or promised the land has to be cleared for both private re-developments for commercial purposes and secondly for public social housing which will absorb the relocated residents. The former could potentially provide the much needed financial resources for the re-development of the entire area while the latter requires the mobilization of additional funding to meet public housing objectives. This can be very difficult and so urban renewal has to be supported politically and financially and with a clear legislative and regulatory framework. The re-development of a slum has to follow not only the requirements of the local areas or re-development plan but also meet the planning requirements set out in the comprehensive urban development plans of the local authorities. Urban renewal requires that least two-thirds of the difference of the total cost should be provided by the Government while one third of the local matching contribution is taken up by the local authority. Thus the costs of land acquisition, clearance and preparation for redevelopment often exceed the amount realized upon the re-sale or lease of the land to private entities which makes renewal untenable to public agencies.

There are several strands that characterize successful urban renewal projects: having a clear relationship to the community context and clear lines of accountability; development of a clear brief and a well-defined management structure and institutional arrangements; a continuous investment in the improved capacity of both staff and management. Strong leadership, coherent briefs and previous experience in running urban reconstruction schemes all appear to reinforce the potential for successful formal project

ISBN 978-0-86970-787-6
structures. Although urban renewal projects in developing countries are by no means equivalent to their

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Livingstone, Zambia
ISBN 978-0-86970-787-6

parallels in the developed counties in terms of scale and investment levels, it is possible to achieve such initiatives with good political will, commitment and strong leadership.

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-052

Urban infrastructure, housing markets and housing development: An institutional analysis

Ephraim Kabunda Munshifwa

Abstract

Urban infrastructure such as roads, water, electricity and sanitation are important components in land servicing and in the production of the urban built environment. In Zambia, this has traditionally been provided by the government. However, with reduced funding to the sector from 1975, the country witnessed deterioration in the state of infrastructure in urban areas. After 1991, the new government's strategy was to involve the private sector more in the provision of infrastructure and housing development. Evidence however shows that the private sector has been unable to fully participate in this sector. This paper examines why, and finds that there are institutional aspects such as policies, rules and regulations which still remain unsupportive to private sector involvement. Therefore, the way forward is for government to complete the legal and policy reforms aimed at supporting the private development market.

Keywords: housing markets, housing development, institutions, organisations, urban infrastructure

1. The Crisis of Urban Infrastructure

Provision of urban infrastructure such as roads, water, electricity and sanitation, is an important component in land servicing and in the production of the urban built environment in any city. Traditionally, government has provided urban infrastructure in support of housing markets and housing development in Zambia. However, by the 1980s, the state of infrastructure in towns and cities had reached serious levels of deterioration as local authorities were now unable to deliver these needed services (United Nations (UN) HABITAT, 2013). In the absence of state and local government provision of urban infrastructure and housing development, private and informal mechanisms emerged to fill this gap. Thus two systems are recognisable in the Zambian urban environment, the formal city where government focuses on the provision of infrastructure and the informal city where self-organised mechanisms are prominent (UN-HABITAT, 2012).

The change in government in 1991 resulted in change in perspective on how the economy was to be run. Thus at the time of formulating the National Housing Policy in 1996, government thought it was necessary to include a specific strategy to look at the provision of infrastructure such as roads, water, street lighting and sanitation in order to stimulate the real estate development market, particularly in relation to housing. However, over the years the situation has no improved much resulting in UN-

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

HABITAT (2012, 99) asserting that there "is a general lack of provision for financing, maintenance and refurbishment or replacement in the way infrastructure is financed in Zambia."

Interestingly, over the last five years, and with the help of borrowed funds, the country has seen the refurbishment of urban roads particularly in old municipal townships. Ironically, very little development has been seen in opening up new residential areas or the upgrading of informal settlements, which constitute the bigger part of most urban areas. Furthermore, an examination of the laws and policies also reveals that very few notable changes have taken place in this area over this time period. While some positive changes have been seen in the development of private housing estates, especially in Lusaka, there seems to be a general inadequacy in legislation and policies to support urban land servicing and housing development. Thus the research questions for this paper are: what are the appropriate State mechanisms, agencies, laws and policies in facilitation of the real estate development market, particularly housing? What is the role of government, on one part, and the private sector, on the other, in land servicing and housing development in urban areas? How do we actually explain the subtle positive developments seem in the real estate industry?

1.1 Purpose of the study

This paper examines the provision of urban infrastructure to support the development of the housing market from an institutional perspective. It uses tools of institutional economics to put meaning to institutional changes in the country. It thus defines laws and policies as institutions and further discusses the real estate market as an institution and the development process as an activity within this market. The paper also uses an episodic framework to examine laws and policies that support provision of urban infrastructure and housing and in Zambia.

1.2 Objectives of the study

a. To analyse various State mechanisms, agencies, laws and policies used in the facilitation of real estate development, particularly in the production of housing.

b. To examine the different roles of the public sector, on one hand, and the private sector on the other, in land servicing and housing development in urban areas.

c. To analyse the subtle positive developments seem in the real estate industry in relation to the institutional framework.

1.3 Research methodology

This study is mainly a literature review, having initially being a part of a larger empirical study on property rights and the production of the urban built environment in Zambia. Thus although the data used in this paper is mainly historical and qualitative, the data collection for the larger study involved household surveys, in-depth interviews with key informant, focus-group discussions and case studies.

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2. Institutions, Institutional Change and Real Estate Institutional Analysis

Institutions are generally defined as "rules of the game" (North, 1990: 3). As rules, they provide structures that coordinate, guide, enable and constrain human actions. Swallow and Bromley (1992: 2) further define them as "standards" in that they outline "actions that agents are expected to perform, (or refrain from performing) under appropriate circumstances". Thus from an institutional perspective, institutions can be formal and/or informal, and argues that they matter in any society (Coase, 1960; North, 1990; Williamson, 1984). Formal institutions include laws, rules and regulations as found in constitutions, legislation and other government policy documents while informal institutions include beliefs, traditions, norms of actions, conventions, routines, etc. (Pejovich, 1999).

New Institutional Economics (NIE) begins with two premises, the first being that the theoretical framework should be capable of integrating neo-classical theory with an analysis of the way institutions modify the choice set available to human beings; and secondly that this framework must build upon the basic determinants of institutions, so that the choice set available is not just defined but also analyze the way in which institutions change and therefore alter the available choice set over time (North 1986). NIE is at base a study of contracting, both political and economic. It therefore uses specific contracts in legal cases, political decision cases and property rights as observations for analysis and to provide an understanding of institutional procedures and an analysis of institutional change (North, 1986).

The market, in this case the housing market, is one of the institutions that shape the actions of individuals through the interaction of actors, resources and activities in order to support production and exchange. Therefore theories in NIE provide insight in understanding how real estate markets emerge and work. It also helps to understand the behaviour of individual actors in the real estate market because it argues that the explanation of any social phenomena must be based on the views and behaviour of the individuals, because their actions give rise to the phenomena being studied (Furubotn et al., 1998). Therefore NIE argues that the actions of individuals and organisations in the real estate market are structured by rules, norms, conventions, etc.

Literature, such as D'Arcy and Keogh (2002), acknowledge that little attention is given to the role of development market institutions and organisations and the role they play as mediators in the production of urban built space. The development market is understood here simply as a submarket of the real estate market, therefore the development process is an activity within the market. D'Arcy and Keogh (2002) presents an outline conceptual framework to explain the development process as depicted in Figure 1 below. Thus real estate development is seen as a property market activity and involves the participation of various actors/agents such as landowners, developers, planners, etc.

As can be seen from Figure 1, the explanation of development from an institutional perspective therefore goes beyond examining the functions of the developer to examining the "role of development market institutions and organisations as mediators of the development market outcomes" (D'Arcy and Keogh, 2002: 20), which includes urban infrastructure, such as land servicing, and real estate development. From the sketchy conceptual framework above, three areas are key in the analysis of the real estate development process, that is: the institutional environment of rules, laws and regulations; the property market itself as it facilitates interaction; and property market organisations of developers, users, government and various other actors. The next section uses the Zambian development experience as an example in this analysis.

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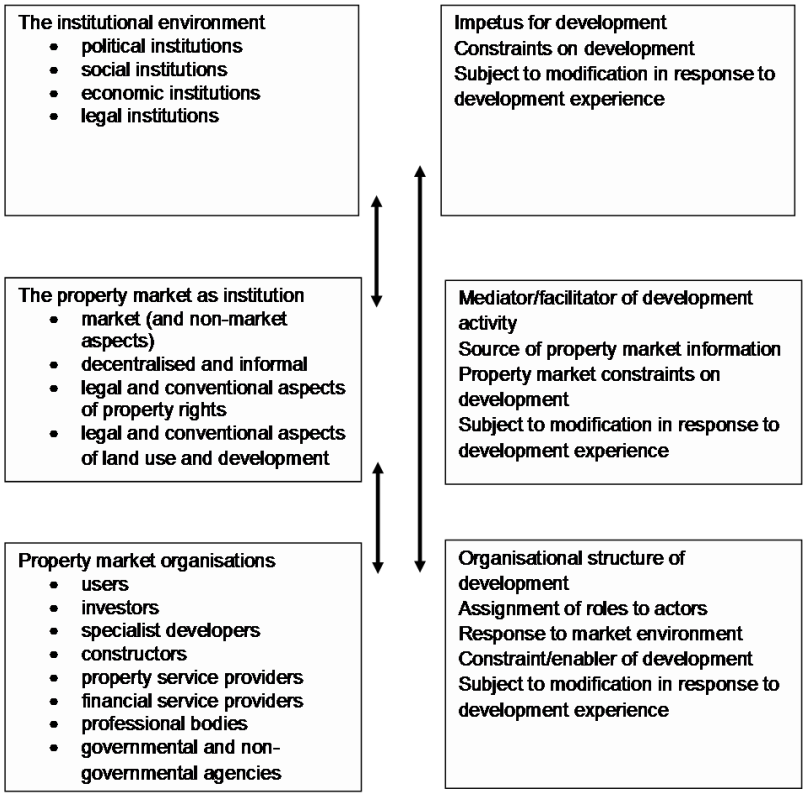

Figure 1: Contemporary institutional framework for the analysis of development activities (Source: D'Arcy and Keogh, 2002: 19)

3. Infrastructure, Housing Markets and Housing Development: The Zambian Experience

Zambia has generally pursued some form of state capitalism for its economic management which has seen shifts in orientation from more government (hierarchy) and less market, or to more market and less government. This has resulted in distinct periods of economic (re)orientation with various effects on institutions such as property rights, exchange and contracting regulations, and planning regulations. This has had further implications on the larger institutional structures of the property market and outcomes such as urban infrastructure and housing development. It is therefore important to trace these changes within an episodic framework that enables the analysis of institutional reforms over time (from pre-independence to date) and broken into episodes of major changes in policy and legislation (events/reform) and their effects on the built environment. As this review shows, there have been significant effects on physical developments depending on the changes and orientation of economic policies generally.

Using this framework, four periods are discernible in Zambia's historical economic development process:

a. The period from pre-independence up to 1968, during which period the economy was more capitalist orientated. At independence in 1964, most laws and policies continued as inherited from the colonial government. The private sector was more active in economic production.

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b. The period from 1968 to 1991 when Zambia saw major changes in laws and policies towards more socialist/communist orientation and had profound effect on economic production in the country. This resulted in less involvement of the private sector.
c. The period 1991 to 2011 during which a shift was made again back to more capitalist orientated laws and policies and more focus on the development of an "enabling environment" targeted at encouraging private sector participation in economic production.
d. After 2011 in which a number of laws and policies are targeted for change by the new government and could rightly be called a transitional period.

The effect of institutional change on physical development in urban areas within these episodes can be analysed under at least five areas, its effect on (a) property rights (b) provision of land for development, specifically for housing (c) property market transactions (marketing, contracting and exchange), (d) housing development and infrastructure provision, and (e) urban spatial arrangements. The historical narratives that follow, and the summary in Table 1 below, relates the periods of policy reforms to effects on these development areas.

Table 1: Summary of institutional reforms and urban development – Pre 1964 to After 2011

Development Period **Institutional reforms**	**Pre-independence to 1968 post-independence**	**1968 to 1991**	**1991 to 2011**	**After 2011**
Economic/Ideological Orientation	Capitalism	State Capitalism	Mixed system with elements of both State Capitalism and privatae sector participation	State Capitalism (Transitional state)
Property Rights Land use planning regulations	Freehold and Leaseholds	Freehold and Leaseholds	Leaseholds	Leaseholds
	Central/Local Authorities	Central/Local Authorities	Central/Local Authorities	Central/Local Authorities
Property market transactions	Open	Restricted to improvement only and controlled through state consent	controlled through state consent	Controlled through state consent
Contract Enforcement	Public/Private Order (varying combination)	Public/Private Order (varying combination)	Public/Private Order (varying combination)	Public/Private Order (varying combination)
Institutional Arrangement (Market or Hierarchy)	More market less hierarchy	Less market more hierarchy	Less hierarchy more market	Transitional
Development Agents	More private and less public	Local authorities and parastatals	More parastatal and less Private	Less parastatal more private
Entrepreneurial Initiative	More private developers and less public	Public housing, Owner-occupiers Employer housing	Financial institutions; Emergence of development companies	Private property initiatives, redevelopment of parastatals, private company developments, capitalist environment with socialist undertones

3.1 Pre-independence capitalism up to 1968 post independence

At independence in 1964, Zambia inherited the system of land tenure as established by the British Colonial government, which had freeholds and leaseholds as the main estates in land. Statistics shows that even as early as 1950, "African" land (reserve and trust land) occupied a greater portion of Zambia's land such that by 1987 the country was still divided in 6% (4,518,953 hectares) state land (formerly

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

crown land), 36% (27,297,500 hectares) reserves and 58% (43,447,900 hectares) trust land (Roth and Smith, 1995). During this period, there were no restrictions on the operation of the property market such that property rights on land were freely traded and facilitated by a number of estate agency firms. Private property developers, such as insurance companies, were the main producers of real estate space and services.

A number of important legislation, in relation to real estate and the functioning of the market were enacted during this period. These include the Public Order Act of 1955, Zambia Police Act of 1966, Town and Country Planning Act of 1961, and the Local Court Act of 1966. Despite having undergone a number of amendments over the years, these Acts are still in effect and contribute to physical development in one way or another.

3.2 Socialist orientation (1968 to 1991)

Although 1975 is marked as the point of significant institutional reforms on land and property development, following the President's speech and the enactment of the Lands (Conversion of Titles) Act of 1975, the re-orientation of the economy towards socialist/communist policies started in 1968/1969 following the President's speeches at Mulungushi and Matero Halls in Lusaka (Kaunda, 1968, 1969; Saasa, 1987). The initial reforms of 1968 and 1969 targeted the mining, financial and industrial sectors while the 1975 reforms focused on the land sector.

As a turning point, 1968 marked a shift in policy orientation towards what Turok (1980; 1981) calls state capitalism by adopting socialist policies. This culminated into a countrywide nationalisation programme especially after 1970. The main characteristics of this form of state capitalism is "concentration of political power in the state, the predominance of the state sector in the economy, the persistence of profit as the principal economic criterion in a class-divided society in which the national bourgeoisie is still underdeveloped" (Turok, 1980: 455).

This characterisation also extends to ownership relations, market relations and political power relations which are essential aspects of the system. From a New Institutional Economics (NIE) perspective, this classification equates to North's *et al* (2009) description of Limited Access Orders (LAOs) and describes the major differences between developed and developing economic environments. State capitalism, as experienced during this period was highly interventionist, with economic production undertaken mainly through the establishment of state corporations such as Industrial Development Corporation (INDECO), Mining Development Corporation (MINDECO) and Finance and Development Corporation (FINDECO) which controlled interests in all economic sectors such as mining, insurance, building societies, manufacturing, etc (Turok, 1980). This literally meant the end of the private sector's involvement in economic production (including housing production) in the country as 80 per cent of economic production was now undertaken either directly or indirectly by the State. Parastatal organisations became dominant economic agents in economic production in the country. The role of the parastatal was to act as the main actor/agent of the state in fostering economic development along socialist lines (GRZ, 1979; Turok, 1981); hence they are an important aspect to understanding Zambia's system of state capitalism.

Production of housing was mainly by the public and parastatal organisations under the National Development Plans (NDPs). These fared badly during the period 1975 – 1991, such that UN-HABITAT (2012: 37) could contend that "since the 1970s, virtually all new housing has been provided in informal

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ISBN 978-0-86970-787-6

and peri-urban settlements outside local planning guidelines." Because of failure by government to provide housing and the resultant backlog, it is estimated that Zambia now needs to build 1.3 million new urban dwellings between 2011 and 2030 or "one [house] every two minutes of the working day for 19 years" (UN- HABITAT, 2012: 67), which is an impossible task given the current scenario and the past performance.

Many political pronouncements of the 1970s were followed by legal reforms. For land and the property industry, this saw the introduction of the Land (Conversions of Titles) Act of 1975 (now replaced by the Land Act of 1995), Housing (Statutory and Improvement Areas) Act of 1974, Building Societies Act of 1968, Land Acquisition Act of 1970, Registration and Development of Villages of 1971, Landlord and Tenants (Business Premises) Act of 1971, Industrial Development of 1977 (replaced by the Investment Act of 1991), etc. After 1991 a number of these Acts have either been repealed and replaced or amended; examples include the Land Act of 1975, Investment Act of 1991 or introduced such as the Privatisation Act of 1992. Many other Acts such as the Town and Country Planning Act of 1962 have undergone several amendments to try and fit in changed capitalist environment. However these amendments have not yielded any measurable results.

3.3 Return to capitalism (1991 to 2011)

The year 1991 marks another major turning point in the country's economic orientation due to a change in government from United National Independence Party (UNIP) to the Movement for Multiparty Democracy (MMD); the latter's main goal being to re-orient the economy towards more capitalist policies from the former socialist policies. The movement from a socialist environment envisaged a shift from a more hierarchical system as a governance structure, and dependant on central command, to the market system where the price mechanism became prominent.

The intentions in the early 1990s to 2009 reforms were to provide facilitative planning through an enabling environment concept (MMD, 1996). Private sector participation in economic production was encouraged and policy and legal structures were reformulated with the aim of enabling that participation (MMD, 2011). However, the land and property sector saw a typical case of path-dependence in legal reforms. For instance, the revised Land Act of 1995 specifies the following objectives: (a) to provide for the *continuation* of leasehold tenure, (b) to provide for the *continued* vesting of land in the President, (c) to provide for the alienation of land by the President, (d) to provide for the statutory recognition and *continuation* of customary tenure, and (e) to provide for the conversion of customary tenure into leasehold tenure. While a number of superficial changes were made, the core structure remained the same, particularly on the vesting of land in the President and the continuation of leaseholds only; which were some of the contentious issues at the *National Conference on Land Policy and Legal Reform* of 20th to 22nd July 1993, held at Mulungushi International Conference Centre (Roth and Smith, 1995). The *vesting* of all land in the President is a carryover from the Land Act of 1975. It is reinforced in Section 3 (1) of the Lands Act of 1995, which effectively means that the provision of all development land in the country was and still remains the responsibility of the State through the Ministry of Lands and delegated to the Commissioner of Lands (GRZ, 1975, 1995).

Production of real estate, and particularly housing, by the private sector was more emphasised during this period, although anecdotal evidence shows that the private sector had not responded as envisaged by the reforms. This indicates that something else is constraining the development of property through private initiatives. At conferences dubbed *"Investment Opportunities in Zambian Real Estate*" held in

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2005, 2008 and 2012, the private sector pointed to a number of challenges faced by various actors/agents involved in the production of the urban built environment. Participants at these conferences listed (a) inadequate services and infrastructure (b) inadequate land use planning, (c) absence of complimentary investment opportunities such as unit funds, (d) decay of housing stock, (e) shortage of development land, and (f) lengthy land delivery procedures as some of these challenges. Underlying each of these challenges is an inadequate institutional structure to support private sector participation in the production of housing in particular and real estate in general.

The logic of state interventionism also extends to informal low-income settlements through squatter upgrading programmes. Government intervenes in the informal development process by providing public infrastructure such as water, power, roads, clinics, police stations, etc. through various economic agents such as local authorities and parastatals. Under "*Vision 2030 – A Prosperous Middle Income Nation by 2030*", government planned to have all settlements planned (GRZ, 2006). To achieve this, government hoped to develop the first Urban Policy which was to "incorporate informal and unplanned settlements into comprehensive country-wide urban development strategies" (UN-HABITAT, 2012: iv). The reality on the ground is however different.

3.4 Current institutional framework after 2011 (The transitional phase)

The general elections of 2011 ushered into office a new Patriotic Front (PF) government which campaigned on a pro-poor manifesto. This was on a backdrop of a reported economic growth during the MMD era (1991 to 2011) centred on a more capitalist oriented economy. This has marked another turning point in the country's economic timeline. It should be noted that the PF manifesto was based partly on the same rhetoric as the struggle for independence, which called for more government involvement in the production sector especially through sharing of mining revenue (Patriotic Front, 2011).

The 2013 National Budget provided the first real opportunity for the PF government to implement its campaign promises, with the 2012 budget having been inherited from the MMD government. The opening statements of the 2013 national budget, as presented by the Minister of Finance and Development Planning on Friday 12th October 2012, captured the PF government's "change of … mind-sets and priorities", the desire for "structural transformation of [the] economy", driven towards "equitable distribution of the tangible benefits of development", and its ideology of "a more peoplecentred development agenda" (GRZ, 2012a). The cadence of the PF government policy statements was once again of an economy in transition. The exact form it takes is again a matter of time.

For the land and property market, the current policy and legal framework still vests all land in the President, thus the responsibility to make land available for development remains delegated to the Ministry of Lands. It is however important to note here that the *First Draft Constitution* of 2012, in Part XIX Section 298, mentions the establishment of the Land Commission whose function, amongst others, will be to "administer, manage and alienate land on behalf of the President" (GRZ, 2012b: 225). However, the final outcome of this Constitution review process is yet to be determined.

Despite this land holding structure, where all land is vested in the President, evidence shows that the private sector is taking initiatives to participate in the production of housing by providing fully serviced land. Examples in this category include Meanwood Development Corporation, Lilayi Development

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Holding, National Pensions and Securities Authority (NAPSA) (formerly Zambia National Provident Fund – ZNPF), and National Housing Authority (NHA). A common observation amongst this group of developers (old and new) is that they seem to have large tracks of land in close proximity to growth points. Evidence further reveals the existence of a development land market on which serviced land is traded. As shown in Table 2 below, private developers are able to provide services such as roads, water, sewerage, etc and sell land on the property market for profit. The case of the Kitwe City Council is included to show that government through local authorities can equally do the same, except the issues have always been to use funds collected from land sales to provide the services.

Table 2: Comparison of public and private housing development projects (Source: Munshifwa, 2008, adapted from UN HABITAT, 2012)

Developer	Plot Sizes and Price	Services
Meanwood Development Corp. *Vorna Valley (High cost)*	1000m2 – K25million 2000m2 – K48million 4000m2 – K85million	Basic road infrastructure, a cadastral survey and title deeds
Kwamena Village (Low to medium)	400m2 – K10million 500m2 – K12.5million 600m2 – K15million	
Lilayi Development Holdings	200m2 – K170million (House) 400m2 – K285million (House)	Roads, survey, finance and title Deeds
Kitwe City Council – Kitwe West	380m2 - K3million 580m2 - K6million 1800m2 – K15million	Still to be serviced with roads. Additional fees at Ministry of Lands.

Despite this apparent involvement of the private sector in the provision of infrastructure for housing development, there still seems to be a number of bottleneck in the economic environment to enable full participation of the private sector. Tables 3 and 4 show the major legislation in support of infrastructure and also their assessment in terms of how they have performed. The overall assessment shows that the current institutional and organisational framework is either out-of-date or simply inadequate to support infrastructure provision through private sector involvement.

Table 3: Key legislation in support of infrastructure for housing development

Services	Legislation
Water and Sewerage	Local Government Act (No. 22 of 1991), which gives the local authorities the responsibility for water supply throughout their areas, Water and Sanitation Act (No.28 of 1997) which specifies how the local authorities should provide the services directly or through commercial utilities. National Water and Sanitation Strategy of 1994 provides an overall policy framework for water and sanitation.
Power	Electricity (Cap 433)
Roads	Road and Road Traffic Act (Cap, 464)

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	National Road Safety Control Act (Cap. 471).
Housing development	National Housing Authority Act, No. 16 of 1971
Land Acquisition	Land Act of 1995
Planning	Town and Country Planning Act, 1962, and Amendment, 1997.
Surveying	Lands and Deeds Registry Act [Cap. 185]

Table 4: Assessment of institutional framework in relation to infrastructure provision (Source: Summarised from UN HABITAT (2012, p. 158 - 163)

Criteria	**Assessment**
Institutional and organization framework	Existing institutions are currently inadequate for full service provision
Regulatory and legal framework	Regulatory systems are out of date and are operating in an inappropriate context.
Supply	Water and sanitation supply prices are controlled at less than sustainable levels.
Policy	Pricing policies give infrastructure providers no motivation or ability to extend the reach of services or to provide service to low-income customers or peripheral areas.
Demand	Up-front payments for fitting services to new plots appears to reduce demand
Implementation arrangements and instruments	There is a lack of coordination among service providers
Institutional (organisational) capacity	Urgent need for re-capitalising service providers

Furthermore, preliminary evidence shows that privately-initiated housing estates which focus on servicing and selling undeveloped land, such as Meanwood housing estates in Ibex and Ndeke in Lusaka, seem to perform better than fully developed housing estates such as NAPSA's Kalulushi housing estate, Henan Gouji's Silverest estates and Lilayi housing estates in Lusaka. Thus two major conclusions can be made at this point: (a) Zambia's legislative and organisational reforms seem to lack sufficient incentives to entice the private sector into the infrastructure and housing development sector. Policies, laws and regulations on land and provision of infrastructure are still more socialist orientated than capitalist. As argued by UN-HABITAT (2012), regulations are out of date while the pricing structure of water and sanitation services are egalitarian (believing in equality). (b) The land holding structure and the accompanying planning standards constrain the involvement of more development entrepreneurs from entering the development market. From the analysis of Meanwood Development Corporation and Lilayi Development Holding, it can be noted that developers as main actors/agents in the development market should have the prerequisite factors for development such as land and finance.

4. Conclusion

It is clear from this paper that both the public and private sectors understand the role that a market plays

ISBN 978-0-86970-787-6
in a market economy and in the production of urban built space. In institutional economics the market

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Livingstone, Zambia
ISBN 978-0-86970-787-6

mechanism is understood as a system of governance where the pricing mechanism is dominant. Its role is to coordinate exchange and production. In such a system the developer is the key economic agent but their strategies and plans are influenced by the interaction between/within the institutional environment where they operates and also with other property market organisations. The developers' objective is to produce serviced land, infrastructure and/or real estate. However the full participation of the developer in this market will mostly depend on the incentives available to them which are provided through the institutional framework of the country.

Evidence shows that private developers in Zambia do not feel incentivised enough to get fully involved in infrastructure provision to support the production of housing in the country. Thus a critical analysis of laws, policies, rules and regulations is needed in order to understand impediments to private sector participation. On the other hand, developers need to reexamine their role in a market economy. It may be possible that developers could also be nursing a hangover from a system that provided everything for them. They have to understand that in this market environment the private developer is the key actor/agent but their actions will be structured by the rules in the institutional environment. These institutions will either enable or constrain economic production.

This study has essentially given an overview of the state of infrastructure provision to support the functioning of the property development submarket. Information available reveals that very little has changed as infrastructure provision has remained a challenge. The study thus concludes that there is need for a critical analysis of laws, policies, rules and regulations vis a viz infrastructure development and production of housing in the country.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-043

Nutritional Awareness in the Construction Industry

Chioma Okoro[1], Innocent Musonda[2], Justus Agumba[3]

Abstract

Good nutrition enhances construction worker health, wellbeing and productivity improvements. Unhealthy eating may result in reduced immunity, increased proneness to developing chronic diseases, reduced concentration and alertness and reduced productivity. Improving the nutrition of construction workers is therefore of paramount concern. Although it is generally acknowledged that improving nutrition requires an understanding of the factors which influence construction workers' food choices, it has also been shown that the first step in achieving healthy eating is through an increased nutritional awareness and knowledge which will help in inculcating positive nutritional behavior. The present paper therefore aims to highlight the state of nutritional knowledge among construction workers and possible ways of increasing nutritional awareness. A review of literature related to nutritional knowledge of workers, as well as health, safety and productivity of construction workers, was conducted. Sources included web-based journal and conference articles, magazines and reports. The distillation of literature through thematic analysis revealed that construction workers are aware of the benefits of nutrition in improving their health, safety and productivity, albeit it is seldom reflected in the food choices they make. Further, it was reported that nutrition education programmes which target specific audiences and go beyond disseminating information to creating an enabling environment, ultimately beget long-term positive nutritional behaviors. The study argues that increasing awareness of the importance of nutrition education and similar interventions could primarily improve construction workers' nutrition and in turn, health, safety, wellbeing and productivity. Construction stakeholders view nutrition education as an integral aspect of health and safety training on sites. It should be mandatory for companies to have nutrition training sessions for employees on a continual basis.

Keywords: construction workers, H&S, nutritional awareness, nutrition education

1. Background

Good nutrition has a positive impact on occupational safety and health as well as workplace productivity (International Labour Organisation (ILO, 2009). Unhealthy foods can lead to obesity, chronic diseases and malnutrition which are detrimental to a productive workforce (Yates, 2006; ILO, 2009; World Health Organisation (WHO), 2003). Good nutrition is essential for maximum concentration and alertness required to perform mentally and perpetually demanding tasks, thereby preventing the

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

occurrence of incidents, accidents, injuries and deaths (Bates and Schneider, 2008). Fatigue and impaired concentration or reduced cognitive capabilities, partly as a result of unhealthy eating, can result in accidents and productivity losses (Hunt, 2002; Bates and Schneider, 2008).Research by the ILO found that poor nutrition accounts for up to a 30% impairment of physical work capacity and performance and 20% loss in productivity, and is tied to absenteeism, sickness and higher rates of accidents (Wanjek, 2005).

Furthermore, research has shown that construction workers have poor health, partly due to poor nutrition (Groeneveld et al., 2011; Thabit et al., 2013). Consequently, strategies to combine protection from occupational risks with programs to encourage individual change to diminish health and safety risks from nutrition-related conditions warrant consideration (Schulte et al., 2007). This is especially true for construction workers who are the most valuable resource involved in the process of constructing facilities and who engage in perpetually demanding tasks, and as such, their health, wellbeing and safety must be assured (Hinze et al., 2013). Their health and safety cannot be assured solely by compliance with existing safety regulations (Hinze et al., ibid.).

The first step towards improving nutrition and encouraging behavioural change is through nutritional knowledge and education (McNulty, 2013). According to Grunert et al. (2010) and Chenhall (2010), nutritional knowledge encompasses an ability to identify healthiest foods from various sources or knowledge of what a healthy diet means; knowledge of the sources of nutrients; knowledge of the health implications of eating or failing to eat particular foods; and an ability to cook. In the authors' views, equipping individuals with the information necessary to choose healthy foods and the ability to decipher "wrong" foods from "right" foods will ultimately lead to improvement in diet.

In spite of the importance of nutritional knowledge in improving nutrition and thus health, wellbeing, safety and productivity of construction workers, it appears that scant research has been conducted on the level of nutritional knowledge amongst construction workers. Previous studies were either too broad (for instance, Deacon and Smallwood (2003) which dealt with health-related aspects of safety including inter alia, nutrition) and conducted amongst construction contractors; or were not conducted in the construction industry (for example, Divakar et al., 2012). The present paper focuses on nutritional awareness amongst construction workers.

The specific objectives are to investigate the level of nutritional awareness amongst construction workers and to identify effectual ways of improving nutritional awareness amongst construction workers. Increasing awareness of the value of nutrition, among construction workers will encourage positive individual changes with regard to nutritional uptake. In addition, construction employers and managers could be assisted in planning and implementing relevant and effectual nutritional knowledge programmes to equip and encourage their workers to make good food choices.

In a bid to achieve the above-stated objectives, a distillation of existing literature about the subject was done. Various sources including journals, conference proceedings, magazines and government reports that were related to nutrition and physical health and wellbeing of workers were consulted from search engines such as Googlescholar, Google, ScienceDirect, Ebscohost and Emerald Insight. The materials which focused on nutritional knowledge and ways of improving nutritional knowledge were then selected for the purpose of achieving the objectives of current paper. Thematic analysis was then used to analyze and present themes (patterns) emerging from the synthesis of literature (Alhojailan, 2012). The findings from the synthesis are presented hereunder.

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2. Nutritional Awareness in the Construction Industry

Literature suggests that construction workers' bad food choices are partly as a result of the predominantly low level of knowledge about the poor nutritional value of the foods they eat regularly (Men's Health Forum (MHF). Likewise, Wanjek (2005) investigated how workers, in general, eat and found that lack of nutritional awareness led to workers rejecting healthy food offering to the extent that vendors refused to provide them anymore because they didn't sell.

Another study in the United Kingdom (Men's Health Forum (MHF), 2009) investigated the nutritional habits of construction workers by reviewing existing evidence and speaking with industry stakeholders and construction workers themselves. Findings from this study revealed that construction workers especially male workers generally have less knowledge of particular foods and consume high-fat foods in the belief that this will enable them to undertake a physically-demanding job.

In a literature review of factors influencing the diet and nutrition of blue-collar apprentices in Australia, du Plessis (2012) reviewed previous literature and found that construction workers, especially young male workers have poor nutritional status due to a number of factors including, inter alia, lack of nutritional knowledge. Likewise, Viester et al. (2012) intimated that blue collar workers in a Netherlands construction company have some basic knowledge of nutritional standards but they were not aware of their personal intake levels. This seems to suggest that construction workers may be oblivious of the poor nutritional content of the foods they consume even though they may be somewhat knowledgeable about healthy eating.

The above studies were not conducted in South Africa. Nevertheless, similar research in South Africa expresses the same views. Kolver (2012) stated that many South African workers are unaware of the poor nutritional value of the foods they eat regularly. Additionally, in a survey on construction contractors' perception of benefits of addressing various health-related concerns including, inter alia, healthy eating, Deacon and Smallwood (2003) revealed that 61% of the participants were aware of the benefits of nutrition to their safety, 26.8% were unaware and 14.3% disagreed that nutrition is important. Albeit this study was conducted amongst construction contractors, and not craftworkers, it gives an idea of the opinions of workers in the construction industry regarding the role of healthy eating in preventing accidents and injuries. The study suggests that workers are somewhat aware of the importance of healthy eating.

The above studies seem to suggest that there are construction workers who may know better about nutrition but practice little and some who may know but do not practice healthy eating at all, and still some who may not practice healthy eating simply because they are not aware of the healthy food sources or benefits of healthy eating. Consequently, there is a need to increase awareness and encourage healthy eating behaviours among construction workers, because as McNulty (2013) and Soederberg-Miller and Cassady (2009) rightly opined, nutritional knowledge is a pre-requisite to making positive dietary modifications.

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3. Towards Improving Nutritional Knowledge/Awareness

It is generally acknowledged that improving nutritional knowledge can be through various avenues commonly termed *nutrition education* (NE). Numerous terms have been used to define NE. According to Contento (2011), NE is any combination of educational strategies (which can be delivered individual, community and policy levels), accompanied by environmental supports, designed to facilitate voluntary adoption of food choices and other food-and–nutrition-related behaviours conducive to health and well-being. Nutrition education strategies focus on educating population groups about the importance of and means to increase intake of nutritious foods (Habicht et al., 2009).

Other definitions (Table 1) also portend that NE essentially encompasses programmes advocating positive dietary behavioural change and that interventions should go beyond disseminating information to creating enabling environments for long-time change.

Table 1: Definitions of nutrition education (Source: McNulty, 2013)

Definition	**Original source**
"Nutrition education includes all types of actions designed to change knowledge, attitudes and behaviors of individuals, groups of individuals or populations to contribute to the prevention and control of malnutrition in all its forms, and any erroneous food consumption, including of course the economic aspect."	MataixVerdú, 2000
Nutrition education is defined as instruction or training intended to lead to acquired nutrition-related knowledge and/or nutrition-related skills and be provided in individual.	ADA, 2011
"All communication activities aiming at the voluntary modification of practices that have an incidence on population nutritional state, in order to improve it."	Ministèred'ÉducationNationale 2013 (France)
Set of planned educational activities targeted at certain population groups and aimed at acquiring healthy nutrition behaviors.	Gil, 2010
Nutrition education's main goal is to make people aware of what constitutes a healthy diet and ways to improve their diets and their lifestyles	Eat Well, 2011

Research evidence indicates that nutrition education brings about significant positive nutritional changes. Wanjek (2005) identified several workplace campaigns where education was vital in motivating employees to eat well. The study also found case studies in which a lack of employee educationled to employees rejecting healthy food offering to the extent that vendors refused toprovide them anymore because they didn't sell. Philadelphia (2013) reviewed research that investigated the effects of three nutrition classes on the nutritional knowledge and behaviours of low-income women of ethnically diverse backgrounds. Nutrition training and instruction classes, whereby basics about nutrients, cooking techniques and ways of increasing limited food resources (e.g., gardening), were delivered. This study showed that the participants had increased vegetable intake, decreased "fast-food" intake and read labels more often, after participating in the classes.

Another study by Irvine et al. (2004) evaluated multifaceted ways of imparting nutritional knowledge. The authors developed and evaluated the effectiveness of presentations, audio-visual materials, counseling, dietary assessment and behavioral feedback, self-help manuals and tailored written materials, mailings, and telephone counseling and support in improving nutritional awareness and behaviours. Positive changes in attitudes and nutritional awareness were reported. The authors viewed that the different media used appealed to the diverse and individual attributes of the groups studied. A

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ISBN 978-0-86970-787-6

multimedia program, albeit generalized, can be individualized in multiple ways.An individual's motivation, interests, willingness to change and stages of change are taken into consideration (Irvine et al, 2004; Prochaska & DiClemente, cited by du Plessis, 2012).
Additionally, Viester et al.(2012) demonstrated the effectiveness of a multi-faceted health programme to improve physical activity levels and dietary patterns among construction workers. The programme consisted of tailored information, face-to-face and telephone counseling, training and instructions.

The study by Groeneveld et al. (2011) evaluated the efficacy of interventions that involve more personal approaches such as individual counseling. The study investigated short and long-term effects of a lifestyle intervention programme on diet, physical activity and smoking among male construction workers with an elevated risk of cardio-vascular disease. It was indicated that after six to eight months of delivering individual counseling in the form of motivational interviews, there was a statistically significant beneficial effect on snack and fruit intake which was sustained long after the intervention programme had ended.

Iriyama & Murayama (2014) also agree with the view that worksite nutrition promotions in educational form induce behavioural change such as changing eating habits and the effects of these changes such as weight loss and general improvement in health conditions, last for a long time. The intervention consisted of a six-month programme comprising nutrition education and the provision of healthy cafeteria meals along with nutritional information.

4. Summary of findings

Literature reviewed in the present paper regarding the level of nutritional knowledge suggests that the nutritional knowledge may be limited as evidenced by the unhealthy food choices which construction workers make. In addition, it has been suggested that while some construction workers might know the basics about healthy, it may not be rflected in their nutritional behaviour since other factors such as economic factors and personal preferences may be contributory to their circumstances.

With regard to nutritional knowledge interventions, the studies synthesized found that NE is an effectual means of imparting nutritional information and inculcating healthy eating habits. The study also revealed that counselling, training, instructions and employee participation are helpful avenues by which nutritional awareness can be created and indeed increased.

Furthermore, the study revealed that the degree of sustainability varies with interventions. The results of interventions with regard to willingness of participants to continue to practise what they learnt either last for a long time or wither after a short while. Without constant stimulation, the knowledge gained might fade away. However, there have been arguments in favor of short-term intervention programs, in the sense that they promote immediate processing of information via stimulation of senses (Society for Nutrition Education and Behaviour, 2013). Furthermore, given the impermanent nature of construction, short-term programmes may be suitable since participants would be involved for the duration of construction activity at a particular site, no matter how short their engagement at a site may be. Due to the changing and temporary nature of the construction industry, workers may not be at one site for a long time. But since they need to continue to fend for themselves while they are between jobs, lasting knowledge which will instill values to encourage positive behavior, attitudes and beliefs are necessary. Hence, short-term multiple interventions to increase nutritional awareness and motivate healthy eating could be effectual on construction sites. Also, multi-media nutrition intervention programs could suit

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the construction labour force stratified by age, gender and ethnicity.

5 Conclusion and Recommendations

The study set out to investigate the level of nutritional awareness in the construction industry and to identify possible ways of increasing awareness about nutrition. It was found that the level of nutritional knowledge is that poor food choices are made by construction workers. Individual counseling and multi-faceted programmes were advocated as means of improving nutritional awareness. Effectiveness of nutrition interventions would be enhanced if programs are tailored to suit workers in the construction industry, taking into account individual/personal factors/influences such as family and friends and financial capabilities. Programmes should put emphasis on creating a healthy environment to support behavioural change. "Enabling environment" could also entail improving lunch menus, and supporting vendors to offer healthy foods and snacks, as well as eliminating or reducing frustration by proffering information which cannot be acted upon due to personal constraints.

Therefore, successful nutrition awareness programmes, in addition to improving nutritional knowledge, should positively influence perceptions and beliefs regarding nutrition and encourage healthy eating practices for a long time, thereby ensuring that construction workers are continuously in healthy state of mind and body, to perform their duties safely and productively. It is recommended that construction managers and other stakeholders should encourage and entertain the various forms of training and education highlighted above, aimed at improving nutritional knowledge of the workers.

The current paper is not without some limitations. First, it is only a literature review. Future studies could attempt to investigate the actual level of nutritional knowledge of construction workers. Secondly, it focuses on improving nutritional awareness in general, without specific attention to other ways of improving nutrition. Future research could conduct longitudinal studies to investigate feasible ways of improving construction workers' nutritional uptake. In addition, research is recommended to identify barriers to improving nutritional knowledge.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-044

Bamboo as a Construction Material: Prospects of Ghana Species

Akwada, D. R.[1], Akinlabi, E.T.[2]

Abstract

Bamboo usage as a structural engineering material is on the increase globally due to its multi-functionality, change, improvement, adaptation and development. The study therefore explores the use of bamboo, as a potential construction material. A critical review of literature on the mechanical properties and potential uses of bamboo was conducted. Findings revealed that bamboo possesses mechanical properties such as strength, stiffness and corrosion resistance, which makes it a suitable alternative construction material. Bamboo fibers were also found to have many advantages such as low cost, low density, ecologically friendly, sustainable and biodegradable. In line with the plans of international communities, and with adequate promotion of research into bamboo, its use in place of timber coupled with the establishment of bamboo plantations on degraded lands will significantly promote the production and the utilization of bamboo in the Ghanaian construction industry.

Keywords: bamboo, construction, development, Ghana, mechanical properties

1. Introduction

Ghana is a country in Africa, along the Gulf of Guinea, just a few degrees north of the equator. Its vegetation is as shown in appendix below. Ghana's forest products industry plays a very important role in the country's economy, ranking fourth in export value, its exports trail only on gold, oil and cocoa. The sector contributes about 6% of the country's GDP; 11% of foreign exchange earnings and 30% of export earnings (Bank of Ghana, 2010). The past few years have seen a sharp depletion of the nation's forest resource, production capacity within the sector has been in decline. However, most of the resources are largely in the savannah woodland with limited potentials. With an estimated population of about 28 million, Ghana has enormous domestic demand for construction and joinery raw materials (Blackett *et al.*, 2008).The major wood and plywood production industries are gradually closing down as a result of reduction in the volume of economic wood species as reported and reviewed by Blackett *et al.* (2008) and Bonsi (2009). Currently, a considerable volume of wood products is being imported into the country from Europe and other parts of the globe (Baah-Nuakoh, 2003). There is high dependence on imported raw materials in the building industry as well as other industries, and this dependence has been a major factor limiting the development of the economy of Ghana (Baah-Nuakoh, 2003; Helpman, 2004 and GSS, 2006). As a result, the government of Ghana has directed that

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

researchers should look at the potential development and utilization of bamboo as a sustainable, climate friendly alternative for building purposes.

The drive by the government of Ghana and researchers into looking at the prospects of bamboo species in Ghana has been subject of intensive discussion in recent years. There has been some research conducted on Ghanaian bamboo by(Oteng-Amoako *et al.* 2004, 2005*;* Obiri *et al.* 2006; Ebanyenle *et al.* 2007; Akwada *et al.* 2014) and other studies. The focal point of their works is on adoption of bamboos in Ghana as an alternative material for construction and other industrial usage. According to Oteng-Amoako *et al.* (2004; 2005), there is the need for an intense research work on the various species of bamboo in Ghana and their mechanical properties for documentation as a base for further research works to help for sustenance and development of bamboo industries in Ghana. In another research work by (Bonsi 2009), he stated that since bamboo has a short term of growth rate as compare to wood, it is prudent to adopt it in Ghana's forest products as an alternative wood products. He added in his statement that for bamboo development to be sustainable in Ghana, it should be backed with adequate policy (Bonsi 2009). However, little has been achieved towards the development of this important industrial material.Developing and harnessing various bamboo species could reduce the nation's dependence on imported wood related raw materials for construction, create more employment opportunities, develop local skills in several industrial sectors across the nation and ultimately, increase the nation's foreign exchange.

1.1 Objectives

The broad objective of the study is to explore the potential benefits of bamboo as a structural construction material. The specific objectives are to determine the availability of bamboo in Ghana,assess the mechanical/structural properties of bamboo as a construction material and other industrial uses as well as the challenges impeding the use and the development of bamboo for construction and other industrial purposes in Ghana. In addition, the study looks at the most appropriate species which culms when processed could possess the properties to withstand applied load and canbe commercial into board products that can be manufactured into a structural member.

1.2 Methodology

Literature was used to explore the availability species of bamboo in Ghana with particular focus on constructional effective species. The potential for bamboo to be effectively utilised as a constructional material is being considered. To achieve this, various published articles on species of Ghana bamboo and bamboo prefabricated products were consulted. A few are the Journal of Bamboo and Rattan, Ghana Journal of Forestry and Engineering Structures.The Journal of Bamboo and Rattan which covers publications on bamboo species in general,genetics, preservation methods and industrialised bamboos were explored for theproperties and industrial processes of bamboo. The Ghana Journal of Forestrypublished by the Forestry Research Institute of Ghana (FORIG) covers publications onforest conservation and was useful in obtaining bamboo species in Ghana (GSGDA, 2010).

3. Industrial Properties of Bamboo

The industrial uses of bamboos are based on its properties. The density of bamboo is reported to vary from 500 to 800kg/m^3 depending on anatomical structures such as quantity and distribution of fibers

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Livingstone, Zambia
ISBN 978-0-86970-787-6

around the vascular bundles. According to a study conducted by Sharma *et al.* (1970), the density increases from the center to the periphery of the culm. It also increases from the base to the top of the culm. The maximum density is from about 3 years old culms (Kabir *et al.* 1993andEspiloy,1994). The culm of bamboo plant is characterized by nodes whilst its internodes are surrounded by large cavity called lacuna, which is axially oriented. Culm wall of a bamboo is composed of parenchyma cell, ground tissue, in which vascular bundles are embedded. The sclerenchyma fibre sheaths around the vascular bundles determine mechanical properties. Yan *et al.* (2006) stated that the fibre sheath consists of many single fibres whose diameter is 10-20 mm each in average. Shao *et al.* (2010) emphasize that parenchymateous tissues can pass loads when force is applied.

The physical and mechanical properties of bamboo are extremely complex (Kabir *et al.*1993 *and* Espiloy1994). The complexity is due to uneven distribution of vascular bundles, variation in moisture content, differences in the physical and mechanical properties of the node and internode parts, most especially with age. The physical and mechanical properties of bamboo material in all the three directions are also different. Bamboo possesses high moisture content which is influenced by age, season of felling and species. Although unlike wood, bamboo starts shrinking above the fibre saturation point. Nevertheless, bamboo possesses excellent strength properties, especially, tensile strength. The properties of bamboo have proven its muliti-functionality to be a valuable and sustainable natural resource (Naxium,2001*)*. This is because of possible variability of properties along the longitudinal and radial directions as well as physical dimensions of the products required (Naxium, 2001).Interestingly, the fibres of bamboo pole posses' high strength both in tension and compression. Its compressive strength is roughly twice the compressive strength of concrete and has roughly the same tensile strength to weight ratio as steel has. The hollow cross section and solid diaphragms at regular intervals contribute to the strength of the bamboo pole.(Janssen1997*)*

The industrial utilization potentials of bamboo are most suitable for structural products due to its good mechanical and physical properties. In recent years, bamboo has seen a dramatic growth in a variety of products as a multi-functional composite material (Janssen 2000) used for structural products rather than the raw bamboo.In economies such as China and India bamboo has reduced dependence on solid wood, while in less strong economies; there are emerging new opportunities for bamboo products that are targeted for rural development and poverty reduction (Hunter *et al.*2002, Zhu *et al.*2002 and Jiang, 2007).

Bamboo is very advantageous in load carrying structural components, where mechanical properties such as tensile strength, compressive strength, shear strength, flexural strength and bending elasticity modulus are important (Janssen, 2000 and Li, *et al*. 2011). In recent years, the use of bamboo in Ghana has created gainful employment to the rural dwellers who engage in its harvesting as a means of improving their livelihood, whilst other small and medium scale enterprises also engages in its trading across the country.The investment opportunities of bamboos in Ghana are that investors can easily invest into processing of fresh bamboo culm and other parts into multiple products for the enhancement and sustenance of the industry for raw material supply for our local industries (GSGDA, 2010). The next section focuses on the usefulness of bamboo for construction purposes.

4. Use of Bamboo in the Construction Industry

Bamboos in Ghana can be usedinconstruction, for production of floorboards, furniture, panel boards, decorative boards, roofing materials, and other building materials. Bamboo's traditional applications in

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Ghana also include temporal structures and fencing. According to Naxium (2001), bamboo-based panels, made from raw bamboo through a series of mechanical and chemical procedures, such as spraying glue, laying-up and hot-pressing,are relatively ideal engineering materials. They have the advantages of large size, high strength, stabilization in shape and size, and its parallel and perpendicular strength and property that can be adjusted according to different demands. The panels are manufactured under high temperature and pressure with the aid of adhesives. The thickness of bamboo based panels varies from 2-40 mm and the dimensions depend on the manufacturing equipment adopted. The main feature of its manufacturing technology is high temperature softening and flattening (Qisheng *et al.*, 2002). As an anisotropic material with mechanical properties in the three principal directions (longitudinal, radial and transverse directions) (Ahmad *et al.* 2006), the raw bamboo is a giant grass consisting of a hollow culm having longitudinal fibres aligned within a lignin matrix, divided by nodes (solid diaphragms) along the culm length. The thickness of the culm wall tapers from the base to the top of the culm. Although the raw material has excellent strength properties, the circular section and inherent variability limits its widespread use in structural applications. To increase utilisation, engineered bamboo was developed as a laminated composite and polymer composite, which maintains the inherent strength of the raw material to form with a uniform section, thus reducing the variability in properties (Sharma *et al*., 2014).

Similarly, Qisheng *et al.* (2002) concluded that bamboo can be split, planed, milled, dried and used for further processing, thereby making it a comparatively ideal material for engineering structure. Hence, this product can reduce the dependence on wooden planks. Ply bamboo is used in truck floors as weight of steel materials is too high. In addition, ply bamboo has a high friction coefficient and it does not rust. The bamboo species in Ghana at present can be developed into bamboo based panels which can be used in the structural application fields in a form of Mat Plybamboo, Curtain Plybamboo, Laminated Bamboo of Strips, Plybamboo, Bamboo Particleboard, and Bamboo Composite Board. Bamboo-based composite may also be the suitable alternative as the materials of prefabrication in terms of the various advantages they contain. Development of panel products based on bamboo strips and fibre polymer is gaining importance as these panel products reassemble wood when used in a particular fashion as in parallel laminates and as reinforcement in other matrices. These products have superior physical, mechanical properties and are suitable for structural and specialized application. Moreover the requirement of resin adhesives is expected to be lower compared to bamboo mat based composites and therefore making the products cost effective which are considered to be ideal for alternates to wood and plywood for several end user applications. Bamboo laminates and fibre polymers could replace timber in many applications such as house building, doors, windows, ceiling, furniture, and severalother structural applications.

There are three main types of bamboo housing of which only the first two can be found in Ghana but the last technology can be adopted by Ghana. These houses includes: (i) traditional houses, which use bamboo culms as a primary building material; (ii) traditional bahareque bamboo houses, in which a bamboo frame is plastered with cement or clay; and (iii) modern prefabricated houses made of bamboo laminated boards, and composite panels. Experts estimate that over one billion people live in traditional bamboo houses across the globe. These buildings are usually cheaper than wooden houses, light, strong and earthquake resistant, unlike brick or cement constructions. New types of prefabricated houses made of engineered bamboo have certain advantages. They can be packed flat and transported long distances at a reasonable cost. They are better designed and environmentally friendly. Bamboo housing is being successfully used around the globe as reported by (Sastry, 2008). One of the major impediments to bamboo housing development was the lack of adequate bamboo treatment methods. However, this has been perfected and structural bamboo culm can now be treated with borate to create a long lasting insect

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and fungus resistant material (Edward *et al.* 1995*)*. The government of India declared housing for all in 2010 and anticipated the building of 2 million low cost houses per year by the public sector in addition to ongoing housing construction in the private and informal sectors (Deshmukh *et al*., 2007). The National Habitat Policy of India recognized the housing sector as a medium to promote environmentally friendly and cost effective building materials where bamboo can be promoted (Deshmukh *et al* .2007*)*. In view of its low cost and fast growth rate, bamboo offers an ecologically viable alternative to timber for construction.

In order to promote acceptance of bamboo houses globally, efforts are being made to formulate an international building code for bamboo stated by (Janssen, 1995). According to Janssen (2000), the advantages of codified design with bamboo include engineering recognition, promotion of contract and trade advantages coupled with increased use of bamboo as codification leads to better social acceptance and innovation. Among the types of bamboo houses that are required in Ghana are prefabricated houses made of engineered bamboo because their cost is reasonably cheap and also environmentally friendly. Bamboo weaving mats in between structural bamboo weaving columns should be fixed in such a way that they could be replaced easily (Janssen, 2000). Modern prefabricated houses made of bamboo can be built in towns in elegant manners. This can be achieved if the government encourages the development of industrial prefabrication and standardization in the country. Modern bamboo houses can assist the government in solving the current housing problem in the country.

4. Challenges of Bamboo Development in Ghana

A number of problems are constraining the use of bamboo for constructional works and other industrial usage to help generate income and alleviate poverty in developing countries, including Ghana. According to Leonard (2000), there is a general lack of understanding of the industrial potentials of bamboo among policy makers in developing countries more especially in the continent of Africa. The national forest policy under which bamboo is subsumed gives little or no attention to its development. Consequently, the bamboo sector in Ghana is still part of the informal and backward rural economy. There has been no concerted effort to grab the large potential which has been successfully demonstrated by the Chinese, Indians and some Asian countries in the bamboo industry (Leonard, 2000). Presently, the abundance of the bamboo species in Ghana is being underutilized (Gyansah, *et al.* 2011). As a result, it has been impossible to develop bamboo to the level where it can contribute to a reasonable measure of raw materials supply and as a foreign exchange earner through export of bamboo products.

Though in recent years the government is urging researchers to go into bamboo products, there is no policy backing its usage, there is no basic/specific consideration to bamboo development as it is treated as one of the numerous non timber forest products. This classification indicated that bamboo does not have official backing despite its multiple industrial potentials in Ghana. This creates a disjunction between the modern international forest policy and the needs of many people in developing countries (Jepson *et al*., 2011). Jepson *et al. (*2011) reported that the key emerging issues for many developing countries continue to be the supply of timber in the face of increasing demand. While bamboo presents a promising alternative to products from trees, the international forestry policy focus on tree lands (Hunter, 2002). The situation in Ghana is more difficult as tropical forests have a significant characteristic which makes monocultures difficult to develop as trees usually respond to minor localized climatic differences that have led to the diversification of species (Gorte *et al,* .2010). This makes sustainable management of tropical forests a difficult objective to pursue (Gorte *et al.*, 2010). According to Jepson et *al*, this problem has four dimensions. One of the most important is that bamboo is neither

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treated as a crop nor as a tree. Thus, it has no apparent silvicultural or cultivation relevance in tropical forestry. Secondly, historic policy frameworks equate forest with trees which seek to accommodate bamboo in silvicultural management, logistics, despite its being a fundamentally different plant. Thirdly, the power and influence of western silvicultural science and practice in international development, continues to expand and as bamboo is not found in most western countries, it is not given primacy in forest policy development. Fourthly, bamboo receives minimum attention by development agencies, leading to underfinanced research and development (Jepson *et al*. 2011).

Nevertheless, in view of the need to accommodate bamboo development, it has been considered as being on the same level with trees in the context of afforestation and reforestation. According to Jepson et *al.* (2011), the importance and utilization potentials of bamboo in various industries are compelling arguments for a more assertive approach category for bamboo on the same level as trees in Ghana

5. Recommendations for Bamboo Industry Development in Ghana

According to a suggestion by Bonsi (2009), if Ghana bamboo sector should deal with the problems among which bamboo in Ghana are unplanned for harvesting, lack of large organized bamboo industries, prevalence of low cost, low added bamboo products and lack of research and inventory data for bamboo species and bamboo lands. Industrialization of a bamboo based sector is very important for generating livelihood without any damage to the environment. The vast and yet untapped potentials needs cultivation, primary processing, integrated processes and transfer of technology and a coordinated sustained national level effort. According to Obiri *et al.* (2005), a vibrant bamboo industry needs to be established in Ghana, and these are some recommendation he made:

- Establishment of a bamboo development institution or organization to coordinate activities relating to bamboo development in Ghana. Such an organization should be in a better position to advice policy makers on bamboo development initiatives. There is a need for a national bamboo policy in Ghana.The policy should spell out the objectives of bamboo development and provide detailed guidelines for implementation.
- Ghana needs a bamboo inventory. It is necessary to determine the quantity and quality of bamboo that currently exists, their distribution and types of species available.
- There is a need for the establishment of an association of Ghana bamboo producers which could help set up quality standards and implement effective quality control, provide a forum for the exchange of information and ideas, collaborate with government agencies to formulate favourable bamboo manufacturing policies with regard to export and import regulations and also organize a business promotion activities and build marketing networks.
- The government of Ghana must promote bamboo tenure reforms. This could be done by giving farmers or groups who are committed to managing bamboo resources proper incentives.

6. Conclusion

Bamboo is fast becoming a very important industrial raw material globally as a result of its multiplicity of uses. The development of bamboo for building and construction purposes in Ghana will propel development of a number of industries, reduce dependence on imported raw materials and free foreign exchange for other uses. From the findings of Ghana bamboo species, has revealed that it possesses the mechanical properties that makes it a constructional and for other industrial uses. Bamboo with its high possession of mechanical property tensile strengthcould be used as areinforcement materialin columns

ISBN 978-0-86970-787-6

of cement/concrete buildings. The potential use of bamboo laminated beams in place of reinforced

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ISBN 978-0-86970-787-6

concrete beams should be taken into consideration, hence its use as a reinforcement in polymer matrix is worth working since it reduce weight when use on ceilings of buildings. It is envisaged that if a system is put in place, development of bamboo for multi-functional uses in Ghana will lead to savings of more than 300 billion Ghana cedis annually. Incorporation of bamboo into the vision 2020 action plan will present more opportunities for a successful outcome. Development of bamboo in tropical countries has a lot of advantages. Among these is the development of the wood products sector of the different economies, reduction in the rate of deforestation and expansion in employment opportunities coupled with skills acquisition. With the increase in marketing outlets of bamboo in the world market, farmers should be encouraged to go into growing bamboo on all depleted and reserve lands in the country. This will help in improving the sustainable management of housing projects of the nation and serve as a foreign exchange to the country Ghana.

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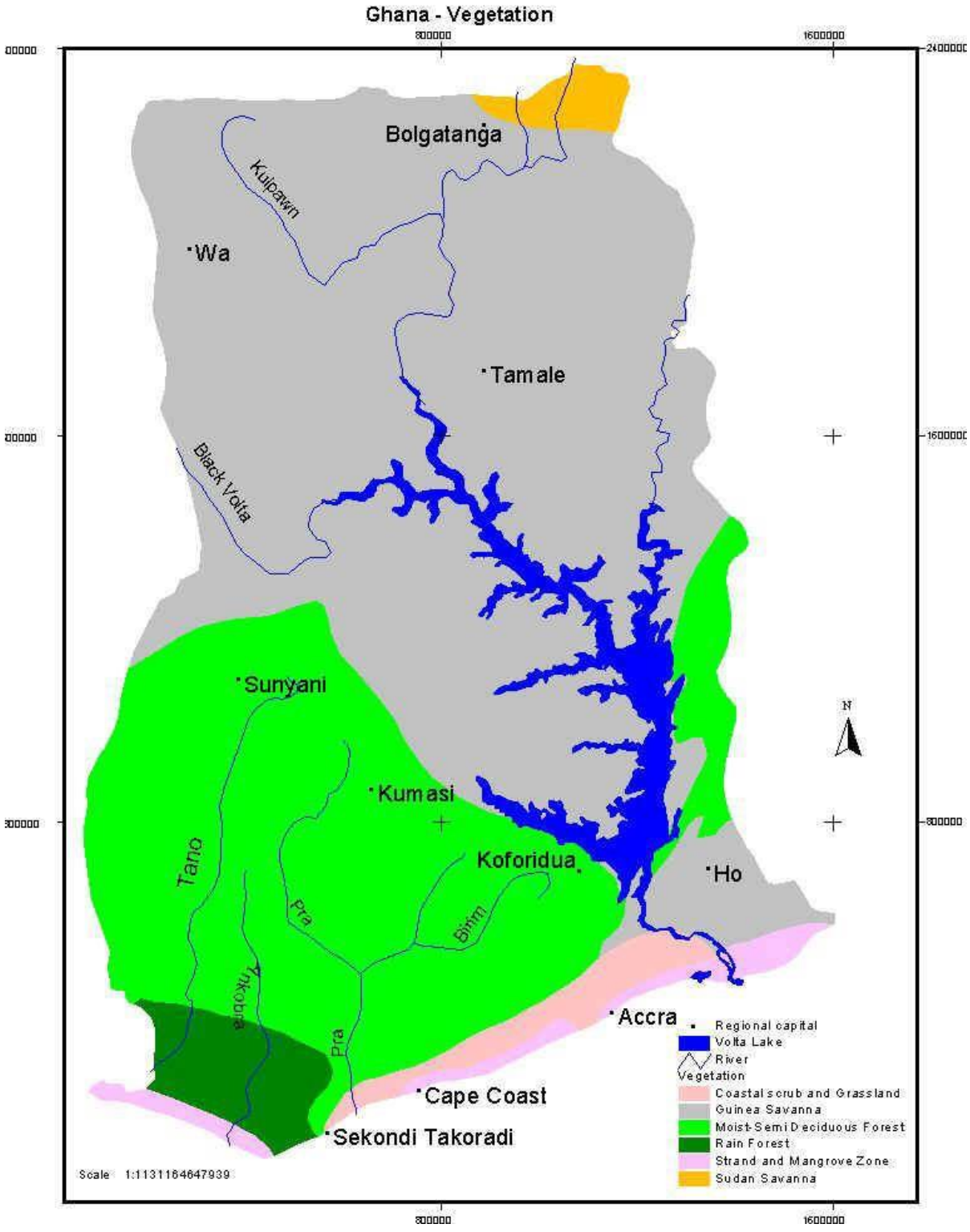
ISBN 978-0-86970-787-6

APPENDIX



Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-040

Traditional Procurement System as a Source of Unsustainable Development: Empirical Evidence from Public Infrastructure Project Delivery in Botswana

Aderemi Y. Adeyemi[1], Joseph Samman[2], Pasis C. Mselle[3]

Abstract

Rapid public infrastructure development after World War II and attendant project failures around the world exposed the traditional procurement system (TPS) as an inefficient project delivery system as many projects lagged behind schedule, overshoot budgets and compromised quality. When the contractor moves to site, the design team, headed by the architect takes over the construction supervision. This has been the 'normal' practice around the world until gradual move away from this system started in the US and UK and many other industrialized countries in the 1960s as a result of project failures. The move away from TPS had been in favour of integrated procurement system typified by design build (DB) and recently public private partnerships/private finance initiatives (PPP/PFI). Unfortunately the developing countries still use the TPS overwhelmingly for project delivery irrespective of the size. Botswana is one of these countries that still rely mostly on TPS to deliver public infrastructure. In this paper we provide empirical evidence of poor cost performance of this procurement system based on a survey of 40 diverse projects. The result showed that every one of these projects incurred cost overrun ranging from one % (1%) to as much as 129%. For a total initial contract sum of approximately three billion pula for the 40 projects, the cost overrun amounts to 622.55 million pula translating to 21% cost overrun on the initial contract sum. It is recommended that the developing countries embrace the newer procurement system such as DB (currently making wave in developing countries), PPP/PFI and Performance Information Procurement System (PIPS).

Keywords: Botswana, cost overruns, procurement, public projects, sustainability

1. Introduction

Rapid public infrastructure development after World War II and attendant project failures around the world exposed the TPS as an inefficient project delivery system as many projects lagged behind schedule, overshoot budgets and compromised quality. By the inception of the 1960s many countries in the western world had been counting their losses through TPS- a system that invites the contractor only after the design of the facility had been completed by the client (Government) representative mainly an

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

architect who invites the structural engineer to work on the stability of the structure vis a vis loading and resistance to external forces and the quantity surveyor to prepare the bill of quantities for tender purposes. According to Murdoch and Hughes (2000), TPS involves the separation of construction from design and the main contractor is employed to build what the consultants have designed

When the contract is awarded and the main contractor moves to site, these three professionals (architect, structural engineer and quantity surveyor share the construction supervision among themselves in various capacities with the architect heading the supervision team. This has been the 'normal' practice around the world until gradual move away from this system started in the US, UK, Australia and many other industrialized countries on discovering that the system is responsible for huge revenue losses to government as a result of project failure.

The problems of TPS can be broadly categorized into two namely, its organizational structure and preference for contractor that submits the lowest bid. The organizational structure of TPS is such that there are two separate teams; the design team and the construction team. The construction team gets to know about the facility to be constructed when the design has been completed and during tendering. When the construction team moves to site, the design team headed by the architect takes over the supervision of the work using management and control tactics (Adeyemi *et al.* 2011). Since a lot of constructability issues were not resolved before the construction team moved to site, adversarial relationship which manifest as dispute and litigation is fueled. This is addition to the problems of systemic corruption manifesting as collusion, bid rigging and plethora of ethical violations which the tendering processes attracts.

Adding immensely to TPS non-performance is the selection of low- bid construction team. The preference for a low-bid contractor ensures that the contractor that can manage the risks associated with the contract best (best value contractor) is dissuaded from bidding for the work. This is so because the best value contractor is visionary, has better experience with project risk management and uses well trained personnel. Hence their price cannot be driven as low as that of the inexperienced contractor. Due to inexperience and personal objective of maximizing profit, the contractor drives the quality objectives of the work down (Adeyemi et al. 2011). As a result of the differing objectives between the three project stakeholders (the client, the design team and the inexperience construction team) theproject in the end incurs time and cost overruns, low quality, rework, claims and sometimes dispute.

There has been consistent move away from TPS in favour of integrated procurement system typified by DB, public private partnerships/private finance initiatives (PPP/PFI) and recently PIPS in the developed countries. Love *et al.* (2008) for example, noted in the case of Australia, that the use of TPS is waningparticularly in states such as Queensland, New South Wales and Victoria where Design and Construct, Construction Management and hybrids thereof, have become the norm. Unfortunately the developing countries still use the TPS overwhelmingly for project delivery irrespective of the size. Botswana is one of these developing countries that still rely mostly on TPS to deliver public infrastructure.TPS as a dominant public project delivery system in Botswana was attested to byRwelamila, Talukhaba and Ngowi (1999). A study by Ngowi (2000), found that the hybrids or variants of the TPS are dominant in Botswana, with only a few projects procured using integrated procurement system. Zulu and Muleya (2009) provided a comparative use of public-private partnership (PPP) in the SADC countries (Table 1). The table showed a relatively low use of PPP in the SADC countries for infrastructure delivery. It is also gleaned from the table that Botswana has only executed two PPP projects ranking her in the 14th place among the 15 countries.

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Table 1**: Comparative data: PPP in SADC (Source: Zulu and Muleya, 2009)**

Country	GNI	No of PPP Projects	Total Investment
South Africa	5390	32	25341
Tanzania	350	21	2115
Mozambique	340	15	2241
Mauritius	5450	11	549
Madagascar	280	9	216
Congo Democratic Republic	130	7	915
Malawi	170	6	133
Zambia	630	6	944
Zimbabwe	-	5	841
Namibia	3230	5	104
Angola	180	5	834
Lesotho	1030	3	114
Seychelles	8650	3	94
Botswana	590	2	247
Swaziland	2430	1	53

2. Public Infrastructure Procurement in Botswana: An Overview

The statutory body vested with overseeing public infrastructure procurement in Botswana is the Botswana Public Procurement and Asset Disposal Board (PPADB). The body came into power by Act of Parliament on the 2nd of July 2002. The board is empowered to ensure efficient, transparent and accountable management of the public procurement system for the purpose of achieving the country's socio-economic objectives as part of Vision 2016. The board which accounts to the Ministry of Finance &and Development Planning, operates as an independent parastatal responsible for coordinating and managing procurement of public works, supplies, services and disposal of assets on behalf of the federal government.

For construction projects, the Department of Building and Engineering Services (DBES) operating under the Ministry of Infrastructure, Science and Technology is responsible for new construction works from conceptualization through design to implementation while also maintaining the existing facilities. The main function of DBES is to design, construct, supervise and maintain government building projects and associated infrastructure. The specific functions of DBES can be summarized as:

- Overseeing the implementation of government built infrastructure projects to ensure they meet time, cost and quality objectives.
- Responsibility for Maintenance of all Government facilities.
- Provide and maintain power in small villages and government institutions.
- Set and regulate standards for building and infrastructure development projects.
- Provide technical services and secretariat support to the Building Regulations Board.
- Give input in the setting of Building Standards, as a member of the Building Regulations Board.
- Provide training facilities for professional and technical staff in government buildings for the purpose of building local capacity.

DBES therefore acts as consultant for the ministries and departments they are carrying out work for. When the design, specifications and bill of quantities are ready, DBES passes the process of contractor

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Livingstone, Zambia
ISBN 978-0-86970-787-6

selection to PPADB for open tendering. Since the procurement is price-based and not necessarily best value, the lowest bid contractor is sought through competitive tendering. A recent modification to the price-based mentality is to select the contractor whose price is closest to the mean bid. When the low-bid contractor moves to site, DBES takeover the mantle of project supervision using its consultants. The entire lines of communication from the design of the facility to implementation are encapsulated in Figure 1.

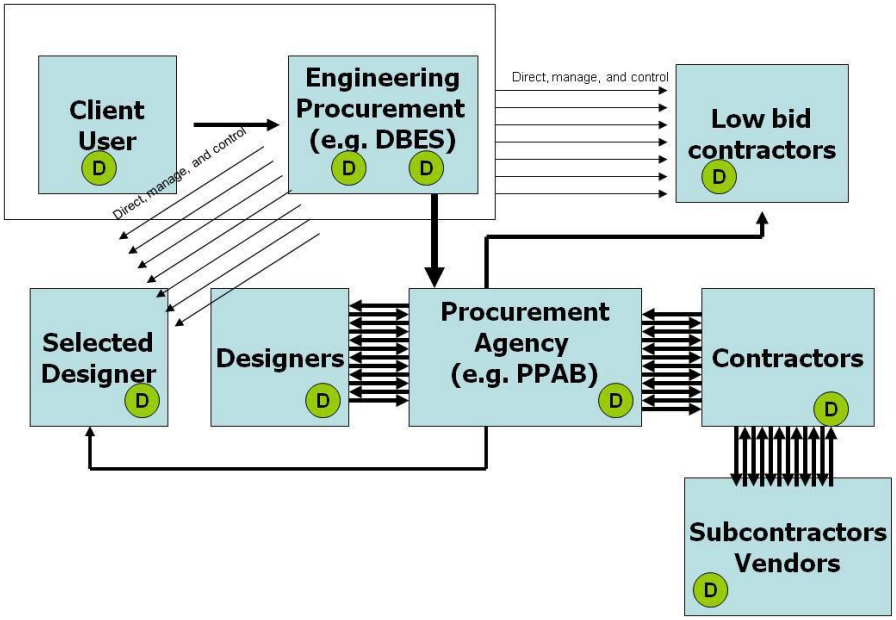

Figure 1: Current Botswana infrastructure project delivery system (Source: Adeyemi et al., 2009)

3. Cost Performance of Traditional Procurement on Public Projects

The cardinal objective of this paper was to provide empirical evidence which suggest that the traditional procurement system negates the economic pillar of sustainable development as it involves cost overrun that often result in huge revenue loss to government. In order to satisfy this objective, we relied solely on the use of archival data (secondary data) which is deemed more appropriate for this particular research. Archival data on initial contract sum and final account were collected from the two public infrastructure project delivery parastatals under the Ministry of Infrastructure, namely the Department of Roads in charge of roads, highway and transportation projects and DBES in charge of building construction, maintenance and supplies. The Appendix shows the archival data collected on 40 diverse projects from these two parastatals. Cost overrun was derived by subtracting the initial contract sum from the final account while the %age cost overrun was obtained by dividing the cost overrun by the initial contract sum.

Analysis shows that all the 40 projects incur cost overrun whose %age range from one % on residential housing unit to 129% on the revenue premises. The highest revenue loss in millions of pula in descending order, were from: District hospital (151.41); stadium construction (72.52); airport project (63.94) and secondary school (48.66). On these 40 projects whose total initial contract sum was approximately three

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billion pula, the cost overrun was 622.55 million pula representing a %age loss of 21% revenue loss to government.

4. Need for Paradigm Shift in Procurement

The high rate of revenue loss by government (the major client of the construction industry in the developing countries) is born out of poor performance of TPS and this does not constitute a sustainable development as defined by WCED (1987). In Botswana and indeed in all developing economies there is a need for paradigm shift to procurement routes that shift the risks inherent in the project to the contractor and in the case of PPP to the concessionaire. In Figure 2, it is shown that risk transfer to the contractor is more feasible in the Design Build Procurement System (DBPS) than in the variants of the TPS and Construction Management (CM).

Figure 3 shows a comparative organizational structure of TPS and DBPS. It will be noted in this figure that the source of the problem with TPS is inviting the low- bid main contractor after the design had been completed This causes adversarial relationship as pointed out earlier. In addition the low-bid contractor often drives the quality of the work down in order to make profit. The bad values inherent in the TPS has been discoursed extensively by Kashiwagi and Byfield (2002), Kashiwagi *et al.* (2004), Rijt *et al.* (2010) and Adeyemi*et al*. (2011) where Performance Information Procurement System (PIPS) is being suggested. In PIPS the contractor selection processes is based on experience and how to manage the risk associated with the work best.In all these publications it is being suggested that emphasis should be placed on the production processes using best value contractor rather than price which normally favours the less experienced low-bid contractor.

In BDPS, the best value main contractor is engaged at the conceptualization stage to manage the work and he employs the design team and the subcontractors. In this case, the possibility of adversarial relationship is removed and since the contractor charges his own price rather than submitting low-bid, the possibilities of having conflicting objectives with the client and driving the quality of the work down is also remote. Both PIPS and DBPS are favoured in the developed economies in addition to PPP/PFI since they are getting good results and these are the directions to which infrastructure procurement in the developing countries should shift.

The best-value contractor selection approach either in PIPS or DBPS requires that the bidders submit proposals for evaluation to the client. These proposals are evaluated first for technical quality such as the ability of the contractor to manage the technicalrisks associated with the work, method statement and past experience. This process allows the client to sieve out the bidders until the best value contractors emerge. Price competitiveness come in as a last resort when two or more contractors emerge as the best value during the sieving process.

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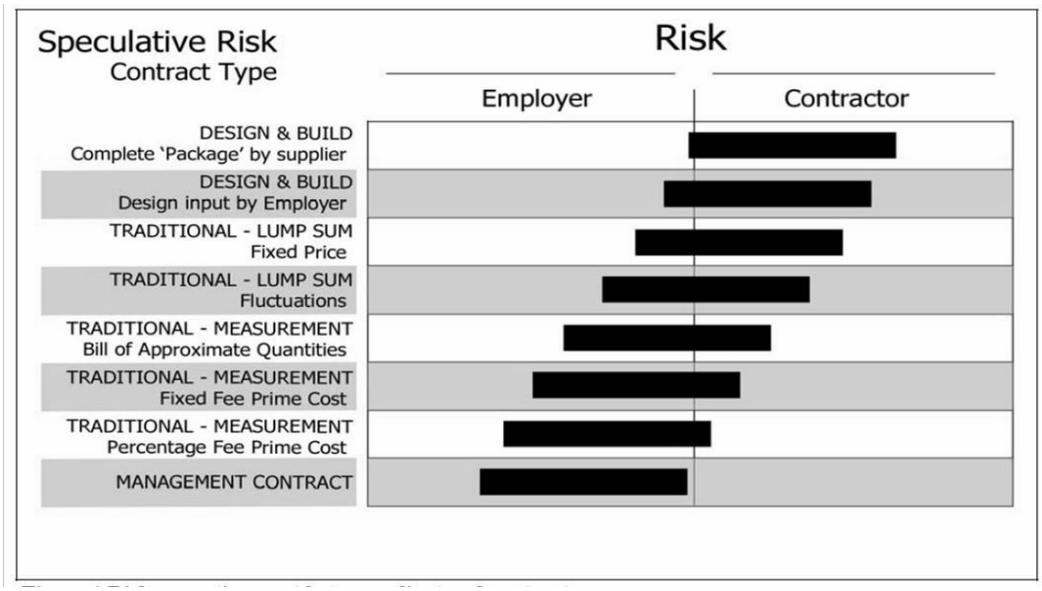

Figure 2: Risk apportionment between client and contractor (Source: Davis et al., 2008)

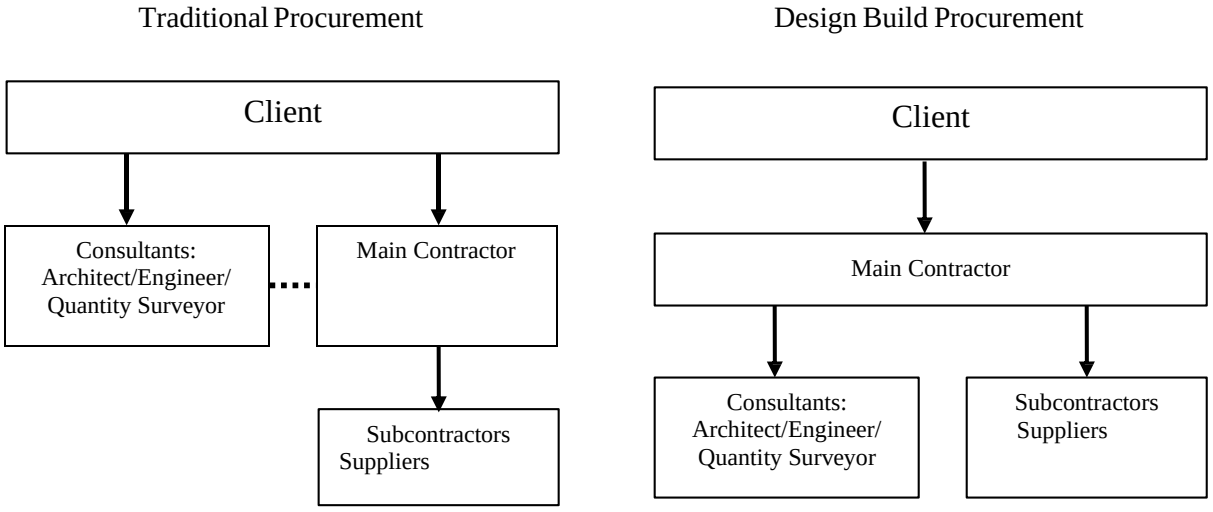

Figure 3: Comparative organizational structure of Traditional Procurement System (TPS) and Design Build Procurement System (DBPS)

5. Conclusion

This survey was conducted to provide empirical evidence on the sustainability of the overwhelming use of TPS to deliver public infrastructure project in the developing countries with Botswana as case study. This system of procurement proved economically unsustainable when all the 40 projects surveyed incurred significant cost overrun and the total revenue loss on them amount to 21% of the original contract sum. Sources of non-performance of traditional procurement according to literature can be

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traced to non-engagement of the general contractor at the right time and emphasis on price which gives

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ISBN 978-0-86970-787-6

preference to low bid contractor and dissuading the high performance contractor from bidding for the work. Therefore there should be paradigm shift to best value procurement systems such as DB, PIPS and PPP/PFI which are process oriented and are highly embraced in the developed countries.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

APPENDIX

Cost overrun on some selected public infrastructure projects

S/No	Project Type	Contract Sum (Million Pula)	Final Account (Million Pula)	Cost Overruns (Million Pula)	% Cost Overrun
1	Tribal Administration Premises	1.93	2.02	0.09	5
2	Installation (Automatic Message Switching System at Airport).	4	5	1	25
3	Technical College	5.99	7.94	1.95	33
4	BDF Facility	7.3	12.77	5.47	75
5	Technical College	8.91	12.22	3.31	37
6	Secondary School Facilities	11.4	15.43	4.03	35
7	Border post	11.45	12.95	1.5	13
8	Road construction (27km)	12.19	13.6	1.41	12
9	Dental Oral Health unit	12.96	16.63	3.67	28
10	Operating theatre	13.43	16.34	2.91	22
11	Staff Housing	15.64	18.39	2.75	18
12	Library	17.13	18.43	1.3	8
13	Installation (Replacement of Air navigation aids equipment at Airport)	19	22	3	16
14	Road construction (25.8Km)	21.3	25.12	3.82	18
15	Revenue Houses	24.78	56.65	31.87	129
16	Secondary School	24.8	40.03	15.23	61
17	Road Construction (38km)	25.2	27	1.8	7
18	Senior Secondary School (Phase 3)	31.5	40.79	9.29	29
19	Road construction (41km)	31.9	48.35	16.25	52
20	114 Blocks of Flat	42.8	45.57	2.77	6
21	Road construction (kilometrage unknown)	44.3	54.76	10.46	24
22	Court Building	44.88	61.91	17.03	38
23	Road construction (84km)	54.24	69.63	15.39	28
24	168 Residential Housing Units,	54.31	55.41	1.1	2
25	Road Construction (70km)	57.5	75	17.5	30
26	Road Construction (76.2km)	59.02	61.86	2.84	5
27	Prison's Training College	58.78	66.89	8.11	14
28	Road Construction (72.5km)	61.9	71.02	9.12	15
29	Renovation Work (Stadium)	62.6	72.31	9.71	16
30	198 Residential Housing Units,	80.73	81.94	1.21	1
31	Road Construction (150km)	85.6	108.27	22.67	26
32	Road construction (kilometrage unknown)	99.4	102.96	3.56	4
33	282 Blocks of Flat	109.2	115.5	6.3	6
34	Secondary School Facilities	129.46	151.22	21.76	17
35	Stadium Construction	139.34	211.86	72.52	52
36	Airport Project	160.35	224.29	63.94	40
37	Higher Education	192.64	208.28	15.64	8
38	525 Medium Cost Residential Houses	250	260	10	4
39	District Hospital	254.49	405.9	151.41	59
40	Secondary School	651.34	700	48.66	7
Total		2,993.69	3,616.24	622.55	21

Source: Field Survey (2015)

Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2915-034

Gas-Fired Power Station: An Air Inlet Case Study

Brian Wasserman

Abstract

The Medway Power Station, a dual turbine gas-fired power station, located in Kent in the United Kingdom (UK), was in need of a new inlet filtration system due to two factors. The first factor was the repeated occurrence of freezing fog, which caused a steep rise in the pressure drop of the inlet filter system and hence, reduced the overall efficiency of the turbines. The second issue was one of moisture and salt-laden air from the nearby ocean, which required increased compressor washes to keep the turbine free from contaminant build-up and corrosive materials. The costs of producing power are immense and a small savings that can be generated affects the cost of the electricity. The decision was made to replace the air inlet for one of the two turbines and use the second turbine as a control. The purpose of this research was to provide a side by side comparison of the efficiencies of two methods for air filtration. The replacement air intake was a 2-stage system. Stage 1 contained a trace heated vane separator and a G4 filter. Stage 2 contained an H-10 filter. Results of the experimental air intake system showed a 2.35% improvement in overall performance, significant enough to warrant the installation of a similar air intake system for the second turbine.

Keywords: air inlet, air intake system, filtration, gas turbine, power station

1. Introduction

Air inlet filtration's role in power generation is critical. It protects the most valuable equipment in the power generation process from degradation caused by exposure to harmful outdoor air conditions, such as moisture, freezing temperatures, and salt in the ambient air. Gas turbine power plants, especially those located near coastal areas or in areas with freezing temperatures, experience two significant exposure challenges. The first challenge, for power plants located near coastal areas, is turbine damage from salts contained in the intake air used to operate the turbines. The second challenge, for power plants located in areas with below freezing temperatures, is icing of moisture in the air used to operate the turbines. Each condition reduces the efficiency of the turbines and thus, reduces the power output of the plant. Power plants located in areas experiencing both conditions are particularly susceptible to a decline in operating efficiency (Goodson, 2011).

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

1.1 Medway Power Station, Kent, UK

This paper is a case study of the installation of a new filtration system on the Medway Power Station in Kent, UK, located 38 miles east of Central London. The power station is located at a confluence of the Thames River and the Medway River as they empty into the North Sea as shown in Figure 1.

Figure 1: Location of Medway Power Station on the Medway River in Kent, UK

The Medway Power Station, shown in Figure 2, is a 688 megawatt (MW) gas-fired power station. It was commissioned in 1995 and equipped with two General Electric® (GE®) turbines. The photo shows the air intake for turbine one, known as GT-1, on the right and turbine two, GT-2, on the left. The photo was taken subsequent to the remodeling of the air intake system for GT-1 and thus, the two systems look physically different.

The turbines installed in the power station were GE® 9FA Heavy Duty Gas Turbines. Under ideal conditions, these turbines will provide full power in as little as 15 minutes. The GE® 9FA turbine shown in Figure 3 shows three adults working on the turbine with the upper casing removed.

Weather data for the Medway region, referred to as England SE and Central South, were obtained from Met Office, the UK National Weather Service. The data in Table 1 includes mean temperature for each month, average mean monthly temperature for the 30-year period from 1971 to 2000, rainfall amount for the month, as well as average rainfall for the 30-year period, and days of air frost for both the month and the 30-year average.

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Figure 2: Photograph of Medway Power Station (Neal, 2011).

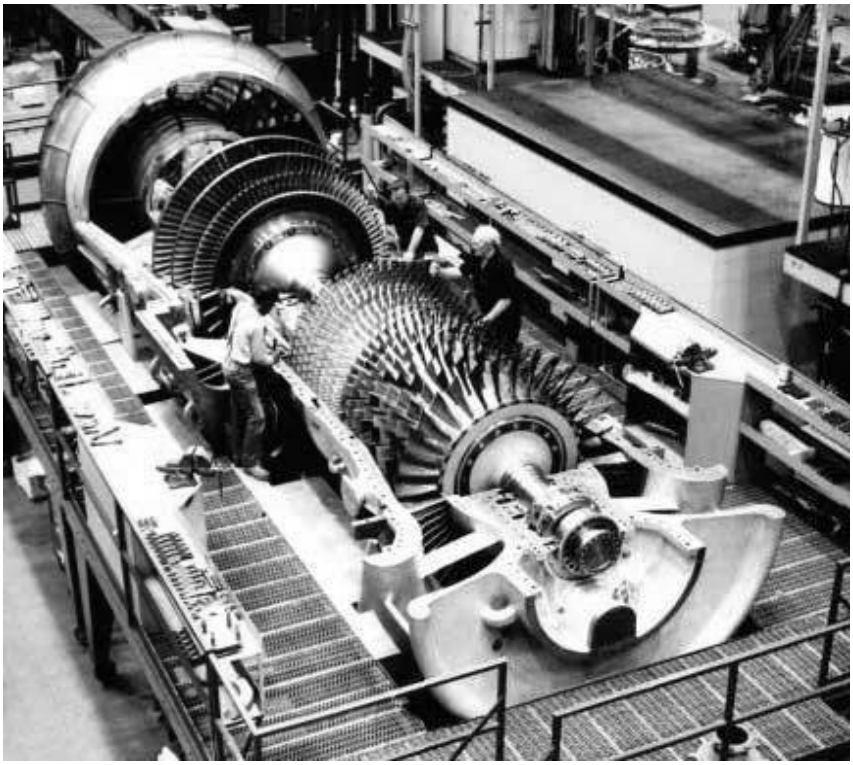

Figure 3: GE® 9FA turbine (GE® Power Systems, 2013).

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

The records indicate that the study period from November 2010 to November 2011 included extremes of both hot and cold weather. Temperatures in December 2010 were 4° C colder than the 1971-2000 average, making it the coldest month in decades. That same December, there were 24.1 days of air frost, which was also a contributing factor to power station performance. The mean temperature for April 2011 was 12.4° C, which was 3.7° C hotter than the 30-year average. There was only 3.7 mm of rainfall, while the 30-year average was 52.9 mm, only 7% of the average rainfall amount.

Table 1: Weather data from Medway area (Met Office, 2013)

Yr	Month	Mean Temp (C)	30Yr Avg Mean Temp (C)	Var from Avg Temp	Rain (mm)	30 YrAvg Rain (mm)	Var from Avg Rainfall	Days Air Frost	30 YrAvg Days Air Frost	Var from Avg Air Frost
2010	November	5.9	7.0	-1.1	76.3	79.5	-3.2	9.9	4.2	5.7
2010	December	.3	5.3	-4.0	42.2	86.1	-43.9	24.1	15.6	8.5
2011	January	4.4	4.4	0	99.5	80.9	18.6	10.2	10.5	-.3
2011	February	6.5	4.6	1.9	58.7	55.4	3.3	3.4	10.4	-7.0
2011	March	7.0	5.9	1.1	15.9	61.2	-45.3	7.5	7.8	-.3
2011	April	12.4	8.7	3.7	3.7	52.9	-49.2	.3	3.4	-3.1
2011	May	12.8	12.0	.8	27.0	55.1	-28.1	.3	.6	-.3
2011	June	14.5	14.8	-.3	99.0	120.3	-21.3	0	0	0
2011	July	15.7	17.1	-1.4	49.1	51.7	-2.6	0	0	0
2011	August	16.2	16.9	-.7	78.0	57.4	19.6	0	0	0
2011	Sept	15.6	14.5	1.1	40.3	62.0	-21.7	0	0	0
2011	October	13.0	10.8	2.2	36.1	84.0	-47.9	.8	1.3	-.5
2011	November	10.1	7.1	3.0	45.4	79.6	-32.4	1.3	5.8	-4.5

2. Background

Power plants use a tremendous volume of intake air while in operation, and some power plants need upwards of 772,00 cubic feet of air per minute (cfm) in order to operate at peak efficiency (Goodson, 2011). If the air contains corrosive agents, such as alkali metals, the maintenance and repair costs required to keep the plant at peak efficiency will be higher than necessary. A restricted volume of air will reduce the efficiency of the turbine and reduce the output of the power plant. If sufficiently restricted, such as during an ice storm, the power plant could shut down completely.

Corrosive elements, such as salt, sodium, and potassium chloride may result in the deterioration of compressor blades if deposits are not removed by water washing. Sodium and potassium are both alkali metals that can combine with sulfur to form highly corrosive agents that will attack metallic materials within the hot gas path. In coastal regions, the ambient air contains salt and seawater (which consists of more than 85% sodium chloride) aerosols. The concentration is highest at the shore and falls rapidly until, at a distance of approximately 8 to 12 miles, it reaches an equilibrium with a value of approximately 2 to 3 parts per billion (Lourd, 1991).

Another natural element that can prove to be hazardous to power plants is ice. Typically, ice forms at two different areas within a power plant: around cooling towers and around air inlets. The discharge of air from the top of the cooling tower is warm and moist. In climates thatexhibit extreme cold conditions, a combination of the moisture content of the discharged air and ambient temperatures can cause freezing

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

fog, which contains suspended super-cooled water droplets. These droplets freeze on contact with solid objects, forming a build-up of ice in a process that is similar to icing on aircraft wings. If the inlet filters or weather hoods ice up, the turbine will lose power and may eventually shut down due to excessive inlet filter pressure drop. As demand for power increases in cold weather conditions, supply will decrease due to these icing issues.

Similarly, with large volumes of cold and moist air entering the system, ice forms around the air inlets. An air inlet consists of four main components: the intake louvers or weather hoods, the inlet filter compartment, the inlet ducting, and the gas turbine inlet plenum. Each component is critical to the efficient operation of the power plant. Figure 4 depicts the weather hoods, the inlet filter compartment, and the inlet ducting.

2.1 Components of a filtration system

As previously mentioned, each component has an essential function to the operation of the power plant. The function of the intake louvers or weather hoods is to provide a path for air to enter the inlet filter compartment from the ambient surroundings. In a relatively clean environment with light weather conditions, the intake louvers on a small unit or weather hood on a larger unit reduce the concentration of entrained rain droplets and provide protection against large objects striking the filter media.

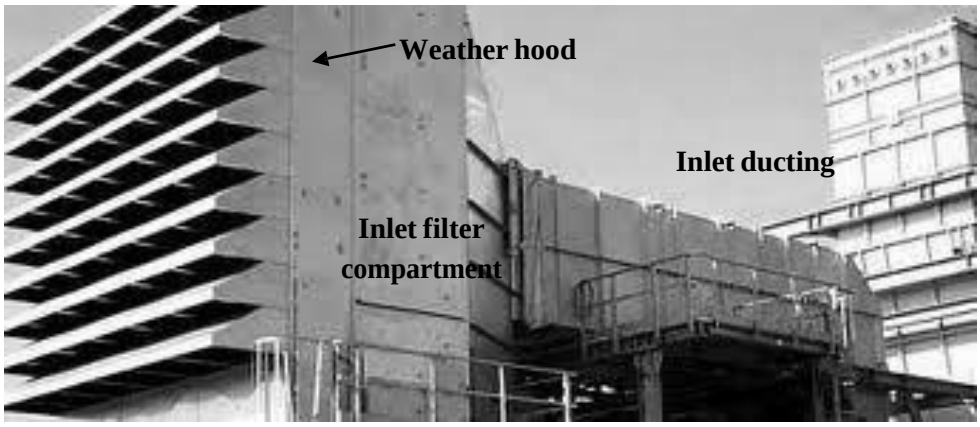

Figure 4: Intake weather hoods, inlet filter compartment, and inlet duct (Maurer, 2012).

Figure 5 shows air and water movement within the weather hoods. In even moderate rainy conditions, water tends to cascade down typical weather hoods and break through, soaking the lower levels of the inlet filters. In regions of moderate to severe weather climates, the weather hoods may be supplemented by or replaced with vane separators designed to reduce the entrainment of snow, rain, or freezing rain.

Figure 6 depicts the vane separators, which are designed to prevent the risk of flooding the filter system. A bank of coalescing filters is then installed downstream of the vane separators to coalesce fine mist or fog and feed the moisture back into the vane separators so that it can be easily drained out of the air inlet system.

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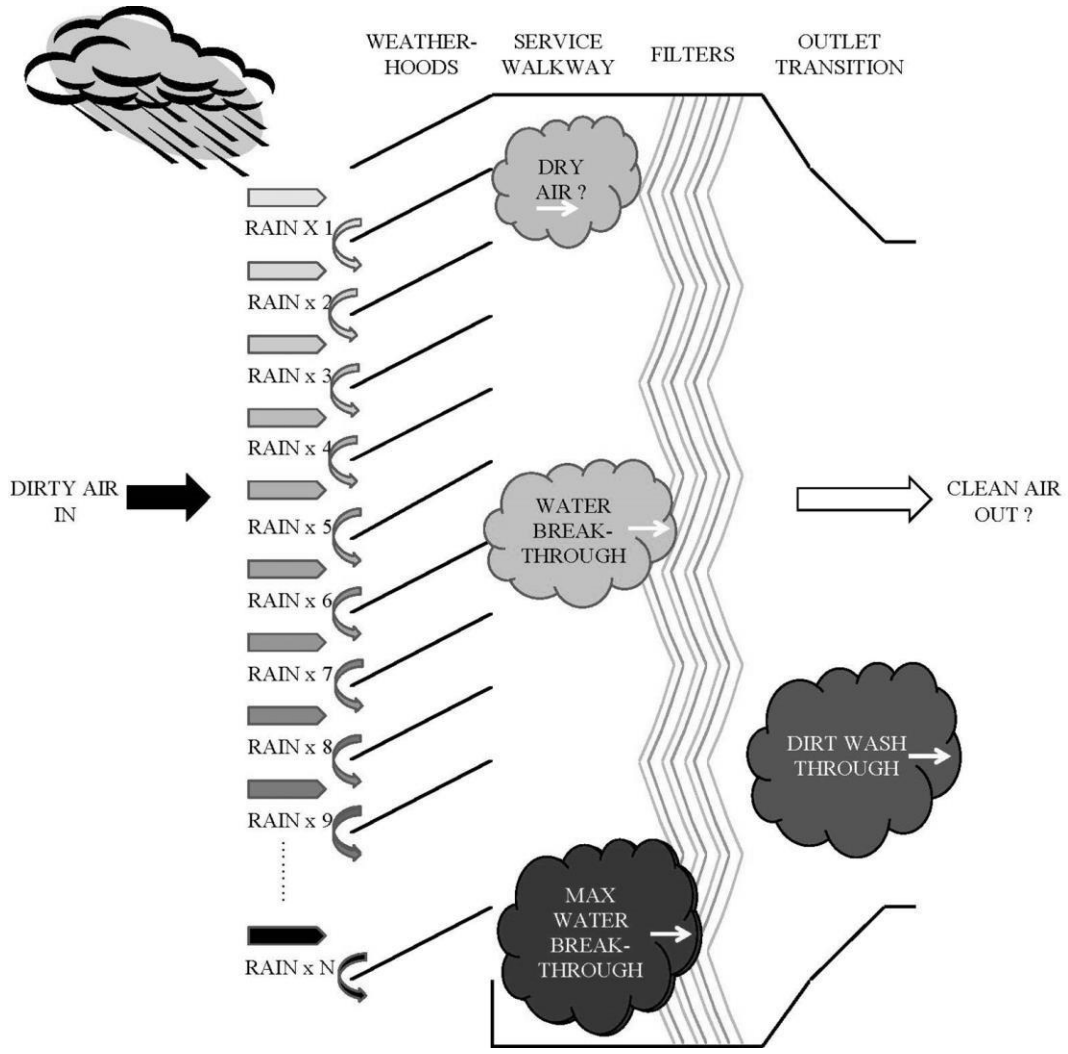

Figure 5: Intake weather hood during a major rain event (Valsler, 2012).

The second component is the inlet filter compartment, which provides a location for the filter system. Coalescing filters remove liquids and some particulates, and are configured as replaceable panels or bag filters located upstream of the high efficiency particulate filters. The high efficiency particulate filters may either be static replaceable bags, replaceable cylindrical cartridges, or self-cleaning, cylindrical pulse filters. Static filters must be periodically replaced when the pressure drop exceeds a preset value. The self-cleaning filters are periodically pulsed by high velocity air discharged from the rear of the filters. The air is designed to dislodge the accumulated dust cake on the particulate filter. The pulsing sequence is triggered when the measured filter pressure drop exceeds a preset value. The dust falls to the bottom of the inlet compartment and is removed to the outside of the compartment through a grating, by a dust hopper, or by some form of rotating auger and seal system for collection and disposal. Failure to pulse the self-cleaning filters results in a loss of gas turbine performance and ultimately, failure of the filter elements.

The third component of the power plant is the inlet duct, which is designed to move the treated inlet air from the inlet filter compartment to the gas turbine inlet plenum. The intake duct contains acoustically treated silencing panels, the inlet bleed heat system, if specified, and the trash screen. Internal struts are used to strengthen the inlet ductwork.

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Finally, the fourth component, the inlet plenum, is located immediately upstream of the gas turbine inlet duct and contains the compressor inlet bellmouth. The purpose of the plenum is to provide a relatively turbulence-free region at the inlet to the compressor inlet guide vanes. The inlet bellmouth contains nozzles used for either online or offline water washing.

These four components of the air inlet system control the supply of air to the turbines. The supply of clean, dry air must be guaranteed under all conditions for gas fired turbines to maintain efficient operation (Maurer, 2012).

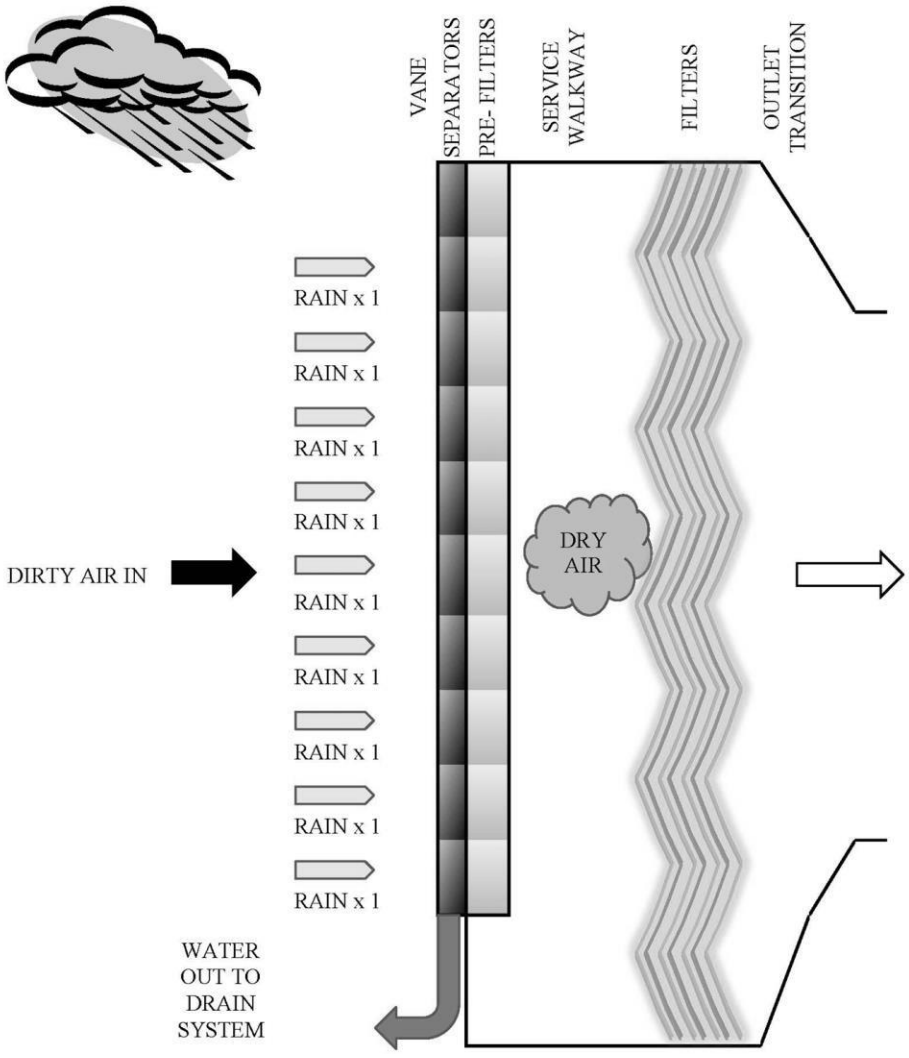

Figure 6: Weather vane separators during a major rain event (Source: Valsler, 2012).

3. Methodology

A new 2-stage filter protection system was designed to eliminate both icing of the inlet filter compartment and prevent moisture from reaching the inlet duct portion of the air intake system. The system was designed with a trace heated marine vane separator with a G4 panel filter, followed by an

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Livingstone, Zambia
ISBN 978-0-86970-787-6

H-10 cylindrical/conical cartridge pair. The new air filtration system was used on one of the two turbines at the Medway Power Station. Turbine GT-1 was outfitted with the redesigned filtration system, and turbine GT-2 remained intact with the previous filtration system. The installation of a new system on only one of the twin turbines allowed for a case study of the difference in performance between GT-1, the experimental turbine and GT-2, the control turbine.

Stage 1 of the filter design contained an electrically trace heated vane separator as shown in Figure 7. The vane separators replaced the weatherhoods because they are more efficient at dealing with severe weather, such as icing or heavy rain. The trace heating was sufficient enough to prevent the vane separators from icing during freezing fog weather events.

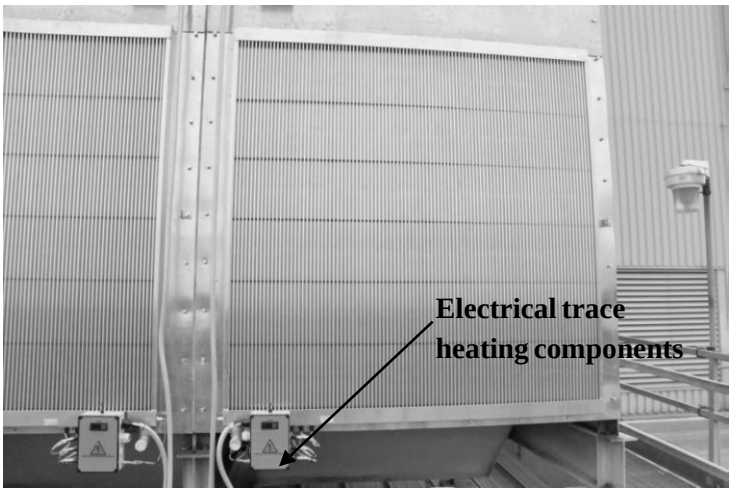

Figure 7: Intake vane separators with trace heating components (Source: Veotec, 2011).

Vane separators contain a series of corrugated metal sheets that form pockets designed to extract the bulk of the incoming moisture. As the moisture is forced to change directions within the separator, the large droplets are caught in the pockets, as shown in Figure 8, and fall to the bottom of the separator, where they are removed from the intake filter compartment.

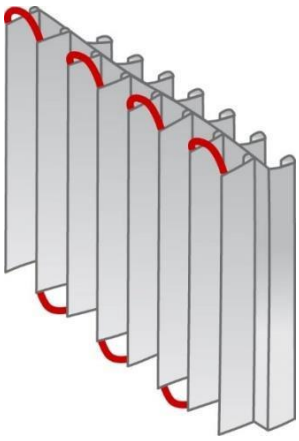

Figure 8: Trace heated vane separator (Source: Veotec, 2011).

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ISBN 978-0-86970-787-6

The panel filters used in Stage 1 filtration were designed for coalescing of any moisture carryover and low-efficiency particulate filtration at high air volumes. The efficiency was rated as G4, meaning the filter allows particles less than 5 microns through the synthetic material, but filters out material greater than 5 microns.

Stage 2 filtration cartridges were E10, as defined in EN 1822, and shown in Figure 9.

Figure 9: Filter house; Stage 1 filter to the right and Stage 2 to the left (SSE, 2012).

4. Data Analysis

Data, as shown in Table 2, were collected over a 13-month period beginning in November 2010 and ending in November 2011. The original data was collected at each hour of each day. Note the use of the 24-hour clock. Due to normal maintenance schedules, the data included times when both turbines were not in operation and times when only one turbine was in operation. There were also times when weather data was not available and "Total Adjusted MW Output" could not be calculated. For the purposes of this study, only times when both turbines were in operation simultaneously were included in the side-by-side comparison. Table 2 shows samples of the raw data.

Table 2: Sample of raw data tables

Date/Hour	GT-1 Total MW Output	GT-1 Total Adjusted MW Output	GT-2 Total MW Output	GT-2 Total Adjusted MW Output	Included in Data Analysis
06/11/11 16:00	157.7	BadData	149.3	218.1	No
07/11/11 01:00	174.8	215.2	162.4	216.3	Yes
07/11/11 09:00	224.4	219.1	-0.1875	TrainOff	No
13/11/11 10:00	N/A	N/A	N/A	N/A	No
25/11/11 06:00	-1.125	TrainOff	-0.1406	TrainOff	No

The Total MW output was adjusted to ISO standard conditions, 15° C, 1 atmosphere pressure, and 60% relative humidity. The data column for "Total Adjusted MW Output" was used for this analysis. The

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ISBN 978-0-86970-787-6

adjusted MW output per hour, when both turbines were in operation, was compiled into monthly totals, as shown in Table 3. The data clearly shows that turbine GT-1 maintained a higher efficiency than turbine GT-2. Table 3 shows GT-1 with a 2.35% efficiency improvement over GT-2 (SSE, 2012).

Table 3: MW output per monthduring simultaneous operation (SSE, 2012)

Month/Yr	Hrs of Simultaneous Operation	Unit GT-1	Unit GT-2	Difference (GT-1)–(GT-2)	%age Difference
November 2010	285	62,202.2	60,846.6	1355.6	2.18
December 2010	873	126,673.5	123,279.7	3393.8	2.68
January 2011	303	66,021.4	64,137.4	1884.0	2.85
February 2011	402	87,454.9	84,727.8	2737.1	3.13
March 2011	637	138,013.1	133,866.5	4146.6	3.00
April 2011	541	117,769.8	115,382.5	2387.3	2.03
May 2011	729	158,783.6	155,331.3	3452.3	2.17
June 2011	694	151,246.6	147,772.3	3474.3	2.30
July 2011	293	63,861.4	62,402.3	1459.1	2.28
August 2011	591	128,466.1	125,566.9	2899.2	2.26
September 2011	144	31,644.4	30,829.5	814.9	2.58
October 2011	163	35,752.5	35,190.4	562.1	1.57
November 2011	129	28,384.0	27,964.7	419.3	1.48
Totals	**5784**	**1,196,283.5**	**1,167,297.9**	**28,985.6**	**2.35**

The MW output for each turbine during simultaneous operation was totalled for the entire study period. Table 4 shows the total output for each turbine from the beginning of November 2010 to the end of November 2011. Turbine GT-1 showed 28,985.6 MW greater output than turbine GT-2, a difference of 2.35% during time when both turbines were operating. Table 4 includes a sample market price (U.S. Dollars) per kilowatt (KW) and a calculated total income difference between the two turbines. The retail income difference between the turbines shows a remarkable payback for the installation of the new filtration system.

Table 4: Total MW output per turbine during simultaneous operation

Turbine GT-1 (MW)	Turbine GT-2 (MW)	Difference in Output (MW)	%age Difference in Output	Price per KW of Electricity (U.S. Dollars)	Total Income Difference (U.S.Dollars)
1,196,284	1,167,298	28,986	2.5%	0.083	$2,405,838

5. Conclusion

Following installation of the new filter system, Kent had one of its worst winters in a long time with considerable snow, and long periods of time where the temperature was well below freezing. December 2010 showed record cold conditions, but despite these harsh conditions, the filter house performed normally with no adverse conditions due to the extreme weather.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

Turbine GT-1, the experimental turbine, showed a 2.35% improvement over turbine GT-2 during simultaneous operation, resulting in a positive financial return of over $2.4 million (U.S. Dollars). Even the small difference in output translates into a significant return on investment, given approximate rates for the electricity.

As gas turbine engineering and design improves, greater performance and maintainability benefits are required. Along with turbine improvements, there is a need to better protect the internal components. In order to meet expected maintenance intervals, it is necessary to remove solids and liquids that are considered harmful to the compressor and turbine flow path. Advances in filtration technology, media materials, and system design are able to provide the necessary protection from most naturally occurring airborne contaminants.

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-042

Sources and types of credit for construction of small and medium enterprises in the South Africa: A literature review

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Abstract

Small and medium enterprises (SMEs) have a distinct role to play in the South African economy; not only to solve the unemployment issues but also to act as a poverty alleviation mechanism. However, construction SMEs are faced with challenges to access suitable credit facilities. The purpose of this paper is to identify the different types and sources of credit lines available to construction SMEs. This paper is based on a review of literature focusing on the various types of credit facilities and mode of obtaining such facilities. The literature review was based on both South African context and international trends. Findings revealed that there are different types of credit facilities available for construction SMEs, which can be formal or informal. Formal sources include commercial bank, co-operative, micro-finance institutions and government agencies, while informal sources include friends, family/relative, trade credit, private money lender and/or stokvel. Knowledge of the various sources of funding available could help construction SMEs to make informed business decisions about their investments.

Keywords: construction, credit facilities, SMEs, sources, types

1. Introduction

The availability of finance has been highlighted as a major factor in the development, growth and successfulness of construction SMEs (Ou & Haynes, 2006; Cook, 2001). Financing methods employed by SMEs vary from initial internal sources, such as owner–manager's personal savings and retained profits (Wu, Song & Zeng, 2008) to informal outside sources, including financial assistance from family and friends (Abouzeedan, 2003), trade credit, venture capital and angel financiers (He & baker, 2007), and thence to formal external sources represented by financial intermediaries such as banks, financial institutions and securities markets (Chittenden, Hall, & Hutchinson, 1996).

According to the financial growth cycle paradigm proposed by Berger and Udell (1998), financial needs and the financing options available for SMEs change throughout the various phases of a firm's lifecycle. In other words, at different stages of the firm's growth cycle, different financing strategies are required. In general, because of the unique features that characterise SMEs during the start-up phase, such as informational opacity (Berger & Udell, 1998), a lack of trading history (Cassar, 2004) and the high risk of failure (Huyghebaert & Van der wijst, 1989), SMEs in this stage depend heavily on insider funding sources.

As SMEs advance through their business lifecycle, they begin to gradually adjust their capital structure (La Rocca, La Rocca, & Cariola, 2011). During subsequent growth stages as SMEs mature, they start to

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Livingstone, Zambia
ISBN 978-0-86970-787-6

establish a track record in addition to the ability to provide collateral. This serves to improve the creditworthiness of the firm and thereby attracts the attention of investors willingly inject money into the business. As a consequence, firms begin substituting internal with external financing sources, including venture capitalists, trade credit and bank loans to name a few. In the more advanced stages of their growth cycle, when SMEs become more transparent with information, they may develop access to securitised debt and publicly listed equity markets (Berger & Udell, 1998).

1.1 Definition of small and medium construction

According to Berry *et al*. (2009), when defining SMEs it is important to differentiate it from small, micro and medium-sized enterprises (SMME's). Although both terms are used to refer to small businesses, SMMEs comprise a wider range of firms, from established businesses employing over one hundred employees to self-employed owners of informal micro- enterprises. SMEs form an upper end of the ranges contained by SMMEs; these are larger in size compared to the micro and very small medium sized enterprises. The definition of small and medium sized contractors can vary from one country to the other. However, the definition used for this research study will be largely based on turnover and the number of permanent employees. Dlungwana *et al.* (2002) defines small construction companies in South Africa as those companies with an annual turnover of less than ten million rands (R10 million), while medium contractors have a turnover ranging between ten million rands (R10 million) up to fifty million rands (R50 million). The National Small Business Act No 102, 27 November 1996 (1996) defines small contractors as firms that employ between five (5) and fifty (50) permanent employees, while medium contractors employ between fifty (50) and two hundred (200) permanent employees.

1.2 Importance of small and medium enterprises to the economy

The importance of small businesses is recognised in numerous African countries such as Togo, Uganda, Ghana, Cote d'Lvoire, Nigeria, Kenya, Malawi, Burkina Faso, as well as others. According to Rwigema and Karungu (1999), SMEs are dominant in numbers in most economies. In First World countries like the United States of America and the United Kingdom, small enterprises play an important role in the economy, accounting for an estimated one third of industrial employment and a lower %age of output. In Third World countries where SMEs dominate economically active enterprises, the SMEs prosperity is considered far more important than in First World countries (Rwigema and Karungu, 1999). The activities of SMEs in Africa are of vital importance for the promotion of economic growth, job creation and the mitigation of poverty (Rogerson, 2001). However, research conducted on SMEs in Africa by Mead and Liedholm (1998) confirmed that on average, there are more SME closures than expansions, with approximately only 1% of micro enterprises growing from five or less employees to ten or more. It has long been debated that SMEs are pivotal to employment creation and economic growth, particularly in countries such as South Africa that has a high unemployment rate, estimated at up to 40% (Friedrich, 2004; Watson, 2004).

Upgrading the roles of the SME sector in the South African economy to improve economic growth through increasing competitiveness, and by generating employment and redistributing income (Rogerson, 2004; 2006) has been the focus of new development policies since the democratic transition (Berry et al., 2002). In order to aid in the facilitation of the SME environment, the South African government tabled the National Small Business Act of 1996 amended with Act 29 of 2004 to provide equal standing to SME enterprises (Rwigema and Venter, 2004; Ntsika, 2001) in South Africa's economy. The vital role the SME sector plays in the South African economy in addressing sustainable

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Livingstone, Zambia
ISBN 978-0-86970-787-6

development, was highlighted by the 2003 Human Development Report (UNDP, 2003) for South Africa (Rogerson, 2004).

In South Africa, it is estimated that 90% of all formal businesses are small, medium or micro enterprises (Rwigema and Karungu, 1999). The SME sector is one of the largest contributors to the South African economy. The SME is not only seen as an employment creator, but this sector also acts as an absorbent of retrenched people coming from the private and public sector (Ntsika, 2001).

1.3 Problem

There are various sources available for financing of construction SMEs. However, despite various breakdowns in names of these sources, they fall into either debt or equity financing. Although, equity as a source of financing for construction SMEs has received little attention in literature, it is an important source of financing for construction SMEs. Despite emphasises by several authors on fostering access to debt, Churchill and Frankiewicz (2006) argued that credit is not sufficient as a developmental tool. Therefore other sources of financing such as equity financing, and in particular venture capital, should be considered

Despite the promising potential in fostering SME financing of the above mentioned financial arrangements, their relevance to SMEs, particularly start-ups, who in many circumstances, do not have assets to pledge as collateral security for these transactions, is controversial. Furthermore, issues of optimal financing structures (another controversial issue in SMEs) should be considered in SME financing. Correia *et al*. (2008) described the optimal capital structure as the debt-equity ratio that the company adopts so that its Weighted Average Cost of Capital (WACC) is at its lowest point. Correia *et al*. (2008) confirm that over the years, a number of theories have been developed to explain the relevance of capital structure. However, Modigliani and Miller (1958) as cited by Correia *et al*. (2008) presented a rigorous analysis in which he argued that there is no optimal capital structure. Their argument was based on the premise that, irrespective of the level of gearing (the degree to which the firm's activities are financed by owner's funds versus debt financing), a firm's weighted cost of capital will not change.

The issue of capital structure in the SME sector received little in South African literature. However, the focus of this paper is more on access to finance for SMEs irrespective of whether its equity or debt financing. In South Africa, SMEs face constrained access to both debt and equity financing. Theoretically and in practice a problem of access to finance exist when there is a need for finances from a client with an investment project that warrantees financing, but are impeded access to external financing. This occurs due to the gaps that exist between the suppliers of external financing and the demand for financial resources. The objective of the current paper is therefore to investigate the sources and types of credit available to construction SMEs while highlighting the ease of accessibility of the credit types.

2. Literature Review

2.1 Introduction

This chapter on literature reviews discuss various theories that underpin source and the challenges facing construction SMEs in accessing credit facilities. Specifically, sources of credit theory. This is followed

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Livingstone, Zambia
ISBN 978-0-86970-787-6

by conceptual framework, empirical review of literature related to the topic under the study and critique of the literature.

2.2 Sources of credit for construction small and medium enterprises

2.2.1 Equity financing

Due to moral hazard and problems with information opacity typically being more severe during the initial stages of SME development, internal equity financing, as best represented by owner–manager personal savings, is a critical source of funding for SMEs in these early stages (seed financing and start-up). Subsequently, in later stages, in order to develop and grow SMEs tend to reduce their dependence on these sources and start seeking alternative channels for raising capital. Internally generated profits and venture capital exemplify just two of the other equity options SMEs seek to expand as they grow.

In general, "…equity capital is that capital invested in the firm without a specific repayment date, where the supplier of the equity capital is effectively investing in the business" (Ou &Haynes, 2006, p. 156). Equity capital can be raised either internally or externally. Internal equity is funds obtained from the current owner–manager(s), family, and friends or from the retained earnings within the firm. External equity, however, is capital acquired from external channels other than the existing partners and their relatives.

As mentioned above, equity financing is preferred over debt as a mode of financing for new and young SMEs as they undergo a typical cash shortage and are generally unable to secure loans with collateral during the founding phase. The advantages of equity financing in this regard are twofold (Ou & Haynes, 2006). First, unlike debt, equity offers long-term financing with minimum cash outflow in the form of interest. Second, equity capital helps enhance the new/young firm's creditability by indicating that the firm has the approval of sophisticated financial professionals.

Ou and Haynes (2006) determined two situations when SMEs pursue financing from equity capital sources in order to meet expansion needs. The first case is when SMEs face financial distress coupled with a lack of alternative sources of finance. The second case is when cash outflows exceed the cash inflows generated from regular sources. Ou and Haynes (2006) attributed this attitude adapted by SMEs in these two particular cases to the reluctance of regular lenders to lend to the firm because of uncertainty about the firm's future growth opportunities. As a result, these firms are usually classified as high risk. Inconsistent with this, in their investigation of the determinants of financing mode chosen by young innovative SMEs in Germany, Schafer, Werwatz and Zimmermann (2004) found that risky SMEs are more likely to receive equity financing.

Other arguments suggest that some SMEs owner–managers may choose not to use equity as a source of financing in order to avoid any undesirable changes in the ownership of their firm (Reid, 1996). Other entrepreneurs, nevertheless, may choose to source funding from external equity in order to share the risk with less risk-averse investors. However, the valid judgement of the importance of the external equity for SMEs should be based on the eventual success of firms that receives it, not on the quantity that the firm utilises (Berger & Udell, 1998).

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ISBN 978-0-86970-787-6

2.2.2 Venture capital

Venture capitalists are financial intermediaries. Venture capital is that form of financing in which funds are raised from investors and redeployed by investing in high-risk firms which for the most part are young or start-up firms (Potter & Porto, 2007). Further, venture capitalists decide the timing and type of investment in addition to their role in monitoring, screening and contracting (Gorman & Sahlman, 1989).

Moreover, by performing these functions, venture capitalists virtually participate in strategic planning and decision making in the firm. The venture capital market includes a variety of organisations, including public corporations, small business investment corporations and private limited partnerships.

Compared to other more conventional financing sources, venture capital displays some particular characteristics. To start with, investments employing venture capital often involve high levels of asymmetry information and uncertainty as well as higher intangible assets (Gompers, 1995). In addition, Hellmann (1998) explained that the situation in which a company has a sufficiently large incentive for active monitoring takes place only when the venture capitalist has a concentrated stake invested in that company. He added, monitoring in such cases may include spending more time in the company and regular meetings with the managers. Finally, venture capitalists can provide the firm with strategic access to new suppliers and clients as well as strategic partners (Bygrave & Timmons, 1992).

As discussed, venture capital investment is uniformly associated with high risk and uncertainty. For example, when providing external finance to firms, venture capitalists encounter a significant adverse selection problem and moral hazard (Smolarski & Kut, 2011). Another problem that may arise is the agency problem (Berger & Udell, 1998). This occurs in the relationship between the venture capitalist and the entrepreneur when the latter lacks sufficient information or skills to make optimal production decisions. This problem might also be combined as information about the project is imperfect and revealed over time (Bergemann & Hege, 1998). In order to alleviate these problems and reduce uncertainty, particular mechanisms can be implemented. In this context, Gompers (1995) emphasised three control strategies. These strategies are: (i) the use of convertible securities, (ii) the syndication of investment, and (iii) the staging of capital infusions.

According to Cumming (2006), most venture capital transactions include convertible securities. Bascha and Walz (2001) asserted that unlike traditional debt and/or equity instruments, convertible securities have the ability to mitigate the agency problem effects by leaving the owner–manager with some control during the investment period. In addition, as the price of conversion is a function of performance, the venture capitalist has a better chance to recover the investment if the venture is not successful. Other studies show other motivations for employing convertible debt, with examples including reducing the risk-shifting incentives of the entrepreneur (Green, 1984), resolving problems arising with debt financing and gaining indirect equity financing when issuing traditional equity is unattractive (Stien, 1992).

Syndication is a common form of venture capital risk alleviation and refers to two or more venture capitalists sharing in a single financing round. The syndication mechanism is used in order to decrease problems associated with adverse selection through the participation of a co-investor sharing the investment risk (Smolarski & Kut, 2011). A study by Cumming (2006) reached a broadly similar conclusion stating that venture capital syndication significantly mitigates adverse selection problems. Additionally, Lerner (1994) suggested that adverse selection problem can be efficiently mitigated in the

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ISBN 978-0-86970-787-6

presence of high information asymmetry in venture capital financing by implementing the syndication strategy. It was also found that syndication reduces the entrepreneur's opportunistic behaviour (Wright & Lockett, 2003).

Another main characteristic of venture capital is staged financing. As the term suggests, venture capital staging refers to that mode of financing in which venture capitalists invest in stages in order to maintain the project under control (Organization for Economic Co-operation and Development (OECD), 2004). Gompers (1995) provided evidence indicating that staged investment enables venture capitalist to gather more information allowing him/her to monitor the firm prior to refinancing decisions to be made. As such, the venture capitalist has the option of abandoning the project if and when any unattractive information regarding the investment emerges. Wang and Zhou's (2004) results showed that the staging financing plays a crucial role in controlling moral hazard. Therefore, it is an effective mechanism in controlling agency problems.

Not only do venture capitalists provide an alternative source of funding for SMEs, they also help resolving many informational problems plaguing SMEs. Hence, by helping increasing the financial flexibility of SMEs, they offer them the chance of sourcing finance from other financial channels, such as banks and insurance companies. However, the supply of venture capital appears to be relatively inflexible, at least in the short-term, as it requires years of experience to develop the necessary skills (Kortum & Lerner, 2000).

2.2.3 Business angels

Unlike other external sources of financing, business angel finance is not intermediated. It is instead an informal market for direct finance (Berger & Udell, 1998). Angels are highly-selective wealthy individuals with long business experience who invest directly in high growth SMEs with which they have had no previous relationship (Madill, Haines, & Riding, 2005). This form of investment is usually based on an equity contract, typically common stock. Though angels by definition are individuals, they sometimes coordinate their investment in small investment groups.

According to Harrison and Mason (1992), there are three features that make angel financing an appropriate option for SMEs. First, angels are more active in the early stages of enterprises (seed and start-up) closing the so-called 'equity gap' by forming a 'bridge' between internal financing sources and outside investors. Second, by having lower rates of rejection and being a more patient form of capital with longer exit horizons, angel financiers tend to be more obliging to the needs of SME owner–managers. For example, German entrepreneurs have ranked business angels as the most desirable funding providers (Brettel, 2003). Finally, unlike venture capitalists, angel investors prefer to invest in their local economies where the majority of SMEs operate.

Angel investors are a crucial source of financing for many SMEs, especially start-ups. According to Morrissette (2007), the amount of capital that angels provide is estimated to be eleven times that provided by venture capitalists. Data collected by Shane (2012) from different surveys conducted between 2001 and 2003 showed that between 140 000 and more than 260 000 angels injected investments between $12.7 and $36 billion into between 50 000 to 57 000 ventures each year. In Germany, for example, a study by Stedler and Peters (2003) estimated the total capital assets for each business angel in the country at €2.5million to €5 million distributed across a portfolio of between 1 and 5 firms, all start-ups.

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The extent to which angels are involved in the firms in which they invest is debatable. Barry (1994) claimed that angels are not active investors. Yet, other empirical research show opposing results (e.g. Harding & Cowling, 2006; Landström, 1993). In terms of benefits, Mason and Harrison (1996) questioned a sample of 20 dyads regarding the role played by business angels apart from their financial stake. The respondents reported that nonfinancial contributions made by angels included assistance with management functions, finance and accounting functions, strategic advice, financial advice, general administration, networking and marketing. Further, 50% of the entrepreneurs rated these angel contributions as either helpful or extremely helpful.

Worldwide, and based on quantitative analysis, angel financing dominates venture capital financing in terms of both the number of firms utilizing it and the financial value of investment (Fairchild, 2011). However, as a source of financing, business angels have two main limitations (Wall, 2007). First, few angels are prepared to inject additional money into a firm to enable it to grow and be a real competitor in its market. Second, most angel investors do not have neither the skills nor the interest in investing in a firm after it has access to other external sources of finance, including public equity markets.

2.2.4 Debt financing

It is well known that capital structure decisions, in SMEs as in large firms, relate to the use of either equity or debt or both. However, Berger and Udell (1998) believe that in the case of SMEs, this is partly incorrect because information opacity is more severe in SMEs. Issuing additional equity to satisfy the firm's financial needs would then lead to a dilution in ownership and control. Therefore, in order to keep full ownership and control of their businesses, SMEs owner–managers may prefer to seek debt financing rather than external equity.

Three significant differences between debt financing for SMEs and that of large firms have been identified in the literature (Wu et al., 2008). First, unlike managers of large firms who usually have the choice of broader range of debt financing resources, SMEs tend to be more attached to commercial lenders, especially institutional lenders, as a source of short-term debt financing that can be renewed for long-term debt. Second, as information asymmetry problems are more acute in SMEs than in large firms, long-term lending relationships are important for SMEs in order to deal with the resultant agency problems along with the other three conventional mechanisms; signalling, monitoring and bonding (the provision of guarantee or collateral). Third, in concentrated owner–managed SMEs, and contrary to what the agency theory suggests, it is not clear whether debt can lower the agency costs that result from information asymmetry arising due to different motives of owners and managers.

2.2.5 Trade credit

One of the most important sources of external financing for SMEs is trade credit. For instance, Berger and Udell (2006) estimated that one-third of the total debt of SMEs in the US in 1998 was represented by trade credit. According to García-Teruel & Martínez-Solano (2010), trade credit is a delay in the payment for goods or services after they have been delivered or provided as a result of an agreement between the supplier and the firm. Therefore, for the firm this is a source of financing appears in the balance sheet under current liabilities, whereas for the supplier it is an investment in accounts receivable. The rationale behind the widespread use of trade credit among SMEs has been argued in the literature. Ellihausen and Wolken (1993) attributed this attitude to both transaction motive and financing motive. The transaction motive suggests the better ability for both parties (the seller and the buyer) to predict

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ISBN 978-0-86970-787-6

their cash needs in the short-term. As such, cash management transaction costs can be economized. The financing motive is that SMEs resort to trade credit when alternative sources of finance are unavailable or more expensive. In addition, (Fatoki & Odeyemi, 2010) argued that trade credit financing is preferred by new and young SMEs when the risk of default is high during the early years of operations. Moreover, in relation to financial motives, firms with easier access to credit market can act as a financial intermediaries and offer funding for firms that face difficulties in accessing external financing (Demirgüç-Kunt & Maksimovic, 2001).

2.2.6 Non-bank financial institution debt

As finance institutions tend to differ from banks in their lending policies possibly in part because of regulatory differences (Berger & Udell, 1998) and following Ayyagari, Demirgüç-Kunt and Maksimovic (2010) who separate bank finance from other non-bank financial institutions funding, the focus in this section is on nonbank financial institutions as the role of banks will be discussed in the later section.

Non-bank debt offers a channel for SMEs to raise funding in both developing and developed nations. In Zimbabwe, for example, loans granted by non-bank financial institutions account for nearly 30 % of total debt, and were ranked second in order of importance by domestic SMEs (Aryeetey, 1998). A more recent study conducted by the Federation of Small Businesses found that 15,000 financial institutions in the US competed to lend to SMEs, of which half were nonbank lenders in the form of credit unions (Goff & Nasiripour, 2012). Still in the US, an earlier study by Denis and Mihov (2003) using a sample of 1,560 new debt issuers firms during 1995–96 showed that of the total amount of debt of $350 billion raised by the firms in the sample, nonbank debt was responsible for almost $40 billion.

Johnson (1997) explained that while banks prefer short-term debt (as their liabilities are also short term), non-bank financial institutions such as insurance companies are generally in favour of long-term loans as they have long-term liabilities. However, Johnson (1997) believes that non-bank financial institutions can act as a financial intermediate between banks and public debt.

In general, the main advantage that encourages SMEs to use more debt than other external sources of finance in their capital structure is the tax shield benefit. In addition, when seeking external funding, SME owner–managers tend to limit the use of equity in order to meet control aversion and maintain control of their firms (Hutchinson, 1995). However, Abor (2008) found that SMEs with many shareholders (group-owned SMEs) may choose to utilize low debt levels to avoid bankruptcy and the agency costs accompanied with debt financing.

3. Research Methodology

The literature review of scholarly work spanned the period September 1995 to 2015 and was based on a systematic Keyword combination search on the following debases: UJDigispace/Multidisciplinary, Sabinet /Multidisciplinary, ProQuest MTD, Emerald on Business studies and Entrepreneurship, Scopus /Economics Engineering and Technology, OECDilibray, Oxford journals online and Socio-logical Abstracts.

The search was conducted by deducing the main keywords and the keyword variables based on the aim of this paper and above stated background. From here the search was continuously expanded with new

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ISBN 978-0-86970-787-6

keyword variables as they appeared throughout the search in the specific databases. Following this, the search was conducted in every single database by searching the main keywords in combination with every single keyword variable. Where the results exceeded 30 hits yet another and keyword variable was added to the search. The review established the source and the types of credit facilities and challenges affecting the construction SME accessing credit to be; creditworthiness of the borrower, collateral requirement by the banks, risk default and lack of business plan.

4. Summary of Findings and Discussion

The following sources of financing have been identified: equity financing, debt financing, venture capital, trade credit, business angels and non-bank financing institution debt. Others were indicated to be vendor financing in the form of loans or preference shares; loans or debentures (Aryeetey, 1998; Johnson, 1997); preference shares issued to banks and assets securitisation or Initial Public Offering (IPO).

This seems to suggest that the various types of credit available could be formal or informal. Informal sources tend to have less stringent criteria and are more easily accessible to construction SMEs, while on te other hand, formal sources are more challenging to obtain. This is partly as a result of the high risk associated with providing credit to SMEs. According to Malhotra *et al*. (2007), a number of commercial banks around the world have learned the lending and pricing strategies that allow them to compensate for the high transaction costs of making many small loans and have adopted risk management techniques commensurate with the higher risk profiles of their SME clients. Many of the innovations originated in serving clients at the lower end of the private sector range using microfinance technologies. These innovations consisted of providing small, uncollateralized working capital loans; promising access to larger amounts for longer terms based on repayment performance; and permitting small savings accounts that were safe, convenient, and flexible in terms of withdrawal.

5. Conclusion and Recommendations

The study provided a concise discussion on access to finance issues. Issues surrounding the types and sources as well as the relative ease of accessing the various types of credit were discussed. It was suggested that construction SMEs are a risky investment. To mitigate risk, government intervention in form of credit guarantee schemes may be an effective step towards addressing access to formal finance challenges.

The central government must work hand in hand with the private sector financial services to support funding for construction SMEs. More research is needed to identify barriers to obtaining these credit facilities and feasible strategies to overcome the barriers. It is paramount for future research to assess the effectiveness of policy recommendations in the South African literature as well as monitor progress in as far as improving access to finance by SMEs concerned.

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Livingstone, Zambia
ISBN 978-0-86970-787-6

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Proceedings of the DII-2015 Conference
on Infrastructure Development and
Investment Strategies for Africa

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-047

Evaluating Design-Build Procurement Method Suitability Relative to Project Performance in South Africa

Babasola Ilori[148], Hoffie Cruywagen[249]

Abstract

Though it is true that not every design–build (DB) arrangements project is a straight-away success, this method can be described as one of the most attractive methods of procurement for construction clients because of its several advantages. Unfortunately, stakeholders in the South African construction industry are not using these advantages to a large extent. This paper aims to investigate the perceptions of construction stakeholders on the suitability of the design-build procurement method for projects. Data were collected using a structured field questionnaire and interviews. The empirical data were analysed using the Statistical Package for Social Sciences (SPSS) software. Chi-square test, frequency distribution tables and charts were used to analyse and present the data. This study found that the design-build procurement method is suitable for projects with design complexity. Design-build should be considered for industrial projects for a better project performance because design-build combines design and construction resulting in the best possible results. The study recommends that project stakeholders in the South African construction industry should recommend and adopt this procurement method to achieve optimum results.

Keywords: design-build, client, project, client characteristics, project characteristics

1. Introduction

Design-build started being used in America during the early 1900s (Greenfield, 1982). In the 1970s and 1980s, design-build was used extensively, especially in major power and industrial projects (Poirot et al, 1994). In 1991, about 5% of all construction in the USA was based on design-build (Setza, 1991). In the mid-1990s, more than one-third of construction projects were using the design-build approach and in response to the growing demand for it, the "Design-Build Institute of America" was set up.

Denmark, Germany, Norway, Russia and Sweden use design-build contracts and approximately 50% of private and 20% of public sector projects are procured in this way. 70% of projects are procured in Japan by the private sector using design-build while in Brazil, design-build accounts for approximately 30% of the private sector projects. In Mexico, about 60% of the public sector and 40% of the private sector projects are procured by the use of this method (Thomas, 2006).

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

The design-build project delivery method brings various disciplines and aspects of construction together, which is supposed to minimise incidents of constructors having to repeat work and which results in cost and time savings for the clients; however, in some types of project the result is the opposite. The reasons may be because:

- Project clients feel that they need to bear more risks;
- Design-build facilities are not of high quality; and
- Maintenance issues are not adequately considered;
- Furthermore, in South Africa clients may be misinformed about design-build projects.

Many people hold different views about this procurement method, depending on their experiences with the procurement process. These views to a certain degree help to indicate the way forward in the successful implementation of design-build projects. In addition, the client's knowledge and understanding of the construction and project implementation has been regarded by many researchers like Morledge (1987) as critical characteristics in terms of client behaviour when dealing with the construction industry. Behavioural responses exert a significant influence on the effectiveness of the project management process because of the views of the various professions and skills involved, many of which have strong allegiances and perceive projects from very different positions (Walker, 1996). Some of the perceptions held by different scholars about the design-build method include the following:

Chris Johnson (2006), managing director, Gensler, London:

"While most architects hold reservations with regards to working in the design-build environment, I personally enjoy the closer relationships between the architects and the builder contractors which over time develop into mutual trust as opposed to the antagonist behaviour more common in the contracting environment."

John Christopher (2006) Associated Architects:

"Design-Build seems much more appropriate for some types of project than for the others. The risk is that, if cost is fixed before quality is fully defined, then quality may suffer. It is also sometimes difficult for architects, with or without a 'retained duty', to act in the client's best long term interests when employed through the contractor."

Steve Andrews (2006), principal, Gensler London:

"Design-Build whilst laudable in its intent to make things easier for the end user, with a single point of contact, has hugely variable outputs. In its most raw form, quality can suffer hugely as the drive of cost savings vastly outweighs aspiration. At its best, the process is easy; the client gets exactly what he wants at the price he wants to pay. Ultimately the difference between success and failure comes down to one of attitude and people."

16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

It can be deduced from these different views that while the design-build procurement method has many benefits, there are project types and circumstances that do not suit its use. This demonstrates that design-build generates its own difficulties which need to be taken into account before it can be considered as the appropriate method to be adopted for a specific project.

2. Design-Build Method

Richard (1975) referred to "design-and-build" (also known as design-build) as a situation when a client contracts with a single firm in both design and construction. For Harold (1976) it is present when a substantial amount of building is accomplished under a single contract, covering both the design and building of the project (construction). According to Balogun (1992), design-build is a contract in which a building contractor does some or all of the design work and produces the building very quickly, particularly if the contract is a negotiated one. Ellis (1990) pointed out that with design and construction work under one roof, the contractor's knowledge of the building process is incorporated in the design process.

Forms of suspicion are eliminated because those responsible for design-build are able to perceive themselves as members of the same team, unlike in the traditional method. In addition, the line of communication becomes short and relatively informal. Arguing the case for design-build, Titmus (1982) remarked that the traditional competitive tender process is increasingly losing favour, especially as competitors are often unequal in standing and ability, which causes the project to be eventually executed in an atmosphere of "them and us".

According to Finlay (1983), this form of project procurement may be on a fixed price or cost reimbursement basis. It may also be competitive or negotiated. Examples of such projects include factory buildings, medical clinics, and schools using a proprietary system, where benefits can be obtained. Also, where a contractor's proprietary system can be used without detriment to the client's requirements, economic advantages stem from a modified form of design-build. Jones (1984) referred to this system as one where the designer is also the builder of a project. All these definitions can be summarized thus:

"Design-build system is when both design and construction are included in a single contract between the owner and the contractor either on a lump-sum or cost-plus basis e.g. housing and industrial constructions or an arrangement where one contracting organization takes sole responsibility, normally on a lump sum fixed price basis, for the bespoke design and construction of a client's project. The fundamentals of this procurement method are that the responsibility for design and construction lies with one organization and project carried out to meet the needs of the client".

3. Design-Build Process

In an increasingly competitive world, almost every product is being produced more efficiently. Global competition means that customers have to take all costs into account. Clients want better value from their buildings. Design-build has developed distinct strengths to make a product benefit from cost, schedule, quality and aesthetics and use proven accounting standards; in addition, innovative use is made of materials and system so as to satisfy clients' needs (Neo, 2006).

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A design-build project should result in lower production costs on site, a shorter design and construction period, an overall saving in price to the client and an implied warranty of suitability to the client. But a major disadvantage is the discouragement of possible variations by the client: where the client considers these to be necessary, he often has to pay an excessive sum of money for their incorporation within the finished building (Ashworth, 1986). Figure 1 illustrates the design-build process at various stages from inception to implementation.

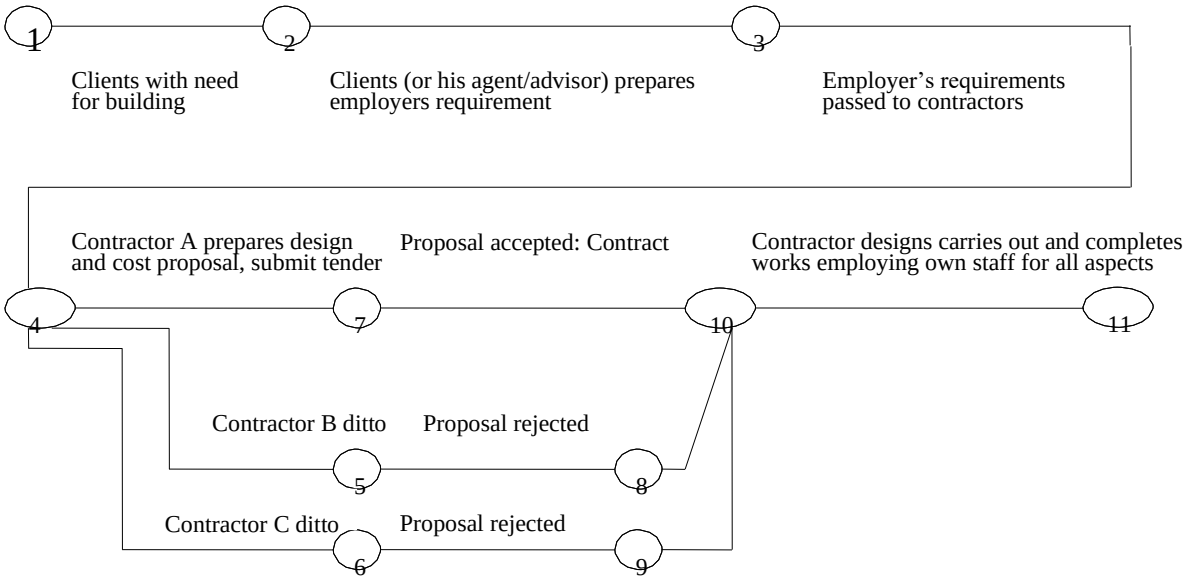

Figure 1: Design-build by Franks (1984).

4. Clients

The establishment of a definition of the client is essential in order to avoid misunderstandings, and the following description will be used throughout this work: "The organisation, or individual, who commissions the activities necessary to implement and complete a project in order to satisfy his/her needs and then enters into a contract with the commissioned parties" (Masterman, 1996).

Project implementation begins with the client, the sponsor of the construction process, who provides the most important perspective on project performance and whose needs must be met by the project team (Latham, 1994). The importance of identifying the real client has been amply demonstrated in both theory and practice (Cherns and Bryant, 1984). However, the increasing complexity of many clients' organisations, and the complicated structures of most consortia and similar groupings, means that the industry must accept the need to deal with such difficult characteristics as a matter of course.

5. Client Characteristics

Galbraith (1995) suggests that all clients will be influenced more by experience when choosing their procurement strategy than by project-specific factors. In addition, it is a fact that different clients use

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ISBN 978-0-86970-787-6

the same procurement system to a greater or lesser extent, depending upon the nature of their business and in some cases the type of project they are implementing at the time.

This phenomenon is best illustrated by the results of the two surveys undertaken by NEDO in 1983 and 1988, when it was established that industrial clients carried out more than one-third of their building projects using the design-build system whereas commercial clients only used this system for less than one-quarter of their schemes. A study carried out by Moore (1984) found that (1) 24 percent of the annual workload of the sample of thirty eight contractors examined was executed using the design-build and that (2) all of the contractor participants were confident of increasing their involvement in this method in the immediate future.

This confidence was proved to be well founded by the 1996 design-build survey carried out by the University of Reading which established that the market share, by value, of the commercial, industrial and housing sectors in 1995 was 32 percent; this finding was influenced by respondents who had experience of using the design-build method (Bennet *et al,* 1996). Boudjabeur (1997) established that design-build was the fastest growing procurement system in the UK and suggested that it was likely to account for over 50 percent of the total construction workload by the year 2000.

6. Project

A project is an endeavour that is undertaken to produce the results that are expected from the requesting party (Orbelender, 2000). “A project is a temporary endeavour undertaken to create a unique product, service, or results, the temporary nature of projects indicates that a project has a definite beginning and end” (Pmbok, 2013). Selection of the designer and constructor varies depending on many factors including the type, size and complexity of the project; the owner’s knowledge in handling engineering and construction projects, and how soon the wants the project completed (Orbelender, 2000).

7. Project Characteristics

In 1975, the Wood Report revealed the results of case studies of fifty building and civil engineering projects which demonstrated that clients consistently mentioned the need to meet the criteria of cost, low maintenance charges, time, quality, functionality and aesthetics as being necessary for a project to be considered successful.

In 1988, Faster Building of Commerce was published, drawing on statistical analyses of 8,000 projects. This report established that clients’ priorities were determined by the need to minimise the commercial risks associated with property development and that their main concern was the functionality of their buildings.

Fast and punctual construction periods were demanded as a matter of course, and quality standards were high and often very demanding. In the same year, the Centre for Strategic Studies in Construction, based at the University of Reading produced a report (1988) on the future of the building industry in the UK which maintained that although the modern client is more sophisticated than in the past, his/her needs, in terms of construction projects, broadly remained the time-honoured triumvirate of time, cost and

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ISBN 978-0-86970-787-6

quality. Both of these last two reports confirmed that clients wanted certainty of performance in all three of these criteria, and did not want any surprises during the implementation of their projects.

8. Methodology

Research was carried out through the use of questionnaires in two ways:

- Structured interviews with managers and directors of companies who are known to be stakeholders in the South African construction industry using interview questionnaires. Interviews were conducted by running through the questionnaire; and

- Emailing questionnaires to managers and directors of companies who were known to be stakeholders in the South African construction industry. The questionnaires were self-administered by the respondents and expected to be sent back via email.

The questionnaire was personally administered to the respondents using a structured questionnaire while an interview was conducted for those who could not complete the questionnaire on their own. The other questionnaires were completed by respondents via email. These included the construction managers, quantity surveyors, project managers, engineers and clients.

The respondents were asked to rate the extent to which they agreed that design-build should be recommended for certain types of project, where 1 = strongly agree/always/very good; 2 = agree/often/good; 3 = undecided/regularly/average; 4 = disagree/rarely/bad; 5 = strongly disagree/never/very bad depending on the type of question. Respondents were also invited to furnish their comments, state other design-build related problems and rate them.

This study adopted an opinion research approach to gather useful information on the design-build method. Data from the survey were first entered manually on a data sheet with coded variables. Data from the forty questionnaires were then analysed and evaluated using the Statistical Package for Social Sciences software (SPSS). A chi-square test of the mean and Spearman's rank correlation were carried out with the help of SPSS to find out whether the stakeholders' opinions agree with the statements or not. In addition the frequency tables for each attribute were computed using the SPSS and results presented using bar charts, pie charts and scatter line diagrams.

9. Limitations - Organisational Structure

The study was restricted to Gauteng, Mpumalanga and Kwazulu Natal Province in South Africa. In addition, Civil Engineering projects were not extensively evaluated in the study because of their limited use of design-build. To conclude, the main limitation of the research was the reluctance of certain companies to furnish pertinent information that they considered confidential and the lack of records.

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10. Objective of the Study

The study's objective was to evaluate the design-build procurement method's use and suitability relative to project performance in South Africa. Consequently the study sought to establish the views of stakeholders in the construction industry on the use of the procurement method in South Africa.

11. Importance of the Study

A better understanding of the problems faced by using the design-build procurement method will allow more clients to use this procurement route which has been proven to demonstrate superior performance in some types of projects. Studies have shown that its use results in improved time performance (Ling, 2004).

12. Findings

On the question of whether the Design-build build works for all construction projects, respondents were asked to rate the extent to which they agreed that the procurement method does not work for all types of projects, the respondents significantly agree ($X^2 = 49.8000$, $P \leq 0.05$) that design-build works only for certain type of projects.

This is further explained from the frequency data (Table 1, column 2 and figure 2) in which most of the respondents, 29 (72.5%), agreed that the procurement method should only be recommended for certain types of projects. This view was also held by respondents in response to another question indicating that the "Design-build procurement method was a popular and valuable form of procurement for certain types of projects and not to all construction projects.

Table 1: Design-build usage should be recommended for certain types of projects

Q2.4 (V9) Rating	Frequency	Percentage	Cumulative %	Cumulative Freq.
Strongly agree (1)	7	17.5	17.5	7
Agree (2)	29	72.5	90.0	36
Undecided (3)	2	5	95.0	38
Disagree (4)	2	5	100.0	40

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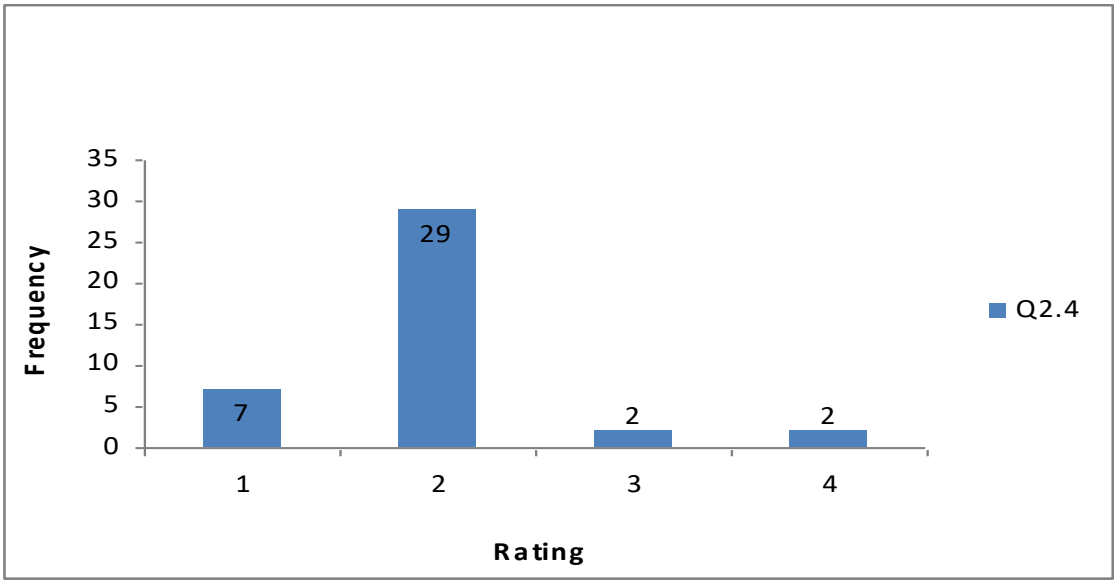

Figure 2: Frequency of response regarding whether design-build should be recommended for certain types of projects (Bar chart).

To benefit fully from a design-build delivery system, the client should give the contractor, with his/her architects and design team, the opportunity to develop the design and to produce a building solution that utilises their specific skills and resources.

The general comment by respondents was that design-build contracting is still growing, especially in the mining industry, but it is still not well understood in the South African construction industry and some have never used it before. In addition, most comments suggested that design-build is appropriate for industrial projects and for fast tracking projects, especially the emergency ones

From the above it can be shown that the general view held by most respondents was that design-build contracting should be used for certain types of projects only such as industrial and fast track projects. In simple terms, despite the numerous benefits of the design-build contracting method, there are many projects that do not suit it. Marshall (1999) summarised the right underlying conditions under which design-build contracting should be selected as the most appropriate method. These conditions include the following:

- Design complexity and scope for method innovation: Projects containing both of these factors are particularly suitable for design-build, as this combination maximises the scope for a designer/contractor team to benefit by matching design and method for the best possible results. Where neither condition exists, the benefits of design-build diminish considerably.

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13. CONCLUSIONS AND RECOMMENDATIONS

13.1 CONCLUSIONS

From the findings design-build procurement method should be used in certain types of projects especially for projects with design complexity. Design-build should be considered for industrial projects for a better project performance because design-build combines design and construction resulting in the best possible results.

This study contains several limitations. Firstly, the responses gathered from stakeholders were based on their perceptions, which are subjective. Secondly, different respondents may hold different views on the points of the rating scale. While other respondents may have rated an answer as 3 (undecided), they may nevertheless not encounter the same level of difficulty as regards the issue identified. Lastly, the composition of the respondents did not include any architects because no responses from the questionnaire sent out stemmed from these professionals. Thus, there may be biases in the results against the architects' perception. In future, more data should be collected from the public sector so that a more balanced comparison can be made.

13.2 RECOMMENDATIONS

In order to effectively manage design-build projects in South Africa, the clients need to have construction experience and handled design-build projects in the past. Consultants should have a high level of construction sophistication and a design-build project experience. Contractors should have adequate staffing level, a good track record for project completion on budget, ability in financial management and quality control. To increase the level of usage of design-build contracting, government as the major client of the construction industry need to enact statutory legislation recognising the design-build practitioners in the South African construction industry. Overall, the construction industry should invest in training, skills development, research and technology.

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

DII-2015-028

A Critical Analysis of the Impact of Sinkholes and Dolomite on the Settlement Distribution of Ekurhuleni Metropolitan Municipality

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Abstract

The City of Ekurhuleni forms part of the local government of the East rand region of Gauteng, South Africa. This is the area where OR Tambo International airport and Rhodes field Gautrain station are. Ekurhuleni covers 1 889 square kilometers in size. Ekurhuleni is regarded as the industrial, agricultural and mining hub of Gauteng province. It is divided into three (3) regions, which are North, South and East. Dolomite dominates the Northern and Southern parts of Ekurhuleni and this causes a lot of sinkholes that impacts on agricultural, mining and residential land. The primary objective of this research was to identify and analyse the impacts of dolomite and sinkholes in environment of the City of Ekurhuleni. This paper presents an investigation on the effects of sinkholes and dolomitic conditions on human settlement activities in Ekurhuleni. The study concluded that clear guidelines on the geological state of the city need to be investigated in view of the risks and threat of sinkholes and dolomite is posing to people and their environment.

Keywords: sinkholes, dolomite soils, human settlements, environment, people

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16-18 September 2015
Livingstone, Zambia
ISBN 978-0-86970-787-6

1. Background To The Problem

Apartheid legacy is still haunting South Africa even after 20 years of liberation. This is due to the fact that majority of the previously disadvantaged people/blacks are still disadvantaged with poverty and unemployment dominating in most of the settlements in black communities. Land tenure and land ownership is a big challenge for many black people as the price of land in terms of the current market value is expensive. The Constitution of South Africa aims to address issues of inequality and other fundamental issues in the Bill of Rights which essentially states that "Everyone should have access to adequate housing" (South African Constitution, 1996).

In South Africa the most severe elements affecting people's welfare is the housing need. The persistence and enormity of the housing backlog facing low-income earners is an indication of the depth of the housing crisis in South Africa. This challenge exists despite major policy and legislation changes ushered in with the new post-1994 democracy. New forms of housing needs are emerging in the context of urbanisation, of neo-liberal policy environments, the politicization of housing, and imbalances and inequality among social classes. It should be noted, however, that the government has been rolling out monotonous Reconstruction and Development Programme (RDP) houses, which are often located in urban peripheries and which are of poor quality. The location where these RDP houses are situated is a problem because residents are placed far away from their work places.

In the quest for a better life and job opportunities many people find themselves leaving in the rural areas and migrating to the cities as a result of the harsh realities of limited resources and income. However, while in pursuit of employment people find themselves stranded in the cities.

Ekurhuleni Metropolitan Municipality (EMM) has a population of 3,178,470 million people (Stats SA, 2012). Population growth since 2001 to 2011 is estimated at the rate of 2.47% , with a higher rate of the growth occurring in the south, where the townships of Katlehong, Vosloorus and Tokoza (south west), Kwa-Thema, Tsakane and Duduza (southeast). Other concentrations of low-income housing are on the eastern periphery (Daveyton and Etwatwa) and the north east (Thembisa). Informal settlements are concentrated in and around these existing peripherally identified as low income areas. Informal settlements in Ekurhuleni provide homes to 130 000 households (22% of the city's population, assuming a household size of four people) the majority of the settlements are located on privately owned land and the government has a mandate to provide the poor with adequate housing and land tenure.

Currently there is shortage of land in Ekurhuleni this is either due to issues of land ownership being private and the majority of the land underlined by dolomitic conditions. Dolomite dominates the Northern and Southern parts of Ekurhuleni and causes a lot of sinkholes that impacts both agricultural, mining and residential land.

Many households in the Katorus and Vosloorus area of Ekurhuleni are living on high risk and dangerous dolomitic land. Dolomitic land refers to the land or areas that have the dolomite rock type for up to 100 meters. Dolomitic rock is composed of the mineral dolomite, which is a carbonate of calcium and magnesium. Dolomite is soluble that is why it dissolves easily when in contact with water. Rainwater and percolating ground water gradually dissolve the rock over time as it seeps through joints, fractures and fault zones in the rock. The dissolution of the dolomite gives rise to caves resulting in catastrophic ground movement on the surface (Department of Public Works, 2013: 1).Based on the aforementioned problems, this study addresses the following questions:

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Livingstone, Zambia
ISBN 978-0-86970-787-6

1.2 Research Questions

- Can human settlements be developed on dolomitic land?
- What can be done to build stable human settlements on dolomitic land?
- What measures are in place to ensure sustain human settlements on dolomitic land?

1.3 Aims and Objectives

The primary objective of this research is to identify and analyse the impacts of dolomite and possible sustainable development of housing on dolomitic land, which will result in resolving the current housing backlog and scarcity of land for development of sustainable human settlements in Ekurhuleni. The main aim is to establish clear guidelines on the geotechnical and dolomite stability of the land in Ekurhuleni with a focus on Vosloorus Area. To investigate the possibility of developing sustainable human settlements on dolomitic land. To identify measures that can be put in place to sustain human settlements on dolomitic land.

1.4 Research Methodology

This research is a qualitative study based on literature review. In qualitative research methodology, research often starts with general research questions rather than specific hypotheses. This research project requires exploration and observations to build theory from the ground up. The qualitative research process is more holistic and 'emergent' with the specific focus, design, measurement instruments and interpretations developing and possibly changing along the way (Leedy& Ormond, 2005: 95).

1.5 Literature Review

According to White & White (1986) in a study in United States the karsted limestone valleys of central Pennsylvania contain two populations of sinkholes. Solution sinkholes occur in the Champlainian limestone units along the margins of the valleys. Solution sinkholes are permanent parts of the landscape and, although a nuisance to construction, do not present other problems. The second population is the suffosional or soil-piping sinkholes. These occur on all carbonate rock units including the Beekmantown and Gatesburg dolomites that comprise the two principal carbonate aquifers in the valley. Suffosional sinkholes are the principal land-use hazard. Suffosional sinkholes, according to the findings are transient phonomena. They occur naturally but are exacerbated by runoff modifications that accompany urbanization Suffosional sinkholes are typically 1.5–2.5 m in diameter depending on soil thickness and soil type. The vertical transport of soil to form the void space and soil arch that are the precursors to sinkhole collapse is through solutionally widened fractures and cross-joints and less often through large vertical openings in the bedrock. The limited solution development on the dolomite bedrock combined with soil thickness, seldom greater than 2 m, limits the size of the sinkholes. All aspects of suffosional sinkhole development are shallow processes: transport, piping, void and arch formation, and subsequent collapse take place usually less than 10 m below the land surface.

In a similar study (Waltham, 2008) noted that with few exceptions, the ground collapses that constitute the karst geohazard in engineering activity in limestone terrains are induced by human activity, including housing. Subsidence sinkholes, formed entirely within the soil profile, constitute the most widespread karst geohazard, but are largely induced by engineered works, either directly or accidentally. Water table

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decline (as a result of pumped abstraction or quarry de-watering) and uncontrolled surface drainage input are the two key factors that induce subsidence sinkholes, especially where both are involved. Collapse sinkholes, formed by failure of bedrock over a cavity, are rare in natural karst landscapes, but may be induced by excessive loading imposed on limestone that lies above an open cave; the risks associated with this geohazard should be eliminated by implementation of an appropriate site investigation that includes proof drilling

1.6 Local Context

In South Africa the term "Dolomite land" has a negative connotation due to its damaging effects of sinkholes and dolomites. Twenty percent of the densely populated land in Pretoria, Witwatersrand and Vereeniging area of Gauteng Province is underlined by dolomite and most of the gold mining area in the far West Rand(Ekurhuleni Metropolitan Municipal area) and North West Province.

According to statistics South Africa, (2011) census, 448 541 households in Gauteng lived in informal settlements or shack. Poverty and social, ostracism are the main cause of informal settlement. Furthermore, urbanisation is also a catalyst of the formation of informal settlements. This has been further enhanced by the need for job opportunities and increased prospects for material gain.

Dolomite has been shown to be soluble and therefore water can gradually dissolve the rock over time giving rise to voids or cave systems. The soil covering the rock can collapse resulting in the formation of sinkholes. In the early 1980's a sinkhole developed at the existing Natalspruit Hospital. Natalspruit Hospital is located in a high risk dolomite area in which sinkholes have developed in the past, and as a result there is a high potential for serious damage to infrastructure to occur in the future (Candy, 2009: 3).

Sinkhole is a feature that occurs suddenly and manifests itself as a hole in the ground. Sinkholes result from the hollowing out of a space below the earth surface, which eventually breaks through at the surface. They are generally circular in shape and grow up to 50 metres in diameter, steep-sided and deep. Sinkholes can occur with the little warning through cracks in building walls (Council for Geoscience, 2007: 2).

The process of sinkhole formation is closely linked to the lowering of the water table in the substrata. The stability is then dependent on the rate of abstraction, continued infiltration of water from the surface, the size of cavity and the thickness of cover over cavity. Sinkholes in these Ekurhuleni usually occurs in areas underlain by dolomite rocks and more than 40 per cent of Ekurhuleni is dolomitic (I, Kleinhans, Personal Communication, February, 2013).

Damage to property and loss of life has been recorded in rural and urban areas, including residential, commercial and industrial developments. In spite of the sad history there is an increasing pressure to provide more housing on dolomite. Urbanization and affordability of housing is one of the influences that created and formed informal settlement. South Africa is currently facing crises due to insufficient green field land and the mushrooming of informal settlements is affecting South Africa's land development priorities and the irradiation of informal settlements.

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Ekurhuleni has a detailed database of informal settlement data which includes:

- Informal settlement name
- Detailed description location
- Date established
- Number of households
- Status of settlements
- Land ownership

According to Ekurhuleni Metroplotitan Municipality data set there are 114 informal settlements in the municipality with 160.336 household living in these settlements.

1.7 Study Area

This research is focused on Vosloorus Township which is situated within the Ekurhuleni Metropolitan Municipal Area under the Boksburg Customer Care Centre. The study area is dominated by informal settlements, farms as well as some formal housing and a small scale retail area. The reason for the choice of this area is because there is currently a shortage of land and the majority of the land is being privately owned,secondly there is a large demand for housing in the area as it is dominated by informal settlements and poor people who cannot afford to aquire prime land for development. Vosloorus is a large township situated south of Boksburg and just east of Katlehong in Ekurhuleni Metropolitan Municipality. It was estabiashed in 1963 when Black African's were removed from Stirtonville, because it was considered by Government too close to a white town (Census, 2011). Stirtonville, renamed Rieger Park, has since become home to Boksburg coloured community. A local authority was established in 1983 when Vosloorus was given full municipal status. It has an area of 32.10km2 and a population of 163,216.

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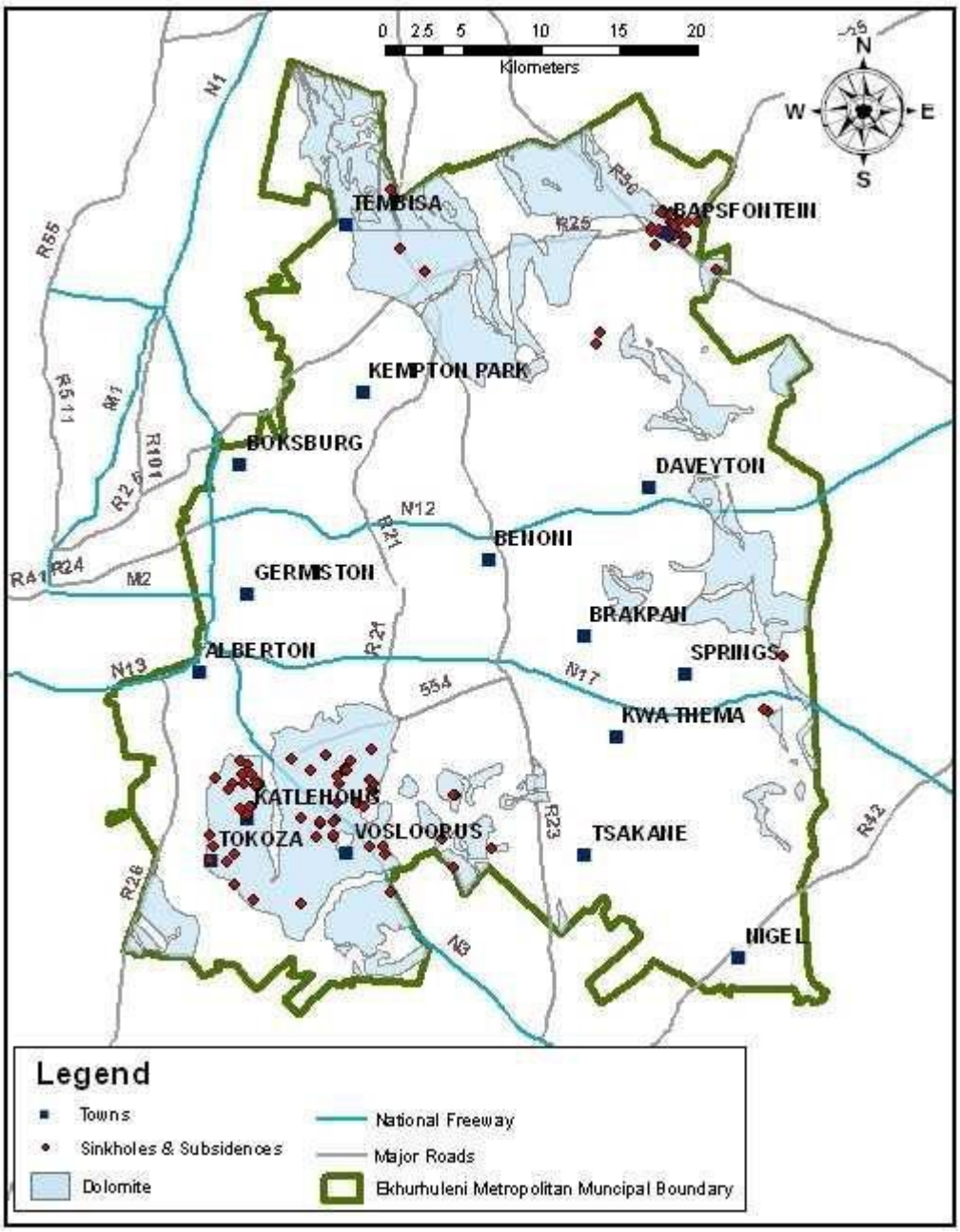

1.8 Analysis

Dolomite is a type of rock that slowly changes into soil when exposed to the sun, wind and rain. When rain water runs through the cracks in dolomite rock it dissolves it very slowly, and hence carry it away. It can take many thousands of years, and a lot of rainwater to dissolve a small piece of dolomite rock about the size of a fist. The rock is composed of carbonate of calcium and magnesium which is soluble

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in acids such as rainwater. If lots of rain water finds its way in to a dolomite and running through the cracks in the rock for years the rock may weaken and cracks get wider and wider. Polluted water like acid rain water can cause dolomite rock to break down at a faster rate. Dolomite land is defined as "land underlain by dolomite at depths of no more than: 60m in areas where no dewatering has taken place and the local authority has jurisdiction, is monitoring and has control over the ground water levels in the areas under consideration; or 100m in areas where de-watering has taken place or where the local authority has no jurisdiction or control over ground water levels" (Dolomite Risk Management Policy, 2013: 2).

Sometime some part of dolomite rock does not dissolve and these parts are left behind to form soil that is very dark and/or very light and soft, called **wad soil**. Dolomite, as a rock, contains more than 90 % dolomite and less than 10 % calcite (limestone) as well as secondary silica (**chert**). These are often found within dolomite rocks. Chert is usually hard and does not break to form soil; it is white on the outside and grey in the inside. Because it does not break down easily, it always remains behind when the dolomite dissolves. Ferroan Soil (reddish silica soil material), is another insoluble residual of a weathered dolomite rock. Gauteng formed part of a 500 000 km2 inland sea some 2550 million years ago. At this time algae populated the sea. Algae are considered to be one of the sources of carbonate sediments (algal photosynthesis) (Pilane, 2012). Photosynthesis of the algae promoted the removal of Carbon dioxide (CO2) from solution, thereby encouraging the dissociation of soluble calcium bicarbonates (Ca (HCO3)2) to form insoluble calcium carbonate (CaCO3). Another source of carbonate sediment is inorganic precipitation. Dolomite and limestone, with little or no impurities, are valuable industrial commodities and are used in the making of a wide range of products such as cement, glass and fertiliser.

Mechanisms of a sinkhole formation:

According to Pilate, (2012) cavities may exist within bedrock or the overburden, which may be in a state of equilibrium. Active subsurface erosion of the overburden caused by concentrated ingress water will result in transportation of materials down the nearest slot. Headward erosion leads to successive arch collapse. The last arch may be stable for a considerable length of time and is often supported by a surrounding stable surface layer of hardpan ferricrete. A triggering mechanism leads to the breaching of the last arch. Particularly in the case of small sinkholes, the cross-section resembles a bottle neck, a shape which may be maintained for some time.

Environmental risks can never be completely dissociated from the economic risk factors; as there are relative risks and absolute risks to the risks that sinkholes pose to the environment:- With massive urbanisation, sinkholes risk increases due to excessive demand for ground water and subsequent over pumping of water.

- Should a sink hole develop, the impact will have effect as far as the off-site areas affected.
- Different species (macro & micro flora and fauna) will be affected with varying degrees relative to the off-sites affected.
- Pollution to environment, depending on what has been exposed to pollute (e.g. sewer pipes, pesticides, industrial toxic materials) on site.

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1.9 Dolomite Risk Management Policy

A Dolomite Risk Management Strategy refers to the process of using scientific, planning, engineering and social processes, procedures and measures to manage an environmental hazard, and encompasses policies and procedures set in place to reduce the likelihood of sinkholes and subsidence occurring on dolomite land. It is resolved that the structure and content of the Dolomite Risk Management Strategy should serve to meet the legal obligations of the Ekurhuleni Metropolitan Municipality with respect to safe development of dolomite land and the management of the associated risks. The Dolomite Risk Management Section is tasked with establishing and maintaining a Dolomite Risk Management Strategy and supporting systems.

1. The Dolomite Risk Management Section is authorised to select, from time-to time, the relevant standards and specifications to be adhered to in land use planning, infrastructure design, construction, maintenance and mitigation of dolomite risk,etc.

2. The Municipality maintain a Dolomite Risk Management Strategy to ensure sustainable development and the safety of its inhabitants.

3. Dolomite risk management is to be undertaken in accordance with current industry Standards. Applications in terms of land control legislation will be consistent with and give effect to the principles contained in the Dolomite Risk Management Strategy.

4. The Dolomite Risk Management Section should develop procedures for controlling of the approval process for Site Development Plans in dolomite areas.

5. Building inspectors of the Building Control Office shall apply the Dolomite Risk Management Section's policy requirements, standards and precautionary measures in areas underlain by dolomite.

6. Regular meetings should be convened between the Dolomite Risk Management Section and the Building Inspectors operating in dolomite areas, preferably on a three monthly basis. The purpose of these meetings is to exchange information concerning problems encountered by inspectors, technical and policy matters.

7. Individual home owners, organisations managing private developments such as Bodies Corporate and Section 21 companies shall be responsible for risk management on their properties. With respect to Bodies Corporate and Section 21 Companies it is resolved that structures are created for this risk management process and data to be reported to the Ekurhuleni Metropolitan Municipality at time-intervals to be determined by the Dolomite Risk Management Section from time-to-time.

8. The dolomite areas of the Ekurhuleni Metropolitan Municipality are mapped in terms of hazard zones. These hazard maps are a fundamental part of the Dolomite Risk Management Strategy and will be maintained and updated to appropriate levels over time to ensure safe, sustainable development.

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9. Development in the dolomite areas of the Ekurhuleni Metropolitan Municipality is to be appropriate in terms of the hazard zonation of these sub-regions.

10. The Dolomite Risk Management Section is authorised to select, from time-to-time, those standards, guidelines and specifications that pertain in this regard.

11. Development planning, development types and densities will be in accordance with the hazard zonation of the dolomite areas of the Ekurhuleni Metropolitan Municipality and will take cognisance of current standards and specifications identified by the Dolomite Risk Management Section of the Ekurhuleni Metropolitan Municipality.

12. The Dolomite Section is to create and maintain a dolomite risk management database which stores relevant cadastral (including topographic, road networks, infrastructure networks, land uses, etc), geophysical, borehole, geological, geohydrological data (including groundwater compartments, groundwater

CONCLUSION

This research has revealed the challenges that the Ekurhuleni Metropolitan Municipality is facing with respect to Dolomite. Damage to property and loss of life has been recorded in the Municipality as a result of this hazard. In spite of this there is an increasing pressure to provide more housing on dolomite land. Urbanization and affordability of housing is one of the influences that created and formed informal settlement. Dolomite is very soluble and that is the reason why it dissolves easily when contacted with water. Rainwater and percolating ground water gradually dissolve in the rock over time as it seeps through joints, fractures and fault zones in the rock. The dissolution of the dolomite gives rise to caves resulting in catastrophic ground movement on the surface and this pose adverse consequence to human settlements and environmental pollution. However, in spite of this problem, thorough settlement restructuring and planning efforts are now being made to set up integrated human settlement on Dolomite soils. This is with the development of an innovative Dolomite Risk Management Policy of 2013. The management of disasters in dolomite areas shall take cognisance of dolomite risk management requirements and applicable standards.

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