Construction Trends in Strategic Management

WORKERS' SAFETY ON CONSTRUCTION SITES: USE OF PPEs IN LESOTHO

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Abstract
This paper presents the findings of a study that focus on the safety of construction workers. The study explored the poor use of personal protective equipment (PPE) by construction workers in Lesotho. The aim of the study was to identify and assess the causes of poor usage of PPE on project sites in Lesotho in order to suggest practical solutions to them. The primary data for the study were collected through direct site observations and face-to-face interviews with construction workers and their site managers in Lesotho. Given that textual data do not lend itself to statistical analysis, thematic analysis was used for producing the results of the study. The study reveals that inadequate enforcement of regulations, unfounded attitude towards H&S and non-availability of PPE forms the major reasons for their poor usage by workers on project sites. These imply that inspection functions related to regulations must be addressed while contracting parties should see investment in PPE as money spent wisely for the business. In other words, PPE can prevent injury and fatalities on construction sites of workerds, as it is evident from practice that its optimum usage is crucial to saving workers in the event of an accident during construction.

Keywords: Construction, Health and Safety, Workers, Lesotho

1 Introduction

The construction industry in the global context has a poor health and safety (H&S) record and Lesotho is no exception. The construction industry has been closely linked to the economy of a country and is often a good indicator of the state of an economy (James et al., 2012). This is also applicable in Lesotho where the construction industry is an important player in the economy and in spite of the numerous constraints facing the industry in developing countries; it makes significant contributions and plays a vital role to economic growth. The construction industry is a challenging environment to work in, and the industry has been associated with high risks where workers are exposed to tough and hazardous situations. For example, workers have to work with dangerous tools, plants and equipment on a daily basis and as a result every construction worker is likely to be temporarily unfit to work at some stage in their life as a result of moderate injuries or health problems caused by working on a construction site.

Although industrialisation and advances in technology in recent decades have made inroads into the construction industry, the industry is still very much dependent on human resources to perform the physical work required on a construction site. It is therefore imperative that the health and safety (H&S) of workers are taken into consideration. This consideration will be beneficial as it will save the employer a lot of time and money that would have been spend managing an accident that occurred due to poor H&S on site. If the construction industry and the economy of a country are so closely linked, then it makes economic sense to care for the people active in the industry (Dainty et al., 2007). It should also be noted that the cost of managing accidents is higher than the cost of prevention; therefore H&S should be viewed as a profit centre by contractors and their employers (Smallwood, 2004).

The international construction management literature also alludes to the fact that H&S is part of employers' legal, moral and management obligation because it is an investment, a cost saver, and productivity promoter (Reese, 2008). From a business point of view, accidents affect the bottom line of projects since the economic impacts of site accidents add direct and indirect costs to projects. In fact, the construction H&S literature is full of evidences that finger management failure is a major cause of injuries and accidents in the workplace (Choudhry and Fang, 2008). The lack of PPEs at work can be likened to be a form of management failure, which engenders workplace fatalities, injuries and diseases (Cavazza and Serpe, 2009). In the context of this research, management failure pertains to either non issuance of required PPE to workers or non-enforcement of the use of the PPE by workers. The problem statement of the research is therefore predicated on evident poor use of PPEs by workers on construction project sites in Lesotho, especially in Maseru. To unravel the problem, three questions were used to drive the research. The questions include:

- What is the attitude of employers towards the Health and Safety (H&S) of construction workers in Lesotho?
- Why do construction workers in Lesotho proceed with construction site activities without the required Personal Protective Equipment (PPE)?
- What role should clients and the government in Lesotho play to ensure that construction workers' H&S are not compromised?

2 Literature Review

Occupational H&S is neglected in sub-Sahara Africa (Puplampu and Quartey, 2012) where H&S performance appears to be poorer in comparison to developed countries (International Labour Organization (ILO), 2003). This view is partly because of the lack of resources in developing countries that has constrained H&S performance (Kheni at al., 2007) and this is obvious in sub-Sahara Africa where Lesotho is located. In addition, the inadequate legal and institutional arrangements for management of H&S have compounded the problem of H&S performance in developing countries (Kheni et al., 2007). Other contributors to poor H&S performance include a lack of effective mechanisms to implement legislation and regulations (Alkilani et al., 2013), the lack of infrastructure, equipment and rampant corruption and lack of concerted effort by policy makers to address H&S (Kheni et al., 2007). In addition, the industry is also labour intensive and utilises people for physical conversion processes on site even for tasks that may be hazardous (ILO, 2005). The industry in developing countries is dominated by small and medium contractors and most of these do not have effective systems to manage H&S (Kheni et al., 2007). Protecting people through PPEs is therefore mandatory on project sites.

2.1 Personal Protective Equipment

PPE refers to protective clothing, helmets, goggles, or other garment or equipment designed to protect a construction worker's body from injury by blunt impacts, electrical hazards, heat, chemical hazards, and infections. In South Africa, the construction regulations (2003) urge the use of PPEs to reduce employees' exposure to hazards where administrative controls are not feasible or effective in reducing these exposures to acceptable levels (Republic of South Africa, 2003). To ensure a safe and effective use of PPE by employees, a PPE programme should be designed and implemented. The implementation will always elicit reactions from workers who are directly involved in physical work on sites. The reaction of workers to unsafe working conditions is however dependent on whether they identify the condition as “unsafe” or not. Hosseinian and Torghabeh (2012) summarise the issues as:

- The worker does not identify the unsafe condition; therefore there is no risk and hazard consideration by the worker. Some unsafe conditions cannot be identified such as not-human-related conditions or human factors violation. Human factors violation may lead to injuries namely cumulative trauma disorders, carpal tunnel syndrome, fatigue and overexertion.
- The worker identifies the unsafe condition and recognizes the related hazards; the reaction might be ‘safe act’ meaning one would quit the task until the unsafe condition is modified or one could disregard the unsafe condition and continue the task (unsafe act). The reasons of failure to identify unsafe conditions and also the reasons that worker continue the task after identification of unsafe condition should be investigated by management.

H&S climate also affect the use of PPEs by workers (Cavazza and Serpe, 2009). Please see Cooper (2001) for a discussion on H&S climate in relation to organisational systems, leadership, risk control systems, H&S auditing, training and behaviour in the workplace. Cavazza and Serpe (2009) observe that organisational H&S concern, senior managers’ H&S concern, and supervisors’ attitudes towards H&S tend to be positively associated with the individual ambivalence level in terms of the use of PPE. In brief, the poor use of PPEs is indicative of the elements of poor management of construction H&S (Tam et al., 2004).

2.2 Attitudes towards Construction Health and Safety

Despite efforts to effectively prevent and control the cause of accidents in the construction industry, the problem of H&S in the industry is still a cause of great concern (Health and Safety Executive (HSE), 2003). Much of this concern can be minimised with the active involvement of the client, which will ultimately result in less incidents and accidents on site. Enshassi and Mayer (2004) state that if construction sites are to become safer, the major task is to change people’s attitude. In practise, for example, not all clients pay great attention to H&S management because of other business objectives such as profitability, schedule and quality (Zeng et al. 2004). Issues of H&S are rarely addressed by owners, engineers and contractors during the construction planning and execution processes (Rowlinson, 2004).

Thus, striving for enhanced H&S performance in Lesotho will remain elusive if the client is not actively involved in solutions. Huang and Hinze (2006) argue that the involvement of clients or owners is an essential requirement for the achievement of the zero harm goals. Other researchers have also recognised the importance of the client in the management of H&S. Suraji et al. (2001) noted that construction H&S can be successfully influenced by clients. To emphasise the point that clients are very important in the management of H&S, Suraji et al. (2001) argue in their paper on accident causation that construction accidents are caused by inappropriate responses to certain constraints in the environment. They observed for example that the client responses are the actions or failure to act in response to constraints that emerge during the development of a project. According to them, these include reducing the project budget, adding new project criteria, changing project objectives and accelerating the design or construction efforts of the project. These perceptions are reinforced by clients who abdicate their roles and put on H&S responsibilities on contractors.

Increasing research findings are beginning to highlight the gaps in enforcements (Geminiani and Smallwood, 2008). In essence, regulations alone are not a panacea in dealing with the challenges of H&S in the construction industry. Trained manpower also has a role to play in dealing with the matter. At the moment, anecdotal evidence suggests that there is a competency deficit in the sector in Lesotho. Most contractors do not have trained personnel who understand the complexity of issues on the construction site and are able to come up with interventions. Though it would be unfair to paint all contractors with one brush, as some contractors may have employed competent H&S practitioners and the situation of those contractors would be better than those who do not have competent practitioners; contractors that lack competent H&S practitioners are the ones that have high potential to accommodate failures. It would also be good for the economy of Lesotho, if contractors whose H&S performance is poor learn from best practices. One of such best practice is the provision of required PPEs for workers on project sites.

Nevertheless, a proactive management of H&S requires the use of an approach that is not dependent on the monitoring of injuries after they occur (lagging indicators of performance) (Hinze, 2005). Rather than basing H&S actions on measures of failure, a shift in thinking is needed whereby the focus is on actions that can lead to good H&S performance (leading indicators of performance) (Hinze, 2005). The attitude of leaders plays an important role in cultivating a good H&S culture. As an illustration, a good leader will ensure that workers have all required protections in the form of PPEs while working on site.

3 Research Methodology

Qualitative research explores the attitudes, behaviour and experiences through interviews and focus groups. It aims to obtain rich perceptions from participants. As it is attitudes, behaviour and experiences which are important, fewer people take part in the research, but the contact with people yields expected rich data (Ritchie et al., 2014). Moreover, qualitative research focuses on meaning, language and cultural experiences in social context. This approach is concerned with understanding particular situations, rather than generalizing findings, so the method used in this study is analyses of interviews, and recorded observations (Thomas, 2011). Thus, face-to-face interviews that were preceded by on site observations were used to collect the responses to the research questions. Site observation is necessary to visually establish how construction workers use PPEs on site in Lesotho. Although pictures were prohibited in the sites, the researcher was able to identify poor use of PPEs on the selected sites and several other sites visited in 2014. Figure 1 is indicative of the extent of the problem in Lesotho. The picture was taken on a construction site in Maseru, Lesotho. The picture is one of the random construction site pictures obtained for the study. The interviewees include 12 construction workers in four project sites, four contractors in charge of the four project sites, and a represented of the Department of Labour (DoL) in Maseru, Lesotho. The interviewees were therefore 17 and for a qualitative study, the number is reported to be enough for data analysis (Thomas, 2011). In conformance to qualitative research tradition, the interviewees were purposively selected by visiting construction sites in which work activities were on going in Maseru (Tracy, 2013). The 17 interviewees were asked 10 open ended questions with the use of a protocol that was designed based on the research questions presented in section 1. The interview protocol is enclosed as annexure 1 at the end of this paper. The length of industry exposure of the interviewees ranges from 2 to 44 years. The interviewees hold certificates, diplomas and degree qualifications, and they were all fluent in the use of English Language, which makes the interviews less problematic. The textual data from the interviews were analysed thematically as shown in the discussion of the findings in section four of this paper.

4 Findings and Discussion

As mentioned earlier, interview data were collected and the analysis of the data provides the basis for the results in this section. The perceptions of the interviewees concerning the PPE issues are herein discussed in the next sub sections.

Figure 1. Illustration of poor use of PPEs in Lesotho construction (Source: Authors)

4.1 Attitude towards construction H&S in Lesotho

In response to questions related to the above mentioned theme, the interviewees from the DoL confirm that construction H&S is a priority in Lesotho as there are regulations that mandate stakeholders to fulfil their responsibilities. For example, he noted that employers have to advocate for optimum H&S compliance when appointing contractors. This employer interest motivates the contractors to exercise H&S effectively. The interviewed contractors also commented on the theme. According to the contractors in Lesotho the attitude of the employers regarding H&S are positive, this can be witnessed by the H&S practices that are carried out. As a good practice, the contractors mentioned the induction that is done for every worker regardless of their time in construction industry, as all sites are different and have a wide range of hazards that change as the site develops. They emphasised that every site has a specific induction and provides information on the current hazards of the site and provides the site rules. The inductions facilitate the type and use of PPEs on sites. The contractors also highlight that the DoL takes interest in how inductions are conducted on project sites.

It is however notable that the response of the interviewed workers is at variance with that of the contractors. The workers response regarding the attitude of employers is that employers do not care about their safety as they do not always go on site to check if the contractor exercises H&S according to the H&S plan that the contractor presented to the client. So the contractors take the advantage of safety of the workers because they are aware that follow ups are made infrequently or not even made at all. The workers says that there are some instances when safety officers are not on site, yet the regulations clearly state that there should always be H&S officer to check the workers processes to ensure they follow safety precautions. The workers confirm that inductions have to be made regularly irrespective of whether workers are newly employed or already have experience in construction as every project is unique. Every induction is specific to its site; it provides relevant information on the current hazards and informs workers on the rules for the specific site. It therefore inform on the type of PPE to be used by workers on each site. In brief, the interviewed workers say that in Lesotho inductions are not always done.

4.2 Possible reasons for poor use of PPEs in Lesotho

In response to poor use of PPE, the DoL representative says that it is not possible for workers to work on site without proper PPE as the contractors are aware of the consequences they face if they do not make it a point that PPE is available for workers. Moreover the DoL representative added that due to the fact that H&S officers are always on site, it is not easy for workers to work unprotected. This perception of the DoL representative clearly differs from that of the interviewed worker.

When the interviewed contractors were requested to comment of the poor use of PPE, they all agreed that PPE is required and compliance is mandatory. Although one interview flag gaps in the compliance aspect, he was of the opinion that PPE should be a compelling factor in terms of conditions of tender and supervising engineers should not permit work without it. The interviewee further says that inspections by the DoL should endeavour to close the compliance gaps. Even on-site audits by contractors should also be used by contractors to see where gaps lie. In their responses, most workers mention that PPE is not a standard measure as mentioned by the contractors because if it happens that they provide full PPE to the workers on arrival they do not make replacements when the PPE is no longer in good conditions. It is not possible for H&S officers to check workers' H&S compliance as they are not always present on construction sites. This is another gap that negates the intent of compliance. In the workers opinion with regards to compliance in terms of PPE use, the regulating bodies should have regular audits or inspections to check the construction sites, H&S officers should conduct toolbox talks on site to make workers aware of the risks involved in construction activities. It is important to note that PPE use cannot be compromised.

4.3 The role of the regulator of construction H&S in Lesotho

In Lesotho there are regulations that are solely government responsibilities to implement in the construction industry. Moreover the government responsibility through DoL organises inspections on construction sites to make a follow up on rules and regulations compliances. For non-compliant contractors, the group of DoL in inspection process draw up the report and give warning to the contractor and allow the contractor some time to rectify the mistakes observed, when the regulatory bodies come to make a follow up and find the situation to not be rectified, the contractor is taken to the courts of law. Clients in Lesotho are forced by law to take H&S as an important factor when choosing a competent contractor to carry out their projects. Clients when choosing the contractor look at their H&S plans and their reputation in H&S matters. This mechanism is in place so that clients do not award tenders to contractors with a bad reputation in H&S. The interviewed contractors confirm the response of the DoL representative. They opine that as required by law, clients are required to take a major role in construction H&S. In Lesotho the government sets the regulations and the clients ensure that the contractors are executing their work according to the regulations. Clients initiate this process by awarding the contract to the contractor with a good H&S plan, workers compensation insurance cover, and evidence of good reputation in H&S matters. Moreover, the interviewees note that the DoL ensures construction workers H&S by setting regulations and organising site inspections to ensure compliance by contractors.

The analysis of the responses from the workers show that they agree that there are regulations in Lesotho that are said to be governing the construction sector, but there is nothing done by the government to ensure compliance. There are workers who agree that the inspectors from the DoL do conduct inspections while others say they do not. If the main issue is to strive for zero accidents in construction all the on-going construction sites should be checked. On the part of the client, the workers say it seems in most cases clients do not take initiative in relation to H&S issues. According to them, this is why contractors take advantage of workers by not ensuring the good working conditions in terms of PPEs.

5 Conclusion and Further Research

Construction work on various sites is not only people intensive, but it could also be highly dangerous. Completion of tasks without the usage of required PPEs is not in the interest of workers, their employers, and the industry. This exploratory Lesotho study that focus on PPEs provides answers to the research questions of section 1 by pinpointing the reasons for poor use of PPEs in Lesotho through the perceived attitudes of employers in the construction industry. The study also flags the role of the DoL in this context. As illustrated in section 4, the interviewed workers are concerned about matters related to attitudes towards construction H&S in Lesotho. Whereas the DoL representative portrays the image that all is well, the contractors noted compliance gaps and the workers were unanimous about implementation and enforcement gaps. The study reveals that construction workers in Lesotho may proceed with construction site activities without the required PPEs due to either limited or total lack of requisite site inductions and inadequate H&S site supervision – no H&S officer on site.

These perceptions indicate that the government of Lesotho through the DoL should play a more active role to ensure compliance. When the responses from the DoL representative is reflected upon, one arrive at a conclusion that there are disconnections / misalignments between what is happening on various construction site as attested by the workers and what the regulator view as the status quo in Maseru, Lesotho. It is therefore suggested that:

- The government should establish a system to allow for constant monitoring and evaluation of the steady and careful application of the regulations by DoL officers to ensure that duties are executed with due diligence.
- The DoL should also ensure that a competent person inspects construction project sites at suitable and regular intervals to ensure complete compliance.
- Clients should improve their interest in H&S and appoint contractors that provide proper programmes that are consistent with national regulations to ensure the H&S of workers, especially in relation to PPEs.
- Employers and contractors should explore the costs for PPE measures and explicitly include it as part of tendering and costing for project execution.
- Contractors should ensure that PPEs are checked at regular intervals to ensure that they remain fit for purpose and site supervisors should not abdicate their H&S role by allowing the execution of work on site by workers that do not make use of required PPE.
- Workers should also wear PPE properly either as directed by their employer or in compliance with the instructions of the person in control of the construction site.
- Worker should also take care of the equipment; refrain from misuse of the equipment and most importantly, report defects and problems to their supervisors.
- Workers at a construction site have a right to proper information regarding their safety before they start of on a project. This information should be obtainable in a language that they can understand. In other words, inductions as mandated by the law must be properly conducted on project sites and it must include the basics such as the compulsory usage of PPEs.

6 References

Alkilani, S.Z., Jupp, J. and Sawhney, A. (2013) Issues of construction health and safety in developing countries: a case of Jordan. *Australasian Journal of Construction Economics and Building*, Vol. 13(3), pp. 141-156.

Cavazza, N. and Serpe, A. (2009) Effects of safety climate on safety norm violations: exploring the mediating role of attitudinal ambivalence toward personal protective equipment. *Journal of Safety Research*, Vol. 40(4), pp. 277-283.

Choudhry, R.M and Fang, D. (2008) Why operative engage in unsafe work behavior: investigating factors on construction sites. *Safety Science*, Vol. 46(4), pp. 566-584.

Cooper, D. (2001) *Improving safety culture: a practical guide*. Hull, Applied Behavioural Sciences.

Dainty, A.R.J., Green, S. and Bagilhole, B. (2007) *People and Culture in Construction: A Reader*, London, Spon Press.

Enshassi, A and Mayer, E (2004). *Analysis of construction site injuries in Palestine*. In: S Rowlinson (ed.) Construction safety management systems, London, Spon Press, pp. 73-80.

Geminiani, F. & Smallwood, J. (2008) A critical review of the effectiveness of the Department of Labour (DoL) Occupational Health and Safety(OH&S) Inspectorate in relation to the construction industry in South Africa. *Acta Structilia*, Vol. 15(2), pp. 1-28.

Health and Safety Executive (2003) *Causal factors in construction accidents*. Research report 156, Norwich, HSE.

Hinze, J. 2005. *A paradigm shift: leading to safety*. In: Haupt, T.C and Smallwood, J.J. Eds. Rethinking and Revitalising Construction Health Safety, Environment and Quality, Port Elizabeth, 17-20 May. Walmer.

Hosseinian, S.S. and Torghabeh, Z.J. (2012) Major theories of construction accidents causation models. *International Journal of Advances in Engineering & Technology*, Vol. 4(2), pp. 53-66.

Huang, X. and Hinze, J. 2006. Owner's role in construction Safety: guidance model. *Journal of Construction Engineering and Management*, Vol. 132(2), pp.174-181.

James, P.M., Rust, A.A.B. and Kingma L. (2012). The wellbeing of workers in the South African construction industry: A model for employment assistance. *African Journal of Business Management*, Vol. 6(4), pp.1553-1558

International Labour Organization (2003). *Safety in Numbers: Pointers for a Global Safety Culture at Work*. Geneva, Switzerland.

International Labour Organization (2005). *Number of Work related Accidents and Illnesses Continues to Increase*. ILO/WHO Joint Press Release. Bank Regions.

Kheni, N.A., Dainty, A.R.J. and Gibb, A.G.F. (2007). Influence of political and socio- cultural environments on health and safety management within SMEs: a Ghana case study. In: Boyd D (Ed) *Proceedings of the 23rd Annual ARCOM Conference*, 3-5 September 2007, Belfast, UK, Association of Researchers in Construction Management, 159-168.

Puplampu, B.B. and Quartey, S.H. 2012. Key issues on occupational health and safety practices in Ghana: a review. *International Journal of Business and Social Science*, Vol. 3(19), pp. 151-156.

Reese, C.D. (2008) *Occupational health and safety management: a practical approach*. 2nd ed. Boca Raton, CRC Press.

Republic of South Africa (2003) *Construction Regulations*. Government Gazette No. 20095. Pretoria: RSA.

Ritchie, J., Lewis, J., Nicholls, C.M. & Ormston, R. (2014) *Qualitative research practice: a guide for social science students and researchers*. 2 ed. London, Sage.

Rowlinson. S. (ed.) (2004) *Construction safety management systems*, London, Spon Press.

Smallwood, J.J. (2004). The influence of clients on contractor health and safety (H&S). In: Khosrowshahi, F (Ed.), *20th Annual ARCOM Conference*, 1-3 September 2004, Heriot Watt University. Association of Researchers in Construction Management, Vol. 2, 1095-105.

Suraji, A., Duff, R.A., and Peckitt, J.S., 2001. Development of causal model of construction accident causation. *Journal of Construction Engineering and Management*, Vol. 127(4), pp. 344-34

Tam, C.M., Zeng, S.X. and Deng, Z.M. (2004) Identifying elements of poor construction safety management in China. *Safety Science*, Vol. 42(7), pp. 569-586.

Thomas, G. (2011) *How to do Your Case Study: A guide for students & Researchers*. London, Sage.

Tracy, S.J. 2013. *Qualitative research methods: collecting evidence, crafting analysis, communicating impact*. Chichester, Wiley-Blackwell.

Zeng, S.X., Tam, C.M. and Deng, Z.M (2004). *Construction site safety in China*. In: S Rowlinson (ed.) Construction safety management systems, London, Spon Press, pp. 49-66.

Annexure 1 - The Interview Protocol

Part 1: What is the attitude of employers to the H&S of construction workers in Lesotho?

1. Is H&S a priority in construction projects in Lesotho?
2. Is there a health and safety officer always on project sites?
3. Are the workers inducted for health and safety purposes on project sites?
4. Who is responsible and accountable for health and safety on project sites in Lesotho?

Part 2: Why do construction workers proceed with site activities without required personal protective equipment (PPE) in Lesotho?

1. Is PPE a standard measure for H&S on construction projects in Lesotho?
2. Does the health and safety officer ensure compliance in terms of the usage of required PPE on project sites in Lesotho?
3. Based on your experience in Lesotho, what can be done to control or assure compliance in terms of PPE use on project sites?

Part 3: What role should clients and the government in Lesotho plays to ensure that construction workers' H&S are not compromised?

1. What are the contributions of the various government structures with regard to health and safety compliance on project sites in Lesotho?
2. As a major client of the construction industry, to what extend has the government of Lesotho work to limit exposure of workers to health and safety hazards in the sector?
3. Do the inspectors from government departments check the extent of compliance with health and safety on in construction projects?

FACTORS THAT INFLUENCE REAL ESTATE PROJECT INVESTMENT: PROFESSIONALS' STANDPOINT

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Abstract

Studies have shown that a number of significant factors influence property value in different real estate markets around the world. These factors affect real estate stakeholders' decisions and the economy in general. Due to the uniqueness and heterogeneous nature of the property market, this study aims at identifying and examining the significant factors that influence property value adopting Lagos, Nigeria, as a representative case. This study was carried out in two phases. First, a systematic review of studies focused on factors affecting property value in Lagos, Nigeria and other real estate around the world was conducted. Twenty factors which are peculiar to the study area were identified from the review and used to design the survey instrument. The questionnaire was administered electronically to experienced real estate professionals practicing in the Lagos metropolis property market selected from the 2014 membership directory of Nigerian Institution of Estate Surveyors and Valuers (NIESV). The professionals ranked the factors in the order of significance based on their perception. The data collected was analysed to establish the mean score of each attribute which signifies their relative importance to property value determination. Out of the 20 identified attributes, only six are highly significant to real estate investment value in the Lagos metropolis. They include location, neighbourhood characteristics, property state of repair, property size, and level of security in the neighbourhood and age of property. These highly significant attributes when accorded outmost consideration by all real estate stakeholders when embarking on property investment in the study area, will yield profit maximization.

Keywords: Lagos metropolis, Nigeria, Property attributes, Real estate investment, Valuers

1 Introduction

The importance attached to real estate properties by different property market participants cannot be overemphasized. This is because of the contribution of real estate properties to the economy of a nation as well as the wealth of an investor (individual or corporate) and also serve as an edge against inflation. Real estate property can be held as an investment goods and as consumption (i.e. owner-occupier) (Chin and Chau, 2002). The composition of numerous unique characteristics embedded in a real estate property is responsible for the complex nature of this class of investment (Rosen, 1974; Sirmans et al., 2005). To buttress this, Tse and Love (2000), Mbachu and Lenono (2005), Selim (2008), amongst others have conducted studies in different real estate markets and found that the value of a real estate property is determined by a bundle of independent variables and this complexity affects the value attached to each variable by different stakeholders.

Since the products of the construction industry is largely consumed by the real estate sector (Mbachu, 2003), consequently, assessing the factors that affect this class of investment from the viewpoint of real estate professionals that are knowledgeable about the homebuyers' demand (taste and preference) is appropriate. Therefore, the intuitive knowledge of the property market of an experienced real estate valuer should not be ignored in real estate related investments (Aluko, 2007). In other words, valuers' judgement on the significance of the property characteristics is noteworthy and all stakeholders (existing and stakeholders) should consider this when making real estate investments decisions.

Studies (Ajide and Kareem, 2010; Aluko, 2011; Babawale et al., 2012; Famuyiwa and Babawale, 2014) carried out in Lagos, Nigeria, posited that the attributes that determines the value of a real estate property can be estimated using the 'scientific' approach, whereas, the process of property valuation involves both 'art' and 'science' (Azmi et al., 2013). Besides, the results of these studies may be untenable when a critical event occurs (Rosenhead, 1989), for instance, the global economic meltdown. Hence, a different approach is being adopted in this study, which aims to evaluate valuers' judgement on the significance and importance of property attributes that influence the value attached to real estate property investments in the Lagos metropolis.

This study concurrently identifies from literature and evaluates the variables that influence real estate investment project in Nigeria's megacity. The findings of this current research will be useful to all built environment professionals, academics as well as real estate investors, it will provide an overview of the most significant factors that should be considered when investing in the Lagos metropolis. The next section of this paper presents an overview of property value determinants followed by the presentation of the methodology adopted for the research. The following section presents the results and discussion, while the conclusion and further research is presented in last section.

2 Property Value Determinants – Review of Literature

Different studies have been conducted by scholars in real estate markets around the world to establish the peculiar attributes that influence real estate investments in their property markets. The need for market specific studies could be attributed to the differences in the cultural, legal, financial and economic setting of each country (Olayiwola et al., 2005), which makes the value of real estate investment to be influenced by location, location, location (Li et al., 2011).

In order to develop a comprehensive list of attributes that influence real estate property investments in the Lagos metropolis, the determinants of property value in the Lagos metropolis were identified from published articles retrieved from online databases and search engines and were reviewed. A total of 20 independent attributes were found to be significant in the studies retrieved for review (see Table 1). Table 1 shows that the 'availability of neighbourhood security' is a reoccurring theme in six out of the seven studies focused on the Lagos metropolis property market. It is reasonable to suggest that this variable is the most significant factor determining property value in the Lagos metropolis. Further, a review of similar studies carried out in other real estate markets was conducted in order to identify a comprehensive list of attributes that influence property values from the literature and to compare with the situation in the Lagos metropolis.

Table 1. Lagos metropolis studies

Property attributes	**Olayiwola et al. (2005)**	**Bello and Bello (2007)**	**Ajide and Kareem (2010)**	**Babawale and Johnson (2012)**	**Babawale et al. (2012)**	**Oloke et al. (2013)**	**Famuyiwa and Babawale (2014)**
Location		✓					
Accessibility to place of work	✓	✓	✓				
Accessibility to CBD	✓						
Accessibility to public transport facility	✓		✓				
Proximity to highway						✓	
Accessibility to School				✓			
Accessibility to shopping mall				✓			
Neighbourhood characteristics	✓					✓	
Availability of neighbourhood security		✓	✓	✓	✓	✓	✓
Availability of electricity		✓					✓
Availability of pipe borne water supply			✓		✓		
Availability of waste disposal system			✓				✓
State of repair of the property		✓					
Size of property				✓			
Age of the property		✓					
Numbers of bedrooms				✓	✓	✓	
Number of bathrooms/toilets			✓	✓	✓		
Building characteristics				✓			
Availability of security fence					✓		
Size of bedroom					✓	✓	

From Table 2 it can be seen that the most significant factor that influences property value in other real estate markets is property size. It occurred seven out of the nine studies which depicts that home seekers in these markets place more emphasis on the size of a property, when making real estate property decision. A comparison of the Lagos property market studies with these of other real estate markets reveal that property attributes influencing value are location- specific, which necessitates the need for market segmented studies.

Table 2. International studies

Property attributes	Mbachu and Lenono (2005)	Choy et al. (2007)	Ge and Du (2007)	Selim (2008)	Zietz et al. (2008)	Pozo (2009)	Anim-Odame et al. (2009)	Sanjari (2012)	Baltagi et al. (2015)
Location	✓		✓			✓	✓		
Accessibility to place of work									
Accessibility to CBD								✓	
Accessibility to public transport facility	✓	✓							
Proximity to highway									
Accessibility to School									
Accessibility to shopping mall									
Neighborhood characteristics									
Availability of neighborhood security	✓								
Availability of electricity									
Availability of pipe borne water supply				✓					
Availability of waste disposal system	✓								
State of repair of the property									
Size of property		✓	✓	✓	✓	✓	✓	✓	
Age of the property									
Numbers of bedrooms	✓		✓	✓			✓		
Number of bathrooms/toilets					✓	✓			✓
Building characteristics	✓			✓	✓				✓
Availability of security fence	✓								

3 Research Methodology

In literature, quantitative modelling technique has been used to assess the effect of property attributes on property value (Murie, 1998). However, survey research approach was adopted in this study. The need to collect data on the perception of real estate professionals (a large study population) on the attributes that influence property value in the Lagos metropolis (a large study area) makes survey research approach well suited for this study. This is corroborated by the assertions that can be found in Easterbrook et al. (2008). It is argued that the preference of this research approach in built environment disciplines can be linked to the need for generalization, hypothesis testing and comparative analysis (Laryea and Leiringer, 2012; Phua, 2013).

The Lagos metropolis was chosen as the study area for this research. Lagos has been adjudged as a megacity by the United Nations due to large population and the volume of commercial activities that takes place in the city of Lagos (Lagos State Government, 2015). In addition, a large majority of multinational companies operating in Nigeria have their head-offices located within Lagos (Babawale and Oyalowo, 2011) and the city is the most vibrant real estate market in Nigeria (Oni, 2010). Ibiyemi and Tella (2013) points out that over 50% of registered real estate professionals and firms are practicing and domiciled in Lagos; therefore, it is reasonable to suggest that Lagos metropolis is a justified choice.

In consonance with suggestions put forward in Murie (1998), it was recommended that for housing studies, retrieving information from real estate professionals is important. Hence, the respondents of this study are professional members of the Nigerian Institution of Estate Surveyors and Valuers (NIESV). NIESV is empowered by Decree No. 24 of 1975 of The Laws of the Federal Republic of Nigeria, to regulate real estate professionals in Nigeria. Being a professional member of NIESV means that such a person has acquired the minimum academic qualification, experience and professional expertise to practice as a real estate professional. Out of the 1794 registered members in the 2014 NIESV membership directory, a stratified random sample of 150 valuers practicing in Lagos metropolis who had email addresses in the directory were selected for the study. This is in line with suggested sample sizes in similar previous studies (See for instance Kauko (2007); Adewunmi and Olaleye (2011); Ameyaw and Chan (2015)).

The list of attributes generated and presented in Table 1 was used to design an online questionnaire which was administered on the respondents. The first section of the questionnaire focuses on the demographic details of the respondents while the second section consist the attributes which the respondents were asked to rank in the order of importance on a five-point Likert scale. The scale adopted is from 1 - 5 representing highly insignificant - highly significant, respectively.

The electronic questionnaire was sent to the valuers and they were expected to respond within two months. An additional one month extension was granted at the expiration of the initial two months and this was done to increase the response rate. At the end of the survey period, an effective response rate of 35% was recorded. This is above the common margin of 20-30% obtainable in the similar studies (Akintoye and Fitzgerald, 2000).

The mean scores (MS) was adopted in ranking the attributes in order to establish their level of significance, due to its appropriateness for studies of this nature (Adair et al., 1996). The MS was estimated using the formula in Equation (1). However, in an attempt to categorise the Relative Importance of the attributes, the following criteria was adopted:

Highly significant = MS of 4.00 and above, Significant = MS of between 3.50 and 3.99 Slightly significant = MS of between 3.00 and 3.49 and Insignificant = MS of less than 3.00

$$\mathrm{MS} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{N} \tag{1}$$

Where n is the score given by valuers based on a five-point scale of 1 to 5 and N is the number of valuers that rated an attribute.

In order to confirm the reliability of the data collected, the Cronbach's alpha test was conducted to establish the internal consistency of the responses. Oyedele (2013) posit that the Cronbach alpha if item/attribute deleted means that the deletion of such item will result to an improved reliability of the data. This was conducted to measure the effective contribution of each attribute to the overall data.

4 Analysis and Results

Results from the data analysis revealed that 67% of the professionals have acquired at least Bachelor of Science degree, 33% have obtained Higher National Diploma, while none possess neither High School Certificate nor a Doctor of Philosophy degree. At the same time, 44% of the valuers have working experience ranging between 6-10years, 33% have 0-5 years of industry experience, 17% have experience of between 11 and 15 years, in addition, 6% have 15 years and above years of experience. The characteristics of the respondents suggest that they are well informed and conversant with the real estate industry.

The Cronbach's alpha value of 0.843 was recorded for all the attributes which shows a high level of internal consistency that is above the minimum acceptable value of 0.70 as posited by Hair et al. (2010). The Cronbach's alpha if item is deleted for the attributes ranges between 0.822 (size of bedroom and accessibility to place of work) and 0.841 (state of repair of property), all these values are less than that of the overall Cronbach's alpha value (0.843). This connotes a significant contribution of all the attributes to the internal reliability of the data and they were therefore, all retained for the analysis.

Table 3. Ranking of property value determinants

Factors	Mean Score	Overall ranking	Criticality
Location	4.92	1	H. significant
Neighborhood characteristics	4.31	2	H. significant
State of repair of the property	4.23	3	H. significant
Availability of neighborhood security	4.06	4	H. significant
Size of property	4.06	4	H. significant
Age of the property	4.00	5	H. significant
Numbers of bedrooms	3.98	6	Significant
Number of bathrooms/toilets	3.90	7	Significant
Availability of electricity	3.81	8	Significant
Accessibility to place of work	3.79	9	Significant
Accessibility to CBD	3.75	10	Significant
Building characteristics	3.75	10	Significant
Availability of security fence	3.73	11	Significant
Availability of pipe borne water supply	3.65	12	Significant
Accessibility to public transport facility	3.62	13	Significant
Size of bedrooms	3.60	14	Significant
Proximity to highway	3.56	15	Significant
Availability of waste disposal system	3.38	16	S. significant
Accessibility to School	3.15	17	S. significant
Accessibility to shopping mall	3.13	18	S. significant

Note: H. significant is highly significant and S. significant is slightly significant.

Information in Table 3 shows that the MS of the attributes ranges between 4.92 and 3.13, that is for property location and accessibility to shopping mall, respectively. Based on the evaluation indices set earlier, out of the 20 attributes, six are highly significant to real estate property investment in the Lagos metropolis, 11 are significant, three are slightly significant, while none of the attribute is insignificant.

5 Discussion

Location as a property attribute has been widely examined in real estate research. Property location has been proven to significantly influence property value in different real estate markets around the world as reported by McCluskey et al. (2000), Kauko (2003), Ge and Du (2007), amongst others. This variable was ranked as most highly significant in the Lagos metropolis, which conforms to existing literature, suggesting that homebuyers will consider the location a property when making residential decisions.

The second highly significant variable in this study is neighbourhood characteristics. Which suggest that homebuyers in the metropolis consider the characteristics of a neighbourhood when making real estate decisions. This was established in the studies of Han et al. (2002), Kauko (2003) that homebuyers are willing to pay a premium for a property situated in a neighbourhood characterised with pleasant features. This conforms to the study of Iroham et al. (2014) that found that neighbourhoods that are characterised with modern buildings designs, good roads, ocean view, building constructed with modern building materials commands higher property value.

Gallimore et al. (1996), Clark and Herrin (2000), Amenyah and Fletcher (2013) reported that homebuyers prefer to buy or rent a property located in a safe neighbourhood. Indicating that security of lives and properties is paramount to real estate consumers. This is the same case in the Lagos metropolis as reported in Table 3, where neighbourhood security is ranked as highly significant determinant of property value.

The state of repair of a property which defines the finishes and aesthetics of a property is also ranked amongst the highly significant attributes in this study. As documented by Mbachu and Lenono (2005) that the state of repairs of a property in terms of finishes, beauty, design, etc. is a significant real estate property value determinant. This means that a real estate property in a good state of repairs, will command a higher value when compared to these in a bad state of repair.

Homebuyers belong to different socio-economic and cultural class. Their income, needs and taste may influence the amount they may be willing to pay for a property. On the other side, the bigger the size a of property, the higher the construction cost, which will be reflected in the property value (Ge and Du, 2007). This is also the position of Owusu-Ansah (2012) that argued that the bigger the size of a property, the higher the value of such property. The review conducted by **Sirmans et al. (2005)** also revealed that property size significantly influenced property value in 42 out of the 52 occurrences of the attributes in studies. This is the case in the Lagos metropolis as discovered in this study. The attribute has a MS of 4.06 which makes it highly significant to real estate property value formation.

As documented by Chin and Chau (2002), the age of a property has a significant influence on its value, but this relationship is negative. Meaning that as the age of a property increases, so will the value of the subject property be decreasing. The explanation for this is that as a property gets older, the components begin to wear and tear and there may be need for some level of refurbishment, renovation or repairs and all these comes at a cost which may not be associated with similar new property. Therefore, a rational homebuyer will be willing to pay the added premium on the value of a newer building than an old one. This is evident in the Lagos metropolis property market as the attribute was ranked highly significant to property value, as this is also the case in other real estate markets (Choy et al., 2007); Tse, 2002).

6 Conclusion and Further Research

Due to the complexity of the real estate markets and especially that of a megacity, this research was embarked on to establish the critical determinants of real estate property value, which in turn affects real estate investments in the Lagos metropolis, Nigeria. A review of the literature was conducted in order to develop a comprehensive list of real estate property value determinants in the Lagos metropolis and in other real estate markets around the world. A questionnaire was designed by utilizing these twenty retrieved attributes. The questionnaire was administered on experienced real estate professionals practicing in the study area for them to rank these attributes according to their level of importance and significance. It was found that six out of the twenty attributes significantly influence real estate property value in the Lagos metropolis real estate market and in their order of importance they include property location, neighbourhood characteristics, state of repair of the property, availability of neighbourhood security, size of property, and age of property. Although none of the attribute was ranked as insignificant, the remaining variables were either found to be significant or slightly significant. The goal of every real estate investors and built environment professionals acting as property investment advisors is to maximize profit, therefore, these highly significant attributes should be considered as important criteria when making investment decisions in the real estate sector in Lagos, Nigeria. The findings of this study will ensure that real estate property is developed in such a way that it will meet the taste and preference of the targeted real estate consumers, which will consequently result in profit optimization.

This survey focused on the Lagos metropolis property market, however, a country-wide survey will provide a broad overview of the determinants of real estate property value in other cities in Nigeria. This will be useful to existing and prospective real estate investor as it will show what homebuyers in different real estate markets prefer and are willing to pay for.

It is of essence to indicate at this point that this research is a pilot study to a bigger research targeted at modeling the Lagos metropolis real estate market. The list of property value attributes generated in this study are peculiar to the study area and will be employed as the explanatory variables for the development of artificial intelligence models for the Lagos metropolis property market. Artificial intelligence modeling techniques that have proven to be reliable and accurate for property value modeling, have received much attention in other real estate markets but have not in the Nigerian real estate research domain, will be experimented in the metropolis.

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8 References

Adair, A., Berry, J. and McGreal, S. (1996). Valuation of residential property: Analysis of participant behaviour. *Journal of Property Valuation and Investment, 14*(1), 20-35.

Adewunmi, Y. A. and Olaleye, A. (2011). Real estate research directions and priorities for Nigerian institutions. *Journal of Real Estate Practice and Education, 14*(2), 125-140.

Ajide, B. K. and Kareem, I. (2010). Hedonic analysis of residential housing market in a third world city: A preliminary investigation. *The Social Sciences, 5*(6), 520-524.

Akintoye, A. and Fitzgerald, E. (2000). A survey of current cost estimating practices in the UK. *Construction Management & Economics, 18*(2), 161-172.

Aluko, B. T. (2007). Examining valuer's judgement in residential property valuations in metropolitan Lagos, Nigeria. *Property Management, 25*(1), 98-107.

Aluko, O. (2011). The effects of location and neighbourhood attributes on housing values in metropolitan Lagos. *Ethiopian Journal of Environmental Studies and Management, 4*(2), 69-82.

Amenyah, I. D. and Fletcher, E. A. (2013). Factors determining residential rental prices. *Asian Economic and Financial Review, 3*(1), 39-50.

Ameyaw, E. E. and Chan, A. P. C. (2015). Risk ranking and analysis in PPP water supply infrastructure projects. *Facilities, 33*(7/8), 428-453.

Anim-Odame, W., Key, T. and Stevenson, S. (2009). Measures of real estate values from land registration and valuation systems in emerging economies: The case of Ghana. *Journal of Real Estate Literature, 17*(1), 63-84.

Azmi, A. S. M., Nawawi, A. H., Ab Latif, S. N. F. and Ling, N. L. F. J. (2013). Property valuers' receptive level on knowledge of computer aided valuation (CAV) system. *Procedia-Social and Behavioral Sciences, 105*, 734-744.

Babawale, G., Koleoso, H. and Otegbulu, C. (2012). A hedonic model for apartment rentals in Ikeja area of Lagos metropolis. *Mediterranean Journal of Social Sciences, 3*(3), 109-120.

Babawale, G. K. and Johnson, O. (2012). The specification of hedonic indexes for duplexes in Lekki peninsular area of Lagos metropolis. *Elixir Social Science, 45*, 7689-7698.

Babawale, G. K. and Oyalowo, B. A. (2011). Incorporating sustainability into real estate valuation: The perception of Nigerian valuers. *Journal of Sustainable Development, 4*(4), 236-248.

Baltagi, B. H., Bresson, G. and Etienne, J. M. (2015). Hedonic housing prices in Paris: An unbalanced spatial lag pseudo-panel model with nested random effects. *Journal of Applied Econometrics, 30*(3), 509-528.

Bello, M. O. and Bello, V. A. (2007). The influence of consumers behavior on the variables determining residential property values in Lagos, Nigeria. *American Journal of Applied Sciences, 4*(10), 774-778.

Chin, T. L. and Chau, K. W. (2002). A critical review of literature on the hedonic price model. *International Journal for Housing Science and its Applications, 27*(2), 145-165.

Choy, L. H., Mak, S. W. and Ho, W. K. (2007). Modeling Hong Kong real estate prices. *Journal of Housing and the Built Environment, 22*(4), 359-368.

Clark, D. E. and Herrin, W. E. (2000). The impact of public school attributes on home sale prices in California. *Growth and Change, 31*(3), 385-407.

Easterbrook, S., Singer, J., Storey, M.-A. and Damian, D. (2008). Selecting empirical methods for software engineering research. In F. Shull, J. Singer and D. I. K. Sjøberg (Eds.), *Guide to advanced empirical software engineering* (pp. 285-311). London: Springer.

Famuyiwa, F. and Babawale, G. K. (2014). Hedonic values of physical infrastructure in house rentals. *Journal of Facilities Management, 12*(3), 211-230.

Gallimore, P., Fletcher, M. and Carter, M. (1996). Modelling the influence of location on value. *Journal of Property Valuation and Investment, 14*(1), 6-19.

Ge, X. J. and Du, Y. (2007). *Main variables influencing residential property values using the entropy method–the case of Auckland.* Paper presented at the 5th International Structural Engineering and Construction Conference, Shunan, Japan.

Hair, J., Black, W., Babin, B., Anderson, R. and Tatham, R. (2010). *Multivariate data analysis* (7th ed.). New Jersey: Prentice-Hall.

Han, S., Yu, M. S., Malone-Lee, C. L. and Basuki, A. (2002). Dynamics of property value distribution in an Asian metropolis: The case of landed housing in Singapore, 1991-2000. *Journal of Property Investment & Finance, 20*(3), 254-276.

Ibiyemi, A. and Tella, E. (2013). Critical issues in economic risks consideration by commercial property investors and valuers in Nigeria: The case of Lagos. *International Journal of Emerging Science and Engineering, 1*(12), 35-43.

Iroham, C., Durodola, O., Ayedun, C. and Ogunbola, M. (2014). Comparative study of rental values of two gated estates in Lekki peninsula Lagos. *Journal of Sustainable Development Studies, 5*(2), 218-235.

Kauko, T. (2007). An analysis of housing location attributes in the inner city of Budapest, Hungary, using expert judgements. *International Journal of Strategic Property Management*, *11*(4), 209-225.
Kauko, T. J. (2003). Residential property value and locational externalities: On the complementarity and substitutability of approaches. *Journal of Property Investment & Finance, 21*(3), 250-270.
Lagos State Government. (2015). Population. Retrieved 3rd March, 2015 from http://www.lagosstate.gov.ng/pagelinks.php?p=6.
Laryea, S. and Leiringer, R. T. F. (2012). *Built environment research in West Africa: Current trends and future directions.* Paper presented at the West Africa Built Environment Research (WABER) Conference, Abuja, Nigeria. 24 - 26 July.
Li, C. W., Wong, S. K. and Chau, K. W. (2011). An analysis of spatial autocorrelation in Hong Kong's housing market. *Pacific Rim Property Research Journal, 17*(3), 443-462.
Mbachu, J. I. and Lenono, N. (2005). *Factors influencing market values of residential properties.* Paper presented at the Queensland University of Technology Research Week International Conference, Brisbane, Australia. 4-8 July.
Mbachu, J. I. C. (2003). *A critical study of clients' needs and satisfaction in the South African building industry*. (Doctoral dissertation), The University of Port Elizabeth, South Africa.
McCluskey, W. J., Deddis, W. G., Lamont, I. G. and Borst, R. A. (2000). The application of surface generated interpolation models for the prediction of residential property values. *Journal of Property Investment & Finance*, *18*(2), 162-176.
Murie, A. (1998). Uncertainty and fragmentation: Social aspects of housing studies. In A. J. H. Smets and T. Traerup (Eds.), *Housing in Europe: Analysing patchworks* (pp. 21-32). Utrecht: Danish Building Research Institute, Utrecht University.
Olayiwola, L. M., Adeleye, O. A. and Oduwaye, A. O. (2005). Correlates of land value determinants in Lagos metropolis, Nigeria. *Journal of Human Ecology, 17*(3), 183-189.
Oloke, C. O., Simon, F. R. and Adesulu, A. F. (2013). An examination of the factors affecting residential property values in Magodo neighborhood, Lagos state. *International Journal of Economy, Management and Social Sciences, 2*(8), 639-643.
Oni, A. O. (2010). *Harnessing real estate investment through decision process for selecting tenants in Nigeria.* Paper presented at the 10th African Real Estate Society Conference, Naivasha, Kenya. 26th-29th, October.
Owusu-Ansah, A. (2012). Examination of the determinants of housing values in urban Ghana and implications for policy makers. *Journal of African Real Estate Research, 2*(1), 58-85.
Oyedele, L. O. (2013). Avoiding performance failure payment deductions in PFI/PPP projects: Model of critical success factors. *Journal of Performance of Constructed Facilities*, *27*(3), 283-294.
Phua, F. T. (2013). Construction management research at the individual level of analysis: Current status, gaps and future directions. *Construction Management and Economics, 31*(2), 167-179.
Pozo, A. G. (2009). A nested housing market structure: Additional evidence. *Housing Studies*, *24*(3), 373-395.
Rosen, S. (1974). Hedonic prices and implicit markets: Product differentiation in pure competition. *The Journal of Political Economy, 82*(1), 34-55.
Rosenhead, J. (1989). Introduction: Old and new paradigms of analysis. In J. Rosenhead (Ed.), *Rational analysis for a problematic world: Problem structuring methods for complexity, uncertainty and conflict* (pp. 1-20). Singapore: John Wiley and Sons.
Sanjari, H. (2012). Estimation of the hedonic pricing function for housing units (A case sudy

of Hashtgerd New Town, Iran). *International Business Management, 6*(6), 676-679.
Selim, S. (2008). Determinants of house prices in Turkey: A hedonic regression model. *Doğuş Üniversitesi Dergisi, 9*(1), 65-76.
Sirmans, S. G., Macpherson, D. A. and Zietz, E. N. (2005). The composition of hedonic pricing models. *Journal of Real Estate Literature, 13*(1), 1-44.
Tse, R. Y. (2002). Estimating neighbourhood effects in house prices: Towards a new hedonic model approach. *Urban Studies, 39*(7), 1165-1180.
Tse, R. Y. and Love, P. E. (2000). Measuring residential property values in Hong Kong. *Property Management, 18*(5), 366-374.
Zietz, J., Zietz, E. N. and Sirmans, G. S. (2008). Determinants of house prices: A quantile Regression approach. *The Journal of Real Estate Finance and Economics, 37*(4), 317-333.

WORKERS' PERCEPTIONS REGARDING HEALTH AND SAFETY (H&S) PRACTICES IN THE NIGERIAN CONSTRUCTION INDUSTRY

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Abstract
Construction projects are reputed for their poor H&S record when compared to other industries. This can be attributed to an uncontrolled working environment, risk, workers' behaviour in relation to H&S commitment, cultural and religious beliefs, and uncertainties inherent in projects. These expose workers, engaged in productive activities on construction projects, to hazards, and risks, which result in fatalities and other injuries. The aim of this study is to explore the perceptions of workers regarding H&S and how they relate to their behaviour on construction sites. The study employed a largely qualitative research approach. Various construction workers (ironworkers, masons, carpenters, roofers, and electricians) were interviewed on sites in Lagos State, Nigeria. The findings of the study reveal that workers view productive activities on construction sites as hazardous and risky. However, H&S practices are viewed by workers as unimportant. This perception may also be attributed to their socio-economic realities, cultural and religious beliefs, and inadequate training. Therefore, it is vital for the government and stakeholders in the construction industry in Nigeria to establish localised H&S certifications, policies, and awareness through traditional and religious organisations so as to foster commitment to H&S on construction sites. Further research is needed to understand the training needs of workers in the Nigerian construction industry.

Keywords: Health and Safety, Nigeria, Perceptions, Workers

1 Introduction

The construction industry is generally viewed as an accident-prone industry. Studies on H&S in the field of construction management reiterate the poor H&S performance on construction sites as a global phenomenon (Zhou *et al*., 2013).

Previous studies have shown that poor H&S practices among workers significantly contribute to the poor H&S performance reported in construction-related studies (Haslam *et al*., 2005; Choudhry and Fang, 2008). Also, complexities experienced in the industry due to changing technology, construction methods, clients' demands, construction materials and the changing environment have made hazards and risk controls difficult (Odeyinka *et al*., 2006). Thus, there is an obvious need to improve H&S practices on construction sites.

The need to have a shift in H&S culture within the construction industry is imperative to ensure work is carried out in a healthy and safe manner. According to the International Labour Organisation (ILO, 2005), an estimated 2.3 million people die every year from work-related accidents and diseases and there are 313 million non-fatal accidents per year. Furthermore, 30% of workers suffer from musculoskeletal disorders and more than 20%-40% of work-related deaths occur on construction sites in industrialised countries. In the United Kingdom (UK), 31% of all occupational related deaths dated in 2002/2003 were from the construction industry (Haslam *et al.*, 2005). Chi and Han (2013) also state that on every work day, more than three workers do not return home due to fatalities experienced on construction sites in the United States of America (USA). Similarly, South Africa had fatalities and accident rates of 19.2 and 14 626 per 100,000 workers respectively. This is said to be lower than that of sub-Saharan countries estimated at 21 and 16 021 per 100 000 workers respectively (cidb, 2008). Cokeham and Tutesigensi (2013) note the high accident rate in Rwanda, and the increase in other sub-Saharan countries. Based on the aforementioned, it can be seen that poor H&S performance within the construction industry is a global problem.

H&S problems lead to poor performance of construction projects (Hinz, 1997). Studies have demonstrated that accidents are associated with increased operation costs due to poor productivity, cost of medical care for victims, loss of person hours, absenteeism, and an adverse impact on the image of the organisation (Hinze, 1997; Willkins, 2011). These losses suggest the need to establish effective ways to reduce accidents on construction sites. Willkins (2011) further relates the high rate of injuries and deaths to workers' non-compliance with H&S procedures, inadequate training, and inadequate knowledge of H&S practices. Thus, this necessitates the need for a study to understand how workers view H&S practices in the construction environment.

As highlighted in the opening paragraph, arguments and evidence indicates that the construction industry has a poor H&S record. Despite the fact that Nigeria is a member of the ILO, H&S provisions and conventions are not properly implemented (Umeokafor *et al.*, 2014). This is aligned to the assertion by Idoro (2008) that there are no policies prescribed for H&S in the Nigerian construction industry, therefore contractors and workers are left to use their discretion. This may be accountable for the poor productivity (Khosravi *et al*., 2014) when workers execute work in an unhealthy and unsafe environment. Furthermore, it is known that research provides a body of knowledge that guides a discipline. A review of past-published and unpublished studies in construction management-related disciplines in Nigeria and the West-African region reveal that H&S related research has been limited (Laryea and Leiringer, 2012; Ejohwomu and Oshodi, 2014). However, it should be noted that a study focused on the difference in health, safety and environment practices of construction companies; the relationship between compliance to regulations and the incidence of fatalities on construction sites in the Nigerian construction sector as reported in Windapo and Jegede (2013). Therefore, the objective of this study is to explore H&S perceptions on construction sites.

2 H&S Practices in the Nigerian Construction Industry

The Nigerian construction industry is not immune to the H&S problems of the construction industry. There are no adequate records of construction accidents (Idoro, 2004) or statistics of fatal accidents, disabilities due to construction accidents and deaths (Mohamed *et al*., 2009). Although there is no statistical data, the number of buildings that collapsed (Olusola, 2013) during construction in several parts of the country over the years points to the existence of poor H&S practices.

In addition, the construction industry lacks adequate H&S regulations and if available, they do not apply to the construction industry (Idoro, 2008). This is similar to other developing countries such as Pakistan (Mohamed *et al.*, 2009). This has prompted stakeholders such as contractors, supervisors, workers, and professionals to use their discretion to address H&S issues on construction sites. Furthermore, non-enforcement of statutory regulations and legislation, poor governance, and inadequate infrastructure has limited the progress of H&S in developing countries (Idoro, 2004; Idoro, 2008; Mohamed *et al*., 2009). In addition, the existing framework is not tailored to meet the immediate need of the industry. There is also a lack of support from the government, a lack of concern from professional institutions, corruption in the system, and low levels of education of employees (Idubur and Oisamoje 2013; Umeokafor *et al*., 2014). These challenges have an unfavourable effect on implementing H&S best practices in the construction industry. The effects are poor project performance, poor quality of executed works and unethical practices (Cokeham and Tutesigensi, 2013). Therefore, understanding workers' perceptions on H&S practices and integrating best practices for H&S in the Nigerian construction industry could significantly improve the construction industry.

2.1 Improving H&S Performance in the Construction Industry

Implementing H&S best practice on construction sites can be challenging. This may be due to the migration of workers, method of worker employment, work standards, different backgrounds and experience (Mohamed *et al*., 2009). H&S is of little concern in developing countries because H&S issues are considered after the accident has occurred and the industry is driven by the profits to be made (Priyadarshani *et al*., 2013; Windapo, 2013). Agumba, Pretorius and Haupt (2013) define H&S management as "tangible practices, responsibilities and performance related to H&S, including the association between H&S management, climate and culture." They categorise H&S practices into five basic elements, namely top management commitment and involvement in H&S, employee involvement and empowerment in H&S, project supervision, project H&S planning and communication in H&S and H&S resources, and training. Their study reveals that employee involvement and empowerment in H&S are regarded as irrelevant. It was recommended that workers should be engaged at the project level to improve H&S performance on construction sites. However, H&S management techniques should be tailored to meet the unique needs of the worker.

Researchers such as Cheng *et al*. (2004), Cheng *et al.* (2012), and Ismail *et al*. (2012) opine that limiting human errors will reduce accidents, which can only be achieved by employing H&S management best practices on site. When the system is driven positively to reduce hazards and risks, workers will adopt good behaviours to foster positive commitment to H&S. Smallwood (1995) maintains that management commitment to H&S is reflected in the organisation's values, policy, goals, programme development, resource allocation, behaviour modeling, and injury analysis. Thus, understanding how workers perceive H&S may lead to valuable insights that can be determined to improve on-site construction H&S.

Windapo and Jegede (2013) are of the opinion that fatalities, injuries, and deaths are mainly caused by unsafe and unhealthy practices of contractors and workers. Contractors prefer to spend less on PPE, employ less experienced workers for cheap labour and care only for the profits to be made. Similarly from a qualitative survey, Khosravi *et al*. (2014) identified 8 main categories of factors that influence workers' unsafe and unhealthy behaviours on construction sites. These factors include society, organisation, project management, supervision, contractor, site conditions, work group, and individual characteristics. Workers' perceptions of risk, H&S management, H&S regulations and procedures have been linked to their attitude towards H&S on construction sites (Mohamed *et al*., 2009). The aforementioned study reveals that workers have a self-rated competence and their behaviour relates to their own H&S responsibilities.

3 Research Methodology

This study is part of an on-going study on construction workers' H&S practices on construction sites. The objective of the qualitative study is to explore workers' perceptions on H&S practices in the construction industry. Qualitative methods process variables as an exploration of ideas and concepts. It is inductive by giving detailed descriptions and interactions between the inquirer and the respondent at their natural state. This method was adopted because it is adequate for a small sample size (Levy & Henry, 2001; Creswell, 2012). To obtain the data for the study, a semi-structured interview was employed. The interview questions were designed based on the literature review conducted prior to the actual data collection. The data provides actual words of the respondents, hence adequate to achieve deeper insights into the problems being explored. The findings of Baradan and Usmen (2006) determine that roofers, iron workers, electricians, painters, and masons were more at H&S risk and ranked highest in fatalities when compared to other work trades in the construction industry. Based on this finding, a worker from each of the trades was selected and interviewed. The small size of respondents (interviewees) was to allow an in-depth discussion and for the workers to fully express their ideas without restrictions.

The questions were structured to allow the respondents to discuss their general impression of H&S on site, work environment, and how work is conducted in a healthy and safe manner. All ethical issues were addressed such as formally requesting to visit and interview the respondents, explaining the purpose for the research, and requesting for the workers' consent based on a voluntary decision to be interviewed. The interviewees selected are outsourced employees of contracting firms. The contracting firms selected for this study are registered with the Nigerian Institute of Building (NIOB). There are 191 construction firms registered with the NIOB. Ninety-two (92) of these firms are based in Lagos. The selected firms were those undertaking projects at the time of the research. Further questions were asked to prompt discussions in relevant areas during the interview. The interviews were recorded with permission, and were conducted in local languages before translating into English, then transcribed. The interview sessions were conducted during the lunch breaks and after-work hours. This was because two of the workers interviewed, preferred to be interviewed after work. Their ages, educational status, and years of experience were noted.

3.1 Interviewees' Characteristics

Table 1. Characteristics of the interviewees

Interviewee code	Trade	Gender	Age	Highest Qualification	Years of experience
R1	Roofer	Male	Adult	Primary education	10
R2	Ironworker	Male	Adult	Secondary education	16
R3	Electrician	Male	Adult	Trade school certificate	13
R4	Painter	Male	Adult	Secondary education	9
R5	Mason	Male	Adult	Primary education	9

The interviewees (Table 1) were all male adults between the ages of 30-49 and they all had more than 8 years' work experience, which indicates adequate work experience to provide responses that reflect actual practices on construction sites. The interviewees have been engaged in several projects ranging from engineering works (dam, road, and bridge construction) and building structures (residential and commercial buildings). This reveals that the interviewees' had varied work experiences on different construction sites. This will enhance the quality of the responses on H&S. Of the five respondents, only one had a trade school certificate. The other four were primary and secondary school leavers; they all learned their trade through informal training, i.e. working as an apprentice until they were set to work on their own.

4 Findings and Discussion

4.1 Workers' Trade Union

Interviewee R2 and R5 are members of their Trade Unions. The benefits as members are basically for welfare purposes. They can easily access loans and receive help in the case of any dispute. However, their responses were similar stating that contractors do not entertain unionism on construction sites. This was made clear by the following statements: *"I am a union member because when I need help they will help me. We make monthly contributions as members and we get information about work easily." "I was a union member when I was on permanent employment with a big company as a union member; we fight for our wage increase or when they don't treat us well." "When I get employed for work on any site, I do not tell them I am a union member because you may not get the job; they say as union members we fight always."*

4.2 Management Commitment to H&S / Employee Involvement in H&S

Although the interviewees did not attest to any onsite H&S policies, regulation or rules, interviewees perceived that some managers were committed to their wellbeing while others were not. According to R*3, "Most of the sites I have worked have different types of managers and with different behaviour. Some will make your work easy because they want good work done" and "others will make you work and work making you accomplish some impossible workload as a day's job because they want to save money."* Management commitment to H&S was perceived by the interviewees as not sufficient. They are of the opinion that H&S is not important on most sites according to *R2: "Where I worked, they don't say anything about H&S."* However, *R3* is of the opinion that *"We were taught how to keep our environment clean after work so that your work will be neat and also the site."* Getting involved with H&S on site depends on the Management. However, due to workers' level of education, most workers prefer not to get involved with Management *R1: "we are not as educated as they are so we just work."* The workers prefer to do their work and get paid their wage. Furthermore, management does not have respect for the workers as indicated by an interviewee. He (*R1*) is of the opinion that management is more concerned about work rather than their H&S; *R5: "But some managers do not see us workers as human beings. I am saying this because the man* (i.e. the contractor's representative) *was more concerned about the work being done right rather than about us." R3: "Managers, engineers and supervisors talk to us with disrespect. This often occurs especially when the work is delayed."*

All the interviewees gave accounts revealing that the management of contracting firms was not committed to implementing H&S during the construction stage. Responses from interviewees above included managers who expected workers to carry out tasks that cannot be accomplished within the time frame allotted to the task. Their concern as stated above implies management's poor H&S commitment on construction sites. However, workers do not see H&S as a priority.

4.3 H&S Training

Interviewees indicated that H&S training is generally not conducted on construction sites as suggested by R5: "There is nothing like H&S meetings or training since I started working with this contractor" and R4: "I do not know anything about H&S training." They have not attended any H&S training. Therefore, the workers regarded H&S training as unnecessary to their work. They are of the opinion that, H&S officers are not available on site, H&S meetings were not conducted, and communication was through the supervisors and foremen. R1: "The management does not involve us in any meeting so that we can talk better; they mostly talk with our foremen. The foremen will now pass the information down to us."

As regards to PPE, the interviewees indicated that they were familiar with some PPE such as goggles, ear plugs, hand gloves, helmet (hard hat), boots, reflective jackets, and overalls. However, the use of PPE was not regarded as important or necessary. Interviewees expressed their opinions - R3: "Some of the PPE were not durable; they were of low quality and these contractors buy them to reduce cost", and R2: "They give me hard helmet and boots, only a pair." This indicates that management does not commit adequate resources to H&S and do not care about the H&S of their workers. In addition, workers do not understand the need to wear H&S equipment due to various reasons as indicated by some of the interviewees; R4: "PPE in this hot weather! The weather is too hot to wear them; it makes me very uncomfortable, I will be sweating." R5: "It is only when the client and other professionals are coming to site for inspection that my manager will bring them out and insist we wear helmets, boots and overalls." R1: "The helmet and overall are not necessary. I like using the hand gloves. I do not think I really need it for my job." However, others indicated that some managers they have worked with insisted they use PPE as reported by R3: "I have worked on sites where the managers will insist we use our PPE."

4.4 Workers' Perceptions of Risks

The workers were further asked if they were aware of the degree of risk and hazards related to their work and how accidents are reported on site. Some of the workers affirmed that working on construction sites involves risk. However, they have worked long enough on the job to avoid accidents; they know the "*tricks on the job.*" Interviewee *R1* views risk in this way: *"Every job has a risk, if no risk then no money. It is not easy to climb on a roof and work; the higher it is, the more the money. I have been doing this job and I am still alive; I think when you are afraid that is when you fall."* They believed they are safe. Others believed they are at risk only when their supervisors or managers insist on a method which they are not familiar with and they try not to get afraid. *R5*: "*My boss tells me to do some work and I do the work the best way I can. I feel safe. I am a man I cannot be afraid of my work. I like my work". R2* and *R4* have a similar view: *"For me, when something wants to happen it does happen and you cannot stop it. It is just God or our forefathers that is keeping us safe because we have to provide for our families." We just have to do the job"; "I just pray to God to help me do my work well and not to get injured."* Accidents, according to one of the respondents *"Happen every day, you just have to be careful. Some days you may be unlucky and other days you are not, and if you get injured often you may not be employed again"* and that *"Reporting accidents depends on the seriousness of the accident. Managers handle serious cases, and accidents are investigated with help from the foremen or supervisors. When an accident leads to death the families are compensated, but I do not know if the police get involved."*

The qualitative results provide evidence of the lack of management commitment to H&S and the lack of respect towards workers in the Nigerian construction industry. These have affected the effective management of H&S within the Nigerian construction industry. Hence, the poor H&S practices on construction sites. In addition, workers are not involved in H&S in the organisation, which may be a major contributing factor to inadequate policy formation and implementation especially with respect to H&S in the construction industry in developing countries.

The findings of this study reveal that the activities of workers' unions are limited on construction sites. The unions are not adequately represented on construction sites in Nigeria. Furthermore, if trade unions are fully established, they could be a platform to promote H&S on construction sites and engender management commitment and workers' involvement in H&S. This is buttressed by the findings of various studies regarding how unions and union workers have contributed to improving H&S on construction sites in various countries (see Debobeeleer, 1990: Ulubeyli *et al.*, 2014). In addition, workers are aware of the risks and hazards associated with work. This is different from the findings of Ulubeyli *et al.* (2014) which suggest that workers are not aware of the risks or hazards on construction sites. However, this study suggests that the workers were more interested in monetary gains, than concern for the risks they were exposed to, and relate accidents to lack of precautionary methods when at work. This may be attributable to the low socio-economic characteristics of the workers, and the existence of 'cheap labour'. Furthermore, risks and hazards, associated with the workers' trades on construction sites, are also viewed within the context of workers' religious beliefs. This result is in agreement with Smallwood's (2002) findings, which demonstrate the link between H&S and religion.

Lastly, the results of the study also raised related questions regarding the available H&S training for workers on construction sites. Workers lack formal H&S training, and do not see the need for any training. This is therefore, an indication that H&S is not a priority to workers and to management. The need for adequate codes of conduct, policy formulation, and implementation in the construction industry in Nigeria is vital.

5 Conclusions and Further Research

The construction work environment is complex and the need to adopt best H&S practices to constantly keep the environment healthy and safe for workers should be adopted. This paper explored the perceptions of workers on H&S on construction sites. The findings of the study reveal that workers view construction activities as hazardous to them, and are more interested in the monetary gains. They have little or no knowledge of what H&S in construction is about due to a lack of H&S training. Consequently, H&S is not considered important. Workers view that the number of years spent in a trade determines the level of risk they are being exposed to, and how to manage it. Also, religion is a determining factor of how risk is perceived and managed. Therefore, the workers expose themselves to avoidable risks. In summary, their perceptions could be linked to management inadequacies in promoting best H&S practices, socio-economic realities, cultural beliefs, and inadequate training. The need to train workers in the Nigerian construction industry should be seen as important and the government needs to establish policies and collaborations with agencies that will foster commitment to H&S on construction sites. Given that the findings are not representative of the total number of workers, it should be seen as a limitation to the study, and therefore cannot be generalised. However, the findings provide insight to stakeholders in the industry as regards H&S. Further research is needed to understand the training needs of workers in the Nigerian construction industry. Construction Managers could plan H&S strategies with foremen to systematically analyse work risks and hazards. This will enable management to improve the H&S climate on projects, and to develop an H&S culture among workers through adequate policy formulation and implementation.

6 References

Agumba, J., Pretorius, J., & Haupt, T. (2013). Health and safety management practices of small and medium enterprises in South Africa construction industry. *Acta Structilia,* 20(1), 66-80.

Baradan, S., & Usmen, M. (2006). Comparative injury and fatality risk analysis of Building trades. *Journal of Construction, Engineering and Management,* 132(5), 533-539.

Cheng, E.W., Ryan, N., & Kelly, S. (2012). Exploring the perceived influence on safety management practices on project performance in the construction industry. *Safety Science,* 50, 363-369.

Cheng, E., Li, H., Fang, D., & Xie, F. (2004). Construction safety management: an exploratory study from China. *Construction Innovation,* 4, 229-241.

Chi, S., & Han, S. (2013). Analysis of systems theory for construction accident prevention with specific reference to OSHA accident reports. *International Journal of Project Management*, 31, 1027-1041.

Choudhry, R., & Fang, D. (2008). Why operatives engage in unsafe work behaviour: Ivestigating factors on construction sites. *Safety Science,* 46, 566-584.

CIDB. (2008). *Construction health and safety in South Africa status and recommendations.* Pretoria.

Cokeham, M., & Tutesigensi, A. (2013). An investigation of construction accidents in Rwanda: perspective from Kigali. *Management, Procurement and Law,* 166(4), 179-187.

Creswell, J.W. (2012). *Educational Research: planning, conducting and evaluating quantitative and qualitative research.* Boston, United States of America: Pearson Education.

Debobbeleer, N. (1990). Safety performance among union and nonunion workers in the construction industry. *Journal of Occupational Medicine,* 32(11), 1099-1103.

Ejohwomu, O., & Oshodi, O. (2014). A review of construction management and economics research outputs in Nigeria: Towards a sustainable future. *Journal of Construction Project Management and Innovation,* 4, 900-905.

Haslam, R., Hide, S., Gibb, A., Giyi, D., Pavitt, T., Atkinson, S., & Duff, A. (2005). Contributing factors in constructon accidents. *Applied Ergonomics,* 36, 401-415.

Hinze, J.W. (1997). *Construction Safety.* New Jersey: Prentice- Hall.

Idoro, G.I. (2004). The effect of globalization on safety in the construction industry. *International symposium on globalization. Construction School of Civil Engineering Asian Institute of Tecnology.* Bangkok,Thailand.

Idoro, G.I. (2008). Health and safety management efforts as it correlates with performance in the Nigerian constructin industry. *Journal of Civil Engineering and Management,* 14(4), 277-285.

Idubor, E., & Oisamoje, M.D. (2013). An exploration of health and safety management issues in Nigeria's effort to industrilize. *European Scientific Journal,* 9(12), 154-170.

International Labour Office. (2013). *The health of workers in selected sectors of the urban economy: Challenges and perspective.* Geneva: Sectorial Activity Department.

Ismail, Z., Doosder, S., & Harun, Z. (2012). Factors influencing the implementation of a safety management system for construction sites. *Safety Science,* 50, 418-423.

Khosravi, Y., Asilian-Mahabadi, H., Hajizadeh, E., Hassanzadeh-Rangi, N., Bastani, H., & Behzadan, A. (2014). Factors influencing unsafe behaviors and accidents on construction sites: A review. *International Journal of Occupational Safety and Ergonomics,* 20(1), 111-125.

Larsyea, S., & Leiringer, R.T. (2012). Built environment research in West Africa: current trends and future directions. In: *Proceedings 4th West African Built Environment Research (WABER) Conference,* Abuja, Nigeria, 24-26 July 2012, 797-804).

Levy, D., & Henry, M. (2001). An analysis of published property research methodologies and methods. *The cutting edge,* 3-11.

Mohamed, S., Ali, T., & Tam, W. (2009). National culture and safe work behaviour of construction workers in Pakistan. *Safety Science,* 47, 29-35.

Odeyinka, H.A., Oladapo, A., & Akindele, O. (2006). Assessing risk impacts on construction cost. In: *Proceedings of the Annual Construction and Building Research Conference of the Royal Institution of Chartered Surveyors,* London, United Kingdom, 7-8 September 2006, 1-13.

Olusola, K.O. (2013). Builders document: preparation of health and safety management plan in relation to building projects. *Annual seminar publication,* 1-14. Ado-Ekiti, Ekiti, Nigeria.

Priyadarshani, K., Karunasena, G., & Jayasuriya, S. (2013). Construction safety assessment framework for developing countries: case study of Sri Lanka. *Journal of Construction in Developing Countries*, 18(1), 33-51.

Smallwood, J.J (2002). Health and Safety (H&S) and religion: Is there a link? In: *Proceedings Triennial Conference CIB W099 Implementation of Safety and Health on Construction Sites.* Hong Kong: Department of Real Estate University of Hong Kong, 7-10 May 2002, 201-206.

Smallwood, J.J. (1995). *The influence of management on the occurrance of loss causative incidents in the South African construction industry.* MSc Dissertation. Construction Management, University of Port Elizabeth South Africa.

Toole, T. (2002). Construction site safety roles. *Journal of Construction Engineering and Management*, 128(3), 203-210.

Torner, M., & Pousette, A. (2009). Safety in construction- a comprehensive description of the characteristics of high safety standards in construction work, from the high combined perspective of supervisors and experienced workers. *Safety Research,* 40, 399-409.

Ulubeyli, S., Kazaz, A., & Er, B. (2014). Health and safety perception of workers in Turkey: A survey of construction sites. *International Journal of Occupational Safety and Ergonomics*, 20(3), 323-338.

Umeokafor, N., Umeadi, B., & Jones, K. (2014). Compliance with occupational safety and health regulation:A review of Nigeria's construction industry. In: *3RD Internationl Conference on Infrastructural Development in Africa.* Abeokuta, 17-19 March 2014.

Wilkins, J.R. (2011). Construction workers perception of health and safety training program. *Construction Management and Economics*, 29, 1017-1026.

Windapo, A.O., & Jegede, O.P. (2013). A study of Health, Safety and Environment (HSE) practices of Nigerian construction companies. *The professional Builder,* 4(1), 92-103.

Zhou, Z., Irizarry, J., & Li, Q. (2013). Applying advanced technology to improve safety management in the construction industry: a literature review. *Construction Management and Economics,* 32(6), 606-622.

IMPACT OF PROJECT MANAGER'S LEADERSHIP COMPETENCES ON COMPLEX MEGA INFRASTRUCTURE PROJECT PERFORMANCE: A LITERATURE REVIEW.

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Abstract
This study aims to establish the impact of project managers' competences in addressing project complexity and enhancing complex infrastructure projects delivery success. The objectives include determining the dimensions and levels of project complexity; delineating the competences required to manage project complexity; establishing an integrative project performance evaluation criterion; and developing a model that validates the impact on infrastructure projects performance by linking the different complexity dimensions with required competences. This study constitutes the conceptual phase of an on-going broader research. Consequently, the methodology used is an integrative review of the existing literature on the key concepts including project management, leadership and complexity. The study's results showed that infrastructure projects are complex adaptive systems, which cannot be adequately managed by controlling tripple constraint factors. Project managers must be flexible, innovative and able to learn and adapt new behavioral patterns, in order to adequately manage the complexity levels and dimensions involved. Additionally, the need for project managers' capabilities to balance between administrative processes, adaptive and generative leadership styles was emphasised. Consequently, a Complexity-Leadership Alignment Model was developed to validate the link between the project manager's leadership competences and ability to deal with different dimensions and levels of project complexity. In conclusion, this study underscores the role played by the project managers' competences in enhancing infrastructure projects delivery success. The limitation is that the findings only illuminate key constructs, which will be empirically tested under the subsequent phases of the study.

Keywords: Mega infrastructure projects, Project complexity, Project leadership, Project management, Project performance

1 Introduction

The role of mega infrastructure projects in the economic development particularly among developing countries, characterised by a myriad of socio-economic challenges, cannot be overemphasised (Srinivasu and Srinivasa Rao, 2013). The underperformance of these infrastructure projects, hence, represents a significant but avoidable loss of economic value (Liu, 2009). In South Africa, the economic profile shows a 5% contribution from construction sector (Statistics South Africa, 2015). South Africa embarked on an infrastructure-focused development policy since the year 2000. This resulted in the rolling-out of mega projects like the Gautrain Rapid Rail system, the Gauteng Freeway Improvement program and the Bus Rapid Transit projects across thirteen cities (Presidential Infrastructure Coordinating

Commission, 2012; Economic Development Department, 2011). The government has also set a target to generate a minimum of two million jobs prioritising skilled, semi and unskilled youth categories from previously disadvantaged groups, by the year 2020 (Development Department, 2011). Intense public sector investment in infrastructure projects was one of the core drivers to create employment and stimulate economic growth through various multiplier effects (Presidential Infrastructure Coordinating Commission, 2012; Economic Development Department, 2011).

The successful delivery of mega infrastructure projects is very critical, as they are largely financed from public funds and, hence, compete for priority with other critical social services. The performance of mega infrastructure projects attracts socio-political interest, which affects the reputation of the organisations involved. Mega infrastructure projects are complex systems, which can neither be easily understood through simple linear approaches, nor effectively managed through controlling efficiency measures of time, cost and quality (Hazy and Uhl-Bien, 2013). The general underperformance of mega infrastructure projects (Murugesan, 2012, Riaz et al., 2014) has, therefore, brought the current delivery processes, approaches and management philosophy under scrutiny (Riaz et al., 2014; Shenhar, 2012).

This study underpins the attribution of project failure to qualitative factors such as the project manager's leadership competences, internal and external complexity and gaps in the project management philosophy (Shenhar, 2012; Thamhain, 2012; Back, 2012; Jacques et al., 2007). Consequently, the aim of this study is to establish the impact of project managers' competences in addressing project complexity and enhancing infrastructure projects delivery success. The objectives include determining the dimensions and levels of project complexity; delineating the competences required to manage project complexity; establishing an integrative project performance evaluation criterion; and developing a model that validates the impact on infrastructure projects performance by linking the different complexity dimensions with required competences. The subsequent sections below is a review of existing literature, focusing mainly on the key study constructs, which include project management philosophy, mega infrastructure project complexity and required project leadership competences. This is subsequently followed by a summary of the main findings and associated conclusions.

2 Literature Review

This section of the paper establishes the different constructs regarding project performance, based on an integrative review of existing literature. The investigation draws from the analysis of the main factors behind project performance, which, as outlined in the preceding sections of this paper, include the gaps in the current project management philosophy, project complexity and project managers' leadership competences.

2.1 Project Management Philosophy

Although project performance has been studied for a long time, there has been no universally accepted definition, measurement criteria or what constitutes project success (Han et al., 2013). Different studies have come up with an inexhaustible list of measurement metrics, which have resulted in inconsistencies in the conclusion. In an attempt to deal with the ambiguity, minimize variability of factors and generate objective measures, a distinction has been made between project success and project management success (Han et al., 2013; Turner and Zolin, 2012).

Turner and Zolin (2012) proffered the need to incorporate the priorities of different project stakeholders when measuring project performance. These different stakeholders' views and priorities vary in time after project completion. Shenhar (2012) underpinned this view by demonstrating that stakeholder judgement of project success has very little to do with the triple constraint factors. This was supported by cases where, despite exceeding planned time and budgets, some projects were still considered to be very successful, while those completed on time and within budgets failed to satisfy the needs of investors. These findings underpinned some of the gaps associated with the performance evaluation criteria used under the traditional project management philosophy.

The narrow focus on project goals associated with traditional project performance evaluation criteria was refuted by Aubry and Hobbs (2010), because of the ambiguities involved. They recommended a broader criteria, which incorporates project delivery impacts on organizational value was recommended. The organisational impact was conceptualized under the economic and pragmatic dimensions (Almahmoud et al., 2012). While the former focuses more on demonstrating the direct economic contribution of projects to the organization's bottom line, the latter focuses on addressing the multifaceted nature of project performance beyond just financial indicators (Aubry and Hobbs, 2010). A balance between the two dimensions was recommended in order to harness both the financial and non-financial contributions that project management brings to organizational success. These successes elements include innovation, new organizational processes and employee and team development, as depicted under the balanced scorecard (Shenhar, 2012).

Almahmoud et al., 2012 distilled that a distinction must be made between success factors and success criteria. The former cover apriori conditions that contribute to positive results, while the latter are used to assess a concrete and measurable result a posteriori (Almahmoud et al., 2012). This view was also upheld by Turner & Zolin (2012) who advanced the need for triangulating performance evaluation criteria to adequately address the multi-faceted nature of projects. Project performance factors were grouped into five categories which include efficiency, impact on the team, impact on the customer, business success, and preparing for the future (Turner & Zolin, 2012). Time dimensions include the short term outputs (immediately after project completion), medium term outcomes (few months after project completion), and long term impacts (evaluated years after project completion) were explored (Shenhar, 2012). This study upholds the comprehensiveness associated with the proposed criteria in addressing the gaps highlighted by Aubry and Hobbs (2010) in the foregoing section. Consequently, this criteria is one of the core elements that will be used to develop a conceptual framework for the subsequent phases of this study.

2.2 Mega Infrastructure Project Complexity

Mega infrastructure projects are, generally, large scale in nature, require huge budgets, and are delivered through complex multiple partnerships between the private and public sectors (van Marrewijk et al, 2008). The delivery of these projects involves integrated project management organizations, which consist of multiple institutions, different skills and multi-disciplinary teams and complex contracts (van Marrewijk et al., 2008).These characteristics make mega infrastructure projects susceptible to uncertainty, political sensitivity and multi-stakeholder interest (van Marrewijk et al., 2008). Consequent to the factors above, these projects are perceived as complex adaptive systems, which need to be well understood and delivered using appropriate competences, to be successfully (Curlee and Gordon, 2011). Based on these key characteristics, this study uses the terms 'mega' and 'complex' interchangeably to refer to large scale infrastructure projects. In South African, projects qualify under this category include the Gauteng Freeway Improvement Program, Gautrain Rapid Rail Link, Medupi Power Station, Bus Rapid Transit (BRT) projects, and so on.

The performance of many mega infrastructure projects has been unsatisfactory (van Marrewijk et al., 2008). Mega infrastructure projects often overrun budgets, fall behind delivery schedules and fail to deliver and fully address the need behind their commissioning (van Marrewijk et al., 2008). For instance the cost of the Gautrain Rapid Rail Link ballooned from R3.5 billion - R30.462 billion between 2000 and 2011 (Fombad, 2013). Causes behind this failure involve different project complexity factors such as magnitudes of team competences, inaccurate budget estimates, delays in critical decisions and approvals, changes in project specifications, diverging stakeholder interests, technological factors, and so on (Fombad, 2013).

2.2.1 Complexity Theory

The field of complexity has been studied over a couple of decades, broadly under Complexity Theory (Curlee and Gordon, 2011). Complexity Theory has a universal application across many disciplines such as mathematics, science, meteorology and social sciences, was born out of Chaos theory (Curlee and Gordon, 2011). There are three dimensions of complexity, which are algorithmic, deterministic and aggregate complexity (Mason, 2001). This study focuses more on aggregate complexity, which is concerned with how the interaction between individual elements in a system propagates complex behaviour. The key attributes of aggregate complexity include relationships between a system's internal structure and the surrounding environment, the resultant learning and emergent behaviour, and the different means by which complex systems change and grow (Hazy and Uhl-Bien, 2013).

A system is defined more by the nature of relationships than its constituent parts (Curlee and Gordon, 2011). Therefore, the capacity of a system is greater than the sum total of its constituent subsystems and elements. This implies that a system can have emergent qualities that cannot be easily traceable by analysing its constituent elements (Curlee and Gordon, 2011). Relationships define, and are influenced by a system's internal structure. Well-connected components form subsystems either sustain or destabilize the system's structure (Curlee and Gordon, 2011; Saywisch, 2010).

It was further distilled that complex systems also owe their existence to how they interact with their external environment (Curlee and Gordon, 2011). They achieve this by actively anticipating change and reacting to it, as well as shaping their environments through learning, referring to history and utilizing existing relationships and subsystems (Curlee and Gordon, 2011). Therefore, systems are not static but constantly evolve through self-organization to better interact with their environments. They also dissipate when they struggle to cope with pressures from the internal and external environmental forces (Hazy and Uhl-Bien, 2013).

Complexity Theory refutes the fundamental project management premise which prescribes rational approaches to simplify phenomena as well as finding "best" linear procedures in solving project challenges (Hazy and Uhl-Bien, 2013). The foundational basis of Complexity Theory is, hence, the notion that order, which is the kingpin of management principles of control, does not allow for sufficient flexibility to deal with all human interactions (Curlee and Gordon, 2011). This study underpins this view by positioning that the success and failure of a project is not only a result of how the triple constraints are managed but rather the outcome of complex interactions among individual elements and the resultant complex behaviour and relationship structures (Curlee and Gordon, 2011).

2.2.2 Complexity and Project Management

Projects by nature operate as complex open systems (Curlee and Gordon, 2011). Consequently, a system can be construed as: "an object which in a given environment aims at reaching some objectives (teleological aspect) by doing an activity (functional aspect) while its internal structure (ontological aspect) evolves through time (genetic aspect) without losing its own identity" (Vidal and Marle, 2008 pp. 1095). It then follows that projects as complex systems are defined by these key systematic characteristics (Vidal and Marle, 2008). This underscores the need for project managers to possess leadership competences that enable them to better understand complex systems so as to effectively and successfully deliver on infrastructure projects (Azim et al, 2010).

Project complexity levels lie on a continuum from control, complicated, complex to chaotic (Remington, 2011). The least complex projects are those where the project manager is in control most of the project processes and inter-relationships, while the most complex are those where there is complete chaos (Remington, 2011). This study opines that projects, as complex systems, are rarely in stable states for project managers to exercise full control, particularly given the dynamic nature of the inter-relationships involved. Consequently, this study posits creativity and innovation among project teams, as being the cornerstones for successful performance as opposed to excessive administrative and control processes. Complexity has further been articulated as "complexity in projects" and "complexity of projects" (Geraldi et al., 2011) and consequently categorised into five types including structural complexity, uncertainty, pace, socio political environment, and dynamics (Remington, 2011).

2.3 Leadership Styles and Project Performance

The failure of infrastructure projects across the globe has brought the efficacy of traditional project management tools, practice and competences under scrutiny (Ren et al, 2012). Human factors were highlighted as the main determinants of projects performance (Jiang, 2014; Zhang and Fan, 2013). Research accentuated that most engineering practitioners are trained to be reactive (and largely in relation to management of the triple constraint) and, consequently, are under-equipped to deal with complexities associated with infrastructure construction projects (Riaz et al., 2013). Different leadership competences have been established, resulting in a variety of theories and models (Dinh et al., 2014; Murugesan, 2012). However, this nomenclature has not been conclusive enough to establish a solid theory. The absence of such a theory, which adequately empirically links leadership with project success, represents a gap in the existing literature which still needs to be investigated (Crawford; 2014; Shao et al., 2012).

Based on the research gaps and shortcomings identified, this study's objectives are important as discussed subsequently. Firstly, leadership competences are required beyond traditional project management (Chaudhry et al., 2012). This enables project managers to embrace the different project complexity factors, anticipate challenges and opportunities and align these with the expectations of the different project stakeholders (Chaudhry et al., 2012). Secondly, mega infrastructure project environment are characterised by different complex factors and dynamics, which demand astute leadership skills beyond traditional project management competences (Riaz et al., 2013). Thirdly, the increasingly competitive project environment requires project managers with unique skills to inspire teams towards business success, growth and competitiveness (Crawford, 2014). Lastly, mega infrastructure projects operate as unique temporary organisations, with special characteristics (short lifespan, multi-disciplinary human resource composition, strict delivery scope, timelines and budgets), whose management demands a unique set of leadership competences beyond traditional project management (Eweje et al., 2012). On the basis of these important insights, this study underscores the need to deal with the gaps in the project management philosophy in order to equip project managers to deal with complexity and improve on performance.

3 Research Methodology

This paper is the first phase of an ongoing research, whose methodology consists of an integrative review of existing relevant literature. This is critical to explore the main constructs that address the research aim and objectives. The theoretical framework guiding this literature review consisted of complexity theory, project management and leadership theories, as well as project performance measurement models and frameworks. The main approach involved critiquing, synthesizing and reconceptualising of the literature findings since the elements under study are not new (Torraco, 2005). The integrative literature review process involved about five key stages. Firstly, relevant journals that deal with the project management, leadership and complexity fields were selected using the Social Science Citation Index as well as the Web of Science (Torraco, 2005). Secondly, journal articles published between the year 2000 and 2015, focusing on project management, leadership and complexity, were selected. Thirdly, the most recent articles (2008-2015) were prioritised, although selected older ones were also reviewed to establish the trends in the key findings, arguments and conclusions regarding project management, leadership and complexity. The main criteria for selection included the articles' focus on the core constructs, the methodology used and the main findings and conclusions reached. This is summarised in Table 1.

Table 1. Summary of literature review methodology flow

THEORETICAL FRAMEWORK	RELEVANT LITERATURE SELECTION	CORE CONSTRUCTS	INTEGRATIVE LITERATURE REVIEW	KEY OUTPUTS (THIS STAGE)	KEY OUTPUTS (FSUBSEQUENT STAGES)
• Complexity Theory • Project Management Theory • Project Leadership Theory • Project Performance Measurement Models	• Journal Articles published between 2008 and 2015. • Limited number of journal articles older than 2008 • Limited number of other non-journal articles and books	• Project Management • Project Leadership • Project Complexity	• Critical Analysis • Synthesizing • Reconceptualizatio n	• Trends across constructs • Relationship s between constructs • Main knowledge gaps • Key conclusions • Key questions • Integrative model	• Conceptual Framework • Research questions • Research propositions • Research Methodology

(Source: Author)

The review processes focused on critical analysis of the articles, to distil key trends regarding project management, leadership and complexity, as well as relationships between these constructs. This was important in establishing critical gaps and in drawing specific conclusions relevant to the study purpose. The study topic, problem statements, aim and objectives were the lens through which the various articles were selected and reviewed. The last stage involved the synthesis of the main findings to establish a model which integrates project management, leadership and complexity. The model will be used to develop the conceptual framework which will guide the subsequent stages of the research.

4 Findings and Discussion

4.1 Project Management Philosophy

Through the review of literature, this study has established the need for project performance evaluation to address the overall project objectives and integrate them with broad organisational goals over different time dimensions (Shenhar, 2012). Consequently, project success was accentuated as a better evaluation criterion which addresses both internal and external efficiency and effectiveness than project management success. The latter only focuses on internal measures of efficiency regarding time, cost and quality (Han et al., 2013). A further triangulation of evaluation criteria was proffered in order to capture the financial and non-financial contribution of project performance to organisational value (Shenhar, 2012). Other elements incorporated in the criteria include the views of different stakeholders and the time dimensions involved (Turner and Zolin, 2012).

This triangulation improves the comprehensiveness of the evaluation criteria beyond that of the linear and unitary measures used under the traditional project management philosophy

(Hazy and Uhl-Bien, 2013). This is important, particularly given insights drawn from Complexity Theory outlined in the foregoing sections (Han et al., 2013). These findings underscore the limitations associated with the current project management philosophy and underpin the need for project manager leadership competences.

4.2 Mega Infrastructure Project Complexity

By reviewing existing literature, this study has established that the current project management approaches and practices often fail to effectively address the different complexity dynamics highlighted in the preceding sections (Turner and Zolin, 2012). This has been highlighted as a gap in the traditional project management philosophy. This gap can be underpinned by the exclusion of the subject of complexity from the Project Management Body of Knowledge (PMBOK), which has remained despite the persistent challenges faced by project managers in dealing with complexities within and beyond project boundaries (Han et al., 2013). On this basis of this gap, this study highlighted project complexity as one of the important constructs, which will be explored in greater detail in the subsequent phases. Of particular focus is the complexity dimensions and levels, as well as the required leadership competences alignment to adequately internalise and manage the former and improve on project performance.

4.3 Leadership Competences and Project Performance

Based on the output of the integrative literature review, this study has established the need for leadership competences beyond traditional project management capabilities (Clarke, 2012). This has been underpinned by the findings that at least 80 percent of project failure is associated with human factors (Shenhar, 2012). It was also distilled that project environments acts as complex adaptive systems (CAS), under which the project manager can either promote or stifle performance (Hazy and Uhl-Bien, 2013). CAS require capabilities in creative problem solving, learning and adapting. Consequently, in order to address the unique challenges involved in a CAS, project managers need to be flexible, innovative and open to learning and adapting new behavioural patterns (Ren et al, 2012).

Leadership under CAS requires the astute balancing between administrative, enabling and adaptive styles (Han et al., 2013. Administrative leadership involves bureaucratic processes of alignment, top-down control and reliance on leaders' vision and inspiration. Focus is also on planning and coordination to accomplish prescribed outcomes in an efficient and effective manner (as typically required under the traditional project management philosophy) (Han et al., 2013. Enabling leadership, on the other hand, establishes the necessary conditions that promote team creativity, innovation and learning, in solving problems. Lastly, adaptive leadership results from emergent change activities, in response to generative dynamics within a system. (Ren et al, 2012).

Another concept which has been established under the integrative literature review is emergence. This is a unique behaviour associated with complex adaptive systems as they respond to environmental pressure. It involves three elements of self-organisation and re-formation (Ren et al, 2012). This study has established that since mega infrastructure operate as complex adaptive systems (Hazy and Uhl-Bien, 2013), they are susceptible to emergence. Emergence suggest that, when bureaucratic processes and procedures are simplified, constraints associated with administrative leadership can channel and generate attributes that promote performance in a system (Ren et al, 2012). Consequently, in order to improve performance, project managers will be required to understand the complex adaptive system's emergence properties and design well-balanced, effective and responsive systems (Han et al., 2013). When project managers lack this understanding, they emphasise administrative and bureaucratic controls and, consequently, stifle the team's innovation, creativity and entrepreneurship capabilities, which are important for performance (Ren et al, 2012). This is summarised in Figure 1.

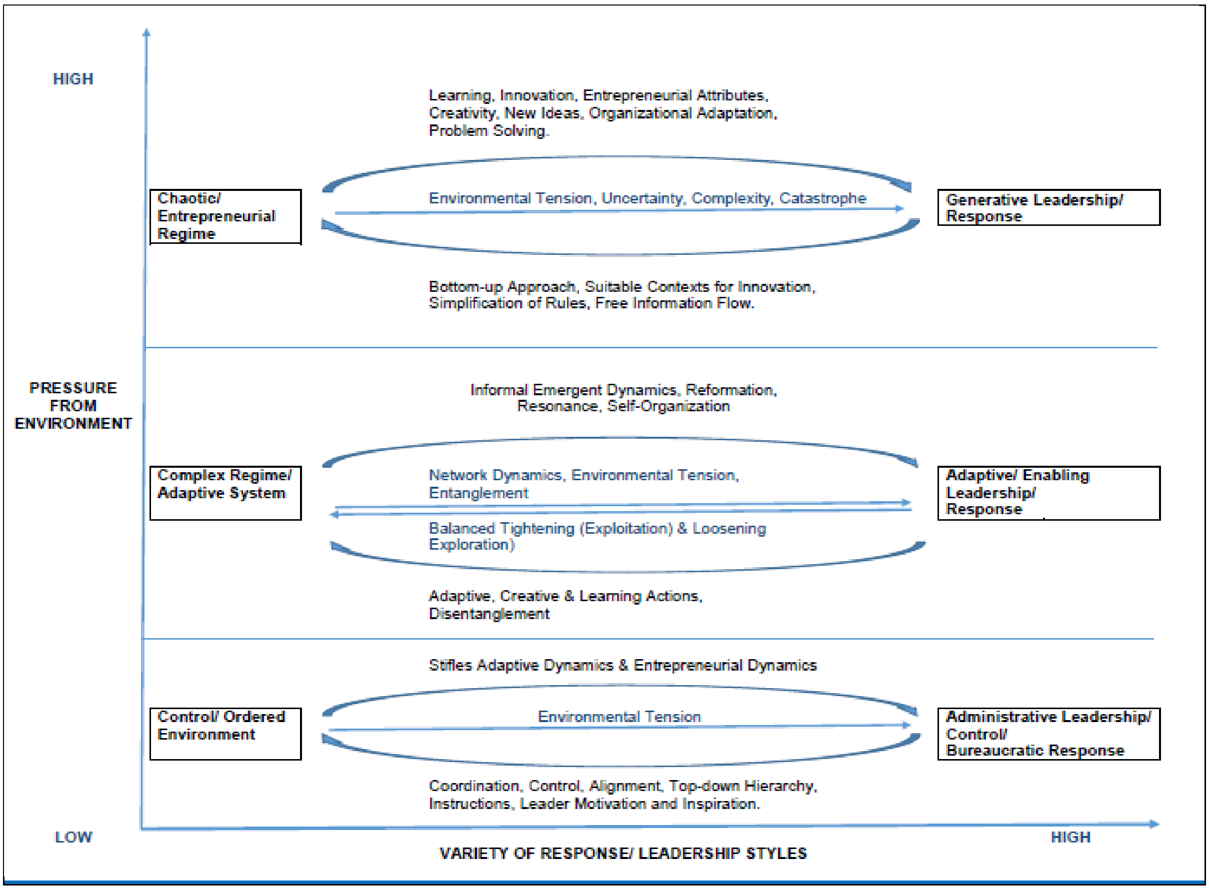

Figure 1. Categories of leadership styles for complex adaptive systems (Source: Adopted from Uhl-Bien et al., 2007; Hazy et al., 2007)

Other important complex adaptive system properties, which have been established through the integrative literature review are intertwinement or entanglement. These two properties manifest whenever the system's agents interact (Hazy and Uhl-Bien, 2013). They require project managers to carefully balance between the three leadership styles distilled in the preceding section. This balancing process involves emphasizing administrative and bureaucratic processes (which focus on drive efficiency) under stable conditions, and alternately activating and emphasizing adaptive leadership attributes during periods of turbulence, intense competition, uncertainty and complexity. Generative leadership attributes will be emphasized when entrepreneurial and innovative attributes are required (Ren et al, 2012). This is important in order to prevent administrative processes from suppressing adaptive attributes through too strict and rigid bureaucratic controls, which may consequently, stifle innovation, creativity and entrepreneurship (Ren et al, 2012). These processes have been accentuated as some of the gaps in the traditional project management practices. The competences required to enable project managers to achieve this go beyond the traditional project management philosophy.

The insights drawn from the foregoing sections of this study were crystallised into an integrative Complexity-Leadership Alignment Model. The model combines the leadership categorization and the complexity dynamics. Consequently, an attempt has been made to validate the impact of the project manager's leadership competences and ability to deal with different levels of complexity impacts on performance. The model is provided in Figure 2.

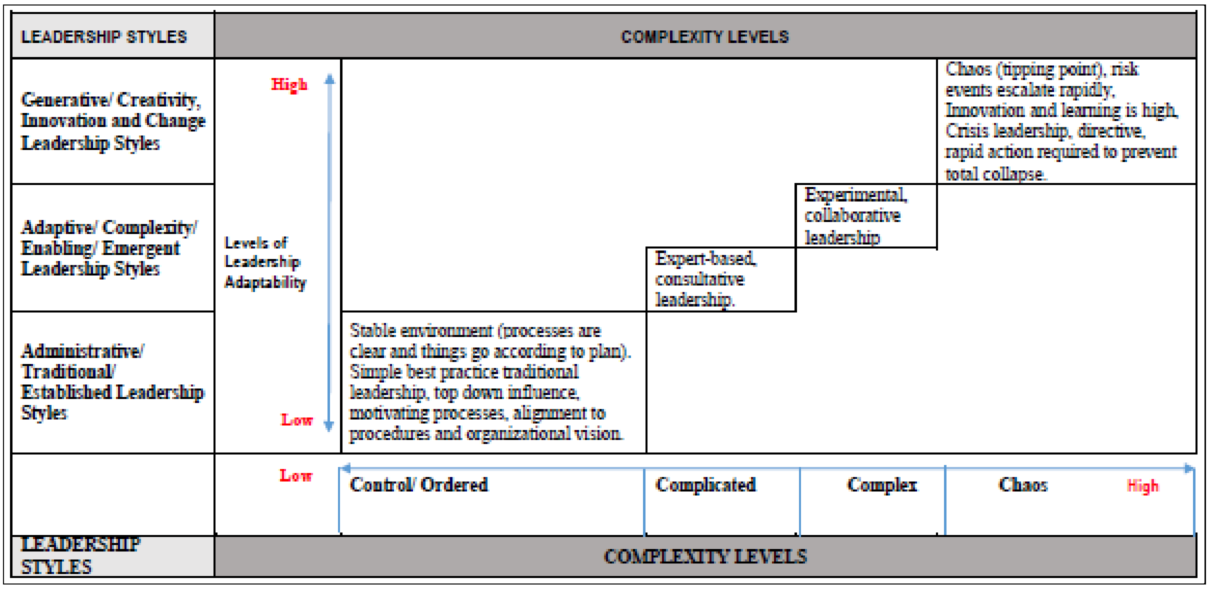

Figure 2. Complexity-Leadership Alignment Model (Source: Author)

5 Conclusion and Further Research

This study achieved the aim by distilling that the competences required under CAS are beyond traditional project management founding principles of controlling time, cost and quality. This raises a further question as to whether mega project success or failure can be ascribed to the project manager’s training or individual agility. The study also achieved the first objective by highlighting the three dimensions of project complexity, where aggregate complexity was selected for more focus under the subsequent phase of this research. The question is whether all projects exhibit similar complexity dimensions and levels, and whether this happens across the entire delivery cycle. The second objective was also achieved through the delineation of administrative, adaptive and enabling leadership styles and the need for balance to deal with the emergence properties associated with complex adaptive systems. The question is whether the project management training sufficiently equips project managers to fulfil these requirements. The third objective was achieved by recommending project success as a more preferred comprehensive and integrative criterion than project management success. The questions remain regarding the role of different stakeholders in designing the project evaluation criteria, performance measurement metrics and key performance indicators. In order to address the fourth objective, this study developed an integrative Complexity-Leadership Alignment Model, which links project leadership and complexity in an attempt to validate the associated impact on project performance. This link will still need to be measured through analysis of empirical data. Overall, this study illuminated the inadequacy of the conventional project management philosophy, the dearth in project managers’ leadership competences and project complexity as some of the critical factors behind the unsatisfactory performance of mega infrastructure construction projects. The questions which arose out of this stage of the study form the basis for further exploration under the subsequent stages.

6 References

Almahmoud, S. E, Doloi, H. K and Panuwatwanich, K (2012). Linking project health to project performance indicators: Multiple case studies of construction projects in Saudi Arabia. *International Journal of Project Management*. Vol. 30 (2012) pp.296-307.

Aubry, M and Hobbs, B (2010). A Fresh Look at the Contribution of Project Management to Organizational Performance. *Project Management Journal*, Vol. 42 (1) pp.3–16.

Back, W. E (2012). An Organizational Approach to Leadership Development for Engineering and Construction Management Project Practitioners. *International Journal of Business, Humanities and Technology*. Vol. 2 (2) pp.121-131.

Barry, M.L and Uys, L (2011). An investigation into the status of project management in South Africa. *South African Journal of Industrial Engineering*. Vol. 22 (1): pp.29-44.

Cavaleri, S and Reed, F (2008)."Leading dynamically complex projects". *International Journal of Managing Projects in Business*. Vol. 1 (1) pp.71 – 87.

Chaudhry, M. S, Kalyar, M.N and Rehman, A (2012). The Impact of Leadership on Project Performance. *Industrial Engineering Letters*. Vol. 2 (2) pp.18-24.

Clarke, N (2012). "Leadership in projects: what we know from the literature and new insights", Team Performance Management: *An International Journal*. Vol. 18 (3/4) pp. 128 – 148.

Crawford, L (2014). Balancing Strategy and Delivery: the executive view. *Procedia - Social and Behavioral Sciences.* Vol. 119 (2014) pp.857 – 866.

Curlee, W and Gordon. R.L. (2011). Complexity Theory and Project Management. Willey.

Economic Development Department, Republic of South Africa (2011). The New Growth Path Framework.

Eweje, J, Turner, R and Müller, R (2012). Maximizing strategic value from megaprojects: The influence of information-feed on decision-making by the project manager. *International Journal of Project Management*. Vol.30 (2012) pp.639–651.

Fombad, M. C (2013). Accountability challenges in public–private partnerships from a South African perspective. *African Journal of Business Ethics*. Vol. 7 (1) 2013.

Geraldi, J, Maylor, H and Williams, T (2011). "Now, let's make it really complex (complicated): A systematic review of the complexities of projects". *International Journal of Operations & Production Management.* Vol. 31 (9) pp. 966 – 990.

Han, S. W, Yusof, A. M, Ismail, S and Aun, A. C (2013). Reviewing the Notions of Construction Project Success. International Journal of Business and Management. Vol. 7 (1) pp.90-101.

Hazy, J.K. and Uhl-Bien, M, (2013). "Towards operationalizing complexity leadership: How Generative, Administrative and Community-Building Leadership Practices enact Organizational Outcomes". *Management Department Faculty Publications*. Paper 108.

Hyväria, I (2014). Project Portfolio Management in a Company Strategy Implementation: A Case Study. *Procedia - Social and Behavioral Sciences*. Vol.119 (2014) 229 – 236.

Ika, L. A, Diallo, A and Thuillier, D (2011). "The empirical relationship between success factors and dimensions". *International Journal of Managing Projects in Business.* Vol. 4 (4) pp. 711 – 719.

Jiang, J (2014). The Study of the Relationship between Leadership Style and Project Success American Journal of Trade and Policy. Vol 1 (1) pp. 52-55.

Li Liu, (2009),"How does strategic uncertainty and project sponsorship relate to project performance?". *Management Research News*, Vol. 32 (3) pp. 239 – 253.

Mason, S.M (2001). Simplifying Complexity: A Review of Complexity Theory. *Geoforum 32*. pp. 405-414.

Müller, R and Jugdev, K (2012)."Critical success factors in projects". *International Journal of Managing Projects in Business*. Vol. 5 (4) pp. 757 – 775.

Murugesan, R (2012). Characteristics and Skills of Leadership for Project Performance. Journal of Business Management & Social Sciences Research. Volume 1 (3) pp.1-9.
Prabhakar, G. P (2008). What is Project Success: A Literature Review. *International Journal of Business and Management*. Vol. 3 (9) pp. 3-10.
Presidential Infrastructure Coordinating Commission, Republic of South Africa (2012). A Summary of the South African National Infrastructure Plan.
Riaz, A, Tahir, M. M and Noor, A (2014). Leadership is vital for Project Managers to achieve Project Efficacy. *Research Journal of Recent Sciences*. Vol. 2(6) pp.99-102.
Remington, K. (2011). Leading Complex Projects. *Gower Publishing*. http://www.gowerpublishing.com/isbn/9781409419051/ (Accessed on 18 June 2015).
Saywisch, M (2010). Beyond Frontiers of Traditional Project Management: An Approach to Evolutionary, Self-Organisation Principles and the Complexity Theory. Results of a Research Program. *Project Management Journal*. Vol. 4 (2) pp.21-37.
Shao, J, Muller, R and Turner, J. R (2012). Measuring program success? *Project Management Journal*. Vol. 43 (1) pp.37-49.
Shenhar, A (2012). What is Strategic Project Leadership? *2012 PMI Global Congress Proceedings*. Vancouver, Canada.
Srinivasu, B and Srinivasa Rao, P (2013). Infrastructure Development and Economic Growth: Prospects and Perspectives. *Journal of Business Management and Social Science Research*. Vol. 2 (1) pp.81-91.
http://www.statssa.gov.za (Accessed on 24 November 2015).
Thamhain, H. J (2012). The Changing Role of Team Leadership in Multinational Project Environments. *Revista de Gestão e Projetos - GeP, São Paulo*. Vol. 3(2) pp.4-38.
Torraco, R.J (2005) Writing Integrative Literature Reviews: Guidelines and Examples. *Human Resource Development Review* Vol. 4 (3) 356-367.
Turner, R and Zolin, R (2012). Forecasting Success on Large Projects: Developing Reliable Scales to Predict Multiple Perspectives by Multiple Stakeholders over Multiple Time Frames. *Project Management Journal.* Vol. 43, (5) pp.87-99.
van Marrewijk, A, Clegg, S.R, Pitsis, T.S and Veensweijk, M (2008). Managing Public-Private Megaprojects: Paradoxes, Complexity and Project Design. *International Journal of Project Management*. Vol. 26 (6) pp.591-600.
Vidal, L.A and Marle, F (2008). Understanding Project Complexity Implications on Project Management. *Kybernotes* Vol. 37 (8) pp.1094-1110.
Zhai, L, Xin, Y and Cheng, C (2009). Understanding the value of project management from a stakeholder’s perspective: Case study of mega-project management. *Project Management Journal*. Vol. 40 (1) pp.99-109.
Zhang, L and Fan, W (2013). "Improving performance of construction projects". *Engineering, Construction and Architectural Management*. Vol. 20 (2) pp.195-207.

THE USE OF BUILDING INFORMATION MODELLING AND RELATED TECHNOLOGY IN THE CAPE TOWN URBAN CENTRE

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Abstract
The significant improvement of technology in recent times has provided an opportunity for construction firms to invest in innovative technology. In South Africa the construction industry seems reluctant to deviate from their traditional ways of delivering construction projects. It is believed that building information modelling (BIM) and related technology can be a catalyst for change, with information replacing documents and knowledge becoming an asset. Hence, this research investigates to what extent construction personnel feel innovative technology can stimulate building production to ensure that building projects are completed within timeframes and budgets and what issues influence a construction firm's decision to invest in these technologies. Both qualitative and quantitative survey methods are employed in data collection. Content analysis and descriptive statistics techniques are used in analysing the data. This research gives a clear indication that construction personnel feel BIM and related technology can have a positive impact on building production processes and that cost, risk and logistics are factors to consider when implementing new technology. It is concluded that construction firms utilising these technologies will have a competitive advantage over others that ignore it.

Keywords: Building Information Modelling (BIM), Building production processes, Construction management, Innovative technology, Project management

1 Introduction

Urbanisation and globalisation are the foremost trends propelling the growth and development of cities and towns in the world today (Tah, 2012:348). The Cape Town central business district is an example of an urban centre that is required to deal with rapid urbanisation. The increasing numbers of inner-city developments suggest congested construction sites are rapidly becoming the norm within the industry (Biddy, 2009 cited in Spillane *et al*., 2011). Therefor innovative building production management is crucial in driving productivity which includes reducing cost at all stages, from planning to completion. According to Hardie (2010) construction firms are not significantly proactive towards using innovative technology that could enhance the efficient delivery of building production. Venkatachalam (2014) adds that improved building production management is advancing at a slow pace both in South Africa and internationally. This becomes problematic as the success of building construction in urban centres hinges upon the ability of the construction firm to be strategic, which is to know what resources are available, and what capabilities to develop in order to fulfil some planned goal.

Hence, this research investigates to what extent construction personnel feel innovative technology can stimulate building production to ensure that building projects are completed within timeframes and budgets and what issues influence a construction firm's decision to invest in innovative technologies.

Innovative technologies considered in this article are building information modelling (BIM), location awareness technology (LAT) and laser-scanners (point cloud data). In South Africa the construction industry seems reluctant to deviate from their traditional ways of delivering construction projects, consequently the tendency is for construction managers to continue with traditional 2D and 3D drawings (Venkatachalam, 2014). It is believed that BIM technology can be a catalyst for change, with information replacing documents and knowledge becoming an asset. BIM is seen as an emerging technology that is globally accepted in the construction industry with its application gaining momentum. In order for BIM technology to be effective in the South African construction industry BIM standards need to be introduced in various policy frameworks of statutory councils and government agencies.

2 Literature Review

Tah (2012:354) acknowledged that knowledge-based decision support in project management has been slow to make an impact in the construction industry. According to Hardie (2010:387) the international construction industry has not adapted quickly enough to both new technologies and new management practices. The lack of responsiveness to more broad-minded management methods has led to many construction firms lagging behind in new management techniques and the use of technology. Hardie believes there is a desire by governments to support management strategies that inspire to continuous improvement and innovation. Lim and Peltner (2011:283) state that the significant improvement of technology in recent times has encouraged construction firms to invest in these innovative ways to improve their competitiveness. Isikdag (2012:385) clarified that BIM momentum is now changing the architecture, engineering and construction (AEC) industries in a way which is likely to cause a change in the general construction process, toward intelligent construction and intelligent buildings.

2.1 Building Information Modelling

Visual representation of a construction site is becoming useful using technologies such as BIM with 3D modelling capability that supports a wide range of construction management tasks such as construction planning, constructability review and site layout planning. Furthermore real-time position measurements during construction can assist in facilitating a variety of construction tasks at an operational level. Kim *et al*. (2005) suggests that using laser-scanning technology to produce point cloud information can also be useful for rapid on-site spatial-modelling. Whyte *et al*. (2007) describes virtual reality as an emerging design support tool that can manipulate in real-time and be used collaboratively to explore different stages of the construction process. Eastman *et al*. (2008) believes BIM is the most promising development in the construction industry today.

The main advantage of using BIM is efficient team work, better collaboration and better co-ordination and automated information management processes. Woudhuysen and Abley (2004:3) believe that construction has approached critical mass as far as the understanding of building modelling by senior technical and managerial staff. However, there are many difficulties being encountered by pioneering teams. Isikdag *et al*. (2008) goes on to describe BIM as a major innovation in technology that can assist with problems related to interoperability and information integration. However Isikdag *et al*. reminds us that an alteration in existing building processes inevitably incurs risk. Risk management is important when considering new technology including factors such as cost, who will be affected and who will be accountable. Furthermore Zawdie (2012:20) believes that innovation does not take place in a vacuum and that the culture within institutions requires a shift which introduces the necessary flexibility for a generation of new ideas. One aspect identified as important for progress in BIM is the need for standardisation.

Venkatachalam (2014:144) stated that the adoption of BIM in South Africa and other developing nations is slow because of socio-economic factors. Venkatachalam believes that despite the numerous benefits of using BIM, challenges still remain in its implementation. Kiprotich (2014:43) revealed that construction firms in South Africa have shown significant interest in BIM since the turn of the new millennium. Kiprotich (2014:15) stated however, that contractors are concerned that BIM blurs the distinction between design and build. Kiprotich indicated that intellectual property also becomes an issue considering that BIM is a collaborative tool. Bengtson (2010) (cited in Kiprotich, 2014:35) indicated that the perception in the construction industry in South Africa is that BIM capability is overrated and this poses the greatest challenge. Although BIM can hold vast amounts of information, it requires additional expertise to manage large data sets. Kiprotich (2014:35) pointed out that regardless of the fact that computer hardware and software are developing quickly, big BIM projects become overloaded and slow down the model.

Porwal and Hewage (2013) (cited in Venkatachalam, 2014:146) indicated that BIM is now being widely used in countries such as the United States of America, United Kingdom, Australia, Hong Kong and Canada. Venkatachalam believes that it depends on the readiness of the industries as to whether they adopt this technology. Venkatachalam went on to say that government and regulatory bodies need to exert a greater influence towards the use of BIM. Venkatachalam believes that the South African construction industry is reluctant to deviate from their traditional ways of delivering construction projects. Thus the tendency is for construction managers to continue with traditional 2D and 3D drawings. Venkatachalam's study revealed that affordability and lack of knowledge are a hindrance in the adoption of BIM. Furthermore, people-related readiness is generally inadequate. Barlish and Sullivan (2012) (cited in Mutale, 2014:136) believe that the challenges in the implantation of BIM are; that benefits may be vague; the cost of introducing a new system; possible conflict between stakeholders; fear of the new system; and its effect on jobs.

2.2 Laser-scanners and point clout data

According to Gleason (2013:2) laser-scanning in the construction industry has mostly been used to model existing structures from point clouds, nevertheless point clouds are now being used for many different applications relating to construction work. Point clouds can be applied in building process monitoring, used within BIM (Tuttas *et al*., 2014:341). Gleason clarified that once the fieldwork has been done the entire individual scans are adjusted and orientated together so that the object model creation process can be done. Gleason goes on to say that the 3D model created from the new data provides enormous opportunities. However there are constraints when using point cloud data which must be considered. The processing of 3D laser scans requires a lot of computer power that will halter the processing of huge data volumes. Gleason noted that scanning can be a time consuming endeavour, resulting in very large and complex datasets. Gleason cautioned that scanning technology projects must be well planned. Attempting to recreate every single element in a single area can lead to loss of focus and failure to meet the broader objectives. Attempting to capture smaller elements is often impractical and unnecessary. Gleason acknowledged that these tolerances can be set in the scanning hardware, to regulate the laser beams; such settings are known as the resolution and quality setting.

2.3 Location Awareness Technology

It has been ascertained that, considering all the activities on a congested construction site, space management becomes the most important task (Tommelein & Zouein, 1993; Spillane *et al*., 2011:143). Yun-Yi Su (2010:1) explained that innovation using LAT technologies assists in all stages of building production and supports important decision-making tasks in the field. Razavi *et al*. (2012:239) explained that location awareness is needed for decision-making and for tracking progress. Health and safety can also be improved using LAT. The challenge is that LAT has been less than satisfactory for inside measurement but rather outdoor environments. The obstruction of signals by buildings and tree canopies places limitations on the outdoor tracking ability of a global positioning system (GPS). Satellite technology cannot receive radio signal inside a building. Recent developments in indoor location sensing systems have overcome this limitation by using radio frequency identification. This offers significant potential on construction sites. However a wide range of protocols need to be followed for indoor location systems to be sufficiently accurate.

3 Research Methodology

The research method is both quantitative and qualitative using surveys for data collection. This type of research aims to record an accurate and adequate description of the problem statement and the sub-question. Data for the study are collected through observations, semi-structured and unstructured qualitative interviews and quantitative close-ended questionnaires administered to construction stakeholders working in the Western Cape Province, South Africa. This research focuses on the City of Cape Town to gain an understanding of the dynamics of innovation in building production processes within the building industry. The population of this research include building project managers, registered contractors as well as consultants. Quantitative data obtained from the structured questionnaire design was analysed with descriptive statistics, Statistical Package for Social Science (SPSS) software 21 and content analysis are used to analyse the qualitative data obtained through interviewees.

The scope of the study is limited to the personnel working on construction sites in the City of Cape Town's urban centres. This study was conducted over three distinct phases. The first phase involved a pilot study which employed qualitative data-gathering techniques to orientate the researcher with regard to the study, and to modify and debug the process, with the expected result being a smooth run for the main enquiry. The second phase of the study establishes to what degree building construction personnel currently involved with building construction projects believe BIM, LAT and laser-scanners are useful during building construction and what issues influence a construction firm's decision to invest in innovative technologies. The third phase entailed the interpretation and validation of data.

The population included personnel in the building construction industry that are currently involved in managing building projects in the central business district of Cape Town. These personnel include: Architect (2), Contracts Manager (10), Engineer (28), Facilities Manager (2), Forman (7), Laboratory Technician (1), Project Manager (12), Consultant (6), Quantity Surveyor (33), Site Agent (7), Junior Contracts Manager (1), Junior Engineer (2), Junior Quantity Surveyor (16), Site Supervisor (1), Surveyor (7) and Technician (4), the total sample being 139.

The majority of respondents (69%) were below the age of twenty six years with the balance (31%) above twenty six years. Respondents with a matric certificate represented 17% of the total sample while respondents with a National Diploma in construction management or equivalent represented 52% of the total sample. Respondents with a Bachelor Degree in construction management or equivalent represented 31% of the total sample. Respondents were employed by a variety of construction business companies/enterprises. These included architectural firms (3%), construction companies (60%), facility management firms (1%), government departments (2%), project management firms (7%), quantity surveying practices (22%), real estate companies (1%) and sub-contracting companies (4%). The majority of respondents were employed by construction companies.

4 Findings and Discussion

The pilot study revealed that respondents felt BIM, LAT and laser-scanning can have a big impact on improving current building production processes and is extremely useful technologies. Respondents believed that BIM is effective from the design stage, into construction and beyond. The respondents agreed that a database-driven model, such as BIM, would be beneficial on site, where project managers and quantity surveyors can count, cost and order material, based on updated real-time information. Furthermore, respondents felt that BIM would be useful for programming, construction sequencing and would reduce mistakes on site. Although some of the respondents described BIM as a just another documenting system, others felt that its use integrates engineering and facilitates collaboration between professionals.

Respondents agreed that laser-scanners are becoming more practical on construction sites. Respondents felt digital engineering should be encouraged at universities so as to produce industry leaders in this regard. Respondents felt that the production of point cloud information through laser-scanning technology provides a vast pool of information about as-built structures. Laser scanners provide point cloud information that can be used to interpolate information between designs and help structural engineers, architects and construction engineers to process, visualise and synthesise design and construction more clearly.

Respondents explained that LAT uses several radio technologies that supply wireless connectivity. This technology is being explored in shopping malls where retailers are experimenting with achieving deeper customer engagement by helping them find the precise location of products and staff. Respondents felt the construction industry can actively deploy these solutions to address factors that affect construction in urban centres such as the management of congested space, locating materials, managing restricted access for delivery of materials, safe movement of materials, health and safety issues, communicating, coordination management and increased resource and personnel management. This survey suggests that the use of LAT is generally used during the executing and monitoring stages in the building production process, however, the true success of implementing LAT on construction sites will only materialise with innovation and the discovery of new applications, which will be either stand-alone applications or in combination with other technologies.

With regard to the issues potentially influencing a construction firm's decision to invest in new technology on building construction projects the pilot study revealed that cost, leadership, risk, logistics, training of personnel, lack of knowledge regarding technology, experimental time, sharing information and technology development were issues to be considered.

The second phase of this research consisted of two objectives, the first objective was to investigate to what extent construction personnel feel innovative technology such as BIM, LAT and laser scanners can stimulate building production. The second objective establishes what issues most influences a construction firm's decision to invest in innovative technologies. Respondents were asked to indicate their response using a five-point scale, 1 = 'not at all', 2 = 'sometimes', 3 = 'often', 4 = 'generally' and 5 = 'almost always'. Some respondents failed to answerer all the questions on the questionnaire. This was because some were unfamiliar with the technology and did not know its usefulness during that stage of a building construction project.

Table 1. The usefulness of innovative technology during a construction project

	Number of responses	Not at all (%)	Sometimes (%)	Often (%)	Generally (%)	Almost always (%)	No response (%)	Mean	Std. Deviation	Rank
Initiating stage of a construction project										
BIM	120	8.6	8.6	18.0	18.7	32.4	13.7	3.7	1.34	1
Point Cloud	121	23.0	17.3	17.3	13.7	15.8	12.9	2.8	1.45	2
LAT	122	28.1	19.4	18.7	11.5	10.1	12.2	2.5	1.36	3
Planning stage of a construction project										
BIM	125	5.8	5.8	10.8	21.6	46.0	10	4.1	1.21	1
Point Cloud	118	22.3	14.4	13.7	20.1	14.4	15.1	2.9	1.46	2
LAT	120	29.5	14.4	14.4	15.1	12.9	13.7	2.6	1.48	3
Executing stage of a construction project										
BIM	118	8.6	7.9	20.1	27.3	20.9	15.2	3.5	1.25	1
LAT	120	16.5	14.4	15.1	23.7	16.5	13.8	3.1	1.41	2
Point Cloud	121	17.3	12.9	24.5	18.7	13.7	12.9	3.0	1.34	3
Monitoring stage of a construction project										
BIM	120	5.0	12.2	18.7	27.3	23.0	13.8	3.6	1.19	1
LAT	121	19.4	12.2	18.0	18.0	19.4	13	3.1	1.46	2
Point Cloud	120	18.0	15.1	23.0	15.8	14.4	13.7	2.9	1.37	3
Closing stage of a construction project										
BIM	118	8.6	10.8	19.4	23.0	23.0	15.2	3.5	1.29	1
LAT	117	25.2	16.5	19.4	10.1	12.9	15.9	2.6	1.42	2
Point Cloud	120	25.2	23.0	15.8	8.6	13.7	13.7	2.6	1.41	3

The results presented in Table 1 show that participants felt BIM technology ‘almost always’ enhance building production process during the initiating and planning stages of a construction project, furthermore BIM technology was considered as ‘generally’ beneficial during the execution, monitoring and closing stages of a building project. Laser-scanners and point cloud data was considered not useful during the initiating, planning and the closing stages of a project but considered useful during the executing and monitoring stages. LAT technology was only considered useful during the executing and monitoring stages.

The second objective of this study was to investigate why construction firms are reluctant to invest in innovative technologies such as BIM, LAT and laser-scanning technologies. The study showed that the cost of implementing new innovative construction methods is almost always a factor (Table 2). Risk, logistics, personnel training and a lack of knowledge significantly influenced a firm's decision to invest in new innovative construction methods, whereas experimental time, sharing information and technology development is more often than not a factor. The study also revealed that strong leadership is often needed to adopt innovative methodologies for new strategic management methods on construction sites.

Table 2. Issues that influence a construction firm's decision to invest in innovative technology

	Number of responses	Not at all (%)	Sometimes (%)	Often (%)	Generally (%)	Almost always (%)	No response (%)	Mean	Std. Deviation	Rank
Cost	138	3.6	5.0	18.0	22.3	50.4	0.7	4.1	1.10	1
Strong leadership	138	5.8	12.2	26.6	23.0	31.7	0.7	3.6	1.21	2
Risk	138	3.6	18.0	23.7	30.9	23.0	0.8	3.5	1.14	3
Logistics	138	3.6	15.8	30.2	33.1	16.5	0.8	3.4	1.06	4
Training personnel	138	6.5	17.3	24.5	29.5	21.6	0.6	3.4	1.20	5
Lack of knowledge	138	10.8	14.4	23.7	29.5	20.9	0.7	3.4	1.27	6
Experimental time	138	4.3	13.7	45.3	22.3	13.7	0.7	3.3	1.01	7
Sharing information	138	11.5	16.5	33.1	23.0	15.1	0.8	3.1	1.21	8
Technology development	138	8.6	23.0	39.6	18.0	10.1	0.7	3.0	1.08	9

5 Conclusion and Further Research

Innovative technology is an effective management tool for building production in urban centres to improve building production workflows. The construction industry in South Africa seems to be reluctant to invest in innovative technology for building construction projects. The biggest obstacle a firm faces when making a decision to invest in innovative technology is cost of equipment and training. Furthermore, weak leadership was found to influence a firm's decision to modernise. Risk, logistics and training of personnel are all issues that a firm needs to consider. The lack of technological knowledge, experimental time, sharing of information and technological development are also influential. The use of technology is proving to be useful during all stages of building construction. BIM is an emerging technology that is globally accepted in the construction industry and is gaining momentum. The BIM trend in African is progressive with building construction personnel in Cape Town believing BIM should be used extensively during the initiating and planning stages of a project. BIM needs to be utilised to its full potential and be supported through various policy frameworks by different stakeholders of the AEC sectors such as the statutory councils and the government agencies. The staged adoption of BIM and a new policy framework in the South African AEC sector need to be put in place. BIM technology is applicable throughout all process in building construction management. BIM technology allows the project to be seen within the context of the system it will operate in. The convergence of building production methodologies and technology is allowing better management of information.

6 References

Eastman, C, Teicholz, P, Sacks, R. and Liston, K (2008). BIM handbook - A guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors. Chester, UK: John Wiley and Sons, Ltd.

Gleason, D (2013). Laser Scanning for an Integrated BIM. Paper presented at the Lake Constance 5D-Conference, 28th–29th of October.

Hardie, M (2010). Influences on innovation in small Australian construction businesses. Journal of Small Business and Enterprise Development, Vol. 17(3), pp. 387–402.

Isikdag, U, Underwood, J, and Kuruoglu, M (2012). Building Information Modelling. In Akintoye, A. Goulding, J and Zawdie, G. (eds). Construction Innovation and Process Improvement., Pondicherry, India: SPi Publisher Services

Kiprotich, C. J. K (2014). An Investigation on Building Information Modelling In Project Management: Challenges, Strategies and Prospects in the Gauteng Construction Industry, South Africa. Unpublished thesis. http://mobile.wiredspace.wits.ac.za/handle/10539/15492 Accessed on 17 April 2015.

Kim, K.J, Lee, C.K, Kim, J.R, Shin, E.Y, and Cho, Y.M (2005). Collaborative work model under distributed construction environments. Canadian Journal of Civil Engineering,Vol. (32), pp. 299-313.

Lim, J and Peltner, F (2011). Innovation performance of construction enterprises. An empirical assessment of the German and Singapore construction enterprises. Construction Innovation, Vol. 11(3), pp. 282–304.

Mutale, L.P, Danstan, C, Tembo, C. K, Matipa, W & N'gandu, V. B (2014). Building Information Modelling (Bim): An Assessment of its Viability in Cost Management in the Zambian Construction Industry. Proceedings of the 8th Built Environment Conference, Building Information Modelling (BIM): An Assessment of its Viability in Cost, Durban 27–29 July 2014.

Razavi, S.N, Montaser A, Moselhi, O (2012). RFID Deployment Protocols for Indoor Construction. The Journal of Construction Innovation: Information, Process, Management. Vol. 12(2), pp. 239 – 258.

Spillane, J, Oyedele, L, Von Meding, J, Konanahalli, S, Jaiyeoba, B, and Tijani, L (2011). Confined site construction: A qualitative investigation of critical issues affecting management of health and safety. Journal of Civil Engineering and Construction Technology. Vol. 2(7), pp. 138-146. http://www.academicjournals.org/jcect Accessed on May 2014.

Tah, J (2012). Virtual Planning and Knowledge-based Decision Support. In Akintoye, A. Goulding, J and Zawdie, G. (eds). Construction Innovation and Process Improvement. Pondicherry, India: SPi Publisher Services.

Tommelein, I.D, and Zouein, P.P (1993). Interactive Dynamic Layout Planning. Journal of Construction Engineering and Management. Vol. 119(2), pp. 266-287.

Tuttas, S, Braun, A, Borrmann, A and Stilla, U (2014). A Comparison of Photogrammetric Point Clouds with BIM Building Elements for Construction Progress Monitoring. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XL-3, pp. 341-345.

Venkatachalam, S (2014). A Study on the various possible policy frameworks for the effective adoption of Building Information Modelling (BIM) in South African Architectural Engineering and Construction (AEC) sector. In Proceedings of the 8th Built Environment Conference, Durban, South Africa, pp. 144-154.

Woudhuysen, J and Abley, I (2004). Why is construction so backward? West Sussex, England: Wiley-Academy.

Whyte, J.K, Ewenstein, B, Hales, M and Tidd, J (2007). Visual practices and the objects used in design, Building Research and Information, Vol. (35), No. 1, pp. 18-27.

Yun-Yi Su (2010). Construction crew productivity monitoring supported by location awareness technologies. Unpublished PhD thesis, Graduate College of the University of Illinois at Urbana-Champaign.

Zawdie, G (2012). Construction Innovation through Change Management. In Akintoye, A. Goulding, J & Zawdie, G. (eds). Construction Innovation and Process Improvement. Pondicherry, India: SPi Publisher Services.

THE IMPACT OF LOAD SHEDDING ON THE CONSTRUCTION INDUSTRY IN SOUTH AFRICA

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Abstract
Eskom generates about 95% of electricity used in SA (Conradie & Messerschmidt, 2000). In 2008 (January) ESKOM introduced load shedding or planned rolling blackouts based on a pre-determined rotating schedule, in phases where short supply threatens the integrity of the grid. Demand-side management has concentrated on encouraging consumers with the aim to conserve power during peak periods in order to reduce the incidence of load shedding. The purpose of this paper is to establish the impact that load shedding has on a construction project specifically on the time and cost elements during construction. The methodology followed was to acquire usable support for the hypothesis through an in depth review of the literature that interprets and discusses the current knowledge on the subject matter, followed by structured interviews and two case studies. The findings of this study indicate that load shedding has a financial effect on a construction project and also influence the time. Therefore resulting in time and cost overruns on the project. Time and cost are therefore influence by the application of load shedding during a construction project. The value of this review reflects the impact of load shedding not only on a single construction project but on the construction industry as a whole. It is suggested that provision such as a specific clause in the contract or provision in the Preliminaries and General section of the construction contract should be made in future construction projects for load shedding to minimise and manage the impact of load shedding on the time and cost elements of the project.

Keywords: Load shedding, ESKOM, Construction industry, Cost overruns, Time overruns

1 Introduction

ESKOM is a South African (SA) electricity public company, established in 1923 as the Electricity Supply Commission (ESKOM) by the government of SA in terms of the Electricity Act (1922). The company is divided into Generation, Transmission and Distribution divisions. Eskom generates about 95% of electricity used in SA (Conradie & Messerschmidt, 2000). In 2008 (January) ESKOM introduced "load shedding", "planned rolling blackouts" based on a pre-determined rotating schedule, in phases where short supply threatens the integrity of the grid. Demand-side management has concentrated on encouraging consumers with the aim to conserve power during peak periods in order to reduce the incidence of "load shedding". However, it well known that load shedding is becoming more frequent in South Africa due to the low supply and high demand of electricity. ESKOM even apologised to the public of South Africa for the inconvenience due to load shedding. They also admitted that while the reserve margin being low, they do not have sufficient capacity to meet demand. This necessitating planned, controlled and rotational "load shedding", to protect the power system from a total country-wide blackout. Alarmingly, a country-wide blackout is a strong probability. The first steps include requesting large consumers to reduce load voluntarily. However, if numerous power station units trip unexpectedly, ESKOM has to skip these steps and implement load shedding, this is to prevent the system from becoming unstable. Scheduled load shedding is measured by way of sharing the available electricity energy among all its customers.

By switching off parts of the network in a controlled manner, the system remains stable throughout the day, and the impact is spread over a broader base of consumers (Conradie & Messerschmidt, 2000).

There are three dimensions to the electricity problem faced in South Africa. First of all, capacity - According to Altman (2008:12) this capacity problem is initiated mainly by the difference between the connected (or operational) generating capacity and the peak demand of South Africa. One main solution is recommended, and that is on the supply side, to increase the capacity by new investment, and ESKOM's capacity resources, while on the demand side, to reduce the peak demand of consumers.

Secondly, supply - Altman (2008:12) also stated that the supply problem of electricity is caused mainly by a difference between consumption levels by the consumers and the ability to supply power from ESKOM. Unfortunately, a combination of operational capacity has to be increased and also the ability to run it over sustained periods by increasing the supply of power. It depends also upon technical requirements for maintenance which must be done regularly, and the availability of complementary inputs, as well as primarily coal that has to be increased. It also seems that in South Africa is there a constraint on production caused by the quantity and quality of coal supplies to ESKOM.

Lastly, the reserve Margin - Newberry (2007: 0nline) and Altman (2008:13) shows that the reserve margin problem in South Africa has been caused by the high demand for electricity which is faster than operational capacity of ESKOM. Therefore, less time for maintenance is available, and the equipment lifespan is shorter, which results in parts that have to be replaced and the electricity price increase. This also reduces the shield for unplanned down time of the electrical equipment, which leads to disruptions of supplies. However, all these problems can be solved in the future by increasing the capacity. The capacity problem, and the ability to meet unanticipated increases in demand of electricity, depends on the availability of coal for the output of electrical energy. When stocks of coal are exhausted, they can only be rebuilt if coal purchases exceed usage. This can only be achieved in part by reducing the electricity consumption from the consumers.

The purpose of this study is therefore to:

1. Explore the impact of load shedding on the construction industry with regards to time lost and cost when load shedding occurs.
2. Identifying the impact load shedding has on the building work but also lack of performance by the construction industry during load shedding.

Time and cost might be the "overruns" that influence the critical path of a project. Load shedding has become a recognized problem, thus by identifying the impact load shedding has on the industry; provisions can be made to address the current problem.

2 Literature Review

When the electricity crisis first arose late in 2007, ESKOM informed all municipal supply authorities and consumers that it required a 10% saving in electricity consumption. This was in order to maintain the stability of the national electricity grid while still allowing for a 4% growth in consumption annually. ESKOM placed a six month moratorium on the approval of all power applications for new construction projects, which was supposed to have ended on 31 May (Greager, 2008). This moratorium by ESKOM applies to all new projects requiring an electricity supply exceeding 100 kVA.

As reported in the May issue of Vector, an Electricity Crisis Forum was established by Master Builders South Africa (MBSA), which includes all role players in the construction industry, including the Electrical Contractors Association of South Africa (ECASA). They appointed a smaller task team to allow role players to discuss and debate with ESKOM appropriate reactions to the electricity supply issues as they unfolded (Greager, 2008). Alarmingly, at the first meeting ESKOM representatives reminded the other delegates that ESKOM was formulating criteria and guidelines that would be used when considering applications for the provision of electricity supplies to new developments when the moratorium ended. However, it had now been decided that the moratorium would continue, and the quotations issued would merely reflect the cost of providing the new supply, and the time frames within which new supply could be provided. The South African construction industry was hard hit by the infrastructure development highs leading up to the 2010 FIFA World Cup, followed by a global recession and/or depressed growth. Detail statistics of the decline of the construction industry over the last three years have been well publicised (PWC, 2013). However, in 2013 the construction industry was also in the headlines for all the wrong reasons. The most notable headlines have been the finalisation of the Competition Commission enquiries as well as the significant delays at ESKOM power plant projects. All these negative headlines have highlighted the importance of the industry, not only for the country's development, but also the challenges of the environment in which it operates (PWC, 2013). According to PWC (2013) large capital projects are inherently risky as well as their multi-year timelines, changing requirements and complex procurement issues. All these require diligent oversight from the construction industries common concern for budget overruns and the effect on financial health.

Kerzner (2001:5) emphasizes that project success includes "completion within the allocated time period, within the budgeted cost, with acceptance by the user/customer, at the proper performance and with minimum or mutually agreed upon scope changes". This paper will firstly identify the effect of load shedding on time in the construction industry, followed by the impact time has on the building process due to load shedding. The impact of time on the construction industry leads to multiple effects on the cost of the project. Secondly the researcher introduces the effect of cost in the construction industry, and the cost implication when time is influenced such as: Penalties for late completion: Late acquirement due to late completion of the building thus lost in income.

It is well known that "cost overruns and delays" have always been serious issues, but companies have recently become increasingly concerned about these elements since the recent economic uncertainty. PWC (2013: online), stated that even by correcting the course of capital projects, is the reality that mega-projects frequently exceed their budgets by 50% or more.

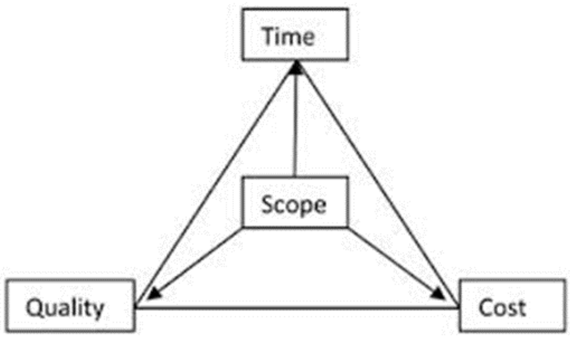

Figure 1. Four critical elements in Project Management (Source: Knipe, van der Waldt, van Niekerk, Burger and Nell, 2002: 18)

Figure 1 show that time is interlinked with cost, thus time lost during the construction equals loss of cost. When the time of construction is lengthened more resources should be allocated to the project to stay within the given time and budget. As seen in the figure quality are also affected.

3 Research Methodology

The methodology that follow is to acquire usable support for the hypotheses through an in depth review of the literature that interprets and discusses current knowledge on the subject matter, followed by qualitative research to test these theories on the effect of load shedding on time and cost in the construction industry. The research method that was applied is qualitative case study research approach. The case study was chosen because the growing problem of load shedding in South Africa, and to identify if this might have an impact on the construction industry. This is also an explanatory study and this has not been studied before in the Bloemfontein area. The case study is based on two construction sites (Project 1 and 2) in Bloemfontein, Free State Province, South-Africa.

The following inclusion and exclusion criteria for the research study were followed: The study is on the impact of load shedding on the construction industry (two commercial projects) in Bloemfontein, South-Africa. Yin (cited in Maree, 2007: 75) explained that a case study as a research method can be viewed as an empirical question that explores a modern phenomenon in a real-life context. The aim of this study and the structure of the research problem are as follows, with the research problem consisting of 'what is the impact of load shedding on the construction industry in South Africa, with the following four research questions:

- What is the cause of load shedding in South Africa?
- What is the effect of load shedding on time during a construction project?
- What is the effect of load shedding on cost during a construction project?
- If load shedding becomes more frequent; what does this mean for the construction industry?

The views of relevant groups of role players are considered in case study research to obtain a deeper understanding of the dynamics of the situation (Maree, 2007: 75). In the qualitative research the authors makes use of purposeful/purposive sampling to gather information (Patton, 2002: 230). The author therefore conducted interviews with two experienced contractors (more than 10 years in the construction industry) in the Bloemfontein area. Friedmann (2011:18) explained that a contractor is exposed to the different elements during construction. This is why the focus group only consisted of two contractors in the Bloemfontein area. Established businesses and residential groups in the area were not interviewed, for the author believed that these groups would not make useful contributions to the research which focused on the impact of load shedding on the construction industry.

The researcher made use of a semi-structured interview protocol consisting of subjective open-ended and close-ended questions. The semi-structured interviews consisting of subjective open-ended questions were found to be effective in testing the propped objectives set in the study. Merriam (2009) explained that in semi-structured interviews all questions can be used flexibly, with specific data required from all the respondents. The largest part of the interview is guided by a list of questions or issues that needs to be explored. Coding the data also formed part of the data analysis and the interpretation of the results of the research. Coding is done to reduce the amount of data to manageable and understandable text, therefore enabling analysis and making sense of the data (Welman, 2005: 211-314). A pilot study with 1 contractor was conducted one month prior to the interview.

4 Findings and Discussion

Project 1

Project 1 is a commercial building consisting of multiple shops surrounding an anchor shop, including basement for parking purposes. The cost of the project is between R 40 000 000 – R 45 000 000 and the size is approximately 9000 m². The penalties amount is R 12 000 per day (Late completion) and the time of load shedding per week was about 2 hours (approx.) The scheduled amount of load shedding per week, 7.5hours (Assuming Stage 1). The contract period was 10 months but only finished after 23 months due to non-payment. A total of 690 hours of load shedding will occur according to the load shedding schedule.

Project 2

Project 2 is a commercial building consisting of luxury finishes with multiple buildings surrounding an anchor shop with high-suspended ceilings. The cost of the project is between R 42 000 000 – R 47 000 000 and the size is approximately 7000m².The penalties amount is R 5 000 per day (Late completion) and the time of load shedding per week was about 2 hours (approx.) The scheduled amount of load shedding per week, 7.5 hours (Assuming Stage 1). The contract period was 9 months. A total of 270 hours of load shedding will occur according to the load shedding schedule.

The following questions in respect of load shedding were asked to the contractors involved in these two projects. The purpose of these questions are to establish the effect of load shedding on critical elements (time and cost) of a construction project. Also to determine if there can be any provisions made for future projects in respect of the effect of load shedding.

4.1 Are you aware of the load shedding schedule?

Both respondents pointed out that they are aware of the load shedding schedule and were given a load shedding schedule for the project. They also added that there are numerous sources from where load shedding schedules can be obtained. The acquiring of a schedule was presented in a meeting in the first encounter when load shedding started becoming more frequent. It was obvious that both contractors were fully informed about load shedding schedules.

4.2 Is load shedding applied according to the schedule?

Both respondents stated that load shedding was not always applied according to the schedule. Therefore, the load shedding schedule was not always checked during the projects due to the unreliability of the schedule. However, both contractors were always aware of the possibility of load shedding. McDonald (2008:4) in an earlier study found that most of the companies reported that they had little or no warning of outages and even when ESKOM had distributed the load shedding schedules, they were infrequently adhered to. A number of companies recommended that they would prefer to have one full-day deprived of electricity once a week rather than random outages. In this way they could accommodate their working hours in discussion with their employees. It is interesting to note that both respondents indicated that they had not bought generators for emergency, or were planning to do so, because of the generator costs ranging between R100 000 and R500 000. Respondents to the survey by McDonald (2008: 4) also indicated that a waiting time from generator suppliers of between two to four weeks. Those answering towards the end of the survey period reported that the waiting period had increased to between eight and twelve weeks. It is understood that the waiting period is considerably longer now.

4.3 What is the average time of load shedding experienced per week?

The respondents indicated that the estimated amount of load shedding per week was two to three hours. The respondents also indicated that the load shedding schedule was unreliable and that load shedding occurred without warning or according to the schedule.

Confirming the results in a previous study that illustrates 85% of the BDO Company respondents stated the average period of load shedding is two to four hours. ESKOM (2015: Online) stated that most customers (those in two hour blocks) might therefore be without electricity for up to 2.5 hours at a time. Also depending on the stage implemented that week.

However, ESKOM (2015: Online) also stated that if more load needs to be shed than has been scheduled in Stages 1, 2, 3 and 4, the National Control will instruct additional, unscheduled load shedding. This means you may be shed outside of your scheduled times. However, both contractors indicated that they have an inexpensive generator on site for emergency, but they also mentioned that they do not plan to buy generators for back-up during load shedding periods. It seems that the cost factor and running cost of a generator outweighs the benefit of a generator.

4.4 Is there made use of generator on site for when load shedding occurs?

Both respondents stated that if you are a contractor in the construction industry, a high-quality, dependable generator is a vital asset to your business. Portable generators are the most commonly used generators at work site that can withstand the harshest of conditions and demands. However, they also mentioned that often times in larger, more difficult projects, a standard generator may not be your best option, especially if space is limited or the conditions can present a challenge. Both respondents confirmed that they do make use of generators on site but not for the purpose of load shedding alone, due to the high hire and operating cost. However, for one project (Project 1) the contractor relayed on a direct line of electricity and was vulnerable to the effect of load shedding. The contractor confirmed that this was an issue they had to deal with. Respondent two use a generator, but highlight again the extra cost involved. To conclude, it seems that for projects that are more heavy duty, you will need a generator that not only has a higher power output, but is built specifically for more demanding construction work. However, the cost of a "custom made generator" which fits construction operation needs exactly and the operating cost of a generator are currently just too high to compensate for the influence of load shedding on productivity as reported by the respondents.

4.5 Effect of load shedding on the project production process

One respondent detailed that due to the nature of the project (Project 1), of having a basement, load shedding delayed production to proceed as there was a health and safety risk of working in the dark. Respondent two mentioned that the load shedding have influenced the work significantly during high-suspended ceilings and multiple shop front installation. Olatunji (2010:15) in an earlier study concluded that time control concerns, and the effort made to the initial specified time of project are under serious constrains to finished the project in time. There are also various aspects of projects to be controlled human resources, health and safety, materials, machine control and maintenance (Olatunji, 2010:15). Both respondents highlight the importance of "health and safety" in their projects, and that load shedding plays a significant role even in the health and safety of the workers when they try to work in the dark.

4.6 Problem experienced when load shedding is applied

Respondent of project 1 has again highlighted all the problems they experienced when working in a basement of the building, stated that load shedding delayed production severely, and the health and safety risk of working in the dark. The respondent also elaborated that at their in-house manufacturing of construction equipment, a delay on the site arises due to load shedding, and this equipment and material is dependable of electrical consumption. Both contractors also mentioned that the unprofessional conduct of time could have an adverse effect on the outcome of the project with respect to cost and quality if load shedding is not taken into account. The time taken to execute the project tasks from inception of site to delivery of the project is known as project duration (Olatunji, 2010:15). To concluded, the "project duration" is a vital variable in the cost of a project. The contractors mentioned that they are always under severe pressure because of these "deadlines" which they have to meet. Both contractors also highlight that it is not always possible to do "other" work during the time when load shedding is effected therefore load shedding influences the productivity of construction work.

4.7 Is the project on schedule?

Both respondents indicated that their projects is still on schedule, but if it exceeds the deadline the penalties amount will be between R5 000 (project 2) to R12 000 (Project1) respectively per day. They also highlight the fact, that for every minute they lost working time, they lose money. Ramabodu (2014:1) also mentioned that time is interlinked with cost, thus as the time of a project exceeds the estimated deadline this influences the cost of a project.

4.8 Provisions made for load shedding?

Interestingly, both respondents indicated that there was no provision made for the continuous load shedding on their construction projects. They mentioned again that the cost involved for a "custom generator" will be over R300 000, and the running cost of these generators is just too high.

Altman (2008:19) stated in this regard that the size of any impact that will shock the construction industry will depend on the time, over which it is measured, for numerous obvious reasons. Firstly, any increasing impact in time will be bigger if the periods become longer, to put it simply because it is cumulative. Secondly, and importantly for the construction industry the impact will be greater the more time there is for it to have knock-on effects (for the shock waves of load shedding to be felt through the construction industry).

One respondent also added that the construction teams do not take the relatively fast growing problem of load shedding into account. He highlighted the seriousness of the problem and his concerns "*If this problem of load shedding increases, provisions will have to be made not only on the time line but claims for time as well*."

These results are aligned to the findings of a previous study by Von Ketelhodt and Wöcke, (2008:8) who indicate that 25.2% of manufacturing respondents strongly agree that load shedding influences the manufacturing process, the work process, and therefore the process duration. It is a fact that load shedding will increase, and provisions must be made not only for time lines, but also for claims if deadlines are not met.

5 Conclusion, Recommendations and Further Research

Based on the literature review it is acknowledged that one of the most common factor that contributes to load shedding is, historical bad assessments made by ESKOM. It is also expected that the reserve margin in electricity will continue to go on a downward trend for the next few years until there is a substantial power plant that can accommodate the demand of this new age. ESKOM admitted that with the reserve margin being low, they do not have enough capacity to meet demand, necessitating planned, controlled and rotational load shedding, to protect the power system from a total country-wide blackout.

Time and cost overruns in projects are problems that are almost always experienced in construction projects. However, while there is almost no clear way of avoiding time and cost overruns, there should always be proper planning to decrease the chances of these overruns occurring. As with load shedding, there is an element of probability in the occurrence of time and cost overruns. Load shedding may cause delays in time overruns and these can affect not only current projects, but will also affect future projects, as time constraints and adjusted deadlines affect their execution. Time is interlinked with cost, thus as the time of a project exceeds the estimated deadline due to load shedding, this might influence the cost of a project.

The aim of this study is to investigate the impact of load shedding on the construction industry in South Africa. In conclusion it is recommended that the construction industry considers the implementation of the recommendations mentioned in this paper. This might result in cost saving for the construction industry. The study revealed several limitations in various areas, which could be overcome in future research. The limitations include the following:

- To the researcher's knowledge, no studies relating to the influence of load shedding in the construction industry was done before, which made it really difficult to draw comparisons.
- The results of this study were based on data obtain from the Bloemfontein metropolitan only; therefore the results cannot be generalized to the other provinces in South Africa, as certain discrepancies may occur. It is recommended that future studies should be conducted to incorporate all the provinces of South Africa.
- This paper includes only case studies on commercial projects, which will be limited to commercial projects completed in the Free State province of South Africa. It is recommended that future studies should be conducted to incorporate all the other sectors in the construction industry in the different provinces of South Africa to establish the total impact load shedding might have.
- This paper is a "pilot" study, with a limited questionnaire. A comprehensive questionnaire must be developed to explore all the sectors in the construction industry which could be influenced by load shedding.
- Lastly, the research only explores what the effect of load shedding is on time and cost during a construction project. All the other project performance elements could be explored and the real time lost as well as cost could be determined as basis of a future study.

Further research can also concentrated on contributions to delay in the delivery of projects by professionals in the industry.

6 References

Altman, M. (2008). *The impact of electricity price increases and rationing on the South African economy*. United Kingdom: Department for International Development (DFID) initiative.

BDO (2015). Citing References. [Online]. Available from: http://www.bdo.co.za/displeycontent.asp?contentpageid854 [Accessed 15 June, 2015].

Conradie, S. R. and Messerschmidt, L. J. M. (2000).. *A Symphony of Power: The Eskom Story*. Johannesburg: Chris van Rensburg Publishers. p. 77.

ESKOM (2015). Citing References. [Online]. Available from https://www.google.co.za/#q=ESKOM+load+shedding: [Accessed 25 June, 2015].

Friedmann, J. (2011). Insurgencies: Essays in Planning Theory". New York: Routledge.

Greager, G. (2008). The electricity crisis and its effect on the construction industry in South Africa, June 11th. Published in Uncategorised articles.http://www.ee.co.za/article/the-electricity-crisis-and-its-effect-on-the-construction-industry-in-south-africa.html.

Kerzner, H. (2001). *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. 7th ed. New York: John Wiley & Sons.

Knipe, A.; van der Waldt, G.; van Niekerk, D.; Burger, D. and Nell, K. (2002). Project Management for success. Sandown: Heinemann Publishers.

Maree, K. (2007). First steps in research". Pretoria: Van Schaik Publishers. Marquard, A.M. 2006. *The origins and development of South African energy policy*. Thesis (PhD). University of Cape Town, Cape Town., South Africa.

McDonald, M. (2008). *Eskom load shedding seriously affecting manufacturing in the metal and engineering industries*. Insight, 2 April 2008, p.4

Merriam, S. B. (2009). Qualitative Research: A Guide to Design and Implementation. San Francis co: Jossey-Bass Publishers.

Newbery, D, & Eberhard. A, 2007. South African Network Infrastructure Review: Electricity Citing References. [Online]. Available from: http://www.gsb.uct.ac.za/files/SAElectricityPaper08.pdf: [Accessed 22 June, 2015].

Olatunji, A. (2010). Influences on construction project delivery time. Degree Philosophiae doctor. Port Elizabeth .Nelson Mandela Metropolitan University.

Patton, M.Q. (2002). Qualitative Research and Evaluation Methods. 3rd ed. London: Sage Publishers.

PWC (2013). Highlighting trends in the South African construction industry December 2013. www.pwc.co.za/en/assets/pdf/sa-construction-december-2013.pdf.

Ramabodu, M.S. (2014). *Procurement guidelines for project success in cost planning of construction projects:* Degree Philosophiae doctor. Bloemfontein. University of the Free State.

Thomas, J.R., Nelson, J.K. and Silverman, S.J. (2010). Research Methods in Physical Activity. 6th ed. America: Human kinetics.

Von Ketelhodt, A. and Wöcke, A. (2008). *The impact of electricity crises on the consumption behaviour of small and medium enterprises*. *Journal of Energy in Southern Africa*, 19, 1.

Welman, K.M. (2005). Research Methodology. 3rd ed. Cape Town: Oxford University Press.

AN EXPLORATORY STUDY INTO THE INFLUENCE OF SUPERVISORY REWARD TECHNIQUES ON CONSTRUCTION WORKERS PRODUCTIVITY IN BELLVILLE, SOUTH AFRICA

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Abstract
The aim of this paper is to assess to which extend current trends in supervisory motivational strategies can improve worker productivity through the use of reward techniques on construction sites. A qualitative approach was adopted by conducting a semi-structured interview to construction workers including bricklayers, plumbers, concrete workers, electricians and earthworks workers. The interviews were done in Bellville in the Western Cape at two conveniently selected construction sites. The data was analysed using content data analysis. Most prevalent in the findings of this study is the fact that the workers complained that a lack of intrinsic and extrinsic rewards negatively impacts their productivity. The intrinsic rewards techniques investigated was responsibilities and training. The extrinsic rward techniques investigated was salaries and bonusses. This research was conducted within the borders of the Western Cape Province of South Africa. Data obtained from only two construction sites, the exploration of other sites would have brought more insight into the subject matter. Data was only obtained from the construction workers, excluding their supervisors. This research has significance for contractors, supervisors and workers in terms of improving productivity. An increase in productivity of motivated workers results in an increase in contractors' revenue. Construction supervisors will reflect on their shortcomings in worker supervision, and gain more insight of the supervisory techniques and skills that will boost the productivity of their workers. Workers feel more relaxed in a conducive supervisory working environment; as a result, the increased productivity leads to financial rewards, and or promotion within their organisation.

Keywords: Motivation, Productivity, Rewards, Supervision, Trends

1 Introduction

Supervisors take up crucial positions in construction projects, because they are the channel through which management and the workforce do communicate (Unakweh, 2005). Thus, supervisors are regarded to be able to understand human behaviour and administer management principles (Catt & Miller, 1991). According to Dubrin (2005), supervisors plan, establish and regulate the project. The supervisor will also assign and utilise resources within the construction company in the quest of the targets set by the owners. However, supervisors get tasks completed through other people where a supervisor's elementary responsibility would be to initiate decisions, designate resources, and more importantly direct the tasks of workers to reach company targets (Robbins, Odendaal and Roodt, 2006).

Mansfield and Odeh (1991) state that even with the advent of more sophisticated technology, the construction industry continues to be pre-dominantly labour intensive and this suggests that a proper emphasis should be given to such matters as communications, participation and motivation. Motivation has been defined as the cognitive decision making process through which goal directed behaviour is initiated, energised, directed and maintained (Buchanan & Huczinsky, 2000:40).

Olomolaiye and Ogunlana (1988) indicate that the construction environment in developing countries is different in terms of site organisation, quality of supervision, availability of production resource, and also is their socio-economic environment which produces a different worker; probably motivated by different factors. Also, it is a common appearance that workers in the construction industry have long been considered expenses, while stock, work in-progress, materials and structures are regarded on the balance sheets as assets (Dell, 1997:23). However, these days the adept employers are now becoming aware of the fact that construction workers are the assets of the company. Additional concerns are now contemplated as being less essential to the success of the company (Dell, 1997).

In 2004 it took the lowest paid worker within the construction sector 167 years to earn the average annual income of a CEO (LRS: online). At 2013 levels this has increased to 287 years, an increase of 71% when we compare the wage gap 2004 to that of 2013 (LRS: online) There is thus a trend in the widening of incomes and increasing inequality within the construction sector. This trend in the wage share within the construction sector, coupled with low level of real wage increases with profitability far outstripping wages and the huge increases in the wage gap all contributed to overall inequality in South Africa (LRS: online).

The general trend also has been for construction companies to down size their workforces to fewer core site employees. Subcontracting arrangements became increasingly popular with up to 70% of building and 30% of civil engineering projects subcontracted out (LRS: online). The majority of employers in the industry also rely on sourcing skilled people. The estimated composition of an onsite construction workforce is normally 50% unskilled, 26% semi-skilled, 19% skilled and 5% supervisory. This trend indicates that there is no real interest in the skilling of the vast majority of unskilled and semi-skilled workers who make up 76% of the general construction production process (LRS: online).

Therefore in order to better the construction workers productivity, worker motivational concerns must be determined and investigated (Doloi, 2007). Knowledge of these concerns and the befitting measures aids the construction industry in creating an efficient motivational environment to improve worker performance, job satisfaction, and to attain high construction productivity (Doloi, 2007). The most basic distinction of rewards is between intrinsic rewards and extrinsic rewards (Ryan and Deci, 1999). The objective of this study is to determine to which extent reward techniques influences productivity on a construction site.

2 Literature Review

2.1 Employee Rewards

Rewards spread far outside money into the array of non-monetary benefits. Fringe benefits would not be if money were all that is significant to workers. The reality of the business world is that money, fringe benefits, culture and leadership all make a motivational change because workers relate to them (Cox, Issa and Frey, 2006). For most workers a fringe benefit and a good old fashioned pat on the back can take the place of a few more rands, which helps explain why effective organisations offer worker benefits as well as encouragement. Different incentives matter in different ways and in different amounts to different workers. It is management's job to identify and clearly comprehend what matters to their workers and what motivates them; then integrate that information into an incentives program that is effective and equally beneficial (Cox *et al*, 2006).

Therefore in order to keep construction workers motivated their expectancies must be addressed as project goals are reached. Satisfying workers expectancies can be viewed as distributing rewards when certain objectives are achieved. Employees have expectancies that they want to meet and employers have goals that they want to reach and they can work together as a team to satisfy the wants of both the employees and their employers. Workers who are motivated to help reach the goal of the employer and do so should be recognised with a reward. When considering what type of rewards to use there are two types to be aware of, intrinsic and extrinsic rewards (Cox *et al*, 2006).

2.1.1 Intrinsic Rewards

There are primarily two types of rewards. These are extrinsic and intrinsic rewards. Intrinsic rewards are positively valued labour outcomes that the individual obtains directly as a result of job performance; they do not entail the contribution of another individual or source (Pettinger, 2006:201). A sense of accomplishment after completing a particularly interesting task is an illustration of an intrinsic reward (Roa, 2009).

Therefore intrinsic motivation is that behaviour which an individual produces because of the enjoyable experiences related with the behaviour itself. Workers who are intrinsically motivated feel satisfaction in executing their work. This satisfaction may originate from any of several factors, including relishing the actual work done, the sensation of achievement, responsibility, meeting the challenges, etc. (Mosley, Mosley Jr. and Pietri, 2008). Supervising intrinsic work rewards offers the added challenge of planning a task so that workers can, in effect, reward themselves for a task well done (Pettinger, 2006). Providing constant training of construction workers aids in intrinsic rewards. Feelings of competence during task completion can enhance intrinsic motivation for that action allows satisfaction of the basic psychological need for competence (Ryan and Deci, 1999).

2.1.2 Extrinsic rewards

By comparison, extrinsic motivation is implemented not for its own sake, but rather for the consequences associated with it. Workers are motivated to perform at a high level only if they think that high performance will lead to outcomes such as salaries, job security, bonuses, or good working conditions (Mosley *et al,* 2008; Maurer, Weiss and Barbeite, 2003).

Supervisors can also offer a selection of extrinsic rewards, such as honest praise for a task well done, or figurative symbols of achievement such as worker of the month rewards, consist of low cost to the company (Schemerhorn, Hunt, Osborn and Uhl-Bien, 2005).

Salary is a particularly complicated extrinsic reward. It can help companies entice and hold on to vastly skilled workers, and it can satisfy and motivate these workers to work hard to attain high performance. But if there is unhappiness with the salary, salaries can also lead to strikes, grievances, absenteeism, turnover, and sometimes even poor physical and mental health (Schemerhorn *et al*, 2005). Table 1 reflects the differences in approach in reward strategies by Southern Africa countries against their global peers.

Table 1. Global and Southern-African trends in rewarding employees

Global approach	Southern-African approach
Companies follow a highly individualise towards managing compensation	A large proportion of South-African companies still struggle to find the correct link between individual performance and rewards.
Companies offer a wide variety of remuneration options customised to individual needs	Most companies grapple with finding the right balance between equitable rewards that acknowledge individual performance and achievement.
Companies extensively use IT in managing and administrating performance and rewards.	A large group of companies are still following a ''one size fits all approach in managing rewards.
Most companies are able to measure performance accurately and effectively link it to rewards.	In recent years, large companies have increasingly implemented flexible benefit plans.
World class companies measure high on performance and commitment.	

(Source: Adapted from Robbins *et al.*, 2006)

According to Nicolaou, (1987) organizations can no longer depend merely on extrinsic rewards to motivate and reward their employees, as these employees are less eager to accept work that gives them little freedom, and they are not easily motivated by work that does not utilise their skills, abilities and education. Rosenbaum (1982) indicates that there are five action principles designed to help supervisors become effective people motivators, namely: a style of interacting with employees in ways that will maintain and enhance their self-esteem, active listening that shows understanding of and respect for employees.

3 Research methodology

An exploratory study was undertaken to determine the degree of motivational strategies used by supervisors on construction sites. The motivational strategy explored in this study was communication.

Two construction sites in Bellville, Cape Town were conveniently selected for the purpose of this study. The study was qualitative in nature and semi structured questionnaires were used to conduct the interviews. Biggam (2008) indicates that qualitative research is linked with exploratory studies. Two open ended questions were posed to the workers. The first questions asked the workers how management motivate them by using rewarding techniques such as salaries, bonuses, responsibility and training to motivate them. The follow up question was how the techniques used by the supervisor influences the workers' productivity.

Five respondents from each construction site were interviewed. The respondents were selected by using purposive sampling. The purposive sampling method employed was maximum variation sampling or heterogeneous sampling, where the workers were purposively selected from various trades. The trades in which these respondents specialise in are earthworks, concrete, plumbing, bricklaying and electrical work. The data was analysed by using content data analysis.

4 Findings and Discussion

4.1 Demographics of respondents

A Total of 10 respondents took part in the study. The respondents were all male. The participants in the study as shown in Table 2 were mainly experienced workers. About 80% were in the construction industry for more than 5 years.

Table 2. Working experience

Years of experience	No	%
1-5	**2**	**20**
6-10	**5**	**50**
11-15	**3**	**30**
Total	**10**	**100**

Table 3 shows the status of the workers employers. 80% of the workers are employed by sub-contractors and 20% by the main-contractor.

Table 3. Employer status

	No	%
Main contractor	**2**	**20**
Sub-contractor	**8**	**80**
Total	**10**	**100**

Table 4 shows the skill level of the construction workers. 70% of the workers were unskilled, 20% semi-skilled and 10% skilled.

Table 4. Worker level

	No	%
Unskilled	**7**	**70**
Semi-skilled	**2**	**20**
Skilled	**1**	**10**
Total	**10**	**100**

Table 5 shows the trades of the respondents were involved in. The trades include bricklaying (20%), concrete (20%), plumbing (20%), electrical (20%) and earthwork workers (20%).

Table 5. Trades of workers

Trades of workers	No	%
Bricklayers	**2**	**20**
Concrete workers	**2**	**20**
Electricians	**2**	**20**
Plumbers	**2**	**20**
Earth workers	**2**	**20**
Total	**10**	**100**

4.2 Reward techniques used

The first question required the respondents to indicate whether the reward techniques used on site, in terms of salaries, bonuses, responsibilities and meaningful work motivated them towards higher performance. The different reward techniques are listed in Table 6.

Table 6. Frequency of use of reward variables (techniques)

No.	Variables	Yes		No	
		N	%	N	%
1	Salaries	10	100	0	0.0
2	Bonuses	2	20.0	8	80.0
3	Responsibility	1	10.0	9	90.0
4	Training	1	10.0	9	90.0

4.2.1 Salaries

In the study, all respondents (100%) stated that they receive their monthly salary. Salaries are an extrinsic reward. However, workers complained that monthly basic salary alone fails to motivate them to higher production levels. Actually the workers felt that salary increases are long overdue. Therefore (Schemerhorn *et al*, 2005) state that unhappiness with salaries can lead to strikes, grievances, absenteeism, turnover, and sometimes even poor physical and mental health.

4.2.2 Bonuses

In the study only 20% of the workers receive annual bonuses. Bonuses are an extrinsic reward. Furthermore 80% of the workers stated that they do not receive bonuses or any other form of reward from their employers. Workers actually indicated that they are reluctant to perform at higher levels, because they will not be rewarded for it. Mosley *et al*, (2008) and Maurer, *et al.* (2003) state that workers are motivated to perform at a high levels only if they think that high performance will lead to outcomes such as pay and bonuses.

4.2.3 Responsibility

In the study 90% of the respondents state that the supervisor, do not entrust them with the majority of the given tasks. Responsibility serves as an intrinsic reward (Ryan and Deci, 1999). The workers feel less empowered because the supervisor crowds them with his presence and will not let the workers take responsibility for some tasks. However, supervisors can boost expectancies through expressing confidence in their workers capabilities (Luthans, 2005).

4.2.4 Training

The study further indicates that 90% of the respondents complained that they do not receive any form of training to ensure that they can produce at higher levels. Training serves as an intrinsic reward (Ryan and Deci, 1999). The workers would like to excel in their various trades but are not given the necessary training in order for them to equip themselves. Jones (2009) states that supervisors can also boost workers expectancy levels and motivation by providing training so that people have all the expertise needed to perform.

4.3 Resulting productivity of construction workers

The follow up question asked whether these reward techniques used by supervisors improved the workers' productivity on site. The findings revealed that 80% of the respondents' productivity was adversely affected by the rewarding techniques or lack thereof used by management. Workers indicated that management show little interest towards their empowerment. Workers feel that they need to be rewarded more in order for them to produce at higher levels.

5 Conclusion and Further Research

Supervisors are the link between management and the workforce. Therefore in order to gain sustainable productivity it is vital that the supervisor, through management, reward the workers to ultimately reach the organisation's ideals and goals.

The findings revealed that 80% of the respondents were working for subcontractors. The trend in this regard is towards outsourcing of the general workforce. In regards to extrinsic rewards the findings revealed the unhappiness of the workers towards their salaries, as they complained that their salaries were too low. The workers also complained about the absence of bonuses. In regards to intrinsic rewards, workers complained that supervisors do not give them enough responsibility. The workers also complained about the lack of training available to them.

The findings indicated that workers need both extrinsic and extrinsic rewards to better their productivity. The literature and empirical findings confirm the relevancy of Victor Vrooms expectancy theory. The theory indicates that motivation is at its peak when great levels of effort leads to performance and that performance gets rewarded with desirable goals (Mosley *et al*, 2008; Maurer, Weiss and Barbeite, 2003). Workers indicated the possibility of an enhanced performance at higher levels if there is an appropriate on job-training or feel that there may be no significant increase in reward for higher performance.

Further studies are recommended to determine how reward techniques can be properly designed to improve the productivity of construction workers.

6 References

Buchanan, A.D. and Huczynski, A.A (2010). *Organizational behaviour*. Essex: Pearson Education Limited.

Biggam, J. (2008). *Succeeding with your masters dissertation. A step by step handbook.* New York: McGraw-Hill Co., Inc.

Catt, S.E and Miller, C. (1991). *Supervision. Working with people*. New York: Donelly and Sons Company.

Cox, R.F., Issa, R.R.A. and Frey, A (2006). Proposed Subcontractor-Based Employee Motivational Model. *Journal of Construction Engineering and Management*, 132(1), 152-163.

Dell,T (1997). *How to motivate people, 2nd ed*. California: Crisp Publications.

Doloi, H (2007). Twinning motivation, productivity and management strategy. *Engineering Management Journal*, 19(3), 30-40.

Dubrin, A.J (2012). *Essentials of management.* Mason, OH: Cengage. *behaviour. A strategic approach.* New Jersey: John Wiley & Sons.

Jones, G.R and George, J.M. (2009). *Contemporary Management, 6th Edition.* New York: McGraw-Hill Co., Inc.

Labour Research Service Bargaininig Indicators (2014). Twenty Years – A Labour Perspective. *Twenty Years of Transformation of the Construction Sector in South Africa since the end of Apartheid*. http://www.lrs.org.za/docs/BI2014-lowres_Chapt7.pdf [9 November 2015]

Luthans, F. (2005). *Organizational behaviour. 10th Edition.* New York: McGraw-Hill Co., Inc.

Maurer, T.J., Weiss, E.M. and Barbeite, F.G. (2003). A Model of involvement in work-related learning and development activity. *Journal of Applied Psychology,* 88(4), 707-724.

Mansfield, N. R and Odeh, N. S (1991). Issues affecting motivation of construction Projects. *International Journal of Project Management,* 9(2) 93-98.

Mosley, D., Mosley, D. Jr. and Pietri, P. (2008). *Supervisory management. The art of inspiring, and developing people.* Mason, OH: Thompson higher education.

Nicolaou, S.C (1987). *Construction labour and productivity. Productivity improvements. Unpublished Masters Thesis*. New Jersey: New Jersey Institute of Technology.

Olomolaiye, P.O. and Ogunlana, S.O. (1988).A survey of construction operative motivation on selected sites in Nigeria. *Building and Environmental Journal,* 23(3):179-185.

Pettinger, R (2006). *Mastering organisational behaviour*. London: Palgrave publishers Ltd.

Roa, V.S.P. (2009). *Organisational behaviour.* New Delhi: Excell Books.

Robbins, S.P., Odendaal, A and Roodt, G. (2006). *Organisational behaviour. Global and Southern-African perspectives.* Cape-Town: Pearson Education, Inc.

Rosenbaum, L.R. (1982). *How to motivate workers: Motivation models for managers and supervisors.* New York. McGraw-Hill Education.

Ryan, R.M. and Deci, E.L. (1999). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology* 25, 54-67.

Schemerhorn, J.R., Hunt, J.C., Osborn, R.N and Uhl-Bien, M (2011). *Organizational behaviour. International student edition.* New Jersey: John Wiley &sons, Inc.

Uwakweh, B.O. (2005). Effect of foremen on construction apprentice. *Journal of Construction Engineering and Management*, 131(12), 1320-1327.

A FRAMEWORK FOR MANAGING CONTEXTUAL INFLUENCE ON HEALTH AND SAFETY IN CONSTRUCTION PROJECTS

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Abstract

This study examines the construction environment in developing countries towards developing a conceptual framework for managing contextual influence on health and safety (H&S) in construction projects. This is on the grounds that the solution to the challenging state of H&S in developing countries depends on understanding the internal and external environment that construction contractors operate in. While the contextual environments of construction contractors in developing countries continue to receive little attention, according to literature review; the little attention does not proffer process-based solutions for companies. In filling the above gap, an existing framework in literature is modified, demonstrating how contextual influence on H&S can be managed in construction activities. This framework will enable organisations to identify the contextual factors (CFs) that will impact on H&S and rank the perceived impact, degree of dynamism, influenceability, producing the outcome of calculated level of awareness for proportionate attention. While identifying the CFs could significantly challenge the use of the tool, the level of awareness it creates puts the organisation that adopts it at the forefront of H&S management.

Keywords: Construction, Contextual factors, Developing countries, Health and Safety, Projects, Toolkit

1 Introduction

Noteworthy, the construction industry is among the most hazardous, and continues to record a high fatality rate (Construction Industry Development Board (cidb) 2009; Health and Safety Executive (HSE) 2014). Typically, in 2013/2014, the British construction industry accounted for 42 fatal injuries (32%) (the highest across all industries) and 32,000 new cases of work-related ill health (HSE 2014). In South Africa, a cidb (2009) report based on Department of Labour records shows an increase in fatal injuries of 52 in 2004/5 to 162 in 2007/8, making the construction industry the third highest per 100,000 workers among others.

While issues such as fragmentation of the industry (Kheni et al., 2005), remain among the generic and inherent causes of the poor H&S record in the construction industry, authors (Kheni et al., 2010; Umeokafor, 2015) strongly contend that in developing countries, the solution is in gaining insight into the internal and external environment that the construction contractors operate in (cf. International Labour Organisations (ILO) 2009). Albeit, the growing emphasis on integrating the internal and external environment of organisations into H&S strategies (ILO, 2009; Kheni et al., 2010; Umeokafor, 2015), it still receives low attention in terms of H&S

issues (Nuwayhid (2004) cited in Kheni et al., 2010) and even outside H&S (Ploesser et al., 2009). Studies that have examined the aforesaid have done well in creating the awareness and demonstrating their influence on H&S (for example Kheni et al., 2010; Umeokafor, 2015) but have not offered the methodological solution(s) to companies for controlling the influence of the environment on H&S.

Consequently, the main objective of this study is to examine the construction environment in developing countries towards developing a tool, which integrates the management of contextual factors (CFs) into H&S management throughout the entire construction project life cycle. First of all, literature on the characteristics of construction and contextual issues will be synthesised, and an existing framework in business management will be modified to produce a tool tailored to construction H&S that meets the above objective. Thereafter, the developed framework will be presented with an exemplary application in a construction process.

2 Literature Review

2.1 Characteristics of the Construction Industry

The characteristics of the construction industry offer possible explanations to the H&S challenges in construction projects. For example, the issues below contribute to the fragmentation of construction activities, resulting to H&S challenges, thus: subcontracting (Mayhew & Quinlan 1997); difficulty in ensuring alliance between major parties in contracts, including subcontractors (Vilacini et al., 2012); differentiation in terms of technology, cultural, and organisational grounds (Lingard, 2013), and complexity or the uniqueness of construction projects (Kheni et al., 2005). Indeed, the use of subcontractors has been linked to unsafe construction practices, which may be due to lack of clarity in roles and responsibilities among subcontractors, *inter alia,* complexity in subcontracting relationships (Mayhew & Quinlan 1997). Such characteristics of construction (or the industry) are also challenges to construction and the industry. While the literature demonstration so far is generic to the industry, receiving adequate attention; the environment of organisations, especially in developing countries also explains the poor H&S record and remains under-examined.

2.2 Integrating Contextual Factor Management into Health and Safety Management

2.2.1 Defining contextual factors

Although authors note the deficiency of an adequate definition of CFs in academic literature (Kronsbein et al., 2014), the conceptualisation of the concept in this study is informed by definitions in studies (for example Edwards & Steins 1999; Rosemann et al., 2006; Kronsbein et al., 2014; Umeokafor, 2015) or descriptions in studies such as Kheni et al. (2010). The definition that CFs are '…dynamic forces constituted in the user groups' social, cultural, economic, political, technological and institutional environment…' can be seen in Edwards and Steins (1999). According to Schmidt (2000) cited in Rosemann et al. (2006), the environment can be described as 'the combination of all implicit and explicit circumstances that impact the situation of a process … in which a business process is embedded'. This tends to be in agreement with other literature discussions of CFs in terms of H&S (Kheni et al., 2010; Umeokafor, 2015), but perhaps from an external context perspective. Therefore, adopting a broad conceptualisation of CFs, they are depicted in this study as dynamic forces within the internal and external environment of organisations influencing its activities, perception, beliefs and attitude. This is where the external environment includes the political, socio-cultural, socio-economic, technological, institutional, demographic, and legal context; and the internal environment relates to conditions or factors within an organisation such as organisational culture, leadership approach. It is, however, possible that CFs correlate (see Banker and Natarajan, 2008; cited in Kronsbein et al., 2014; Rosemann et al., 2007).

2.2.2 Overview of previous studies on contextual factors

Despite the influence of the contextual environment on H&S in the construction industry, Nuwayhid (2004) cited in Kheni et al. (2010) decry the inadequate attention it receives. For instance, an author reports the adoption of H&S policies, *inter alia*, regulations from developed countries, but some are irrelevant or even impracticable in developing countries such as Nigeria (Aniekwu, 2007). This is because they have not been designed based on the contexts of these developing countries. Most of the imported regulations adopted are goal-based, but according to Umeokafor, (2015), developing countries such as Nigeria, lack the wherewithal.

In contrast to the premise of inadequate attention to CFs, studies have examined the contextual influence on businesses. For instance, while studies (Kronsbein et al., 2014; Ploesser et al., 2009; Rosemann et al., 2006, 2007) examine CFs from a non-construction perspective, Kheni et al. (2010) and Umeokafor (2015) examine CFs from a developing countries' construction industry perspective in terms of H&S. The latter two studies have mainly examined external CFs. For instance, Kheni et al. (2010) have identified the key contextual influences on H&S in Ghana and found that owners/managers of small firms in Ghana mainly engage in H&S practices due to their working relationship with their employees and not because of regulatory threats. In Nigeria, Umeokafor (2015) reports an appraisal of CFs where inadequate regulation ranks highest with relative importance index of 0.80, in addition to 43.5 percent of the participants opining that accidents are predestined.

However, while the studies above have created the awareness and made recommendations, they have not offered organisations practical guidance to managing contextual influences. Kheni et al., (2010) echo this while proffering solutions to the impact of contextual issues on H&S practices in Ghana's construction SMEs, recommending practical guidance for construction firms as one of the ways of overcoming the barriers. In other words, awareness of contextual influence or factors is not enough; therefore, to mitigate the effect of the CFs on H&S, organisations need practical guidance to controlling the factors. Thus, a step-by-step toolkit for managing the contextual influence on H&S is imperative. The framework in this study is developed to fill this gap, offering practical day-by-day or month-by-month solution and bridging the gap between theory and practice.

2.2.3 Context knowledge related studies

Models or frameworks relating to context-awareness in business process performance are significantly covered in literature but have some limitations. Saidani and Nurcan (2007) propose a four-step approach for supporting context related knowledge, consisting context elicitation, context categorisation, context adaptation and measure, and business process installation. Between the second and third steps is the context tree (CT), with which, in addition to a three-dimensional vector, context can be modelled and categorised. However, the complexity of constructing CT and valuing the context makes it arguably limited to only domain experts and a particular domain (Saidani and Nurcan, 2007), so its transferability to other domains is not possible (Kronsbein et al., 2014).

Rosemann et al. (2008) focus on integrating context into a process model, where the CFs cover internal context, external context, and intermediate context, advancing our understanding of contexts and their impact on businesses. However, the model concentrates on the classification of the different general layers of CFs, overlooking the different subgroups within each layer (Kronsbein et al., 2014).

Using context-awareness puzzle, Ploesser et al. (2009) argue that the pieces of the puzzle should be incorporated into process management for context-awareness. The puzzle covering context mining and learning, context modelling, context taxonomies for industries, and context-aware process operations is to be applied in the order of appearance (*ibid*). However, it tends not to be fully transferable to construction H&S because of the characteristics of the construction industry. It does not factor in the degree of dynamism of CFs. Also, the ability of organisations to influence CFs tends not to be incorporated in the puzzle.

A more robust work is presented by Kronsbein et al. (2014), discussing the various ways that CFs can influence an organisation, covering contextual influence at entire organisational levels, organisational process levels, and organisational activity levels. The work of Kronsbein et al. (2014) involves: first, assessing the impact of CFs; then the ability of the organisation to influence the factors is also assessed. This will then determine the required level of awareness of the factors after which the 'degree of dynamism' will be assessed and then the frequency for reviewing the entire assessment is determined.

There are, however, limitations to the work of Kronsbein et al. (2014), of which they acknowledge. Firstly, they have not provided any guidance for identification of CFs, which is very crucial to the model. Secondly, the scale of measurement (low, medium and high) lacks a clear distinction. Thirdly, although not acknowledged by Kronsbein et al. (2014), the method used in factoring in the 'degree of dynamism' of the CFs can be considered as inadequate. It can be argued that it should have been factored in at the upper stage of the framework where alongside the perceived impact on the organisation, it informs the influenceability (see: Figures 1 & 2). Finally, no guidance for assessing the perceived impact of the CFs on the organisations has been provided.

From the above, the following intents form the proposed framework in the current study: mining of CFs; impact of CFs on H&S at various stages of the construction project, with adequate guidance; degree of dynamism of the CFs; influenceability of the CFs factored in after the evaluation of the latter two; the awareness level of the CFs.

3 Research Approach

This study investigates the contextual influence on H&S in the construction industry. Literature survey was undertaken to demonstrate the gaps in knowledge and practice, and in modifying a framework in business management (Kronsbein et al., 2014), identified limitations were tackled and the framework tailored to construction H&S. The tool practically guides construction firms in managing contextual influence on H&S. An exemplary practical application was also presented in this paper. As the study is mainly of qualitative paradigm, prompting quantification of some aspects of the tool, it is subject to bias and subjective. Thus, opinions of 28 construction H&S experts were sought in validating the framework, by sending a detailed application of the framework to them between the second week of September 2015 and third week of October 2015. However, none signified interest or was in the position then to take part in the validation process up until the time of writing this paper. The experts were made up of 26 construction H&S experts in South Africa, 2 in Nigeria. However, the academic scrutiny that this paper has gone through during the peer-review process has provided academic validation to the research (Manu 2012). This is because peer-review processes involve professionals querying the content of a paper so as to make an informed decision as to if the paper will be accepted for publication or rejected (Manu 2012).

4 Development of the Process Framework

4.1 Overview of the analytical design

Figure 1 shows the newly developed tool for managing the impact of CFs on H&S in construction projects. This is guided by: PI X DD - IF = LA. The CFs are identified and the perceived impact (PI) on H&S and the degree of dynamism (DD) are noted and evaluated [i.e. PI X DD). After the evaluation, the ability of the organisation to influence the contextual factor (influenceability (IF)] is then factored in to produce the level of awareness (LA). This will then determine the frequency of review and the action to take.

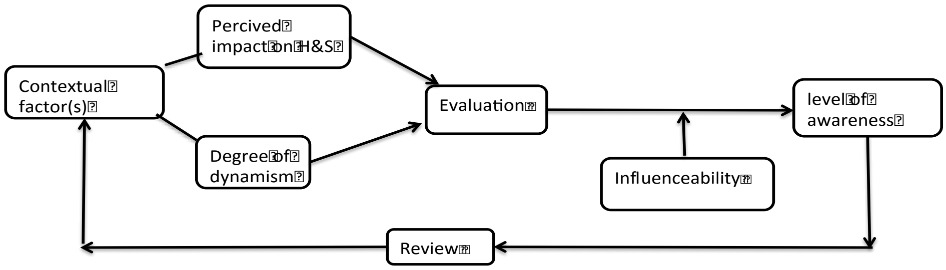

Figure 1. Overview of the framework (Source: Authors' conceptualization)

For this study, scales such as high (3), medium (2) and low (1), *inter alia*, have been adopted and a detailed guidance for measurement is presented. In H&S management, the tool can be applied at the various construction stages, construction processes and at various construction activities of the processes (Table 1). Table 1 details an exemplary application of the framework in an excavation process in a building project. It shows the identified context types, all in Figure 1 and how they are calculated. Figure 3 shows the application of the framework on a construction activity. The framework, however, is dependent on identifying the CFs, which may also be challenging but guidance is provided therein for the user.

4.2 Contextual factor(s): Mining of contextual factors

Although identifying CFs can be challenging (Edwards and Steins, 1999; Banker and Natarajan, 2008 as cited in Kronsbein et al., 2014) and its prediction difficult (Edwards and Steins, 1999), an attempt is made here to guide the users of the current framework on possible ways to identify CFs. A retrospective analysis in the case of contextual issues (Edwards & Steins 1999; Ploesser et al., 2009) on H&S data such as accident records, near miss records can outline the factors. This can also help predict possible outcomes in future events and behaviours of the factors (Edwards and Steins 1999) and even expose gaps in existing procedures (Ploesser et al., 2009). This is already commonplace in H&S for risk identification in areas such as risk assessment (see Windapo, 2013). However, what of the undocumented factors? This is where other ways of identifying CFs perhaps through the exchange of ideas among experts, consulting employees, employing the services of experts can come in. As earlier stated, these CFs can be framed under internal and external categories.

4.3 Perceived impact of contextual factor (PI)

After the mining of CFs in Figure 1, the perceived impact (PI) of the CFs will have to be ascertained. The PI of CFs on H&S is the implications of CF on H&S. Measuring the impact of CFs on H&S may be challenging, as there can be other contributory factors to the impact. However, it depends on the aspect of the impact that is considered. Going by the recommendation of HSE (2001) for measuring H&S performance, in the context of this study, the organisation should consider the following: the impact or contributory effects of the CFs on the hazardous activities of the organisations; the impact of the CFs on H&S management systems; the impact of the CFs on ensuring positive H&S culture in the organisation, covering control, communication, competence and co-operation; and the contributory impact of the CFs to the accident, injury, ill health or fatality records.

From above, it is evident that the *PI* of *CF* on H&S can be based on lagging parameters such as accidents (see Sgourou et al., 2010). The PI of CF on H&S can also be based on leading parameters such as the impact on H&S management elements e.g. H&S audit (see Sgourou et al., 2010) ranking from high to low (Figure 2). For instance, for the lagging indicators such as injuries, the following scale can be used thus: high = fatality; medium = major injuries; low = minor injuries. For ill health, it can be high = more than 7 days out of work; medium = more than 3 days out of work, but below 7 days; and low if the days out of work is less than 3 days. For the PI in terms of leading indicators such as H&S management (e.g. H&S audit), which is subjective, the measurement below can be adopted. If the CF negatively impacts on H&S audit, resulting to no audit then the PI can rank high; if the audit is not thorough, the PI can rank medium; if the audit is good but with little limitations, the PI can be ranked low. This can be applied to the H&S culture context stated above.

4.4 Degree of dynamism (DD)

This stems from the constantly changing or developing phenomenon of the CFs (Edwards and Steins, 1999; Kronsbein et al., 2014). Highly contributory to determining the frequency of review, the points below indicate that this may be challenging to H&S, requiring adequate attention. Typically, as Figure 2 shows, it can rank from high to low. When it is ranked high, it poses a higher level of uncertainty and the likelihood of negatively impacting on H&S; thus, it requires constant attention. For instance, the inconsistency in the language of the casual workforce can be ranked high. However, when it ranks low, it does not pose the same level of concern, as it can be predicted to some extent. Additionally, a daily change in law is not possible so it can be ranked low. Any other CF of DD between the two examples above can be ranked medium. More importantly, the co-relationship among the factors and the continuum of the factors should be considered here.

4.5 Evaluation

This involves factoring in the PI of the CFs on H&S and the DD of the CFs before the 'influenceability' to make an informed decision (Figures 1 & 2). This is against Kronsbein et al., (2014) who consider the DD at the last stage to determine the frequency of review. The evaluation in the current tool stems from the premise that the DD of the CFs determines their criticality, as the likelihood of incidents is increased or decreased. As such, multiplying it with the perceived impact of the CFs before 'influenceability' (Figures 1 & 2) means factoring it in to present a better picture of the CFs (and their implications) to the organisation prior to considering their ability to influence the CFs.

4.6 Influenceability (IF)

The outcome of the above evaluation (in 4.5 and Figures 1 and 2) will inform the incorporation of the ability of organisations to influence the CFs (that is *IF*), providing the adequate level of awareness. For instance, the example in 4.4 (i.e. the inconsistency in the language of the causal workforce) may mean that the organisation can have a recruitment procedure where only workers that can communicate in the main language of most of the workers are employed. This means that they have influence power on the factor. As the DD is factored in before this stage, an informed decision can be made. The influenceability ranks from 1 to 3 with 3 being the highest. The instance above means that *IF* can be ranked 3 if the aforesaid recruitment strategy upholds across all potential workers. It can then be ranked 2 if the recruitment strategy is not applicable to all potential workers such as casual workers, perhaps, because of skills shortage and/or that the available workforce is mainly of workers of different languages. Lastly, *IF* can be ranked 1 if it is not within the powers of the organisation to implement the aforesaid recruitment strategy, leaving it to fate. This will then inform the level of awareness.

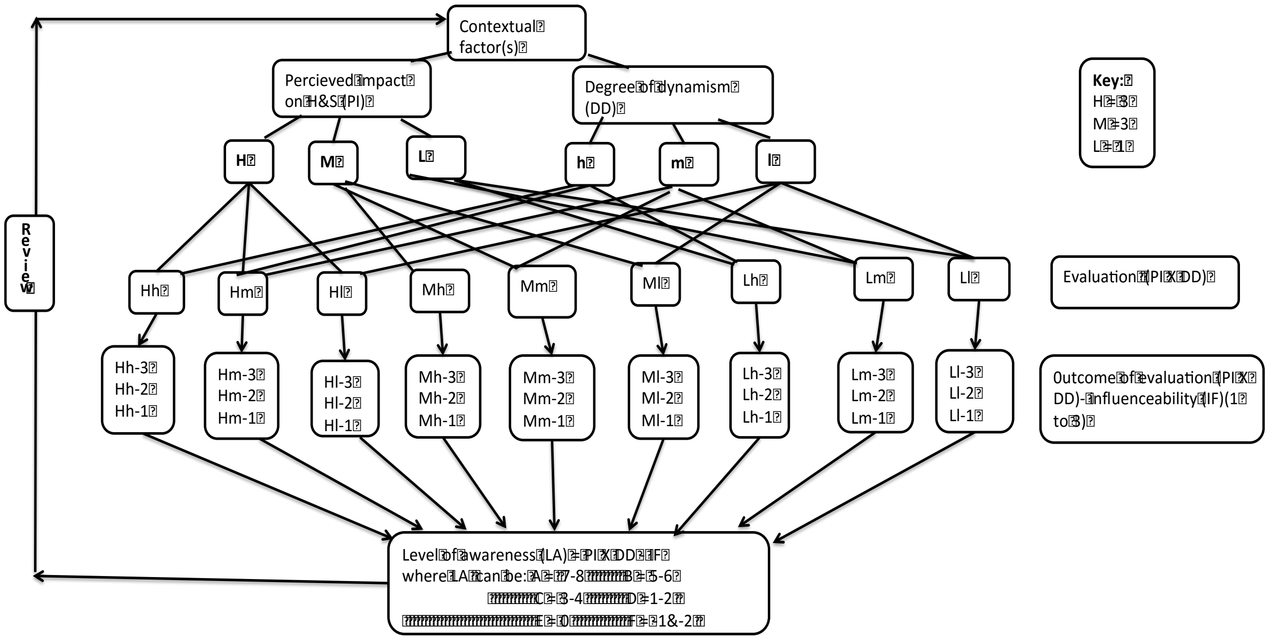

Figure 2. Detailed diagram of framework (Source: Modified from Kronsbein et al., 2014)

4.7 Level of awareness (LA)

As stated above, *PI X DD - IF = LA* is applied here, giving values ranking: A (7-8), B (5-6), C (3-4), D (1-2), E (0), and F (-1 & -2). 'A' shows the highest level of criticality and F the lowest. The value zero does not mean that the factor will be ignored, as it can still impact on H&S. Rather, it means that the level of attention it will receive will be lower than others that rank higher. When LA is E, it is negligible. LA throws the spotlight on the CFs as critical to achieving optimum H&S in construction projects. This provides a platform for organisations to channel adequate attention and resources to managing the CFs.

4.8 Review

This involves going through the entire process from the mining of CFs (Figure 2). This is highly informed by the LA, but DD may also be considered. Additionally, the characteristics of the construction industry make a case for constant review of the framework. Just as it obtains in the risk assessment exercise, a review of the framework may be conducted in events of, *inter alia*, a change of employee and/or work machinery.

5 Application of the Framework

5.1 Exemplary application of the tool to one construction project process

While Figure 3 shows a ground excavation process during the construction phase of a building project by a small and medium-scale enterprise in a developing country, Table 1 details the exemplary application of the framework in terms of Figure 3. It should be noted that the list of CFs in Table 1 is not exhaustive.

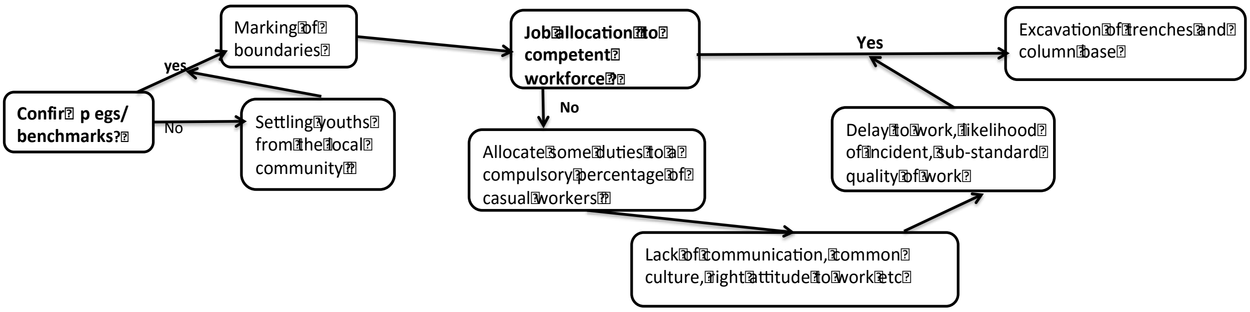

Figure 3. Selected activities in an excavation process in a building construction (Source: Authors' conceptualization)

Table 1. Tabular presentation of the application of the framework in Figure 3

Context layers	Context type	Example of contextual factor	Perceived impact of contextual factors on H&S (PI)	Degree of dynamism of contextual factor (DD)	Outcome of evaluation of PI X DD	PI X DD - Influenceability	Level of awareness
Internal	Organisational	Organisational structure	High	Medium	3 x 2 = 6	6 - 1 = 5	B
	Resource related	Training & skills of the workforce	High	High	3 x 3 = 9	9 - 1 = 8	A
External	Political	Inadequate governmental policies	Medium	Low	2 x 1 = 2	2 - 1 = 1	D
	Economic	Implication of incident and delay in work	High	High	3 x 3 =9	9 - 1 = 8	A
	Cultural	Owner/manager and workforce relationship	High	Medium	3 x 2 = 6	6 - 3 = 3	C
	Social	Complusory requests from community	High	High	3 x 3 = 9	9 - 1 = 8	A
	Technological	Unavailability of alternative equipment	High	low	3 x 1 = 3	3 - 1 = 2	D
	Environmental	Extreme weather	Low	Low	1 x 1 = 1	1 - 1 = 0	E
	Legal/institutional	Inadequate regulation of H&S and laws	High	Low	3 x 1 = 3	3 - 1 = 2	D
	Industry related	Lack of cohesion among workers	High	Medium	3 x 2 = 6	6 - 2 = 4	C

Source: Template modified from Kronsbein et al. (2014)

If not for the challenges of settling the youths and allocating some of the duties to the percentage of compulsory casual workers as specified by the community/contract, the excavation (Figure 1) would have been without any problems. Indeed, a site engineer on arrival on site to confirm the pegs and benchmarks of the already conducted setting-out activity before the commencement of work finds that there are youths of the community waiting for some unofficial apparent customs to be performed (see Figure 3). The youths were later paid off, thus increasing the project cost, delaying the work, in turn, affecting the allocated funds to H&S.

If there were adequate functional governmental policies protecting construction activities, such may not have happened. In this case, it is ranked 'medium' as it does not directly impact on H&S and ranked 'low' in terms of DD, as it is unlikely to change (Table 1). Its degree of influenceability is low (Table 1), as the organisation cannot influence the inadequate governmental policies. It also has a 'D' level of awareness, which is not critical. Internal factors such as skills of the casual workforce are considered to impact highly and directly on H&S; the

DD for the excavation process is also ranked high because of the inconsistency in the workforce (Table 1). Its influenceability is then ranked ‘medium’, as the organisation cannot afford to employ the workers permanently. In addition, they can negotiate with the community on the percentage of compulsory casual workers to employ. This is an instance of correlation with other factors, as it is influenced by the social factor in Table 1 that also ranks high. This is as a result of the community insisting that a certain percentage of the workforce be employed from the community, prompting differentiations in workforce attitude, language, culture to work, causing, *inter alia*, incidents, and delay in work (Figure 3). This, in turn, impacts on the organisation economically, ranking high in terms of the PI and high in terms of DD, as it varies depending on the cost due to the delay or incident (Table 1). The organisation can train the workforce on H&S and even try to instil common work culture, but all depends on the constituency of the workforce. Thus, it is ranked low with ‘A’ level of awareness, which is critical. The LA and the points in the ‘review’ subsection (4.8) inform the frequency of review.

6 Conclusion

A framework for managing CFs throughout the project lifecycle of construction projects is developed and applied in a construction process in the reported study. This stems from the premise that the impact of contextual issues on H&S remains highly underexamined, leaving organisations with no guidance to managing the contextual impact on H&S. The framework is made up of mining of CFs, then the perceived impact of the factors and the degree of dynamism are ranked. This is followed by factoring in the latter two in an evaluation process before the ability of the organisations to control the factors is considered. This takes us to the level of awareness enabling the organisation to channel adequate attention and resources to the factors. The review process is the last activity. Efforts are made in this study to guide the users of the tool to make a clear distinction in the scale of measurement of the tool. Identifying CFs may limit the efficacy of the tool, but the guidance in this paper can help overcome it. While this study may be subjective requiring a real life application, steps such as the academic validation of this paper reduces the level of subjectivity. It also, however, provides a stepping-stone to managing contextual influence on H&S on construction projects. As such, this framework can be validated in future studies based on a case study research approach. Also, areas such as the impact of the interaction among the CFs and their impact on H&S can be examined in further studies.

7 References

Aniekwu, N. (2007). Accidents and safety violations in the Nigerian construction industry. *Journal of Science and Technology*, 27(1), 81 – 89.

Construction Industry Development Board (2009). *Construction health and safety in South Africa.* Retrieved on 12-12-14 from http://www.cidb.org.za/documents/kc/cidb_publications/ind_reps_other/ind_reps_construction_h_s_in_sa_status_recommendations.pdf

Edwards, R. D. J., Davey, J. and Armstrong, K. A. (2014). Profiling contextual factors Which Influence Safety in Heavy Duty Vehicle Industries. *Accident Analysis and Prevention* 73, 340-350.

Health and Safety Executive (HSE, 2001) *A guide to measuring health and safety performance*. Retrieved on 22-09-15 from http://www.hse.gov.uk/opsunit/perfmeas.pdf

Health and Safety Executive (HSE, 2014) *Health and safety in construction in Great Britain, 2014.* Retrieved on 22-04-15 fromhttp://www.hse.gov.uk/statistics/industry/construction/construction.pdf

International Labour Organisation (ILO) (2009). *World day for safety and health at work 2009: Facts on safety and health at work*, ILO, Geneva. Retrieved on 23-08-15 from http://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/documents/publication/wcms_105146.pdf

Kheni, N. A., Dainty, A. R. J. and Gibb, A. G. F. (2005) Health and safety management practices of small subcontractors. In: *Khosrowshahi, F (Ed.), 21st Annual ARCOM Conference, 7-9 September 2005, SOAS*, University of London. ARCOM, Vol. 1, 105-114.

Kheni, N. A, Gibb A. G. F, Andrew, R. J. and Dainty, M (2010) Health and safety within Small- and medium-sized enterprises (SMEs) in developing countries: study of contextual influence. *Journal of Construction Engineering and Management* 135 (10), 1104 – 1115.

Kronsbein, D., Meiser, D. and Leyer, M. (2014) Conceptualisation of Contextual Factors for Business Process Performance. *Proc.:International MultiConference of Engineers and Computer Scientists, IMECS*, 12 - 14 March 2014, Hong Kong, Vol II.

Lingard, H. (2013). Occupational health and safety in the construction industry. *Construction Management and Economics*, 31 (6), 505 - 514.

Manu, P. (2012). *An Investigation into the accident causal influence of construction project features (*Doctoral Thesis University of Wolverhampton). Retrieved from http://wlv.openrepository.com

Mayhew, C. and Quinlan, M. (1997) Subcontracting and occupational health and safety in the residential building industry. *Industrial Relations Journal*, 28 (3), 192-205.

Ploesser , K., Peleg, M. Soffer, P. Rosemann, M. and Recker, J. (2009). Learning from context to improve business process. *BPTrends* 6(1),1-7.Retrieved on 30-8-15 from http://eprints.qut.edu.au/

Rosemann, M., Recker, J. Flender, C. and Ansell, P. (2006). Understanding Context-Awareness in Business Process Design. Proc.: *17th Australasian Conference on Info Systems (ACIS)* Paper 79.

Rosemann, M., Recker, J. and Flender, C. (2007). Contextualisation of business processes. *International Journal of Business Process Integration and Management* 3(1), 47-60.

Saidani, O. and Nurcan, S. (2007). Towards context aware business process modeling. Proc.: 8th workshop on *Business Process Modeling Development and Support*, Trondheim, BPMDS

Sgourou, E., Katsakiori, P., Goutsos, S. and Manatakis, Em. (2010). Assessment of selected safety performance evaluation methods in regards to their conceptual, methodological and practical characteristics. *Safety Science*, 48(8), 1019-1025.

Umeokafor, N. I (2015). An assessment of the influence of contextual environment on health and safety practices in the Nigerian construction industry. In Behm, M and McAleenan (Ed.), Proc.: *CIB W099 International Health and safety Conference*, 10– 11 Sept. 2015, Northern Ireland, UK.

Vilasini, N., Neitzert, T. R., Rotimi, J. O. B., and Windapo, A. O. (2012). A framework for subcontractor integration in alliance contracts. *International Journal of Construction Supply Chain Management,* 2(1), 17-33

Windapo, A. O. (2013). Relationship between degree of risk, cost and level of compliance to occupational health and safety regulations in construction. *Construction Economics and Building*, *13*(2), 67-82.

RISK MANAGEMENT FOR MULTINATIONAL COLLABORATIONS: APPLICATION ON THE CASE STUDY OF GRAND EGYPTIAN MUSEUM

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Abstract
Multinational collaboration projects have a very sensitive nature, where specialized teams must be formed and informed of desired tasks in a progressive manner. Mega-construction Buildings in particular - as a nation's landmark - fall under the category of multinational collaborations and are subjected to many complex variables affecting their success. In these projects, leaders of all parties involved must attain a very high level of cross- cultural intelligence, leadership knowledge and skills to face different design challenges that will certainly occur during the process. Recently, new management Philosophies arose to fulfil the gap resulting from the rapid demand and growth of organizational maturity; accordingly, risk management was adopted by most multinational construction firms to maintain a productive streak in the new globalized market. In Egypt, due to the unpredicted risks and lack of efficient leadership knowledge, many firms revoke collaboration investments in order to avoid these risks rather than adapting to the new situations, thus affecting the development of projects of targeted countries. Hence, this research aims to optimize project efficiency by identifying and investigating the root causes of risks facing a major multi-national mega pilot project: *the case of the grand Egyptian museum,* in addition to conducting literature reviews, an interview, and a Delphi panel. The study findings shed light on the key risks affecting the success of multinational mega projects in the Egyptian Construction context.

Keywords: Grand Egyptian Museum, Multinational construction projects, Risk Management

1 Introduction

Risks included in construction projects are either derived from external or internal sources, where external risks normally represent environmental-related risks, while internal risks exist in the project itself. However, these risks are more evident in the Multinational Construction Projects, which incurs more uncertainties. This owes to their large size and the international involvement of different stakeholders, (Zhi, 1995). In Egypt, for example, the fluctuation of economy and governmental policies had a vast impact on the status of implementation of multinational projects, especially after the unstable political circumstances of January 2011, (Khodeir, 2014).

The aim of this paper is thus to identify and investigate the types and root causes of risks embedded in multinational projects, starting from design initiation to design execution. In general, planning a construction project is the most important pillar of a successful project delivery, but, even with a well-planned strategy, errors and failures will arise. One of the most dangerous aspects in a project is the unpredictability and uncertainty of the project's environment. Influential environments can differ from unsuccessful delivery of design plans (design phase) to a sudden crash in market liquidity (construction phase) of some parties involved in the project. Here comes the role of Risk management, which is defined as a systematic way of identifying, analyzing and dealing with risks associated with a project with the aim of achieving the project objectives, (Patrick, 2007).

Multinational construction collaborations in the Middle East and North Africa (MENA) region in general, and Egypt in particular, have increased over the past few years, starting with joint ventures with Arabian Gulf countries, Japanese infrastructure collaboration and Scandinavian countries partnership projects. This imposes risks, such as differences in practices between domestic and foreign partners, policy and financial risks and legal and political risks. In addition to those risks, the inflation rate in Egypt is quite high: 10.2% (2015 CIA.) By the start of the new millennium, global markets became very dependent on political agendas, financial markets and social events. In order to minimize these impacts, project controlling is attained as proper tool that assesses and deals with risks and cultural aspects of these projects in their own environment. Figure (1) shows the number of annual Multinational projects, in Egypt, (MEED, 2014).

2 Introduction to Risk

The word risk was originally coined by the French, and was spelled as "risqué", then it was transferred to England in the 1830's, (Goral, 2007). Risk was primarily defined as a factor of caution, fatality or injury. Later on, the term was adopted by scientific bodies, and has finally been used to indicate uncertainty in projects, (Smith, 2006). The Australian/New Zealand standard on risk management, 2004, offered a more comprehensive definition for risk as "the chance of something happening that will have an impact on objectives; may have a positive or negative impact".

Moreover, Risk is perceived as the probability of unfortunate or unpredictable events occurring in a building project. These events can be predicted prior to occurrence and can be dealt with or managed; accordingly, the term "Risk management" was formed. Risk management is based on the fact that risk should be Identified and classified. A simple, common and systematic approach to risk management, suggested by Berkely (1991), has four distinct stages: risk classification, going through risk identification, risk assessment and suggesting suitable risk response.

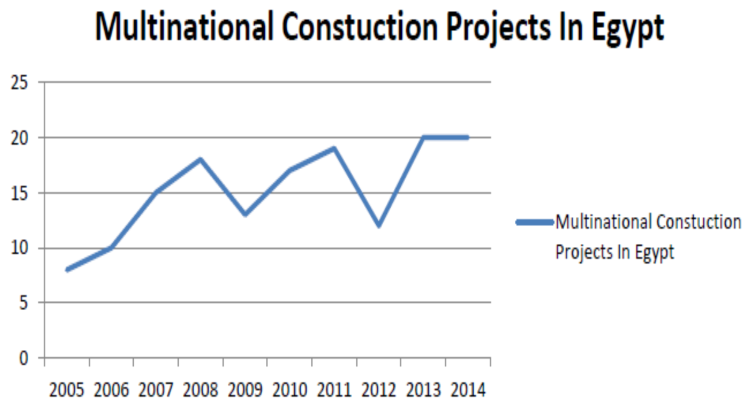

Figure 1. The number of annual multinational projects in Egypt (MEED, 2014)

2.1.1 Identification of Risk

Although the source of risk in multinational construction differs from one project to another, the steps and tools applied for identifying such factors of risk are the same. The first step in the process of risk identification is the risk realization in the building/design process. The next step is the classification of key factors, where root causes of risk are classified. Data concerning the risk identification must be gathered from documentations, expertise or feedback. Identifying risks could be performed by brainstorming sessions, meetings or external notifications, (Goral, 2007). The most widely used and most reliable risk identification tools include using the Delphi technique Interviewing, Root cause analysis, Checklist analysis, diagramming techniques and the SWOT analysis.

The Delphi technique, which is adopted in this paper, is based on a moderator, who is in charge of a session or round. These rounds consist of questionnaires handed to experts (Professional/Academic Experience) (Clarizen, 2013). These questionnaires are then gathered and summarized. Once again, the questionnaires are distributed among the experts for comments. This process can go on for more than several rounds until a solid opinion or model for identified risk factors is delivered at the end of the final session, (DOIS, 2003).

2.1.2 Classification of Risk

This phase of classification of risk factors is dependent on the former phase of risk identification, where gathered and identified risks are classified according to type, severity and impact. The process of risk classification notifies the responsible party whether this risk is affecting the project fulfilment in general or not, (Goral, 2007). According to Zhi (1995), risk factors in multinational construction projects are classified according to economic, political and social change. The most difficult political risks are: war, revolution, civil disorder and inconsistency of government policies, whereas economic and financial risks may arise from a local economic crisis, significant under-development interest rate fluctuations, rising inflation, foreign currency exchange rate fluctuations or raising tax rates. Social environment problems are most likely to be caused by language barriers, religious differences, cultural differences, crime and lack of security, disease, and bribery and corruption.

2.1.3 Risk analysis

This stage involves analysis of identified risks and their impact on upcoming project phases. Risk analysis techniques include both qualitative and quantitative tools. Qualitative risk analysis includes Risk probability and impact assessment (RPIA), the Probability and impact matrix and Risk urgency assessment. The quantitative risk analysis tools, on the other hand, include Data gathering and representation techniques, Probability distributions, Quantitative risk analysis and modeling techniques, Sensitivity analysis, Expected Monetary Value analysis (EMV), Modeling and simulation, Cost Risk Analysis, Schedule risk analysis and Expert judgment, (Clarizen, 2013; DOIS, 2003).

2.2 Factors Affecting Project Failure

Approaching project failure factors is the best way to identify weak links and risks in a project's process. A survey was carried out by Whittaker (1999) to identify the main factor affecting project success. Questionnaires were given to over 1,450 private and public sectors' construction companies' .The outcome of the study was that unmitigated risks and lack of risk management strategies were the main reason affecting successful implementation of projects. The second and third attributes where lack of skilled labour and deficiency of control. (Whittaker, 1999; Rozene, 2006). Another study was carried out in Jordan by Odeh and Battanieh (2002), to identify the delays in construction companies. The main results found where lack of efficient managerial communication in the construction industry, as well as the high risks concerning contractors' efficiency of constructing the proposed designs (Odeh and Battaineh, 2002; Rozene, 2006).

2.3 Project Success and Risk management

Many researches were conducted in recent years, which were summed up by the project management body of knowledge in 2004. The results indicated Monitoring and controlling risk is an ongoing process in which known and identified risk are kept under supervision, old or outstanding risks are monitored and new risks are treated as soon as they arose (PMBOK, 2004). By adaptation of the previous protocol, any controlled risk in project – if dealt with accordingly – will lead to a successful project. Another research was carried out on 60 mega projects indicated that, by creating a reliable strategic risk management protocol, risk factors are minimized drastically (Floricel and Miller, 2001). The study guided by Miller and Lessard (2001) indicated that by establishing a well-designed risk plan, probability of failure due to risk is negligible.

2.4 Risk mitigation deficiencies in MENA

Al-Sabah (2012) conducted a detailed listing of the different risks affecting multinational design and consulting firms in the MENA, with an emphasis on the organizational point of view. The findings of that paper demonstrated the main risks affecting the MENA construction industry regarding internal and external risk factors affecting the efficiency of the project implantation process. One of the most important elements of the research was the increase of cultural risks that affected those projects, ranging from geopolitical uncertainty to conflicts in the design execution. Another sub-topic discussed was the lack of control over the design process risks, weak understanding of the user's needs, communication and cultural conflicts in the design process.

2.5 Risk Mitigation Deficiencies in Egypt

The study by Khodeir (2014) elaborates and examines different risks that affected the overall performance of the Egyptian construction industry over recent years. The paper shed light on the effects influencing the Egyptian market, foreign investment and multinational projects in the construction industry and how they were affected by risks that were not predicted or considered. The paper examined 65 external and internal risk factors that affected Egypt's construction industry between the years 2011 and 2013. The study was based on data collection and risk evaluation techniques. It was conducted on 100 (Local and Multinational) firms in Egypt. The results indicated that among the highest ranked risks (top 20), some were related to design management failures, Communication deficiencies, weak project control and other subsidiary branches of managerial systems that were mostly ineffective. All entities involved in the construction market were involved and affected by these risks (clients, PMs, engineers and contractors).

3 Methodology:

In order to achieve the objective of this paper, the authors applied three main approaches: literature review of theoretical background, an interview and a survey questionnaire.

3.1 Interview

The interview was held In March 2015 with the former director of the committee for implementation of the Grand Egyptian Museum (GEM) (2009-2012). Table (1) shows the design of the interview questions and their related objectives.

Table 1. Design of the interview

Question	Objective/measured attribute
What were the risks affecting the early stages of the design and design execution?	To attain the maximum amount of knowledge regarding risks affecting the design phase from design initiation to design execution
What were the main risks that were the result of not understanding the Cross-Cultural nature of the project (Design, Contracts, Bidding, Tenders, laws and Conflicts)?	To establish a link between risk affecting design projects in a multinational project scale
What were the problems generated due to the lack of proper risk assessment in the GEM in particular and the Egyptian market in general?	To highlight the deficiencies regarding risk management to form a well-designed risk register
What were the financial risks of the project with regards to funding and contracting?	To understand and measure how the financial risks affect a project of this scale
What were the Owner's risks?	In the GEM case study the owner is a governmental entity, which is a major factor affecting project success
What are the futuristic risks of the entire GEM project?	To ensure a realistic nature of probability regarding the risk register
What are the problems facing the design's constructability?	To highlight design problems directly affecting the constructability of the project

3.2 Delphi Panel

The Delphi panel consisted of 16 participants, including the former director of the committee for implementation of the GEM, along with another three top managers in the GEM project. Two participants were from Hill international; they are current project managers in the GEM project. One project manager was from Orascom Constructions, currently working on the GEM project. The other nine participants included three Project managers from Kuwait, whom were a part of mega and iconic projects in the Middle East and Europe. Three participants were from Canada (Two Architects and an Owner), two from UAE (Project Manager and Architect) and one from the UK (Architect). The seven Delphi participants from Egypt were directly provided with a hard copy of the data, whereas the international participants were provided with the information electronically via E-mail. The Interview notes were presented to the panelist on the first round, the final risk register included 73 Risks. After gathering the first round results and refining them, the Risks were reduced to 67. The new risks were then sent again to the panelists for further editing and commenting. The results were collected for the final time and the comments the participants provided were noted. Finally, a list of 60 Risks was ready for further testing for probability and impact Via Survey questionnaire, Table (2) shows sample participants in the Delphi panel.

3.3 Survey Questionnaire

A questionnaire survey was conducted in order to measure both impact and probability of risks that were previously defined through the Delphi panel. A scale was presented for each risk with a numeric range of 1 to 9, where the probability took a range; 1 means that this risk is unlikely to occur and 9 means that the risk will certainly occur. Impact also ranged from 1 to 9, where 1 was given to risks having minimal effect, while 9 was given to risks having the severest impact. A total of 40 participants were requested to fill the survey, all of whom complied. The original Delphi panellists were also among those who conducted the survey. The participants belonged to different countries, genders, ages, expertise and educational background. The detailed information about the participants is indicated in Table (3).

4 Analysis of Pilot Case Study: The Grand Egyptian Museum, Giza, Egypt (In process)

The Grand Egyptian Museum Project was inaugurated by the former Egyptian President, Hosni Mubarak, on Feb 4th, 2002. It is Egypt's largest Cultural and iconic Project. It is planned to replace the original Egyptian Museum located in Tahrir square. It is intended to display the World's largest collection of Pharoanic Artifacts representing the evolution and ingenuity of the Ancient Egyptian civilization. The GEM is located at the outskirts of the ancient culture plateau of the Pyramids. It is designed on a gentle slope with a view to the Pyramids as well as a view towards the city of Cairo. The area of the project is about 493,579m² and occupies a total of 181,438 m² in built up area (Barakat, 2010).

4.1 Description of GEM timeline

In 2002 the Head of Architecture department of Ain Shams University was assigned by the Ministry of Antiques and Ministry of Culture to form a committee for selecting a design for the newly proposed project of building a new Egyptian museum; a museum that will be a new iconic destination for displaying ancient Egypt's historic eras and artefacts .The idea of creating a new Egyptian museum was extremely welcomed and supported by the UNESCO. A competition was formed later on in 2002 to select the best possible design for the proposed project. A total of 2300 entries were made, 700 of which were then eliminated and 1600 were left. Out of the remaining participants, 20 designs were selected for the final rounds. A jury was formed of the best architects in Egypt and the international architectural community was to select the top 3 designs. The First Prize was the Construction of the design and $250,000 (Barakat, 2015). In 2003 a preliminary project plan was offered, including the entire project's scope, from schematic design to project completion. A three-phased plan for project design and execution was proposed and an initial budget of 550 Million$ was projected. Phase I: Project studies; Phase II: Fire station, Conservation centre and Energy Centre; Phase III: Site excavation and project execution. (M.Antiques, 2015).

- **100 million dollars were provided by the** Egyptian government by "The Museums and Archeological Projects Fund";
- **300 million dollars were provide by** JICA "Japan International Corporation Agency" in the form of a facilitated loan;
- **150 million dollars were obtained from different fund-raising agencies**.

In 2005 the project scope rose from 550 to 800 million dollars. This was due to project scale and complexity, where a number of buildings which were not intended in the original project were added to the project. Additionally, there were complexities in transporting some monuments and antiques to the location of the museum. Funds were collected from various cultural philanthropists, (Barakat, 2015). In 2009 the design documentation was delivered and initial site excavation began. The year 2011 had great impact on the project's performance due to the unrest in Egypt as a side effect of the revolution that took place, which gradually returned back to normal in 2012. In April, 2015, The Committee announced that further 300 million dollars were required to complete the project, which increased the overall projects' budget to reach 1.1 Billion dollars (Ayad, 2015). Table (4) shows both planned and actual timeline for the GEM.

Table 2. Participants in the DELPHI Panel

Age	**Percentage**
30-40	18.75%
40-50	37.5%
≥50	43.75%
Total	100%
Country	**Percentage**
Egypt	37.5%
Kuwait	25%
UAE	12.5%
UK	12.5%
Canada	12.5%
Total	100%
Highest Education	**Percentage**
Bachelors Degree	37.25%
Masters Degree	37.25%
Doctorate Degree	25%
Total	100%
Field of Experience	**Percentage**
Architecture/Architectural	37.75%
Engineering (Senior)	31.25%
Project Management (Design and Construction)	31.25%
Top Management (CEO, CFO, COO, etc)	100%
Total	
Years of Experience	**Percentage**
15-25	25%
25-35	43.8%
≥35	31.2
Total	100%

Total: 16 Participants

Table 3. Participants in risk survey

Age	**Percentage**
30-40	30%
40-50	30%
≥50	40%
Total	100%
Country	**Percentage**
Egypt	42.5%
Kuwait	22.5%
UAE	12.5%
Canada	10%
UK	7.5%
KSA	5%
Total	100%
Highest Education	**Percentage**
Bachelors Degree	47.5%
Bachelors Degree	25%
Postgraduate Degree	10%
Masters Degree	17.5
Doctorate Degree	
Total	100%
Field of Experience	**Percentage**
Architecture/Architectural	37.75%
Engineering	31.25%
Construction/Civil Engineering	31.25%
Project Management (Design and Construction)	
Top Management (CEO, CFO,COO, etc)	100%
Total	
Years of Experience	**Percentage**
15-20	12.5%
20-25	35%
25-35	27.5%
≥35	25%
Total	100%

Total: 40 Participants - 40 / 40 Respondents

Table 4. A brief of GEM phase completion (Actual and planned)

Year	Planned Phase Completion	(Planned) % Completed	Actual Phase Completion	(Real) % Completed
2002	Design selection	10	Design selection	10
2003	Design Preparation	20	Design Preparation	20
2004	Design Preparation	30	Design Preparation	20
2005	Design Delivery	35	Design Preparation	20
2006	Site Excavation	40	Design Preparation	20
2007	Site Excavation	50	Design Preparation	20
2008	Construction Initiation	60	Design Preparation	20
2009	Construction Progress	70	Design Preparation	30
2010	Construction Progress	80	Design Delivery	40
2011	Construction Progress	90	Site Excavation	45
2012	Project Completion	100	Site Excavation	50
2013		100	Construction Initiation	60
2014		100	Construction Progress	70
2015	New extension in project completion	100	Construction Progress	80
2016		100	Construction Progress	90
2017	New extension for project completion	100	Construction Progress	95
2018		100	Project Completion (Estimated)	100

5 Findings

Findings presented in this section are extracted from the interview. The Risk register developed using the Delphi panel and the findings of the survey questionnaire. Findings of the interview formed a base for the Delphi panel that was applied later on. These findings were carefully analyzed in order to create a well-structured risk register. The initial register included 78 risks, whereas the final refined register after applying the Delphi panel included 60 risks. The Final Risk register, shown in table (5), identifies the 60 main risks that emerged in the case study project according to both the interview and the Delphi panel. The table offers description of each type of identified risk, the nature of its impact, either positive or negative, and its root cause. A coding system is suggested for the Classification of the risks, in order to facilitate the understanding of root causes of risk and help establishing a relevant mitigation approach. The classification was based on two main factors:

- The source of Risk/emerging phase: Design=D, Executive=E, Legislative=L, Governmental=G, Socio-Political=SP
- The impact of Risk/ Influence on involved parties or phases: Consultants and Contractors=C, Owner=O, Design Execution=DX

The risk register was passed afterwards to the respondents of the questionnaire survey to measure the exact Expected Monetary Value (EMV) of each detected type of risk. In this section, the findings of the questionnaire survey were presented. These included the probability and impact results of each type of the top-identified risks. Results were displayed in terms of Mean, Median and mode ranking. Figure (2) and figure (3) respectively represent the probability and impact results of each top-identified risk. Table (6) presents the final expected monetary value EMV, which represents the total outcome of the risk, whether it has a positive or negative impact depending on the situation. The table arranged risks from highest risk to lower risks, driven by the results received from applying the EMV equation in Risk.

(EMV): Risk = Probability × Impact.

5.1 Highly Ranked Risks

Upon observing the highly ranked risks and remarking risk nature, it appears that legislative risks in general were considered to be a major setback in multinational collaborations, according to the survey participants. They were also drastically affecting the GEM project. Table (6) highlights the top-ranked risks. Table (7) shows the top root causes of risk according to analysis and their related phases of the project. It emphasizes the fact that most top risks are related to decisions made in the design phase.

Table 5. Sample of the Risk Register

#	*Code*	*Risk Description*	*Nature of impact*	*Root Causes*
1	D-1-DX	Design Selection	Positive	UNESCO-sponsored Competitions for GEM Design Selection
2	D-2-DX	International Expertise in Design and Execution	Positive	Joint Funding Venture (Egypt, Japan) Multinational Collaboration (Egypt, Japan, UK, Ireland, Belgium, US)
3	L-1-O	Failure to sign with desired design firm	Negative	Law 89-1998 For Bids and tenders does not consider design competitions as a legit bid or tender which is the only allowed form of contracting (Government contract)
4	L-2-O	Law restrictions	Negative	
5	D-3-O	Law restrictions affect design quality.	Negative	Law 1998-98 For Bids and tenders -Article 16- two committees are formed (Technical and Financial) to study offers in both criteria and the preferable selection is mainly to the lower cost
6	L-3-O	Direct Order (Ministry Funding)	Positive	Law 89-1998 For Bids and tenders - Article 7 - Senior State officials are entitled a direct order of a (limited) governmental fund spending in critical situations.
7	E-1-C	Lack of complex project management knowledge	Negative	Former directors (Early Design stage) lacked proper project management skills.
8	D-4-DX	Lack of Client experience in complex Design projects	Negative	Due to the fear of failure, social and political pressure, the Minister of Culture broke down the design contract into 4 phases which resulted in 2.5x increase in design cost
9	SP-1-DX	Design Contract Break Down	Negative	Competition won in 2002, Design Delivered 2009 (8 years), delivery scheduled (3-4 Years)
10	G-1-DX	Design delivery delay due to misconduct in contracting	Negative	Delay In design Delivery means delay in Construction initiation (Penalty Clause is applicable) Must be paid by client to Assigned firms.

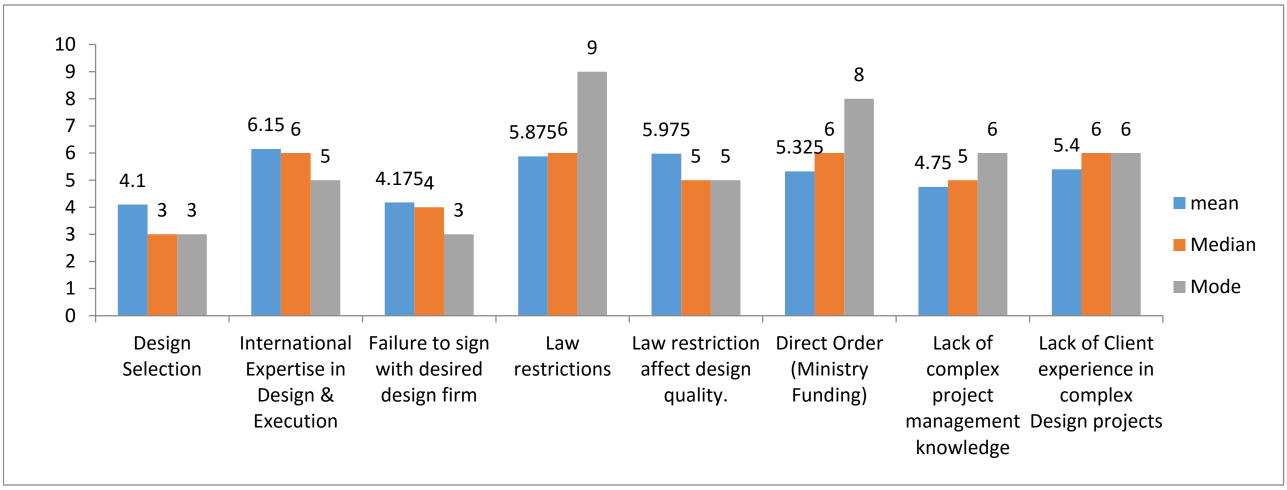

Figure 2. Findings of Risk Probability

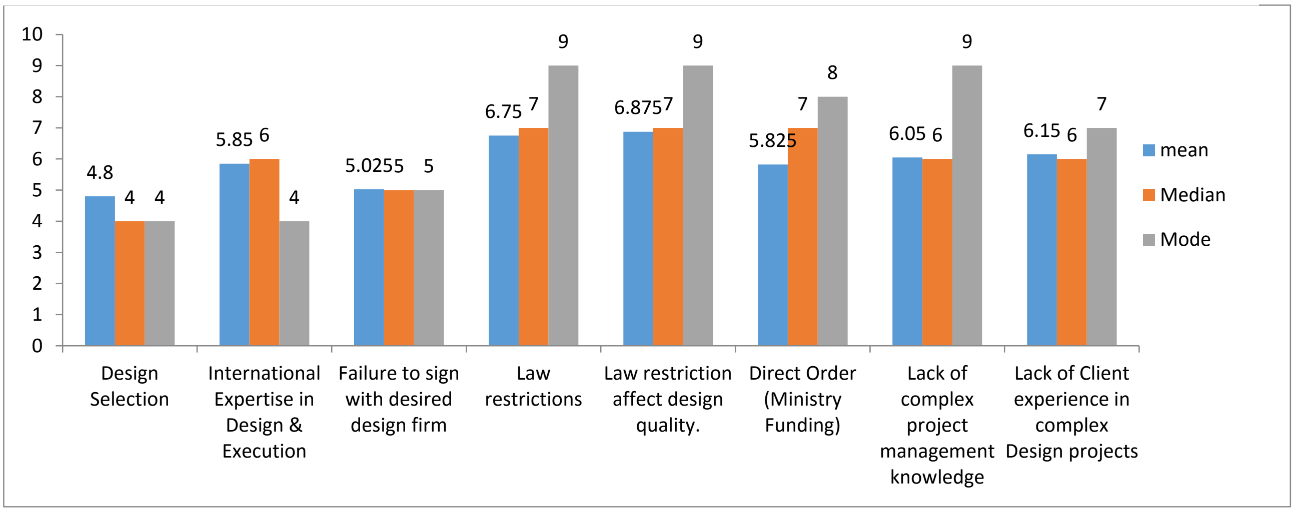

Figure 3. Findings of Risk Impact

Table 6. Top-ranked risks

Rank	Code	Risk	Risk Nature	Effect	T Variance	Total SD	EMV
1	L-5-DX	Egyptian law does not recognize the project management profession (Government Contracts)	Legislative	Negative	**3.438639063**	**0.085966**	**0.61992284**
2	D-3-O	Law restrictions affect design quality	Design	Negative	**7.316951563**	**0.182924**	**0.507137346**
3	L-2-O	Law restrictions	Legislative	Negative	**8.206826563**	**0.205171**	**0.489583333**

Table 7. Top causes and phases of emergence of risk

Source of risk /emerging phase		Impact of risk	Description	EMV
Design	D-3	O	Law restrictions affect design quality.	0.507137
Executive	E-18	O	Unplanned mitigation actions (Management)	0.446142
Governmental	G-10	O	Mistrust (Bidders)	0.425995
Legislative	L-5	DX	Egyptian law does not recognize the project management profession (Government Contracts)	0.619923

5.2 Risk Perception

In this section, a comparison is made among the top 10 risks, according to the perception of Egyptian participants and the international participants. This will allow for a comprehensive understanding of the different points of view. Moreover, this will ease the process of extracting similarities and differences in types of risks affecting both the local and the international construction market, Table (8), where it is clear that the top three risks according to both international and National perceptions are restrictive laws and policies which affect design quality and, in turn, banish experts in management disciplines in the construction market. Both local and international communities are suffering from currency fluctuation.

Table 8. Top national/international risks in Multinational Projects

	INTERNATIONAL EMV		EGYPT EMV	
#	**RISK**	**EMV**	**RISK**	**EMV**
1	Egyptian law does not recognize the project management profession (Government Contracts)	0.639781	Egyptian law does not recognize the project management profession (Government Contracts)	0.607289
2	Law restrictions affect design quality.	0.512757	Law restrictions affect design quality.	0.503704
3	Law restrictions (Egypt)	0.469081	Law restrictions (Egypt)	0.501412
4	International Expertise in Design and Execution	0.433251	Involvement of military contracting	0.480632
5	Unplanned mitigation actions (Management)	0.405322	Design Contract Break Down	0.47759
6	Mistrust (Bidders)	0.396433	Lack of Client experience in complex Design projects	0.475457
7	Limiting exposure to international innovations (Design and Construction)	0.39177	Unprofessionalism (Client)	0.474252
8	Increasing efficiency by increasing monetary reward (Client)	0.39177	Unplanned mitigation actions (Management)	0.471467
9	Involvement of military contracting	0.387106	Opportunity for corruption	0.461906
10	Currency Fluctuation	0.377778	Currency Fluctuation	0.459378

6 Conclusions

This paper sheds light on the inefficiency of planning, monitoring and controlling processes of risks that deal with the different aspects of cultural variances in the present construction industry. This in turn affects the work flow communication among involved parties due to lack of proper preparation and management in different categories.

Upon viewing the current practices of risk management and examining the failures of delivering successfully planned project in the modern construction industry in the MENA region, it is clear that these factors affect the planning, controlling and implanting of successful construction projects. These projects are influenced by a diverse spectrum of risks. These risks are mainly the result of two main deficiencies: lack of adequate cultural knowledge and poor prediction and planning of process risks. Regarding the Egyptian context and the top occurring risks in Multinational projects, findings of this paper show that a number of corrective actions should be adopted, including:

- Review and modification of law 89-1998, which represents a major setback for future Multinational collaborative projects, as it limits the competitiveness of quality and emphasis of quantity.
- Multinational collaborative projects buildings need special consideration in terms of bidding and tendering as the selection process should be based mainly on quality of provided work.
- Project management profession must be acknowledged by the Egyptian law: their roles and responsibilities should be set by the policy makers in order to avoid any conflict with the law.
- The construction industry in Egypt needs robust supervision to eliminate abuse of power and position.
- Flexibility when assigning International ventures to benefit the country both financially and knowledge-wise.

7 References

AS/NZS 4360 (2004). Australian/New Zealand standard on risk management. Standards, Australia and Standards, New Zealand.

Al-Sabah, R. (2012). Evaluating Significant Risks in the Middle East North Africa (MENA) construction projects from perspective of Multinational firms, University of Wisconsin, Madison, Wisconsin, USA - PHD, pp. 1-10.

Ayad, M. (2015). 300m needed to complete Grand Egyptian Museum: Antiquities Ministry. Daily News Egypt , http://www.dailynewsegypt.com/2015/04/26/300m-needed-to-complete-grand-egyptian-museum-antiquities-ministry/.

Barakat, E. (2015). Former Manager of GEM, Interview,Cairo, Egypt.

Barakat, E. (2010). Ministry of Culture-The Grand Egyptian Museum -Project Implementation Report.

Berkeley, D., Humphreys, P.C. and Thomas, R.D. (1991). Project risk action management' *Construction Management and Economics,* 9 (1) 3-1.

Clarizen. (2013), Risk Management, Useful Tools and Techniques.

Department of Defence (DOD) (2011). Work Breakdown Structures for Defense Materiel Items, Revision C.

DOIS. (2003). Methodology report. section 5.

Fact Book by CIA (2015). Egypt economy section website:

Https://www.cia.gov/library/publications/the-world-factbook/geos/eg.html- last accessed 12-4-2015.
Floricel, S. and Miller (2001). Strategizing for anticipated risks and turbulence in large-scale engineering projects. . *International Journal of Project Management* , 19(8), pp. 445–455.
Goral, J. (2007). Risk Management in the Conceptual Design Phase of Building Projects. CHAMLERS University Structural engineering joural , pp.17-35.
Zhi, H. (1995), Risk management for overseas construction projects, *International Journal of Project Management.* Vol. 13, No. 4, pp. 231-237.
Khodeir, L. M., and Mohamed, A. H. (2014). Identifying the latest risk probabilities affecting construction projects in egypt - political and economical variables 2011-2013.
MEED (2014). Middle East Business Intelligence, after International Monetary Fund, World Economic Outlook Database, http://www.meed.com/middle-east-economic-data/3099729.article#Egypt, last accessed 15/11/2015.
Ministry of Antiques (2015). The Grand Egyption Museum Website. http://www.gem.gov.eg/.last accessed 1/11/2015.
Miller and Lessard. (2001). Understanding and managing risk in large engineering projects. *International Journal of Project Management* , 19 (8), pp. 437–443.
Odeh., A. M. and Battaineh, H. T. (2002). Causes of construction failures: Traditional Contracts. *International Journal Of Project Managment*, pp. 67-73.
Patrick X.W., Zou, G.Z. and Wang, J., (2007). Understanding the key risks in construction projects in China - *International Journal of Project Management*. 25, 601– 614.
PMBOK. (2004). Project Management Body of Knowledge, PMI, PM journals 2004, 5th Ed.
Rozenes, S., Vinter, G. and Spragget, S. (2006). Project Control: A litrature Review. pp. 1-11.
Smith N.J. et al (2006). *Managing Risk in Construction Projects*. Blackwell publishing. 2nd Ed.
Whittaker, B. (1999). Unsuccessful projects. *Information Management and Security*. 7 (1), pp. 23–29.

TRENDS IN CULTURAL AND SOCIETAL MANAGEMENT OF CEMENT MURAL IN GHANA

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Abstract

Cement mural over the years has trend with humanity internationally and has played matchless role in cultural and societal management in the definition of Ghanaian culture and traditions. It is an effective instrument for Ghanaian cultural meanings and interpretations based on philosophies, themes, concepts and its social significance of promoting one's self-esteem. This study, therefore, seeks to examine the trends in cultural and social magnitude of cement mural and analysed its traditional connotations based on Ghanaian beliefs and lifestyles. Descriptive research design, using case study was adopted at examining and analysing the trend of cultural and societal significances of cement murals in the Ghanaian tradition. The researchers tend to validate the trending nature of cement mural in these two realms of management on repercussions of its value. Based on the research approach adopted, it was deduced that murals express various traditional, cultural and social meanings that relates to the history, beliefs and personal philosophies of Ghanaian people. As trending, the aesthetic appreciation of cement mural is grounded on individual cultural and societal influences as it is mostly seen on walls, facades and columns of modern architectural edifice and houses in Ghanaian communities. The study concluded that murals tend to draw art lovers to the facility, beautify the structures and make the structures more of traditional or give it an African touch. Implication of findings drawn on individual's dictum revealed that cement murals done on individual homes or houses bring out the true persona of individual uniqueness and also create an undying bond between cultural and societal management as based on aesthetics.

Keywords: Cement mural, Ghanaian, Culture, Architecture

1 Introduction

Cement mural has been aesthetically used for many roles in the development of humanity from time immemorial. Looking at Qi's functions of modern mural art, Murals not only serve as "decoration" for beautifying people's living environment but also have especial social and cultural properties that meet aesthetic needs of the public and possess functions for reflecting the ethnic, folk, and contemporary culture trend as well as functions for socio-cultural welfare purpose. Artistic creation murals in harmony with environment can enhance the art value, cultural value of environment and add its functions. Murals of new era can also reproduce historical events, heroic deeds of historical figures, thus playing a role in narration. As people's living standards have been improved and aesthetic demands have increased, murals begin to enter small space such as private houses and therefore decorative functions of murals, decorative functions of murals become increasingly obvious (Qi, 2014).

In Ghanaian cultural setting, in order to appreciate these impacts of cement mural on architectural buildings, some basic factual elements on both cultural beliefs and major artistic lifestyles are necessary. The artistic lifestyles or qualities in these cement mural affirm that shared aesthetic conscience exists across cultural beliefs, expressed in distinctive and precise form, and that it can be jointly perceived by the creator as well as the perceptive observer. This cement mural is a metaphor for the African Ghanaian cosmology that dramatically harmonizes humanity and the environment, integrating individuals and art into larger structures of family, clan, communal groups, and tribal identity. Cement mural in Ghana is a truly diverse experience of the pleasing aesthetic creations that acknowledges the artistic impulse existed between mankind and his environment. It touches a range of human emotions, some subtle, some overt. Anthropological facts on mural may help every individual to understand the skills and may enhance the appreciation, but ultimately the aesthetic response rests upon the art form presence. Understanding this form of art means to stand the cultural and social significance before it and perceive it closely, being receptive to the emotions it generates.

The ecstasy in Ghanaian cement mural speak to its viewers, this is agreed on Evergreene (2015) statement as shared that "Cement murals – especially those in prominent and public buildings – are designed to interact with the viewer and the space in which they are placed. They often tell a bigger story; a story about a specific time, a specific place, and specific people." However without a doubt, murals have been around as long as people, as a form of valuable testimony of life from the prehistoric time to today. From the cave paintings at Lascaux Grottoes in southern France to the street art murals of today, people have been leaving signs of their own existence in many places around the world. It is because of the earliest scratching, carvings, etchings and paintings that we now have priceless knowledge of our history and predecessors, and these murals hold great significance for mankind, as they depicted life activities, everyday scenery and usually religious traditions of the time they were created in, giving us a priceless look of the diversity of our cultures during different periods. Over the course of time, murals have covered the interiors and exteriors of many public buildings, such as palaces, temples, tombs, museums, libraries, churches and the houses of rich art patrons, spreading onto the streets and architectural elements more recently, all the while keeping their initial meaning and purpose: to paint a picture of society, created from stories, values, dreams, change (Kordic: 2015).

The Ghanaian cement mural sculpture in its finest representations can be culturally and socially examined aesthetically in terms of form, composition, and presence. Again the art works in this rendition possess these characteristics, often in boldly innovative designs or geometric patterns incorporated with Adinkra symbols. Cement murals especially those in prominent individual and public buildings are designed to interact with the viewer and the space in which they are placed. They often tell a bigger story; a story about a specific time, a specific place, and specific people. The cultural and societal of creating cement murals on walls, facades, columns are considered by sculptors to be an integral part of building. As cement murals cover quite large surfaces that could be of different texture, constitution and attributes artists have developed several techniques adaptive to wall surfaces. One of these is plastering, which uses cement or mortar on walls or ceilings. In many cases the sculptural wall is also structural - supporting the rest of the building. Though these cement forms of murals are very trendy in Ghanaian culture, very little is written on the cultural and societal significances these cement murals possessed. The research thus intends to make available answers to the inadequacies as well as strengthen the cultural and societal management of cement murals in the Ghanaian setting.

2 Literature Review

Kordic (2015) again shares that the word mural originates from the Latin word "murus", meaning "wall". Today, we can define murals as any piece of artwork painted or applied directly onto a wall, ceiling or other larger permanent surfaces, flat, concave or convex, to be precise. A favourite technique of many artists, including masters like Leonardo Da Vinci and Michelangelo Buonarroti, the art of muralism flourished during the 1920s, after the Mexican revolution. It is during this time that murals got a new dimension as a powerful visual communication tool, meant to promote the opinion of the people and to transmit social and political messages towards unity. Through the large paintings of "the great three": Diego Rivera, José Clemente Orozco and David Alfaro Siqueiros, murals became the most important form of expression, often the subject of controversy and always a symbol of solidarity, freedom and hope. The Mexican muralism art inspired the creation of many other similar movements around the world, the biggest being the Chicago art movement in the 1960s. Murals also represent one of the most important features of Northern Ireland, depicting the region's past and present political and religious divisions. Since the 1970s, the country has seen almost 2,000 paintings dedicated to the fight against racism and environmentalism, among many other issues. Another famous place charged with political murals was the Berlin Wall, whose Western side saw many murals between its creation in 1961 and its destruction in 1989, including the works by artists Keith Haring and Thierry Noir. Staying true to their role of expressing religious and political beliefs within societies, murals represent a mighty tool of emancipation, freedom of expression and social activism and propaganda. Today, in many places around the world and mostly in South America, mural art is used to speak in the name of and depict communities, nations and cultures. At the same time, murals represent an aesthetic element which helps them integrate into their environments and turns them into true cultural artefacts and even monumental works. Apart from their well-defined meanings, murals are also created with other purposes, such as advertising or simply for the sake of a beautiful image on a wall. With street art becoming more mainstream, many big brands often collaborate with mural artists in creating promotional campaigns and designs, and many world-famous street art and graffiti artists successfully paint their murals everywhere, showing incredible skills and talent which formed their own highly distinctive artistic styles.

Jonsson (2015) is of the view that there have been murals on walls throughout the world for as long as there have been people on Earth. People scratched them, carved them, etched them and painted them. The history of murals and mural painting is rich and varied, from the prehistoric cave paintings at Lascaux, France, to the celebratory and ceremonial murals of ancient Egypt, Rome, Mesopotamia, Greece and India. According to art historians, mural painting dates back at least 30,000 years to cave paintings. (Other historians credit the Minoans and the Etruscans.) Some of these impressive works have been preserved, thankfully, by the very caves which they inhabit. These ancient murals typically depict the activities of a particular civilization's people, encapsulating a moment in time, and range from scenes of hunting, gathering, and family life, to religious and funerary scenes. An interesting evolution continues in the world of murals. New ones are continually being commissioned and created while old ones are constantly being rediscovered and restored (i.e. ca. 100 AD Mayan wall paintings at the remote ruins of El Petén and San Bartolo in Guatemala, which were discovered fairly recently in March 2001). The purpose of murals varies from culture to culture, and from time period to time period. Several examples follow. Many murals in the Tibetan world, both ancient and contemporary, are created as part of meditative and reflective Buddhist practices. During the Baroque period in France, Germany and England, rich art patrons and royalty had Biblical and allegorical murals painted on the ceilings and of their luxurious homes and palaces. Patrons often had themselves painted into the mural, as a way of capturing their likenesses for all time. Mural art appears on the walls and ceilings of interior and exterior spaces, ranging from palaces, temples, and tombs, to museums, libraries, churches, and other public buildings. In our more contemporary era, murals have found their way onto a large variety of surfaces. An important point to finish this section with: Good mural artists will consider their mural in relation to the mural's natural or architectural setting, allowing the piece to become an aesthetic, social, and most importantly, cultural, artefact. Worth noting...Murals date to Upper Paleolithic times, such as the paintings in the Chevaux Cave in Ardeche (southern France) around 30.000 BC. Ancient murals have also survived in Egyptian tombs circa 3150 BC, the Minoan palaces from the Neopalatial period circa 1700-1600 BC, and in Pompeii circa 100 BC to 79 CE (AD). These ancient murals were ‘painted’ with whatever materials, always natural, were available at the time.

Cultural and societal connotations conveyed by cement murals are beneficial to enhancing human mental minds and achieving dual functions of appreciation of aesthetic beauty and enlightenment, truly reflecting social value of cement mural. Diverse space environment and extensive aesthetic collections increase the demand for murals, and especially the increase in large public buildings provides greater prospects for mural development, and meanwhile brings more limiting factors for mural creation as well as imposing more requirements for selecting themes, expressing vectors of inner spirit. Therefore, the viewers' aesthetic ability and aesthetic taste should be taken into account during considering the diversity of space buildings. Murals can adapt to requirements for space functions and forms of specific environment, thereby achieving its own aesthetic perfection, so that people can enjoy the environment aesthetically and get spiritual enjoyment folly. At the same time they can achieve social functions of indoctrinating and promoting human relations, which can be best shown from the square in this respect, as the square buildings as micro-environment are more open and broader, who’s various groups of appreciation have different levels of aesthetic standards and rich aesthetic tastes. It is important to reflect the openness and characteristic civilization of regional cities in medium environment (Qi, 2015).

Lau (2015) cites that many of the murals of Mohammad Mahmoud Street near Tahrir Square, created to commemorate the martyrs of the 2011 Revolution, can be observed to make remarkable use of symbols and motifs of ancient Egyptian art. At the same time, the continuing protests in Egypt have largely been divorced in Western academic discourse from any discussion of ancient Egyptian history. This pattern of disassociating modern Egypt from its ancient past has been prominent in Western thinking ever since colonizers first began to collect ancient Egyptian artefacts and documents in their own private institutions. When one of these institutions, the Institute d’Egypte, burned down in December 2011 together with many of its important historical documents, some in the West began asking questions about the Egyptians’ irreverence toward their own history. In fact, however, history as cultural and social memory could not be more alive in the Egyptian Revolution and its aftermath. The Revolution has reinvigorated history on the street in a way that has the capacity to produce change in society. The most tangible evidence of this is in the street murals of Mohammad Mahmoud Street, which incorporate Egyptian art in a way that endows both ancient and modern history with new meanings and that invites participation from the street, empowering Egyptians on both the individual and societal level, and legitimizing the presence of the people at a time when the state has oppressed their very existence.

Cultural pride serves as a cornerstone of culturally competent social work practice. Cultural competence, in turn, also relies on a strengths perspective toward individuals and communities (Delgado and Barton, 1998).

Looking at these assertions from various authors as cited this literature, all the views are geared towards the cultural and societal impact murals have on the individuals and the community as well.

3 Research Methodology

Descriptive research design, using case study which allows examining and analysing the trend of cultural and societal significances of cement murals in the Ghanaian tradition was used. Case study research conducted for this study involved an in-depth study of individuals who owned private buildings and social business centres with cement murals. Case studies often lead to testable hypotheses and allow one to study rare phenomena. Case studies should not be used to determine cause and effect, and they have limited use for making accurate predictions (Halle, 2011).

The choosing of sample size depends on non-statistical considerations and statistical considerations. The non-statistical considerations may include availability of resources, manpower, budget, ethics and sampling frame. The statistical considerations will include the desired precision of the estimate of prevalence and the expected prevalence of eye problems in school children (Explorable.com, 2015).

On the other hand, the sample size obviously depends on the type of research. (Dawson, 2002). The research sample size of 50 respondents were contacted for this sampling procedure. These 50 respondents were comprised of five building industries as they were purposively selected for the research population. These were Akroma Plaza, Brown's resident, Frebe Mall, Naakoff Chinese Hotel & Restaurant both Takoradi and Adjei-Boye's Villa located at Dawhueya, Tema. Specifically, these five buildings were chosen for the study, based on the criteria that they contained the trendy nature of cultural and societal management pertaining cement murals done contemporary to suit the architectural edifice. Research was conducted by purposive sampling technique for the study. The sample is made up of 15 workers of Akroma Plaza, 5 workers of Brown's resident, 15 workers of Frebe Mall, 10 workers of Naakoff Chinese Hotel & Restaurant and 5 individuals of Adjei-Boye's villa.

A form of non-probability sampling in which decisions concerning the individuals to be included in the sample are taken by the researcher, based upon a variety of criteria which may include specialist knowledge of the research issue, or capacity and willingness to participate in the research. Some types of research design necessitate researchers taking a decision about the individual participants who would be most likely to contribute appropriate data, both in terms of relevance and depth. For example, in life history research, some potential participants may be willing to be interviewed, but may not be able to provide sufficiently rich data (Oliver; 2013).

In this fact, this purposive sampling as a feature of qualitative research, researchers handpick the buildings have cements murals on the basis of their judgement of their typicality or possession of the particular characteristics being sought. In this way, they build up a sample that is satisfactory to their specific needs. (Cohen et al., 2010).

Data collection tools were semi-structured interview, participant observation, focus group on discussions of personal viewpoints. Participant observation helped the researchers in some history, uses and purposes of cement mural done in Ghana. All collected data was validated using a triangulation method and analysed by analytic induction and typological analysis. The results are here presented as a descriptive analysis.

"Careful planning for data collection can help with setting realistic goals. Data collection instrumentation, such as surveys, physiologic measures (blood pressure or temperature), or interview guides, must be identified and described. Using previously validated collection instruments can save time and increase the study's credibility. Once the data collection procedure has been determined, a time line for completion should be established." (Pierce, 2009:159).

4 Findings and Discussion

The beauty of Ghanaian cultural and societal trends takes the standpoint of an understanding of contemporary Ghanaian society and culture that requires a good understanding of traditional institutions, beliefs and practices. This study therefore further goes on with aesthetic appreciations of cement mural works imbued with Ghanaian traditional culture, social organization, social institutions and world-view before tackling the influence of contemporary cultural and social changes on cement mural. Some important factors of change to be considered include: colonialism, Christianity, formal classroom education and monetization of the economy. Other features of modernization to be treated are urbanization, industrialization, migration (rural-urban), globalization and new and increasing advances in communication technology (Nukunya, 2003).

All these influences have taken roots in the Ghanaian arts and culture. Cement mural in places talks more about ones ideology, philosophy of cultural and social affirmation of life. These trend in cultural and societal management are a fundamental skill required of professional artists especially sculptors and in many other fields of art. In modern cement mural practice, an ability to create images and to encode them with meaning is central to the creative process. With an emphasis on design practice and analysis, this art form aims to develop ones understanding of the fundamentals of visual language and design principles. These visual languages and design principles come in a form of geometric patterns, shapes, lines and dots. This provides the public or viewers with a core knowledge base from which one can build visual problem-solving skills and enhance one’s ability to plan, create and critically evaluate one’s own image-making processes.

Looking at these visual languages and design principles that come in a form of geometric patterns, shapes, lines and dots. They have been used to form compositions that speaks and promotes Ghanaian tradition. Below are some aesthetic appreciations of cement murals in various forms of composition on buildings especially walls, facades and columns:

Appreciation 1: In Akan language “Ahyiabia” explains the etymology of the hotel, bar and restaurant name, “Akroma Plaza” as the meeting place. Akroma Plaza started operations in 2002 with the restaurant and catering business as its core business. With the motto “Attaining Heights in taste”. Akroma Plaza climbed high in hospitality ladder to attain the status of the best restaurant of the Western region in the grade one category. With a high demand for conference facility and accommodation, Charlie Hall, the hotel and auditorium were added to the existing facilities. Rightly coined, “A world of comfort in the heart of town”, there is no holding back on quality when it comes to Akroma Plaza. The composition of cement mural on the façades and pillars of the hotel brings the act or process of converging and the tendency to meet in one point. The work has representation of all human forms coming together under one roof. That is the point of convergence or meeting place within the work. The interplay of these element gradually bring the unfolding calescence. The meeting place symbolizes the coming together of different people in the contexts of harmony, joy, happiness, peace and relaxation under a comfort serene environment or atmosphere (below shows figure 1a and figure 1b - The meeting place).

Figure 1a. The Meeting place

Figure 1b. The Meeting place

Appreciation 2: Progression among humanity involves important ideas that are neither trivial nor obvious, these ideas need to be taught in ways that are interesting and engaging to mankind. The totality of concepts involved in this work of art means the gradual movement and development of human activities towards a destination of succession. This describes concepts and representations of relationship between man his creator, ancestors, deities and lesser spirits. In Ghanaian culture, an adage goes like "Enam dua so nti na ahuma hunu esoro" literally means one becomes successful through his fellowman's help. Therefore this long stretched chain composition of distorted human figures seeks to reiterate the value of togetherness and the qualities jointly compose and execute by mankind to attain victory through endurance. Progression is a long stretched chain wall mural composition that has human figures arranged up and downwards, twisted and jointly executed together. The composition reveals various form poses of human figures in geometrical objects.

These forms poses are embedded with geometric lines, dots, patterns and shapes which symbolize a comprehensive and representative state of humanity trying to be successful and help themselves to accomplish their ambitions (see Figure 2: Progression).

Figure 2. The Progression

Appreciation 3: Sankofa symbol appears frequently in traditional Akan art, and has also been adopted as an important symbol in an African American and African Diaspora context to represent the need to reflect on the past to build a successful future. It is one of the most widely dispersed Adinkra symbols, appearing in modern jewellery, tattoos and clothing. This work dialogues to its viewer the philosophical ideas and symbols of taking from the past what is good and bringing it into the present in order to make positive progress through the benevolent use of knowledge. The work is coupled with round objects, bigger dots and smaller ones which seeks to provide enlightenment of Ghanaian culture through educational, cultural, and social events and activities. The lines on the wings symbolizes the Akan people's quest for knowledge among the Akan with the implication that the quest is based on critical examination and intelligent and patient investigation. Thus the Akan belief that the past serves as a guide for planning the future. To the Akan it is this wisdom in learning from the past which ensures a strong future. The Akans believe that there must be movement and new learning as time passes, but as this forward march proceeds the knowledge of the past and must never be forgotten. Sankofa in Akan language literally and culturally means going back to fetch it, that is "se wo were fi na wo san kofa a yenkyi" (it is not a taboo to go back and retrieve if you forget). This symbol of made of cement on a wall proposes wisdom in learning from the past in building the future. The work is composed of a bird that has it head turned backwards with an egg in its beak touching the back. The work teaches us that we must go back to our roots in order to move forward. Visually and symbolically "Sankofa" is expressed as a mythic bird that flies forward while looking backward with an egg (symbolizing the future) in its mouth (see Figure 3: Sankofa).

Figure 3. Sankofa

Cement mural has been aesthetically used for many roles in the development of humanity from time immemorial, when people sculpted and painted depictions of their beliefs. Presently, people have begun to adorn private and commercial or religious structures with cement murals depicting lifestyle and religion and philosophical themes are incorporated.

The findings of the research study clearly revealed that cement murals in private or public places of building evolved generally as a solution to the cultural and societal needs of the individual and people of the community. In making this type of art form, cement is mixed with sieved sand or fine stone dust together with water as materials whereby they were used in the construction of cement murals. This does not only present readily available materials for practicing the above art form, but also made it possible for the aesthetics complement of the place. The cement murals clearly revealed the cultural and social thoughts and characteristics of the individually own buildings. This is in significant agreement with the research of Heather (2009), which investigated the 2500-year-old murals of the Mayan people of Guatemala. Hurst concluded that the creative process, content, style and materials had been adapted in line with technological advancements, social evolution and generational politics. There were clear periods of Mayan murals, such as pre-classic and classic. Cement murals found on these buildings thematically summarized the philosophical and cultural propensity of the buildings. Sculptors and building owners played an integral part in cement mural rendition, which clearly showcased their beliefs, concerns, interests, and aspirations. This lends credence to the findings of Wemegah (2013), who brought out the intricacies of mural decorations in the Sirigu Culture., since it served as a beautification of satisfying aesthetics and evidently showcasing the philosophical and cultural themes of the people.

It was also factual from the research findings that the role of the cement murals on buildings goes beyond adornment of the buildings. This is demonstrated on buildings where cement murals executions are highly propounded and displays the aesthetic values on the general spatial environment. Cement murals therefore, in this perspective, cannot be said to be only limited to the aesthetics, but also helps in cultural and societal therapeutic values on buildings. Buildings or houses with such edifices, are important instrument used in imparting our traditional values not only aesthetics but providing the cultural and social importance to the individual and the community as a whole.

5 Conclusion and Further Research

Based on the findings of the study, it therefore allowed to conclude that cement murals on buildings or houses in private or public places are not done artistically and aesthetically please the individual and the community but based on its cultural and societal connotations. This artistic rendition embodied great percentages of the cultural and social values based on personal philosophies of the people. The research obviously showed that materials used in the execution of cement murals were naturally materials with the exception of cement which is chemically oriented but environmentally friendly when it comes to working with it.

6 References

Dawson, D. C. (2002). Practical Research Methods. Oxford: How to Books, Ltd.

Delgado, M. & Barton, K. (1998). Murals in Latino communities: Social indicators of community. National Association of Social Workers, Incorporated, pp 5 & 6.

Evergreene. (2013, August 30). Evergreene Architectural Arts. Retrieved from WPA Murals: The Cultural Importance of Preserving Artwork in Architectural Settings: http://evergreene.com

Explorable. (2015,August 26). Sample size. Retrieved from Explorable: http://explorable.com

Halle, J. (2011, September 27). The 3 Basic Types of Descriptive Research Methods. Retrieved from Psychcentral: http://psychcentral.com

Heather, H. (2009). Murals and the ancient Maya artist: A study of art production in the Guatemalan lowlands. New Haven, CT: Yale University.

Jackson, S.L. (2009). Research Methods and Statistics: A Critical Thinking Approach 3rd edition. Belmont, CA: Wadsworth.

Jonsson, E. (2015, September 13). *A Brief History of Murals and Mural Painting*. Retrieved from Jonsson World: www.jonssonworld.com

Kordic, A. (2015, September 11). *Mural the Histroy and the Meaning*. Retrieved from Widewalls: http://www.widewalls.ch/what-is-a-mural-the-history-and-meaning/

Lau, L. (2015, August 28). The Murals of Mohammad Mahmoud Street: Reclaiming Narratives of Living History for the Egyptian People. Retrieved from Boston University Arts & Sciences Writing Program: http://bu.edu/Writingprogram

Cohen, L. et al (2010). Research Methods in Education, Sixth Edition. London & New York: Routledge.

Nukunya, G. K. (2003). Society, Culture and Modernization in Ghana, Second and enlarged edition, Accra, Universities Press.

Oliver, P. (2013, August 27). Purposive Sampling. Retrieved from Sage research methods: http://srmo.sagepub.com

Pierce, L. L. (2009). Twelve Steps for Success in the Nursing Research Journey. Journal of Continuing Education in Nursing, 40(4):154-62.

Qi, J. (2014). The Functions of Modern Mural Art. Cross-Cultural Communication, Vol 10, Iss 2, Pp 25-29.

Wemegah, R. (2013). Murals in Sirigu Culture: Philosophical and Cultural Importance. International Journal of Arts and Commerce, Vol 2 No. 3, 108.

EMPLOYEE'S SAFE ACTS TOWARDS HEALTH AND SAFETY COMPLIANCE IN GHANA

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Abstract
The high incidents and accidents rate in the construction industry in Ghana has been attributed to the large number of Small and Medium-Sized Enterprises (SMEs) contractors. The purpose of the study was to examine employee's safe acts that contribute to Health and Safety (H&S) compliance among SMEs contractors. The study adopted Delphi survey method of data collection. Views of experts (construction professionals and academicians) were sought on safe acts of workers leading to H&S compliance. The questionnaires were completed by the experts, based on the impact of otther factors in predicting safe acts of workers towards H&S compliance. The ratings were based on either the impact was considered to be very high or high. Data obtained was analysed with Microsoft EXCEL, spread-sheet software and results were presented in a table and a chart. Findings from the study show that only three measurement variables (ensure equipment /tools are in good condition before usage, ensure the use of personal protective equipment (PPE) and ensure proper positioning of tasks) were considered by the experts to have reached consensus with Inter-quartile deviation (IQD) cut-off (IQD $\leq$1) score. It also indicates strong consensus with very high impact (VHI: 9.00-10.00). Nine other measurement variables also reached consensus with IQD cut-off (IQD$\geq$1.1$\leq$2) score, which indicates good consensus with high impact (HI: 7.00-8.99). The remaining four measurement variables reached consensus with IQD cut off (IQD$\geq$2.1$\leq$3) score. It can be concluded from the findings that employee's safe acts has a high impact on H&S compliance of SMEs contractors in Ghana. It is recommended that questionnaire survey instrument should be used among large construction firms to validate the measurement variables.

Keywords: Employee's safe acts, Compliance, Health and Safety, SME contractors

1 Introduction

Small and Mediun-Sized Enterprise (SMEs) contractors have dominated the construction industry in Ghana as indicated by Frempong and Essegbey (2006), Laryea (2010) Ofori and Toor (2012). Kheni, Dainty and Gibb (2007) posits that the domination of the SMEs has made it impossible for the SMEs to manage H&S effectively. Mustapha, Aigbavboa and Thwala (2015) in their findings from the study of the application of modified statistical triangle of accident causation in construction H&S indicated that construction accidents lead to delay in project completion, increase the expenses and ruin the reputation and reliability of contractors. These incidents have placed the construction industry among the industries with high rates of accidents, both permanent and non-permanent disabilities and even fatalities. Mustapha et al., (2015) posit that not all accidents are preventable since risk is beyond the human intervention and majority of accidents happen when employees disregard safety rules (unsafe acts) and management ignore the presence of unsafe conditions. Employees must desist from acts such as, working under the influence of alcohol and other drugs. Appropriate use of PPE must be ensured by all employees whenever they are carrying out any task. The paper aims to examine employee's safe acts that will contribute to H&S compliance among SMEs contractors in Ghana. Employees' attitude towards H&S compliance in the construction industry has been discussed.

2 Literature Review

The employers and employees have similar perceptions of the respective responsibilities of each party for H&S in the workplace (Elgood, Gilby & Pearson, 2004) because H&S involves all levels of workforce, from the top to the bottom. Therefore, employees' involvement should be encouraged by management. It is important to establish participation, communication and trust between the various role players in order to create a positive safety culture **(**Boshoff, 2015). Smallwood and Haupt (2008) argued that compliance with OSH regulations brings about benefits not limited to avoiding direct and indirect costs (Windapo & Oladipo, 2012) also contributes to organisations' competitive advantages. According to Othman (2012) "inability to realise mechanical faults and inadequate training coupled with harsh work environment and unsafe methods of working *inter alia* are among the causes of non-compliance with OSH regulations in developing countries". Adenuga, Soyingbe, and Ajayi (2007); Idubor and Osiamoje (2013); Windapo and Oladapo (2012) supported this argument with lack of adequate training as a hindrance to OSH regulations compliance and further indicated that safe work environment can determine how issues of compliance with OSH regulations are taken care of by construction firms. Idubor and Osiamoje (2013) posits that adequate OSH training and education enhance the OSH performance e.g., compliance with OSH regulation. According to the Occupational Health and Safety (OHS) Act, the employer must, where reasonably practicable, provide and maintain a safe, healthy work environment that is without risk to employees (Boshoff, 2015). It is therefore, the duty of every employee at work to take reasonable care for the health and safety for himself as well as other persons. Every worker is in other words responsible to take care of his or her own health and safety. The unsafe acts of the worker may not negatively impact or endanger others (Boshoff, 2015).

One of the greatest determinants in workplace safety, especially as employees interact amid a host of varying safety issues is employers' behaviour. Elgood et al., (2004) argued that attitude is a key to understanding employee behaviour and prevention of on-site-job injuries. Therefore, it is the duty of employers' to educate their employees on the possibility of workplace injury before any safety program should be instituted (Schulz, 2004). Smallwood (2010) posits that employees' attitude relates to culture and can be linked to ignorance. If employees' attitude is checked it will lead to improvement towards H&S in the construction industry. Therefore, it is the responsibility of the employer on his employees to make provision a set of rules and regulations that relate directly to safety in the workplace to ensure the general wellbeing for employees (Elgood et al. 2004). The organization must undergo a culture change from the top and filter its way down to all employees for any sort of attitudinal change to occur to every employees (Schulz, 2004). Central to this culture is the feeling that safety is a top priority and nothing else. Employees' good attitude will contribute to their safe act which will finally lead to compliance of H&S in the construction industry. It is also the duty of employees' to co-operate with the employer where the OHS Act imposes a duty or requirement to be performed or complied with. Employees' should always carry out and obey lawful orders and obey the H&S rules and procedures laid down by the employer (Boshoff, 2015).

3 Research Methodology

Twenty (20) experts made up of academicians and construction professionals selected from Building Technologists, quantity surveyors were selected at random from West African Built Environment Research (WABER), International Conference on Infrastructure Development in Africa (ICIDA) and Applied Research Conference in Africa (ARCA) and invited during the initial stage of the study. The experts for the Delphi survey were selected for a purpose to apply their knowledge to a concept raised in the study based on the criteria that was developed from the research questions under investigation. A Delphi Study is a group decision mechanism requiring qualified experts who have deep understanding of the issues at hand (Okoli & Pawlowski, 2004).

Each expert was required to meet at least five (5) of the following minimum criteria: residency – have lived in any of the Metropolitan/Municipal/District in Ghana at least more than one (1) year; knowledge – has knowledge of H&S in the construction industry; academic qualification – has been presented an earned degree (Bachelors-degree/Masters-degree/PhD) related to any field, certification of employment/experience focusing on construction development or sustainable issues; experience – has a history of or currently performing consultation services for the government of Ghana, individuals, businesses, agencies, companies, and or organizations, relating to construction or other sustainable development. The experts must exhibit a high degree of knowledge of experience in the subject matter in addition to extensive theoretical knowledge, employment – currently serves (or has previously served) in a professional or voluntary capacity (e.g., at place of employment - institution, business, agency, department, company) as supervisor or manager of establish that is involved with construction or sustainable development in Ghana, influence and recognition - has served or currently serving as a peer reviewer for one or more manuscripts received from a journal editor prior to its publication in the primary literature, with focus of the manuscript(s) on construction or sustainable development, authorship - is an author or co-author of peer-reviewed publications in the field of construction with emphasis in Ghana, has prepared and presented papers at conferences, workshop or professional meetings focusing on construction, sustainable development and H &S, research - has submitted one or more proposals to or has received research funds (grant or contract) from national, local government, regional, and or private sources that support construction, sustainable development and studies related to H&S, teaching - has organised, prepared, and successfully presented one or more H&S or sustainable development training workshops focusing on the group for which expertise is sought. The workshop or course must have been on H&S practices or has served as an individual or as a collaborative instructor in the teaching of one or more Polytechnics or University courses focusing on construction, sustainable development or related field, membership -member of a professional body (as listed on the expert questionnaire). The expert should also be the representative of a professional body so that their opinions may be adaptable or transferable to the population and finally, willingness – Experts must be willing to fully participate in the entire Delphi survey. The selected expects for the paper represented a wide variety of backgrounds and guarantee a wide base of knowledge (Rowe, Wright & Bolger, 1991). Rowe et al., (ibid) recommendations were adopted for the current study. The number of respondents should be large enough to ensure that all perspectives are represented, but not so large as to make the analysis of the results unmanageable by the researcher (Linstone & Turoff, 1975). The adoption of five of these criteria was considered more stringent than the recommended number of at least two criteria by Rogers and Lopez (2002) and Dalkey and Helmer (1963). The five minimum criteria were framed after the four recommendations made by Adler and Ziglio (1996), with the inclusion of experts' residency status, which was considered to be compulsory for all selected experts. This was considered significant because experts were required to have a wide-ranging understanding of H&S practices within their locality.

From the twenty (20) experts invited to participate in the Delphi survey, thirteen (13) experts responded to participate and completed the first round, but only nine (9) experts remained throughout the study. This number of panellists was considered adequate based on literature recommendations from scholars which have employed the technique previously. Hallowell and Gambatese (2010) suggested that since most studies incorporate between eight (8) and sixteen (16) panellists, a minimum of eight (8) is reasonable. This was beyond the given limit in the current study. Hallowell and Gambatese (2010) argued that the size of a panel should be dictated by the study characteristics, number of available experts, the desired geographical representation and capacity of the facilitator. Experts were asked to rate the impact of other factors in predicting employees' safe acts in relation to their contribution towards H&S compliance as shown in Table 2. Data obtained from the survey was analysed with Microsoft EXCEL, spread-sheet software. The output from the analysis was a set of descriptive statistics such as means, median, standard deviations and derivatives of these statistics.

3.1 Instruction for experts

If the impact is considered to be high, then **'X'** should be marked under the '**7**' or **'8'** box depending on whether your opinion is inclined more towards high or very high impact. Please use your experience, expertise and judgement to rate what you perceive the average negative or positive influence of the various features are for H&S compliance and the Ghanaian SMEs contractors at large would be if the described elements were lacking or present.

Table 1. Impact scale

No impact		**Low impact**		**Medium impact**		**High impact**		**Very high impact**	
1	2	3	4	5	6	7	8	9	10

4 Findings and Discussion

From the sixteen (16) measurement variables or attributes drawn from literature and considered most relevant for the study as shown in Table 2, only three measurement variables or attributes (ensure equipment /tools are in good condition before usage, ensure the use of personal protective equipment (PPE) and ensure proper positioning of tasks) were considered by the experts to have reached consensus with Inter-Quartile Deviation (IQD) cut-off (IQD ≤ 1) score. This score implies the measurement variables have very high impact (VHI: 9.00-10.00) on employee's safe acts towards H&S compliance and indicates strong consensus. The results are in line with Mustapha et al., (2015), Othman (2012) and Elgood, Gilby & Pearson (2004) findings. Moreover, consensus was reached on nine other measurement variables with IQD cut-off (IQD$\geq 1.1 \leq 2$) score. The IQD score indicates good consensus for the nine measurement variables and the impact on H&S compliance was high (HI: 7.00-8.99). Four measurement variables reached consensus with IQD cut off (IQD$\geq 2.1 \leq 3$) score, which indicates weak consensus on the measurement variables and impact on H&S was medium (MI:5.00-6.99). These findings further, indicate similar pattern reported earlier by Boshoff (2015), Windapo and Oladipo (2012), Othman (2012) and Smallwood and Haupt (2008) which emphasized on the need for education and appropriate training towards employee's safe acts. Using the median as a means of reaching consensus, fourteen (14) attributes were considered to have reached consensus, with the exception of two measurement variables (avoid annoyance and horseplay at the workplace and do not service equipment that is in operation) which did not reach consensus as shown in Tables 2 and their representation in Figure 1.

Table 2. Employee's Safe Acts

Employees' Safe Acts	Median	Mean	SD	IQD≤ 1
Inspect workplace before commencing any activity	9	7.86	1.73	1.36
Tidy up workplace at the end of any activity	7	6.5	1.71	2
Use appropriate tools/equipment	8	7.57	1.5	2.25
Do not work under the influence of alcohol and other drugs	8	8.14	1.46	2.25
Do not smoke in flammable materials store	9	8.43	1.68	2.5
Ensure equipment /tools are in good condition before usage	9	8.14	1.36	1
Use correct proper lifting, handling or moving of objects	8	7.86	1.36	1.36
Ensure proper stacking of objects /materials in safe locations	8	7.57	1.4	1.07
Avoid annoyance and horseplay at the workplace	6	6.57	1.84	1.5
Ensure the use of personal protective equipment (PPE)	9	9	0.93	0.25
Do not remove safety guards from the workplace or equipment	8	7.87	1.25	1.25
Do not throw or accidentally drop objects from high levels	7	7.43	1.51	1.5
Ensure proper positioning of tasks	7	7.29	1.38	1
Do not service equipment that is in operation	6	6.14	2.61	2.5
Concentrate on the task at hand	7	7	2	2
Work in good physical conditions	8	8.29	1.5	2

M = Median; $\bar{x}$ = Mean; σx = standard deviation; IQD = Interquartile deviation

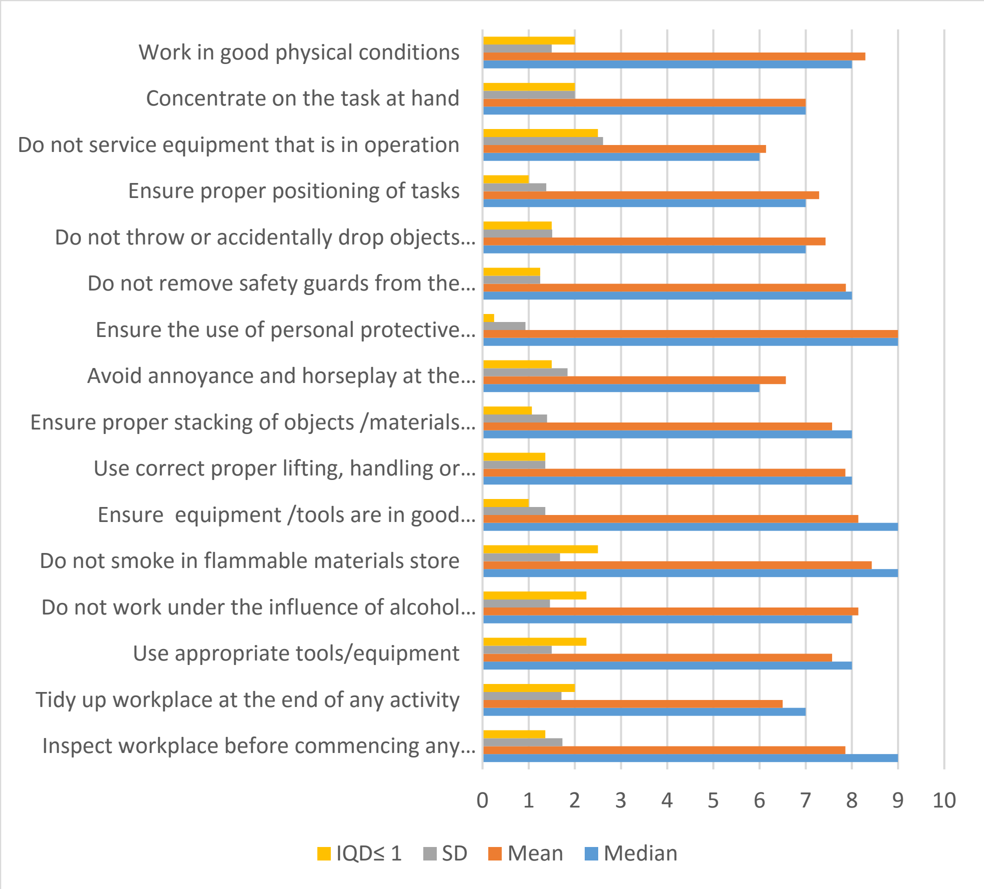

Figure 1. Employee's safe acts

Results from the study revealed that the following sixteen factors or measurement variables were considered by the experts to have varying impact on the employees' safe acts towards H&S compliance.

1. Inspect workplace before commencing any activity (HI)
2. Tidy up workplace at the end of any activity (HI)
3. Use appropriate tools/equipment (MI)
4. Do not work under the influence of alcohol and other drugs (MI)
5. Do not smoke in flammable materials store (MI)
6. Ensure equipment /tools are in good condition before usage (VHI)
7. Use correct proper lifting, handling or moving of objects (VHI)
8. Ensure proper stacking of objects /materials in safe locations (HI)
9. Avoid annoyance and horseplay at the workplace (HI)
10. Do not service equipment that is in operation (MI)
11. Ensure the use of personal protective equipment (PPE) (VHI)
12. Do not remove safety guards from the workplace or equipment (HI)
13. Do not throw or accidentally drop objects from high levels
14. Ensure proper positioning of tasks (VHI)
15. Concentrate on the task at hand (HI)
16. Work in good physical conditions (HI)

From the impact ratings of the factors, findings revealed that 3 of the factors or measurement variables have a very high impact (VHI: 900-10.00), while 9 other factors or measurement variables have high impact (HI: 7.00-8.99) and four other factors or measurement variables have medium impact.

5 Conclusion and Further Research

The purpose of the study was to examine employee’s safe acts that contribute to H&S compliance among SMEs contractors. It was concluded from the findings that employee’s safe acts have high influence on H&S compliance of SMEs contractors in Ghana. Further research will be conducted using a questionnaire survey instrument to evaluate the validity of the factors or measurement variables among large construction firms.

6 References

Adenuga, O.A., Soyingbe, A.A., and Ajayi, M. A. (2007). A study on selected safety measures on construction Companies in Lagos, Nigeria, *RICS (Cobra).*

Adeogun, B.K. and Okafor, C.C. (2013). Occupational Health, Safety and Environment (HSE) Trends in Nigeria. International Journal of Environmental Sciences, Management and Engineering Research, Vol. 2 (1), pp. 24-29, Jan- Feb. Available from http:// www.ijesmer.com [accessed 02 July 2014].

Boshoff, T. (2015). Health and Safety and the Employment,The South African Labour Guide. Available from http://www.labourguide.co.za/ [accessed 08 October 2015].

Elgood, J., Gilby, N. and Pearson, H. (204). Attitudes towards Health and Safety: A Quantitative Survey of Stakeholder Opinion, MORI Social Research Institute.

Frempong, G. and Essegbey, G. (2006). Towards an African e- Index, SME e-ACCESS AND USAGE across 14 African countries, Available from http://www.researchictafrica.net [accessed 30 September 2014], pp. 25-27.

Hallowell, M.R. and Gambatese J.A. (2010). “Qualitative research: application of the Delphi method to CEM research.” Journal of Construction Engineering and Management, ASCE, Vol. 136 (1), pp. 99-107.

Idubor, E.E. and Oisamoj, M.D. (2013). An exploration of health and safety management issues in Nigeria’s effort to industrialise. European Scientific Journal April 2013 edition, Vol. 9 (12) ISSN: 1857 – 7881 (Print) e - ISSN 1857- 7431, p.159.

Kheni, N.A, Dainty, A.R.J. and Gibb, A.G.F. (2007). Influence of political and socio-cultural environments on health and safety management within SMEs: a Ghana case study. *In:* Boyd, D (Ed) *Proceedings of the 23rd Annual ARCOM Conference,* 3-5 September 2007, Belfast, UK, Association of Researchers in Construction Management, pp.159-168.

Laryea, S. (2010). Health and safety on construction sites in Ghana: In :The Construction, Building and Real Estate Research Conference of the Royal Institute of Chartered Surveyors, Dauphine Université, Paris, 2-3 September. Dauphine Université, Paris, France. Available from entaur.reading.ac.uk [accessed on 24 February 2015].

Mustapha, Z. Aigbavboa, C. O. and Thwala, W.D. (2015). Application of Modified Statistical Triangle of Accident Causation in Construction Health and Safety, © Springer-Verlag Berlin Heidelberg 2015 L. Shen et al. (eds.), Proceedings of the 19th International Symposium on Advancement of Construction Management and Real Estate, DOI 10.1007/978-3-662-46994-1_6, pp.57-66.

Ofori, G. and Toor, S.R. (2012). *Journal of Construction in Developing Countries,* Leadership and Construction Industry Development in Developing Countries, Available from http://web.usm.my/jcdc [Accessed 20 May 2015].

Schulz, D. (2004). “Employee Attitudes: A must have. Occupational Health and Safety,” Vol. 73(6), pp. 66-71.

Othman, A. A. E. (2012). A study of the causes and effect of contractors’ noncompliance with the health and safety regulations in the South African construction industry. *Architectural Engineering and Design Management*, Vol.8, pp.180-191.

Smallwood, J.J (2010). “Excavation health and safety (H&S): a South African perspective”. *In:* Egbu, C. (Ed) *Procs 26th Annual ARCOM Conference,* 6-8 September 2010, Leeds, UK, Association of Researchers in Construction Management, pp. 233-241.

Smallwood, J. Haupt, T and Shakantu (2008). Construction Health and Safety in South Africa: Status and Recommendation, *CIDB report.*

Windapo, A. and Oladapo, A. (2012). Determinant of construction firms’ compliance with health and safety regulations in South Africa *In*: Smith, S.D (Ed) *Procs 28th Annual ARCOM Conference*, 3-5 September 2012, Edinburgh, UK, Association of Researchers in Construction Management, pp.433-444.

PERCEIVED RISK IMPACT ON MARKETING OF CONSTRUCTION PROFESSIONAL SERVICES

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Abstract
Risk is inevitable in all aspects of life including the construction industry. Its impact is evident in every activities of construction in which marketing of professional services cannot be left out. Therefore, this paper examined the impact of risk on marketing of the services rendered by the construction professionals with a view to enhancing their marketing outcome. Twenty- one risk factors were identified for assessment by the construction professionals through the administration of questionnaire. Architects (72), Engineers (91) and Quantity Surveyors (73) were systematically selected in Lagos State, Nigeria. Data collected were subjected to relative importance index (RII) and factor analysis. Close competition between the client and other competitor was the most significant risk associated with the marketing of construction professional services followed by tough competition. The result of factor analysis reduced the identified risks into five major factors; which were related to clients' expectation, stakeholders' relationship, cost related, ethics and government influence and economic-related factor. The study concluded that the impact of client professional relationship has a high impact on the marketing of construction professional services. Therefore, it is recommended that these factors should be given adequate and prompt consideration in order to reduce its adverse effects on the marketing objectives.

Keywords: Construction professionals, Marketing, Professional services, Risk

1 Introduction

Marketing is an important function for the success of companies. Effective marketing plays an important role in the overall success of companies and is critical for any business to grow in the competitive business environment. Developing marketing strategies can provide significant advantages for companies over their competitors. However, as Cicmil and Nicholson (1998) stated, many companies do not realize the true worth of marketing until it is too late to change.

Professional service providers are qualified advisors and problem solvers, even though it may encompass some routine work for clients. Marketing, according to United States Department of Agriculture (USDA n. d), is that part of the business that transforms production activities into financial success. It usually helps construction companies to differentiate themselves from their competitors, cultivate and/or keep clients, and thereby create competitive advantage. A professional association needs to market the profession for a number of key objectives as established by Allred (2005). Marketing makes the public aware of the services offered and also increase familiarity among client. Moreover, risk is evitable in all aspects of life including construction activities. Marketing is one of the construction activities which is not an exception that is being impacted by risk. Risk according to Bowen and Edward (1998) is the probability that adverse effects will occur during a stated period of time. Also, Ojo (2010) established that risk is the probability that unfavourable outcome will occur. Risk is an important issue to contractors as well as clients and consultants in the industry due to its inevitability in all aspects of construction. The amount of fee allocated to marketing exercise by any organization will determine the level of benefits to be derived from marketing their services. Despite the fact that marketing is being practice among the professionals, yet they still face a lots of challenges due to the level of competition experienced, therefore, it is of importance that appropriate strategies should be adopt in order to improve the profits and attract higher patronage. Although, the purpose of this research is to examine the risk associated with the services rendered by the construction professional in the area of marketing.

2 Literature review

The professionals in the construction industry bring together expertise and skill to work towards a common goal of satisfying their client. Hussin and Omran, (2009) described construction professionals as the Architect, Engineer and Quantity Surveyor among others. The construction professionals are known to be the most responsible person in a project especially when technical works are concerned. The expertise of each construction professionals must be careful in providing their services as they are answerable to any sinfulness occurred during the constructions.

2.1 Related Studies on Risks and Marketing of Construction Professional Services

Many researchers have worked on the concept of marketing in the construction industry. Morgan (1990) investigated marketing of consulting engineering services and discovered that very few firms had their own marketing departments. Philip and Richard (1977) investigated marketing professional services and found that professionals would like to believe clients would come to them without any organized effort on their part, simply as a result of achieving a good reputation, and that they do not have competitors or that other firms are not aggressively cultivating the same pool of clients. They posit that professional firms that want to grow and prosper will have to shed this attitude and confront the marketing issues and challenges. Ojo (2011) proposed effective marketing strategies among the construction professionals and concluded that the level of practice of marketing among professionals in Nigerian construction industry was very low and inadequate compared to the level and keenness of competition in Nigerian construction industry.

Need for marketing of construction professional services was carried out by Allred (2005) and found out that it improved familiarity among the clients, improved profitability, brings better sales among others. The research did not considered the risk that come along with the marketing of the activities performed by the professionals. In addition, Olujide (2002), Allred (2005) and Ojo (2012) studied marketing strategies employed by construction professionals but did not considered the risk that actually come with each of the strategies. Despite the fact that many research works on marketing exist, few have been recorded on risks associated with the marketing of professional services in construction industry. Hence, this research work will focus on risk factors that influence the marketing of construction professional services in Lagos State, Nigeria.

2.2 Risk Factors associated with the Marketing of Construction Professional Services

Professional Architects, Engineers, Quantity Surveyors, project managers and other consultants often find themselves doing work which could expose them to legal liability. Yet few understand the risks to which they are exposed or the standard of skill and care which the law expects (Alan n.d). Ojo (2010) emphasized that the effect of risk is assessed through the risk factors. Factors that influence marketing of any business were identified from literature (Table 1), meanwhile risk can be assessed through their factors and risk is anything that has negative effects on any outcome of an exercise, therefore, those factors are seen as risk associated with the marketing of construction professional services. For example, Pheng (2003) opines that high spending level of customer is one the factors that limits the services of the construction professionals. This is so, since net disposable income of the customers (Clients) is the primary element that contributes to the sales of any product in the target market.

Furthermore, high level of clients' awareness, inconsistent Government policies as revealed by (Hoxley, 1998; Smyth, 2004) are risks associated with the marketing of professional services. The intelligent or sophisticated client has previous experience of purchasing professional services and enters into each new service encounter with preconceived ideas of what to expect. Also, government policies affects the services rendered by the professionals. Assaults on Professional codes of ethics are another risk factor that limits the marketing of the services rendered by the construction professionals. This is so as the services rendered by professionals such as the Quantity Surveyors are affected by the rules against advertising at least to some extent. According to Philip and Richard (1977), association codes of ethics have erected stringent rules against commercial behaviour. In addition, changing expectations of clients is considered as a risk factor by Geraldine (2006) who reported an important change in customer expectations, which actually influenced the professional's response to these new conditions.

Likewise, tough competition experienced by the construction industry makes it a major task for the professionals in marketing their services. The table below shows the identified factors that influencing the marketing of any business which the study perceived to be the risks impacting marketing of construction professional services.

Table 1. Factors influencing marketing identified from literature

Risk factors	Author(s)
High spending level of Customer	Smyth, 2004
High cost of investing on Electronic Commerce	Brassington & Pettit, 2003; Pheng, 2003
Inconsistent Government Policies	Pattulo, 2003
High cost of innovating products	Smyth, 2004; Bennett, 2005
Rapid increase of Consumer Demand	Geraldine, 2006
Demographic factors	Pheng, 2003
Unavailability of Land and Restriction from the Government	Pettinger, 1998; Pattulo,2003
High level of Clients' awareness	Hoxley, 1998; Basil, 2009
Tough competition	Powell et al., 1999
Lack of infrastructure	
Poor power supply	
Changing clients' expectation	Philip & Richard, 1977; Geraldine, 2006
Assaults on professional Codes of Ethics	
Disdain for Commercialism	Hanlon, 1994
Association Codes of Ethics	Philip & Richard, 1977
Inadequate security	
Close relationship between the client and competitor	
Escalating high cost of technology	Geraldine, 2006
Globalisation	Geraldine, 2006
Increased material costs and labour shortages	
Transportation challenges	

3 Research Methodology

This research makes used of quantitative approach since those factors were perceived to be risk impacting marketing of construction professional services. Total population for the study were 538 professionals which were stratified into three groups comprising of 161 Architectural firms, 168 Quantity Surveying firms and 209 Engineering firms (ARCON, 2008; QSRBN, 2010 and COREN, 2008) respectively cited in Babatunde (2011). Systematic sampling was then used to select a sample from the total population. To calculate the required sample size for this study, the study followed the submission of Trochim (2000) that 10-30% is adequate for a small population and as low as 1% is adequate for a large population. The calculation of the required sample size is according to Equation (1):

$$n = \frac{t^2 \times p\,(1-p)}{m^2} \quad \text{---} \ (1)$$

Where, n = required sample size

t = confidence level at 95% (standard value of 1.96)

p = estimated professional firms in the study area expressed as decimal 0.3 (30%)

m = margin error at 5% (standard value of 0.05)

Therefore,

$$n = \frac{1.96^2 \times 0.3\,(1-0.3)}{0.05^2} = \frac{3.8416 \times 0.3\,(0.7)}{0.0025}$$

$$= \frac{3.8416 \times 0.21}{0.0025} = \frac{0.8067}{0.0025}$$

$$= 322.68 = 323$$

From the above calculation, three hundred and twenty three (323) firms were sampled indicating that 323 questionnaire were administered on professionals in the Architectural firms, Quantity Surveying firms and Engineering firms in the study area. The retrieved and fully completed questionnaire comprised (72) architects, (91) engineers and (73) quantity surveyors which is equivalent to 73.07% response rate. This can be considered adequate following the assertion of Morsan and Katon, (1979) that a study could be considered little or no value if the response rate is less than 30-40%. Moreover, Relative Importance Index (RII) and Factor analysis were used to analyse the data collected. Relative Importance Index (RII) was used to reflect the significant measurement of the factors. This method of analysis has been employed by many construction management researchers including Akintoye (2000); Wang *et al* (2001) and Odeyinka (2003).

All the numerical scores of each of the identified factors were transformed to risk indices to determine the relative ranking of the factors. Relative Importance Index (RII) was evaluated using the expression in equation (2):

$$RI1 = \frac{\sum w}{A \times N}; \quad (0 \leq \text{index} \leq 1) \text{ -- } (2)$$

Where: w = weighting given to each factor by the respondents, and ranges from 5 to 0

A = highest weight (i.e. 5 in this case) and N = total number of respondents.

Furthermore, factor analysis was also used to reduce the variables to a few that represents some combination of original variables by factor extraction. According to Fellows and Liu (2003), such factor extraction is done by means of principal components; which transforms the original set of variables into a smaller set of variables. The extracted factors were named based on the loading items upon which generalization is being made.

4 Findings and Discussion

4.1 Background Profile of the Respondents

The result from Table 1 shows that 40.3% of the registered firms are engineering companies, 30.9% are Quantity Surveying and 28.4% Architectural. Also, the highest respondents as showed on the table were Engineers (38.56%), 30.93% are Quantity Surveyors while 30.51% of the respondents came from Architects. The Table 1 also shows that 33.5% of the respondents are member of NSE, 32.2% are member of NIQS and 32.2% are member of NIA. This shows that 97.9% are members of particular professional bodies; therefore, they are able to provide vital and adequate information necessary for this study. From Table 1, it may be seen that the entire respondent had minimum of HND and others with higher degree had B.Sc. degree holders (66.1%). None of the respondents possess a qualification below HND; hence the respondents are qualified to practice in their respective professional and are therefore deemed competent to provide the needed information for the study.

Table 2. General particulars of the Respondents

Respondents' particulars	Frequency	Percentage (%)
Types of Firms		
No response	1	0.4
Architecture	67	28.4
Engineering	95	40.3
Quantity Surveying	73	30.9
Total	236	100.0
Designation of Respondents		
Quantity Surveyors	73	30.93
Engineers	91	38.56
Architects	72	30.51
Total	236	100.0
Professional Affiliation		
No response	5	2.1
NIQS	76	32.2
NIA	76	32.2
NSE	79	33.5
Total	236	100.0
Academic Qualification		
HND	50	21.2
B.Sc.	156	66.1
M.Sc.	24	10.2
Ph.D	5	2.1
Others	1	0.4
Total	236	100.0
Professional Experience		
No response	3	1.3
1-5	47	19.9
6-10	107	45.3
11-15	70	29.7
Over 20	9	3.8
Total	236	100.0
Number of Employees		
No response	2	0.8
1-5	41	17.4
6-10	102	43.2
11-15	50	21.2
16-20	25	10.6
>20	16	6.8
Total	236	100.0
Types of Work Engaged		
Building construction	105	44.49
Civil engineering construction	63	26.70
Both building & Civil engineering construction	51	21.61
Industrial engineering construction	17	7.20
Total	236	100

(Source: Authors' fieldwork, 2015)

4.2 Perception of the Impact of Risk Factors on the Marketing of Construction Professional Services

The study sought to know the impact of the identified risk factors on the marketing of construction professional services. Relevant data collected in this regard is presented in Table 3. Result from Table 3 indicates that 10 factors out of 21 factors (48%) have a high impact on marketing outcome of construction professional services. The result shows that the factors with very high impact are close relationship between the client and other competitors, followed by tough competition, inconsistent government policies, association codes of ethics, and unavailability of land and restriction from the government. Unavailability of land (expensive amount of land, approval etc) in Lagos State limited the amount of services to be rendered by the professionals due to the fact that clients were unable to purchase and the time awaiting for the government approval. This finding is because the impact of these factors on marketing of the services of construction professionals is aligned to the findings of previous studies available in literature (Hoxley, 1998; Pheng, 2003 and Geraldine, 2006).

Table 3. Impact of the Identified Risks on the Marketing of Construction Professional Services

Risk Factors	RII	Rank
Close relationship between the client and competitor	0.78	1
Tough competition	0.75	2
Inconsistent Government Policies	0.66	3
Association codes of ethics	0.64	4
Unavailability of Land and Restriction from the Government	0.60	5
Changing clients' expectation	0.58	6
Assaults on professional Codes of Ethics	0.57	7
High level of Clients' awareness	0.57	7
High spending level of Customer	0.56	9
High cost of investing on Electronic Commerce	0.51	10
Increased material costs and labour shortages	0.49	11
Poor power supply	0.49	11
High cost of innovating products	0.49	11
Transportation challenges	0.48	14
Lack of infrastructure	0.47	15
Escalating high cost of technology	0.45	16
Inadequate security	0.45	16
Rapid increase of Consumer Demand	0.43	18
Disdain of Commercialism	0.42	19
Demographic factors	0.39	20
Globalisation	0.36	21

Key: RII = Relative Importance Index; R = Rank

4.3 Results of the Factor Analysis Performed

Table 4 shows the result of factor analysis conducted. The factor analysis reduced the identified risks to five major risk factors that were found to have very high impact on marketing of construction professional services. The extracted risk factors were identified as economic related risk, cost related risk, ethics and government influence risk, clients' expectation related risk, and stakeholders' relationship risk. It was observed from Table 4 that the first dominant factor accounting for 30.08% of the observed variance and all the five factors accounted for 64.03% of the observed variance. This shows that the factors identified by factor analysis have very high impact on marketing of construction professional services. The Table also shows how the items loaded to factors after rotation. The cumulative percentage of variance explained by the first five factors is 64.03%, in other words, 64.03% of the common variance shared by the 21 variables can be accounted for by the five factors.

Table 4. Rotated component matrix component

S/N	Marketing related risk	1	2	3	4	5	Mean Values	Rank
	Economic-related risk						0.6499	5
1	Poor power supply	0.736						
2	Lack of infrastructure	0.692						
3	High spending level of Customer	0.680						
4	Transportation challenges	0.662						
5	Escalating high cost of technology	0.632						
6	Rapid increase of Consumer Demand	0.622						
7	Globalization	0.525						
	Cost-related risk						0.6740	3
8	High cost of investing on Electronic Commerce		0.793					
9	High cost of innovating products		0.701					
10	Demographic factors		0.693					
11	Increased material costs and labour shortages		0.509					
	Ethics and government influence risk						0.6540	4
12	Inconsistent Government Policies			0.682				
13	Association Codes of Ethics			0.671				
14	Assaults on professional Codes of Ethics			0.658				
15	Unavailability of Land and Restriction from the Government			0.605				
	Clients' expectation-related risk						0.7280	1
16	Inadequate security				0.789			
17	Changing clients' expectation				0.726			
18	Disdain of Commercialism				0.669			
	Stakeholders' relationship risk						0.7075	2
19	High level of Clients' awareness					0.718		
20	Tough competition					0.708		
21	Close relationship between the client and competitor					0.697		
Eigenvalue =		*6.32*	*3.10*	*1.57*	*1.35*	*1.11*		
% of variance =		*30.08*	*14.78*	*7.46*	*6.45*	*5.26*		
Cumulative % =		*17.67*	*31.75*	*43.99*	*54.93*	*64.03*		

Also, the result revealed that all the reduced factors had very high mean value ranging from 0.7280 – 0.6499 which indicates their high level of impact on the marketing of construction professional services. Clients' expectation related risk had the highest mean value (0.7280), this implies to mean that, client/client executives are becoming more sophisticated in selecting, using, increasingly, and replacing firms. The second rank was stakeholders relationship risk (mean value = 0.7075). Good relationship between the client and the competitor hinders some qualified professionals from achieving their aim even with effective marketing, thereby making it one of the biggest challenges facing the professionals in marketing their services.

5 Conclusion and Further Research

Based on the aim of this study, which set out to examine the impact of risk factors on the marketing of construction professional services in order to enhance marketing outcome, the following conclusions were made from the results of the analysis of data contained in the previous discussions. Three of the identified risk factors had very high impact on the marketing of construction professional services. These factors included close relationship between the client and other competitors, tough competition and inconsistent government policies. Furthermore, factor analysis reduced identified variables to few components, these included cost related factor, ethics related factor and government influence factor. The research work focused on Lagos State as the study location, further research can examine other locations within the country. Other professionals not captured in this research can also be the focus of future research.

6 Recommendations

Marketing activities should be more encouraged among construction professionals by improving on the fee allocated to marketing related activities. Also, construction professionals should use appropriate strategies in order to improve profit and attract higher patronage. Significant risk factors should be given adequate consideration by the construction professionals in order to reduce the occurrence and negative impacts on the marketing outcome of their professionals ‘services.

7 References

Alan B. (n.d). Negligence and Liability of Professionals in Construction, www.google.com, accessed on 28th April 2014.

Allred, K. (2005). Marketing the Profession, Some strategies that work. From Pharaohs to Geoinformatics FIG Working Week 2005 and GSDI-8 Cairo, Egypt April 16-2.

Bowen, P. A. and Edward, P. J. (1998). Risk and risk management in construction: A review and future directions for research. *Engineering, Construction and Architectural Management*, 5(4), 339-349.

Charles .Y. (2000). Risk analysis framework for cost estimation in association with planning and management consultant ltd, South U.S. Accessed online on April 26th 2014.

Cicmil, S., and Nicholson, E. (1998). The role of the marketing function in operations of a construction enterprise: misconceptions and paradigms’’. *Management Decision*, Vol. 36, No. 2, pp 96-101.

Geraldine, T. C. (2006). *Barriers to Marketing within Professional Service Firms. A Study of the Understanding and Application of Marketing within Accountancy and Law Firms*. A Ph.D. thesis, Brunel Business School, Brunel University, June.

Hussin, A .A. and Omran, A. (2009). Roles of Professionals in Construction Industry. *The International Conference on Economics and Administration*, Faculty of Administration and Business, University of Bucharest, Romania ICEA – FAA Bucharest, 14-15th November.

Hoxley, M. (1998). *The Impact of Competitive fee Tendering on Construction Professional Service Quality*. Ph.D, Thesis Time Research Institute Department of Surveying University of Salford, Salford, UK.

Morgan, R. E. (1990). Marketing Professional Services: an empirical investigation into consulting engineering services. *Proceedings of the Annual Conference of the Marketing Education Group*, Oxford Polytechnic. Pp. 973–995.

Odeyinka, H.A. (2003). *The development and validation of models for assessing risk impacts on construction cash flow forecast*, Ph.D Thesis, Glasgow Caledonian University.
Ojo, G.K. (2011). Effective Marketing Strategies and the Nigerian Construction
Professionals. *African Journal of Marketing Management*. Vol. 3(12), pp. 303-311, December 2011
Patrick, X.W., Guomin, Z., and Jia-Yuan W. (2005). *Identifying Key Risks in Construction Projects: Life Cycle and Stakeholder Perspectives*. Faculty of Built Environment, University of New South Wales, Sydney 2052, Australia, College of Architecture and Civil Engineering, Shenzhen University, Shenzhen, P.R. China.
Pheng, L. S. (2003). The extension of construction partnering for relationship marketing, *Marketing Intelligence & Planning* 17/3 [2003] 155160.
Philip, K. and Richard C. A. (1977). Marketing professional services, a specific program for manager of professional services firms, *Journal of Marketing.* 41(1): 71-76.
Powell, T. C. and Dent-Micallef A. (1999). Information technology as competitive
Advantage: the role of human, business, and technology resources." *Strategic Management Journal.* 18(5), 375-405.
Smyth, H. (2004). Effective selling of design and build: architecture as a sales strategy, in, COBRA „96, Royal Institution of Chartered Surveyors, *Proceedings of the Annual Conference*.

STAKEHOLDER MANAGEMENT; A LITERATURE REVIEW OF HISTORICAL DEVELOPMENT AND CURRENT TRENDS

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Abstract
Effective and formal stakeholder management process is critical in achieving stakeholder needs and satisfaction, an important project success factor. Developed countries construction industries have embraced stakeholder management as a soft project management skill and consequently developed suitable approaches for improved project delivery though developing countries are yet. Studies have associated project failures to poor stakeholders' performance, the absence of formal stakeholder management process, industry challenges and lack of proper documentation in developing countries such as Ghana. This study identifies, reviews and documents the historical development of stakeholder management process in Ghana as part of a broader study aimed at "developing sustainable stakeholder management framework for construction process in developing countries" for enhanced project success. An exploratory method with the qualitative technique was adopted. A literature review was conducted into stakeholder management practice to explore the trend, influence of historical development and documentation of stakeholder management process in relation to industry challenges using three countries as case studies. This is aimed at documenting and developing sustainable stakeholder management process for developing countries. A descriptive survey was used for analysis and documentation. Findings are that formal documentation of industry practices, procurement challenges, stakeholders role in project failures led to the reviews and stakeholder focused reports which that advocated for collaboration. A trend which has influenced the development of stakeholder management process. In the absence of formal documentation, the study identified and documented stakeholder management historical development trend in Ghana for the development of a stakeholder management framework.

Keywords: Construction industry, Developing countries, Ghana, Historical development, Stakeholder management

1 Introduction

Construction projects by their diverse nature have individuals and organizations actively involved in the project, or whose interest may be positively or negatively affected by the project outcome (Gardiner, 2005). Studies have revealed that stakeholders can contribute to project success or failure (Newcombe, 2003). The question has been who are these stakeholders, what are their interest and how should they be managed? Strategic management, a stakeholder approach by Edward Freeman in 1984 has been acknowledged as the beginning of stakeholder theory and concept in management circles. In the past two decades, there has been increasing research into stakeholder management due to its positive impact on project delivery (Yang, 2010). Chinyio and Olomolaiye (2010) suggest that there are several but no formal approaches to stakeholder management by many construction industries. Mok et al., (2015) states that the culture of a nation and the construction industry environment impact on the stakeholder management process and project outcome. Stakeholder management is essential to achieve stakeholder needs and satisfaction (PMI, 2013). Nevertheless, studies have identified several approaches to stakeholder management process (Walker et al., 2008).

Stakeholder Management (SM) varying approaches can partly be attributed to the different construction industry practices, culture, environment and historical developments. Jurgens et al., (2010) differentiates between stakeholder theory and practice in Europe and North America as following different trends. Developed countries have adopted different SM approaches for construction projects, a trend aimed at solving construction industry challenges and practices (Beach, 2009). The UK and Finland are examples of countries where SM has largely been embraced and used to enhance project delivery (Chinyio and Akintoye, 2008). In contrast, many projects undertaken in developed countries such as Ghana fail to meet their delivery targets, a situation also attributed to stakeholder roles in project delivery (Auditor General Report, 2013). Although development interventions are crucial for socio-economic growth, developing countries are yet to embrace SM formally as a project management skill for improved project delivery, a situation partly attributed to the absence of historical documentation on the industry.

The aim of this study is to identify and review historical developments in the construction industry and its influence of stakeholder management development processes. It seeks to address three objectives of (1) reviewing stakeholder management theory and trend, (2) review stakeholder management process in selected developed countries and the influence of the historical development (3) review, document industry's and stakeholder management historical development processes in Ghana for the "development of sustainable stakeholder management for construction projects in Ghana". A qualitative research approach was adopted. The literature on stakeholder management including historical development and current trends were reviewed. A case study of three countries were considered, and the influence by historical development noted. A descriptive survey was employed for presentation and analysis. Findings are that stakeholder's role in project failures led to the establishment of committees and reports which are stakeholder focus and developed into SM process. In the absence of formal documentation in Ghana, this study identifies and documents historical development of stakeholder management trend in Ghana as a developing country for improved project delivery.

2 Literature review

2.1 Construction industry

The nature and outcome of the activities of a nation's construction industry are significant for several reasons. These include contributions to the nation's socio-economic development, provision of physical infrastructure for the needed productivity, housing for shelter, education, health and civic responsibilities (Ofori, 2012). The construction industry contributes significantly to the gross domestic product (GDP) of a nation. Chinyio and Olomolaiye (2010) suggest that the relatively low productivity growth of UK's construction industry constantly attracted the UK' government's attention. Similarly in South Africa, the construction industry's low performance in 2013 following highs in 2012 and global recession was a major concern (South African Publication, 2013). It is generally believed that the industry contributes about 5-10% of GDP of all nations (Ofori, 2012). According to UKCG (2009), "The construction industry is a driver of growth in other sectors due to its heavy reliance on an extended and varied supply chain and contributes about 8-10% of UK's GDP. The industry's contribution towards GDP of nations, therefore, cannot be underestimated.

Global statistics indicates an estimated 7 - 10% of the global workforce works in the construction industry (Mwanaumo; 2012, Murie, 2007; ILO, 2005). The large size of the industry affects the growth of the economy due to its labor employment. Further, it is noted as a key sector of every economy and depending on the government, can be an economic regulator (Ofori, 2012; Hillebrandt, 2000). According to OGC (2009), the UK construction industry is a driver of growth of other sectors. Following the Latham (1994) and Egan (2002) reports, the UK construction industry has adopted a trend which is stakeholder focus thus embracing stakeholder management process. Similarly, the realization of the strategic role of the sector in socio-economic growth in South Africa aided the construction industry development board (cidb) establishment which regulates the industry and promotes stakeholder collaboration.

Harris (2010) has suggested that the formal historical reviews have resulted in the different forms of contract development and stakeholder interactions: separated, management, integrated and discretionary. These newly developed contracts are more stakeholder focus, have all key players such as the client, project manager, designers, contractors and supply chain tied in by formal contract, a trend aimed at enhancing stakeholder management and achieving stakeholder satisfaction. Rwelamila and Savile (1994) state that construction projects must be considered in relation to the environment; country, location and project type. There is a relationship and impact of procurement method on stakeholder management with the different contracts placing different stakeholder responsibilities (Harris, 2010; Rwelamila, 2010). Projects cannot be established, accomplished and benefits gained without considering stakeholders (Eskerod and Jespen, 2013).

2.2 Developing Countries

Developing countries have lower economic, technological, education, inadequate health care, infrastructure development, high population growth and low per capita income (World Bank Report, 2012). Infrastructure construction is a development intervention vital for socio-economic growth. Ofori (2012) outlines the industry’s impact on developing countries to include socio-economic development, 5-10% GDP contribution, complex linkages for development and has the ability to alleviate poverty. Nevertheless, the construction industry in many developing countries is neither organized nor controlled by firms and individuals building without the necessary government approval or adhering to the building codes, a practice which has led to the collapse of buildings (Oyedele, 2013). The industry is fragmented with several small and medium enterprise supply chain firms (Ofori, 2000). This has resulted in the on-going entry and exit of construction firms and supply chain organizations in the industry (Oyedele, 2013).

In Ghana, there is a proposal for the establishment of the Construction Industry Development Authority to regulate the industry (CIDA Bill, 2015). This is as a result of client dissatisfaction and unsatisfactory project delivery which also pertains to other developing countries. Othman (2013) identified the challenges of external funding dependence, low technology, low human resources and non-organized construction industry. Oyedele (2013) suggests that 80% of all construction industry project funding is from the public sector hence is affected by the economy’s performance. Further, stakeholders of different background impact on resources, environment and sustainability.

It is pertinent to note that, the sector is dominated by foreign firms in major developing countries like Ghana and Nigeria. Nguyen et al. (2009) suggest the need to consider the traditional procurement approach. Rwelamila and Savile (1994) states that construction projects do not occur in isolation but are influenced by country, location, project type and the procurement systems as it relates to stakeholder management. Moreover, the selection of most appropriate construction procurement system impact on managing the many stakeholders (Rwelamila, 2010). There several construction stakeholders involved in a project with diverse socio-cultural background impacts on the project delivery (Mok et al., 2015). Most developing countries continue to adopt the separated (traditional) approach (PPA 2003, Act 663; Oyedele, 2013).

2.3 Stakeholder Management Theory

Construction projects are unique bringing together different and disparate interests (Olander and Landin, 2005). Researchers have defined and classified project stakeholders differently following the first introduction of stakeholder concept into the management domain by the Stanford Research Institute in 1963. Stakeholders were defined as any groups or individuals who are crucial for an organization's survival and can affect or are affected by the achievement of the firm's objectives (Freeman, 1984). Gibson (2000) defines stakeholders as "groups or individuals with vested interest in the success of a project or environment, which the organisation interacts or has interdependencies". They are further defined as "those that by virtue of their interaction with an organisation may initiate or trigger a project if perceived to be beneficial or antagonistic, disrupt, and stop an ongoing project if perceived not" (Mintzberg et al., 1995; Newcombe, 2003).

Chinyio and Olomolaiye (2010) states that construction stakeholders are many and should manage the many stakeholders including the owners, project manager, users, facility managers, designers, contractors, subcontractors, employees, process and service providers, banks, insurance companies, media, general public, community representatives, customers, pressure groups. Newcombe (2003) have suggested that project managers have always considered the client as the only project stakeholder a trend which needs to change. PMI (2013) suggests that meeting all stakeholders need and satisfaction is an important project success factor. Stakeholder theory has evolved out of the need to consider all stakeholders. Researchers have attributed the fame of stakeholder theory and literature in management domain to the book, *Strategic Management: Stakeholder Management Approach* by Edward Freeman in 1984 (Yang, 2010; Freeman and Mc Vea, 2001). It is pertinent to note that stakeholder theory has gained popularity in the past three decades, focusing on different perspectives on how managers of organizations should manage their stakeholders. Gibson (2000) states that stakeholder theory in contrast with traditional theories asserts that, the interest of individuals and groups affected by an organization's activities should be considered. Elias et al. (2002) state that four areas namely corporate strategy, systems theory, organizational theory and corporate social responsibilities developed out of the management approach.

- Corporate strategy: literature suggests that Ansoff (1965) argued for rejection of the stakeholder theory in his classic book Corporate Strategy since it considered objectives and responsibilities as synonyms. This was part of the fight for the survival of stakeholder theory. Strategic planning literature began to feature prominently stakeholder theory in the late 1970's. Taylor (1971) predicted that the importance of stakeholders will diminish because businesses were going to run for other stakeholders.
- Systems theory: this nevertheless contributed to the development of stakeholder theory. Ackoff (1974) argued for stakeholder participation in system design importance of when he suggested that stakeholder interaction and support helps in solving societal issues.
- Corporate social responsibility**:** many researchers became concerned with corporate social responsibility CSR, as management literature featured stakeholder concept. Post (1981) covered areas such as ideas, concepts and techniques of earlier researchers and included non-traditional stakeholders in literature using as a primary difference stakeholder theory concept.

- Organizational theory: Rhenman (1968), referred stakeholders as individuals and groups which depend on an organization for survival and the vice versa. Pfeffer and Salancik also suggested the effectiveness of an organization as determined by the ability to manage the demands of interest group using a model of organization and environment. Classic stakeholder theory evolved on the basis of survival and diverged into the four areas considered (Freeman, 1984).

Donaldson and Preston (1995) argue that the stakeholder concept is about management, Freeman *et al.*, (2004) suggest it is prescriptive, descriptive, suggestive and instrumental at the same time. Mitchell et al., (1997) states that stakeholder management is embedded in management thinking and practice since Freeman 1984 and that there is no agreement on what Freeman (1984) calls "The Principle of Who or What Really Counts." That is, who (or what) are the firm's stakeholders? This question calls for a normative theory of stakeholder identification, to explain logically why managers should consider certain classes of entities as stakeholders. The second question "And to whom (or what) do managers pay attention? calls for a descriptive theory of stakeholder salience.

Gibson (2000) mentions Donaldson and Preston (1995) as having distinguished between the descriptive, instrumental and normative approaches to stakeholder theory. The descriptive approach examines stakeholder interests, the instrumental approach stakeholder impact in terms of corporate effectiveness while the normative approach reasons why corporations ought to consider stakeholder interests even in the absence of any apparent benefit suggesting the need to consider all project stakeholders. Several research has followed in the three aspects of descriptive, instrumental and normative (Yang, 2010). The stakeholder concept seems to address the questions, who are the project stakeholders? And what do these stakeholders expect from a construction project? (Newcombe, 2003). The question remaining is "how do project managers manage these stakeholder clients?" As stakeholder theory in contrast with traditional theories asserts that interest of groups and individuals affected as a result of an organisation's activities construction project managers consider only the interest of the client as a single entity in the traditional approach (Friedman, 1970; Newcombe, 2003). The UK and Finland stakeholder management addressing the third question are reviewed (Oyegoke, 2010; Thompson, 2010).

Construction stakeholders are classified severally depending on their relationship and contractual agreement. Carroll and Buchholtz (2006) mentions primary; with a formal agreement with the project owner and secondary if not. Primary stakeholders are critical to project delivery (Clarkson, 1995) but could be without strong influence due to buyer dominance (Walker, 2007). Chinyio and Olomolaiye (2010) agree that some stakeholders are critical to the project success though others may change position as the project progresses. The trend then is to monitor stakeholders during the project development stage. Further, stakeholders are referred as internal (key stakeholders) or external to the project (OGC, 2003; Calvert 1995; Winch and Bonke, 2002), Mitchel et al., (1997) however suggest that stakeholder classification should be based on salience to a project considering power, urgency, and legitimacy. Stakeholders are classified as dormant, discretionary, demanding, dominant, dangerous or definitive. Key stakeholders are thus, primary, internal and definitive stakeholders and refer to the project team: client, project manager, main designer, other designers, contractor, sponsors and consumers/end users.

2.4 Stakeholder Management Process

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. Bourne and Walker (2005) states that Stakeholder Management (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, gathering information and analysing stakeholders influence through a systematic approach (Lock, 2007). Eskerod and Jepsen (2013) suggest identification, assessment of contribution, stakeholder prioritization and analyses. Challenges to project managers are identification of diverse stakeholders and the best approach to stakeholder management for effective impact on project delivery (Chinyio and Akintoye, 2008; Mok et al., 2015). Yang (2010) has outlined a chronology of stakeholder management models, processes and approaches to include; Stakeholder Matrix (Chinyio and Olomolaiye, 2010; Newcombe, 1996), Stakeholder Circle Tool (Bourne, 2005), Social Network Analysis (Bourne and Walker, 2005; Rowley, 1997) and stakeholder management framework for developed countries. Research has shown that project managers in Ghana a developing country considers only some aspects of SM keeps mental record instead of documentation and without a formal process (Eyiah-Botwe, 2015). This contradicts a current trend in project development where stakeholder management process involves a high level of the pre-project planning effort, can save up to 20% from cost and 39% of scheduled in facilities projects if considered (Cho and Gibson, 2001).

2.4.1 Historical development of stakeholder management in the UK

Harris (2010) presents the chronology of stakeholder management in the UK which evolved as a result of the construction industry development which was stakeholder focused as follows:

- Early reports- placing and management of contracts, problems before the construction industry, communication, interdependence and uncertainty (stakeholder issues)
- Latham 1 (1993) - mistrust between client's consultants, contractors, subcontractors and client dissatisfactions.
- Latham 2 (1994) - the potential for productivity improvements through better procurement practices notably teamwork.
- Levene (1995) - procurement and management improvement to include better communication and negotiation of deals
- Egan 1 (1998) - inefficiency, unpredictability and customer dissatisfaction. Call for best practice and innovation to result in increased delivery, reduction in project completion times.
- Egan 2 (2002) - a collaboration between members of the supply team, advocate or design and build. For all aspects of the project, partners and stakeholder are crucial.
- National Audit Office (2003-2005) - adversarial relationships, benefits of partnering, modernising construction, adoption of PFI, PPP, Prime contractor Design and Build.
- DCLG (2007) - Greater strategic leadership, more integrated and innovative solutions.

2.4.2 Historical development of stakeholder management in Finland

Oyegoke (2006) suggest that the Finland approach could serve as a subsequent transferable learning opportunity for stakeholder management development. Barrie and Paulson (1992) identified the building industry as custom-oriented, incentive dependent and predicted human factors leading to the fragmented and divisible industry. There is stakeholder management concern of ageing workers, declined the number of skilled domestic labour, challenging combination of product development and value chain production management. SM process in Finland is carried out by evaluating the needs and expectations of stakeholders in relation to project objectives and designing project management process which enables active stakeholder interaction throughout project life cycle. Key management principles to be considered at various stages are:

- Identification- early identification of stakeholder commences as the project is conceived, need to consider legitimacy, power and urgency of stakeholders (Mitchelle et al., 1997).
- Programming- overall guidelines and principles formulated, the management of stakeholders is agreed upon through the form of procurement.
- Appraisal- assessment of key project factors from key stakeholders' viewpoint.
- Implementation- bringing together a different group of professionals in the supply chain and facility management. Client's influence is brought to bear. The Specialist Task organization (STO) approach that allows for upper and lower management through integrated product development. External stakeholders are monitored, and communication enhanced.
- Facility management- this phase is crucial and should be included in the overall stakeholder.

In conclusion, Oyegoke (2006) suggests that stakeholder management is essential in achieving objectives in a project and that project stakes could be through legal or moral rights, Stakeholder management approach is determined by the procurement approach, integrated approach is recommended as project managers carry out all the principles at the different phases.

3 Methodology

This study adopted an exploratory survey approach using a qualitative technique involving a literature review primarily. The research design first considered an extensive literature review on stakeholder management using the institutional database to search for recommended journals by the institution as this study forms part of a broader study of a Ph.D. dissertation. Journals were searched using keywords such as "stakeholder", "stakeholder management" and "construction industry". This was further filtered using a combination of the keywords "construction industry" and "stakeholder management" to narrow the scope of limited literature. This method has been used by Yang et al., (2010) and Mok et al., (2015) for similar studies in stakeholder management. Fifty journals were in all identified and thoroughly reviewed. Three books from Google scholar and different publishers recognized to have well-researched information on stakeholder and construction stakeholder management were examined.

The research further reviewed the UK and Finland SM processes as a case study since their SM process are considered among the best practices in the industry, availability of historical development data and providing best perspective on the theme (Chnyio and Olomolaiye, 2010). Reports and Acts aimed at enhancing stakeholder management approach in the construction industry in Ghana were also reviewed. The literature review sought to find out the impact of the following on historical development of SM:

- historical development of projects, the construction industry and stakeholder theory
- the role of professional and statutory bodies in developing SM
- the role of procurement systems on SM development and
- the process of engaging, monitoring and managing stakeholders in the construction industry

A qualitative approach using semi-structured questionnaire was used to interview four experienced construction industry practitioners in Ghana in order to validate literature reviewed. For the purpose of ethics, they are represented as IA, IB,IC and ID respectively.

Table 1. Interviewees' profile

Interviewee	Profession	Experience	Relevance
IA	Architect, Project Manager	Over 40yrs	Lecturer, Chapter President Ghana Institute of Architects
IB	Architect, Project Manager	Over 15yrs	Architect, Deputy Director, Ministry of Works and Housing
IC	Quantity Surveyor, Project Manager	Over 30yrs	Surveyor, Moderator, Past President, GHIS
ID	Structural Engineer, Project Manager	Over 40yrs	Past President, Ghana Institution of Engineers

4 Findings and Analysis

Although Stakeholder Management (SM) has been in management domain since 1984, the last two decades has seen increased research and development of several approaches. SM has evolved and developed as a result of formal construction industry challenges and reviews aimed at enhancing stakeholder role and project delivery. Developed nations construction industries have embraced stakeholder involvement and participation for improved construction industry performance different SM processes and a framework for SM in development (Yang, 2010). Nevertheless, countries like the UK, Australia and Finland have developed frameworks for their construction sector (Haris 2010, Chinyio and Akintoye, 2008). Professional and statutory bodies have played a significant role in the development SM in developed countries. The setting up of construction industry regulating bodies (cidb) in South Africa has enhanced project stakeholder management.

The study also found out that procurement methods have influenced stakeholder role and participation in project delivery and the current trend of adopting integrated and management contracts as against separated contracts (Rwelamila, 2010). Different forms of contract which are stakeholder focused have emerged, promoting active stakeholder involvement, more successful project delivery, enhanced stakeholder satisfaction, appropriate contractual arrangements for stakeholder management. The five-stage project planning approach in Finland is stakeholder focus. Verification of needs stage suggests the need to identify all stakeholders and the project sponsor or client. A project manager (PM) is appointed to lead the assessment of options stage. The PM and the client plays an essential role in the development of procurement strategy. This planning phase is ended by choosing the appropriate strategy. The stakeholder management approach is influenced by role and identification of stakeholders, the selection of the right project manager, and choice of appropriate procurement strategy, integrated and innovative solutions. Projects cannot be successfully delivered without a systematic approach to SM, which includes project stakeholder identification, classification, analyzing and monitoring. A pre-condition of embracement of SM by industry practitioners, culture and environment related to the industry is critical (Yang, 2010).

The interviewees agreed with the literature findings but bemoaned the poor project delivery and attributed that to the nature of the construction industry practices in Ghana. IA asked *"have you read, the Performance Audit Report 2013, all that we need is a framework for project managers*" to use in monitoring stakeholders. Similarly, IB suggested the need for collaboration and a formal approach to project management. *"There is too much lack of trust affecting decisions".* IC primary concern was the procurement approach adopted. "This *approach requires too much time, the late involvement of some key stakeholders. How do you manage your targets?*" ID had two main concerns; the need for the construction industry regulated and incorporated lesson on previous projects in new ones. "*We seem to be doing new things every day, there is no documentation anywhere to learn from.* In his opinion, the industry is fragmented with each sub-sector trying to develop separate approach instead of one stakeholder management plan. These responses agree with earlier studies (Eskerod and Jepsen, 2013; Chinyio and Olomolaiye, 2010).

4.1 Historical development of stakeholder management in Ghana

The study found out that, projects cannot be successfully developed in Ghana without SM consideration by project managers. Project success is critical due to the importance of the construction industry in the socio-economic growth of Ghana (Ofori, 2013; Fugar, et al., (2013). Historical development towards stakeholder management was then identified and documented as follows:

- Architects Act, 1969(NLCD 357) – regulate practices and operations of architects as project designers, project leaders/ managers to successfully manage the project team.
- Local government act, 1993 act 462, the Town and Country Planning Department was charged with the overall planning and development control within its jurisdiction.
- Building Regulation, 1996 (LI 1630)- Outlines, regulations and bye-laws for development.
- Local Government Act1993 (Act 467) – Metropolitan, Municipal and District Assemblies together with the planning authorities regulate physical development. This should conform to building codes and established the statutory approval bodies to include all stakeholders.
- Ghana vision 2020 (1995)- using resources efficiently to achieve rapid economic growth with emphasis on using local materials and sustainable principles not on managing projects.
- GETFund Act, 2000 (Act 581) – improved education infrastructure
- Public Procurement Act of Ghana, Act 663(2003) aimed at sanitizing the industry, regulating procurement process and encouraging competitive tendering however not aimed at collaboration or integration but separated approach.
- February 2010 – 1st GETFund Consultative meeting – engage all stakeholders for enhanced infrastructure delivery.
- Engineering Council Act, 2011(Act 819) – regulate practices and operations of architects as project designers, project leaders/ managers to successfully manage the project team.
- National Urban Policy Framework and Action (2012)- the participation of all relevant stakeholders to ensure better transparency and accountability, zonal stakeholders consultation workshops to review and validate action plan
- National Housing Policy (2015) – Ensure that there is the participation of all stakeholders in decision-making on housing projects. Involve communities and non-traditional interest groups.
- Proposed Construction Industry Development Authority Bill, 2015. Provide strategic leadership in the construction industry to stimulate sustainable growth, reform, improve and monitor standards in the construction industry (Ofori et al., 2015).

5 Conclusions

This study sought out to review the literature on the historical development of SM and document historical development in Ghana as part of a broader study aimed at developing sustainable SM framework for construction projects in Ghana. Firstly, it identified the construction industry challenges, poor project delivery and procurement approach as having influenced SM approach. This was enhanced by the formal documentation of the historical development of the industry and embracing SM process. Secondary, the study recognized the impact of procurement approach SM hence the need for stakeholder involvement, collaborative or integrated approaches with early identification and participation of stakeholders in project delivery. The construction industry has had a strong monitoring body to review performance.

Thirdly the study aimed at identifying and documenting the historical development of SM in Ghana. This has been documented as a contribution to the body of knowledge in SM. The construction industry has challenges, promotes separated procurement approach, and lacks a body to oversee the performance and a framework for SM approach. The gap was the absence of a historical documentation of SM serving as a basis for the development of a sustainable stakeholder management framework.

6 References

Beach, S (2009). Who or what decides how stakeholders are optimally engaged by governance networks delivering public outcomes? In: *13th International Research Society for Public Management Conference (IRSPM XIII),*6–8 April 2009, Copen. Bus. Sch, Fredericksberg.

Bourne, L (2005). Project Relationship Management and the Stakeholder Circle, Graduate School of Business, RMIT University, Melbourne.

Bourne, L. and Walker, D (2005). Visualising and mapping stakeholder influence, *Management Decision,* Vol. 43 No. 5, pp. 649-660.

Chinyio, E. A. and Akintoye, A (2008). Practical approaches for engaging stakeholders: finding from the UK, *Construction Management and Economics,*Vol. 26 No. 6, pp. 591-599.

Chinyio, E. and Olomolaiye, P (2010). *Construction Stakeholder Management*, Chichester Wiley. Blackwell Publishing Ltd.

Donaldson, T and Preston, L. E (1995). The stakeholder theory of corporation: concepts, evidence and implication. *Academy of management review*, 20(1):65-91.

Elias, A, A, Cavana, R, Y, and Jackson L, S. (2002). *Stakeholder analysis for R&D project management*, Oxford Blackwell Publishers Ltd,

Egan, Sir J. (1998). Rethinking Construction. *Department of the Environmen*t, London.

Eyiah-Botwe, E. (2015). An evaluation of stakeholder management role in getfund polytechnic projects delivery in Ghana: *Journal of Civil and Environmental Research,* Vol 7, No. 3, 2015

Freeman, R.E. (1984). *Strategic Management: a Stakeholder Approach*, Pitman Publishing, Boston, MA.

Gardiner, P,D (2005). *Project Management-A Strategic Planning Approach*. New York,USA: Palgrave Macmillan.

Gibson, K (2000). The moral basis of stakeholder theory. *Journal of Business Ethics, 26(3):245-*

Harris, F (2010). A Historical Overview of Stakeholder Management. In: Chinyio and Olomolaiye, *Construction Stakeholder Management*, Chichester Wiley. Blackwell Pub. Ltd.

Jergeas, G.F, Erin, W, Gregory, J. S and Janice, T (2000). *Stakeholder management on construction projects*. AACE International Transaction, Morgantown, WV, 12.11–12.16.

Jurgens, M, Berthon, P, Papania, L and Shabbir, A (2010). *Industrial Marketing Management* 39 (2010) 769–77

Mitchell, R, Agle, B. and Wood, D (1997). Towards a theory of stakeholder identification and salience: Defining the principle of who and what really counts. *Academy of Management Review*, 22, (4) 853−886

Mok, K. Y.; Shen, G. Q.; Yang, J. (2013), Stakeholder management studies in mega construction projects: A review and future directions. *International Journal of Project Management*.
Newcombe, R (2003). From client to project stakeholders: A stakeholder mapping approach. Construction Management and Economics, 21(8) 841-848.
Ofori, G. (2000). Challenges for construction industries in developing countries. Proceedings of the Second International Conference of the CIB TG 29, Gaborone, Botswana, Nov, pp. 1–11
Ofori, G. (2012), Developing the Construction Industry in Ghana: the case for a central agency.
Olander, S. and Landin, A(2005). Evaluation of stakeholder influence in the implementation of construction projects. *International Journal of Project Management* 23.
Othman, A. (2013), Challenges of mega construction projects in developing countries. *Organisation, Technology and Management*. in Cons. *An International Journal*
Oyedele, O. A. (2013), *Construction Project Financing for Sustainable Development of Nigeria Cities*. FIG Working Week, 2013, Abuja Nigeria.
Oyegoke, A. S, (2010). The Contextual Approach to Stakeholder Management in Finland. In: Chinyio and Olomolaiye, *Construction Stakeholder Management*, Chichester Wiley. Blackwell Publication. Ltd
PMI (2013), *A Guide to the Project Management Body of Knowledge:* (PMBOK guide). Project Management Institute, Newtown Square, PA. 5th ed.
Rwelamila, P. D (2010). Impact of Procurement on Stakeholder Management. In: Chinyio and Olomolaiye, *Construction Stakeholder Management*, Chichester Wiley. Blackwell Publication. Ltd
Rwelamila, P. D and Savile, P W (1994). Hybrid value engineering:the challenge of construction project management in the 1990s. International Journal of project Management, 12(3):157-164
Yang, J (2010). A framework for stakeholder management in construction projects: A thesis submitted in partial fulfiment or the Degree of Doctor of Philosophy. http://www.lib.polyu.edu.hk

BUILDING INFORMATION MODELING IN NIGERIA AND ITS IMPACT ON COLLABORATION IN SCHEMATIC DESIGN STAGE AND POST CONTRACT STAGE OF DESIGN

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Abstract
Building Information Modeling (BIM) is a concept that is transforming the construction world internationally. As Nigeria develops technologically, the use of BIM in design and implementation of projects is also developing. BIM is used to develop a collaborative construction process that includes design, build, operate and maintenance of buildings. However the adoption of BIM in Nigeria is very slow; it is used mostly for schematic design and presentation drawings by Architects. Other professionals in the construction industry still produce their drawings with 2D AutoCAD. The purpose of this paper is to study the use of BIM in Nigeria and determine to what extent it has helped in improving efficiency and collaboration during schematic phase of design and provided effective co-ordination during the post contract stage. The research methodology involved using structured questionnaires to 30 Architectural firms selected through simple random sampling method. Results showed BIM has a high impact on client satisfaction, time for completion, quality and presentation of different concepts in schematic design. It also showed high impact on conflict resolution, supervision, construction programming and quality of completed jobs during post contract stage. Barriers to adoption of BIM were identified as lack of infrastructure, lack of skilled workers and lack of awareness of technology. For Nigeria to compete internationally in the construction industry, BIM should be adopted hence there is need for research on the subject. Recommendations include developing a curriculum that will incorporate the study of BIM in all construction courses. Learning centres should also be developed for private practitioners. Efforts should be made by the relevant professional bodies to increase awareness of the technology.

Keywords: Adoption, Building Information Modeling, Nigeria

1 Introduction

Building Information Modeling (BIM) is the use of computer generated models to simulate planning, design and construction of projects. According to Autodesk (1999), "Building information modeling is a design methodology that maintains a single database of information about a building design. All information for a building design, from geometry to construction data is stored in a project file. This information includes components used to design the model, views of the project, drawings of the design and related documentation".

Internationally, the building industry is transforming rapidly with the introduction of BIM. It is changing the process of design and construction of buildings. "BIM entails a seven dimensional process. The 3D modeling process extends to scheduling and sequencing (4D), cost estimating (5D), sustainable design also termed Green Design (6D) and facility management (7D)" (Hassan and Yolles, (2009).

BIM is a new approach to design depending on collaboration between the Architects, Client, Engineers, Building services, Manufacturers, Contractors and other consultants. It is a team approach where inputs of all the professionals in the design are captured in the same model. The most common softwares for BIM are Autodesk Revit, Microstation, ArchiCad, CBIM and Ruska.

1.1 Problem Statement

Building Information Modeling programs are being adopted by Architectural Firms in Nigeria. However, they are mostly used for sketch and presentation designs. Collaboration and improvement in communication and efficiency during construction is one of the major advantages of Building Information Modeling. It is also one of the major problems in the Nigerian construction industry. This research seeks to find out the challenges and barriers to adoption of Building information modeling in Nigeria, Factors impending adoption of building information modeling and provide solutions to these challenges.

1.2 Aims and Objectives

The purpose of this Research is to study the use of Building Information Modeling in Nigeria and determine to what extent it has helped in improving efficiency and collaboration during schematic phase of design and provided effective co-ordination during the post contract stage. The results will be measured according to primary key performance indicators used in construction industry. These include quality, on-time completion, safety, client/customer relationship, communication between consultants and other stake holders in the project.

Objectives of the research include:

1. To investigate if BIM use improves efficiency and collaboration during schematic design phase.
2. To determine the impact of BIM on supervision and co-ordination during the post contract stage of design.
3. To determine barriers to the full adoption of BIM in Lagos, Nigeria.
4. To identify solutions to challenges and barriers

2 Analysis of Literature Review

A lot of literature is available on Building Information Modeling (BIM). However, Literature on BIM in Nigeria is limited. "BIM can potentially increase the efficiency, quality and productivity of construction projects by reducing the number of mistakes and incompatibilities, providing more accurate and up-to date information, and by giving a more illustrative and accessible exposition of a building, (Eastman et al. 2011). Benefits of BIM include the ability to reuse information stored in a database, (Egbu and Sidawi, 2012). Automation through BIM also improves time and cost management. It streamlines the design process across the company and facilitates automation of emails via knowledge database.

Other benefits include ability to visualize what is to be built in a simulated environment, higher reliability of expected field conditions, allowing for opportunity to do more prefabrication of materials off site (Rajedran and Clarke, 2011). According to Gordon and Holness (2008), "The building design development can continue with the provision of automatic bills of material and generation of automatic shop drawings for everything from structural steel to sheet metal duct fabrication, to fire protection and piping fabrication, to electrical cabling and bus duct layouts".

Benefits of 'GIS-BIM' based site analysis (CICRP, 2009) include aid in determining if potential sites meet the required criteria according to project requirements and minimizing risk of hazardous materials. "The advances in smartphone and tablets technology have allowed contractors and subcontractors to frequently use BIM models at the jobsite for information extraction and coordination. Some of the notable BIM apps include BIMX®, Bentley Navigator®, Buzzsaw®, " (Rubenstone, 2012).

2.1 Challenges to BIM Adoption in Nigeria

Challenges to BIM Adoption in Nigeria include interoperability risks between different programs used (Azhar et al., 2011). A lot of Architects and Engineers still use 2D AutoCAD in Nigeria. This affects collaboration of construction working drawings and limits use of BIM during post contract stage. A survey by AECbytes shows that despite each discipline working in 3D environment, collaboration is still primarily based on exchange of 2D drawings. (Khemlani, 2007).

Furthermore, the ownership of BIM data has not yet been determined. It is not yet clear if the BIM belongs to the client who paid for it to be done or the Architect who developed the model. This can create conflict if the client decides to get inputs from other consultants by himself. Most times the Architect has to bear the cost of changes in the model during construction as the client is not willing to pay for extra costs. This increases the cost of production for Architects. Most BIM in use do not have object libraries that are used in the Nigerian Market. Standards for drawing presentation have not been developed. Integrated concept of BIM increases risk and liabilities to different parties involved (Azhar et al., 2011). This creates problems when vendors and other consultants make input to the BIM. BIM systems create big files, management and transfer of these files with Nigerian internet and power problems is very difficult.

2.2 Barriers to adoption of BIM in Nigeria

Barriers to BIM adoption include lack of skilled personnel. There are not enough trained personnel in the industry. Most Architects train themselves or learn on the Job so they are not aware of all the capabilities of the software. Reluctance of other stake holders (Engineers, Contractors, etc.) to use BIM makes it difficult for Architects who are using BIM because they have to transfer their drawings to AutoCAD for the other consultants to do their work.

"Fear of change" is another barrier to adoption of BIM (Hassan and Yolles, 2009). Most people are very comfortable with the software they are using and find it very difficult to change .Using BIM means a change of mindset from developing drawings with lines to developing drawings in three dimensions putting in walls, windows, doors and other building components. Extra costs involved in hardware, software and developing office procedures are also barriers to adoption. Adopting BIM involves, purchasing of software and hardware that can be used .It involves training of staff already working in the office. This will lead to extra costs for the office.

According to Farley (2011), "lack of BIM object libraries" affects production of drawings because some products are not available in the software. , Lack of constant electricity and lack of internet connectivity affects output of work in the offices. (Abubakir et al., 2014). Constant use of generators increases cost of running the offices. Internet connection is necessary for BIM to be used adequately. Internet has to be connected to get drawings from a vendor site. Internet is not readily available in Nigeria Use of internet also increases cost of production. A lot of professionals in the construction industry are still not aware of the technology. For BIM to be used effectively, all the professionals involved in a project have to be aware of it.

2.3 Solutions to Challenges and barriers

The need to incorporate BIM education in our Universities is emphasized. One of the aims of this research is to establish an Autodesk authorized training centre in University of Lagos that will be used for training of Architects and other professionals in the construction industry. Building information modeling as a course should be introduced in all schools of Architecture

Engineering, quantity surveying and other construction disciplines. We need to create awareness within the professional bodies. Nigerian institute of Architects, Nigerian institute of quantity surveyors and other regulatory bodies in the construction industry need to get involved with Building Information Modeling and help in standardization of BIM in Nigeria.

The Government has to be involved. Most of the countries that have successfully adopted BIM have government participation. "Government has helped to achieve progress in most countries. The General Services Administration (GSA) in the U.S.A made the use of BIM a requirement on all major projects receiving significant public funding in 2007. In Finland, the Senate Properties, a government owned organization implemented BIM Requirements in October2007. Such a role has been played by governments in Northern Europe. In Singapore, the CORENET e-PLAN Check system (Construction Real Estate NETwork), launched by Singapore's Ministry of National Development) provides automated compliance checking against building codes for schemes designed using BIM." (Alufohai, A, 2012). Federal government of Nigeria and other building and construction agencies should enforce the use of BIM by organizing workshops and seminars to educate owners, Architects, Engineers, Contractors and other stakeholders on the uses and advantages of BIM for public and private construction projects in Nigeria. To improve the industry and make us more competitive in the World, there is need for more research on the use of Building Information Modeling in Construction in Nigeria.

3 Research Methodology

The Research was conducted with a structured questionnaire as a tool of data collection distributed to 30 Architectural firms. The questionnaire was divided into 4 parts. The first part gathered general information about the Architectural firm: Company Name, Address, Years in Business, Total No of Employees, kind of projects and software used for drawings. The second part of the questionnaire gathered data on the impact of BIM in schematic design using. The third part of the questionnaire gathered data on impact of BIM on post-contract design stage while the fourth part obtained information on the company's perception of barriers to the adoption of BIM in Nigeria. The factors identified through literature were used as variables for 3 tables on second, third and fourth part of the questionnaire.

Variables for impact on Schematic design were: collaboration with other consultants, client satisfaction, time of completion, quality of drawings, collaboration with other staff in the office, presentation of different design concepts. Variables for impact on post contract stage were: collaboration with other consultants, construction programming, estimation of costs, supervision of jobs, quality of completed project, time of completion, energy efficiency, safety, and conflict resolution. Factors affecting adoption of BIM were barriers to adoption listed in the literature review. Questionnaires were given to 30 companies randomly selected from list of Architectural firms by the Nigerian institute of Architects. The responses obtained were used to draw inferences. The firms were also asked to state their own contributions on the effect of BIM on sketch design and post contract design stage.

4 Findings and Discussion

4.1 *Reliability Analysis of Questionnaire on Impact of Building Information Modelling (BIM) on Collaboration in Schematic Design and Post Contract Design Stage*

Table 1. Reliability test results of instrument

Instrument	Scale Statistics					Reliability Statistics	Validity Statistics (ANOVA)	
Source	No. of Items	N of Samples	Mean	SD	CV	Cronbach's Alpha	F-value	P-value
Impact of BIM on Schematic Design Stage	6	16	26.81	2.040	0.08	0.737	140.904	0.000
Impact of BIM on Post Contract Design Stage	9	16	38.31	3.610	0.09	0.767	22.735	0.000
Factors Preventing Adoption	9	16	32.19	4.722	0.15	0.760	32.626	0.000

Key: SD (Standard Deviation); CV (Coefficient of Variation)
(Source: Field survey, 2015)

The test of reliability of the responses on study of Impact of Building Information Modeling (BIM) on Collaboration in Schematic Design and Post Contract Design Stage, using standardized Cronbach's Alpha is obtained for each section as 0.737 (73.7%), 0.767 (76.7%) and 0.760 (76.0%). These results suggest that the instrument of evaluation is highly reliable judging from the fact that 73.7%, 76.7% and 76.0%. > 70% threshold value, respectively. Further, the results implied that there is an internal consistency of the items in the instruments (questionnaires) used for data collection. These results are supported by the coefficient of variation (CV) values; 0.08, 0.09 and 0.15, which are respectively less than 0.50 threshold value, indicating homogeneity on how the respondents rated the items. Hence, there is an internal consistency of the answers from the respondents and therefore the data do not violate the assumption of reliability. The construct validation of the reliability results of instruments is carried out using analysis of variance (ANOVA) to test if there is no significance variation on how the respondents rated the items in each section of the instrument. The result of the analysis reveals that the test is significant at F-value = 140.904, 22.735 and 32.626, $P < 0.05$, respectively. The results suggest that there is no significance variation on the rating of the items by respondents in the instruments. Hence, the reliability of the instruments is significant, which validates the adequacy of the instruments.

Table 2. Analysis of socio-economic variables

Variable	Characteristics	Freq.	%	Mean	Total
Address	Within Lagos	12	75.0		
	Other South West	3	18.8		
	South South	1	6.3		16
Years in Business	1-5 years	5	31.3		
	6-10 years	2	12.5		
	11–15years	6	37.5		
	Over 21 years	3	18.8	10.8yrs	16
Total No of Employees	1-5 staff	8	50.0		
	6-10 staff	6	37.5		
	11–15 staff	1	6.3		
	Over 21 staff	1	6.3	7 staff	16
What kind of projects do you do?	mostly residential	1	6.3		
	mostly Commercial	1	6.3		
	all Building Types	14	87.5		16
Do you use any Building information modeling software in your practice?	Yes	16	100.0		16
If yes, which software do you use?	AutoCAD Revit	13	81.3		
	ArchiCad	3	18.7		16
If No, are you considering adopting BIM in the future?	No	15	93.8		
	Yes	1	6.3		16
Would you consider an applicant using BIM for employment before one that does not use it?	No	2	12.5		
	Yes	14	87.5		16

(Source: Field survey, 2015)

81.3% of the Architects interviewed use AutoCAD Revit in their office while 18.7% use ArchiCAD. 37.5% of the Architects interviewed have been in practice for 11 to 15 years while 18.8% have been in practice for over 21 years.56.3% of the firms have been in practice for more than 10 years. The architects who are not using BIM stated that they will consider Architects using BIM for employment before those not using it. This means that they consider BIM to be an important skill.

Research Question 1: How has the use of BIM solutions improved your drawings during schematic design stage?

Table 3. Analysis of impact of BIM on schematic design stage

Variables	Response					Descriptive			
	1	2	3	4	5	Mean	Rank	Relative Index	Extent
Client satisfaction	-	-	-	5	11	4.69	1	1.05	High
Quality of drawings produced	-	-	-	5	11	4.69	1	1.05	High
Time of completion of presentation drawings	-	-	1	6	9	4.50	2	1.01	High
Presentation of different concepts of design	-	1	1	3	11	4.50	2	1.01	High
Collaboration with other staff in your office	-	-	2	7	7	4.31	3	0.96	Low
Collaboration with other consultants	-	1	3	5	7	4.13	4	0.92	Low
Pooled						4.47		1.00	

Key: No effect (1), Worse (2), Negligible (3), Much (4), Very much (5)

(Source: Field survey, 2015)

From the results, client satisfaction, quality of drawings produced, time of completion of drawings and presentation of different design concepts were the main advantages of BIM on schematic design phase. Conflict resolution in drawings was the main advantage in post-contract stage of designing (Table 4). This reinforces the statement that BIM improves co-ordination and efficiency during the post contract design stage. The major factors preventing adoption of BIM were identified as lack of skilled personnel, lack of internet connectivity. Reluctance of other stakeholders, lack of awareness of technology and lack of BIM object libraries were also identified as factors preventing adoption. This confirms studies from literature reviewed.

Research Question 2: How has the use of BIM solutions improved your drawings during post contract design stage?

Table 4. Analysis of impact of BIM on post-contract design Stage

Variables	Response					Descriptive			
	1	2	3	4	5	Mean	Rank	Relative Index	Extent
Conflict resolution in drawings	-	-	1	4	11	4.63	1	1.09	High
Construction programming	-	-	2	7	7	4.31	2	1.01	High
Supervision of Jobs	-	-	1	9	6	4.31	2	1.01	High
Quality of completed jobs	-	-	2	7	7	4.31	2	1.01	High
Energy efficiency	-	-	2	7	7	4.31	2	1.01	High
Time of completion	-	-	2	8	6	4.25	3	1.00	High
Collaboration with other consultants	-	1	3	5	7	4.13	4	0.97	Low
Estimation of costs	1	-	1	9	5	4.06	5	0.95	Low
Safety	-	-	4	8	4	4.00	6	0.94	Low
Pooled						4.26		1.00	

Key: No effect (1), Worse (2), Negligible (3), Much (4), Very much (5)
(Source: Field survey, 2015)

Research Question 3: What premium would you place on these factors as the barriers to adoption of Building Information Modeling in Lagos, Nigeria?

Table 5. Analysis of factors preventing adoption of BIM

Variables	Response					Descriptive			
	1	2	3	4	5	Mean	Rank	Relative Index	Extent
Lack of skilled personnel	-	-	6	8	2	3.75	1	1.05	High
Lack of internet connectivity	2	-	2	8	4	3.75	1	1.05	High
Reluctance of other stake holders to use BIM	-	2	5	5	4	3.69	2	1.03	High
Lack of BIM object Libraries	-	2	4	7	3	3.69	2	1.03	High
Lack of awareness of technology	1	2	3	5	5	3.69	2	1.03	High
Extra costs involved in hardware, software and developing office procedures	-	3	4	6	3	3.56	3	0.99	Low
Frequent power failures	2	2	2	8	2	3.38	4	0.94	Low
Lack of contractual documents for BIM	1	3	3	7	2	3.38	4	0.94	Low
Fear of change	-	4	6	3	3	3.31	5	0.92	Low
Pooled						3.58		1.00	

Key: For no impact (1), for little critical impact (2), for fairly critical impact (3), critical impact (4), for extremely critical impact (5)
(Source: Field survey, 2015)

Research Question 4: What are solutions to the challenges and barriers encountered?

Table 6. Analysis of solutions to challenges and barriers to adoption of BIM

Items	Frequency	Percent	Cumulative Percent
None	10	62.5	62.5
Policy maker should promote the use through result of reserches done in the institute.	1	6.3	68.8
Schools should provide necessary equipment and enforce learning to all students.	1	6.3	75.0
Seminars, lectures, demonstrations on use of bim.	1	6.3	81.3
The provision of basic infrastructure that will promote the use of bim.	1	6.3	87.5
Training and awareness.	1	6.3	93.8
Trainings, adaption to changes.	1	6.3	100.0
Total	16	100.0	

5 Conclusion and Further Research

This research was conducted to find the barriers to adoption of BIM in Nigeria and the solution to barriers. The barriers with most impact were lack of skilled personnel, lack of internet connectivity, Reluctance of other stakeholders to adopt BIM and lack of awareness of technology. From the study, the identified solutions to challenges are: Policy makers should promote the use of BIM through result of researches done; Schools should provide necessary equipment and enforce learning to all students, Seminars, Lectures and Training on the use of BIM should be conducted to professionals in the field, Infrastructure that will promote the use of BIM should be put in place. This includes constant electricity and internet connectivity.

Further research will be done on standards of BIM in the country and provision of BIM object libraries. This research will benefit Architects, the Government, Engineers, Contractors and all companies involved in construction in Nigeria.

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7 References

Abubakir, M., Ibrahim, Y., Kado, D. and Bala, K (2014). Contractor's perception of factors affecting building information modeling in the Nigerian Construction Industry. *Computing in Civil Engineering*, ASCE 2014, pp167-178

Alufohai, A. (2012). Adoption of building information modeling and Nigeria's quest for project cost managemen. In FIG Working Week 2012,Knowing to manage the territory, protect the environment, evaluate the cultural heritage,6-10 May 2012, Rome, Italy,

Azhar, S., Hein, M. and Sketo, B. (2008). Building information management Benefits, Risks and Challenges, Mcwhorter school of building science, Auburn University

CICRP (2009). BIM Project Execution Planning Guid. The Computer Integrated Construction Research Group, The Pennsylvania State University, PA.

Eastman, C., Teicholz, P., Sacks, R. and Liston, K. (2011). BIM handbook, a guide to building Information modeling for owners, managers, designers, engineer, and contractors", JohnWiley and Sons, Inc., New Jersey

Egbu, C. and Sidawi, B. (2012). Building information modeling (BIM) implementation and remote construction projects; issues, challenges, and critiques" ITcon, 47, pp 75- 85.

Farley, A. (2011). Assessing the impacts of building information modeling. *The Building economist*, June 2011, pp 13-19.

Gordon, V. and Holness, P. (2008). BIM Gaining momentum. ashrae.org, June 2008.pp 28-30

Hassan, A. and Yolles, H. (2009) "Building Information modeling , A primer" Canadian consulting Engineer, June/July 2009, pp 42

Khemlani, L: 2007, "Top Criteria for BIM Solutions, A survey conducted by AECbytes"http://www.aecbytes.com/feature/2007/BIMSurveyReport.html

Rajedran, S. and Clarke, B, (2011). Building information modeling, Safety benefits and opportunities. *Professional Safety*, October 2011, www.asse.org, pp46

Rubenstone, J. (2012). Autodesk Steers Users Toward the Cloud With Expanded Subscription-basedServices. *Engineering News Record*, April 16, 2012

MANAGEMENT STYLE AND QUALITY OF MANAGEMENT DURING CONSTRUCTION INFLUENCES ON PROJECT DELIVERY TIME

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Abstract
Construction projects are becoming complex in nature, therefore control is fundamental requirement to avoid overruns of key performance parameters. The aim of the study is to identify influencing factors of management style and quality of management during construction on project delivery time with a view to mitigating their impact. A questionnaire survey was conducted among stakeholders in the Building Construction Industry to access influencing factors of management style and quality of management during construction. Finding relative to management style include that set time limits, specify goals people are to accomplish and require regular reporting on progress and for quality of management during construction are effectively coordinating resources, developing an appropriate organization structure to maintain workflow influences project delivery time In most cases these tradesmen require supervision construction, which results in delay and attending, may drastically reduce delay on projects. Based on the finding of the study, ways to mitigate poor management style and quality of management during construction were suggested.

Keywords: Construction, Delivery time, Management, Quality, Style

1 Introduction

Construction involve a lot of tasks, which are executed by tradesmen. In most cases these tradesmen require supervision in order to deliver the work according to specification and quality. The extent of management of these tradesmen with respect to the level of supervision given and management style will determine the quality of product. Management style dictates the quality of quality of product as happy workers engenders commitment to work leading to high productivity and quality products. Generally, workers do not want to be coarse to work. There is a need to balance supervision with the management style being adopted to achieve the optimum level of production and quality. This study assesses influence of management style and quality of management during construction on the delivery of projects in South Africa.

2 Literature Review

2.1 Management style

Management style deals with the personal attributes possessed by the manager in managing an organisation. Managers operate within an organisation and manage the functions of an organisation. These attributes possessed by managers that enable them to succeed are called competency. Rees and Porter (2001) define competence as the skills or knowledge possessed by individuals that enables them to manage an organisation successfully. Smallwood (2006) states that competencies can be divided into two categories: threshold or surface, which are required to be minimally effective and differentiating or core, a yardstick for superior performers.

The threshold or surface competencies are:

- Knowledge – information regarding content, and
- Skills – the ability to perform a task.

According to Singh (2004), competences can predict performance. Goals need to be defined before actions are taken and performance measured. There are three types of goals, namely:

- Organisation-wide goals – these include objectives pertaining to future directions for large segments of the organisation population;
- Task-oriented goals – they are specific objectives assigned to an individual or small group of individuals, and
- Personal goals or level of aspirations – these are goals set by the individuals themselves.

Fryer (2004) points out that many kinds of leadership study have taken account of the leader's competence or ability, either in the limited sense of technical ability or the wider sense of competence to lead. For an effective and efficient management of human resources, both the technical ability and competence to lead must be employed and could be referred to as management style.

The technical ability concerns the laying down of the construction methods and the drawing up of the schedule of works. The competence to lead refers to the motivation and support given to workers.

Griffith and Watson (2004) identify three management styles. These are exemplified by the following types of leaders:

- Autocratic leaders: They give orders which they insist shall be obeyed; determine policies for the group without consulting it; give no detailed information about future plans but simply tell the group what immediate step it must take; give personal praise or criticism to each member on their own initiative and remain aloof from the group for the greater part of the time;
- Democratic leaders: They give orders only after consulting the group; see to it that policies are worked out with the acceptance of the group (this is critical for effective implementation); never ask people to do things without sketching out the long-term plans on which they are to work; make it clear that praise or blame is a matter for the group and participate in the group as a member, and
- Laissez-faire leaders: They do not lead, but leave the group entirely to itself and do not participate.

2.2 Factors influencing management style

The factors that influence management style are discussed below. These include:

2.2.1 *Specific goals people are to achieve*

Pheng and Chuan (2005) state that the defining of goals affects project performance positively. The overall goal of an activity must be set out for each individual. This will be the driving force for day-to-day achievement and overall accomplishment of the goal. Goal-setting can inspire and motivate sub-ordinates, especially if their achievement is linked to remuneration. It also provides an effective means of evaluation and control (Du Toit et al., 2007). Additionally, when staff participate in the decision-making process of the organisation, it creates a sense of belonging which leads to individuals paying greater attention to their jobs. These create an environment conducive for work, resulting in high productivity.

2.2.2 *Organise the work situation*

One of the factors influencing performance in construction projects is sequencing of work and the allocation of crew sizes. Rojas and Aramvareel (2003) are of the opinion that out-of-sequence scheduling of work may result in a loss of momentum (rhythm). Walker and Shen (2002) suggest that contractor-related factors such as poor site management and supervision are major causes of delays in project delivery. Lack of organisation creates a situation of confusion and chaos, a situation in which no meaningful progress can be made. A site that is well laid out, in which offices, storage, and work spaces are well defined, aids the smooth flow of work.

2.2.3 *Set time-lines*

For the achievement of targeted production, time limits should be set for each task to be carried out. A bricklayer has a certain number of bricks to lay per day, depending on the type of brick. A fitter has a certain number of tones / kilograms of steel to bend or cut for a day's wage, and this applies to all trades. Based on this analogy, time lines are set for the achievement of each activity in order to avoid delay as clear time-lines promote more efficient and goal-driven work.

2.2.4 *Provide specific direction*

Managers or site engineers are supposed to provide specific direction on what must be done and how it must be done. Bassioni et al. (2005) declare that one factor that enhances performance is the development of the organisation's mission, vision and values by a leader and communication of these attributes to the workforce. Pheng and Chuan (2005) conclude that thirteen factors affect project performance negatively, among which is the availability of information. When this is lacking errors may occur, which may lead to poor workmanship and repetition of work. When these situations occur, the project will suffer delays.

2.2.5 *Conduct regular updates on progress*

Edum-Fotwe and McCaffer (2000) identify management skills such as time management and leadership as having a positive effect on construction project delivery. Chan et al. (2004) argue that a project leader's commitment to time affects the delivery of a construction project. A work schedule is a tool that is used to monitor the progress of work. In order to avoid delays in project delivery, the performance of the project should be evaluated regularly on this through work schedule. This helps in identifying areas of poor performance.

2.2.6 *Seek people's opinion and concern*

Management of an organisation should not only be concerned about work performance, but also about staff welfare. Management should not turn a blind eye to staff challenges. There should be a means for the personal challenges of workers to be made known to management. The labourers and skilled labour are those who perform construction activities with guidance from management staff, therefore their health is crucial to the speedy completion of a project. These are all factors that create job satisfaction and boost productivity.

2.3 Quality of management during construction

The study by Ponpeng and Liston (2003) of contractor ability criteria determined, inter alia, a contractor's quality management system is an important factor affecting a contractor's delivery of a project within schedule. Below are discussed the factors relative to quality of management during construction.

2.3.1 Forecasted planning date such as activity duration, resource quantities required

Planning tool is an aid for an effective, smooth flow and control of works during the construction phase. Arditi and Mohammadi (2002) conclude that timeliness, which is completion of the contract on the scheduled date, and accuracy, which is the ability to provide the right service performance may be uncovered and solutions found.

2.3.2 Analysis of construction methods

An analysis of construction methods is the consideration of the various techniques to carry out work against the volume and complexity of work, which will result in timeliness, cost effectiveness, quality product, and safety. Failure to do this might result in mistakes and rework. Proverb and Holt (2000) declare that construction methods adopted in the procurement of a project significantly relate to construction time performance. Belout and Gauvreau (2003) declare that trouble-shooting was identified as the second highest factor that explains project success in the execution stage in their study.

2.3.3 Resource movement to, on and from site

Koushki and Kartam (2004) declare that late delivery and damaged materials to site cause project delays, for instance, if there is not a particular material on site such as cement. The process it will take for replacement / purchase might lead to delays. Pertula et al. (2003) report that a total of 2 945 disability days were experienced on a project over a period of eighteen months due to accidents resulting from materials handling on site. This has a negative impact on the delivery of the project on time, with respect to machine requirements. A schedule of movement of heavy machines should be made in order to maximise the cost of hiring and movement to and from the site. Prior to a machine arriving on site the specific quantity of work to be done must have been identified. This will eliminate the situation of having the machine standing idle while work is not completed. Koushki and Kartam (2004) declare that poor planning, equipment breakdown and improper equipment lead to delays in the project.

2.3.4 Work sequencing to achieve and maintain work flow

According to Fox et al. (2003), to realise building designs, practitioners with expert knowledge should be employed in assessing the capability of construction processes. This will aid the comparison of construction methods of contractors against its adequacy regarding the project technology demand. On awarding the contract, the architect or the project manager requests the contractor to provide a work schedule and construction method statement. These explain the activities of work from site clearance to handing over of the site to the client. In other words, specific duration of activities fixed thereon and construction methods are identified. There are several planning tools employed in doing this. Among these are bar charts, the CPM, the S-curves as well as others, but the most commonly used planning tools are the bar chart and the CPM. These tools are used in achieving and maintaining workflow.

2.3.5 Monitoring and updating of plans to appropriately reflect work status

Lee et al. (2004) cite lantelme and Formoso (2000) who conclude that measurement-managed companies have shown better performance compared to their non-measurement counterparts. In order to measure the performance of a project, tools such as the CPM and bar chart are developed to monitor work status. In situations where the project is not performing as planned, areas of weakness are identified and improved on for the achievement of overall goals. Pongpeng and Liston (2002) identify project monitoring as one of the five most important criteria for contractors' ability to perform.

2.3.6 Responding to, and recovering from problems or taking advantage of opportunities present

If a project has to repeat one of its activities, it will take longer (Hardie, 2001). There may be a multiple effect of this problem on activities, which may later lead to stagnation of works on site. These problems are identified by the daily progress record maintained on site. Where there is a lag, problems leading to it are identified. This is responding to a problem. When problems are identified, they are addressed. This implies remedying the situation and sorting out the problems. Once these are solved, the project is restored into full operation. This method employed in solving a problem could be applied to similar problems and where the project is performing well the method adopted in achieving such success should be documented and used repeatedly. Dainty et al. (2004) state that for a project to succeed, there are some qualities the project manager must possess. Among these are analytical thinking power, information seeking and initiative. These will enhance problem-solving on site. Scott-Young & Samson (2007) conclude that there is a direct and positive relationship between effective team problem–solving and project outcomes.

2.3.7 Effective coordination of resources

Tam et al. (2002) declare that site layout planning assists in minimising the travelling time and movement costs of plant, labour and materials, activity interference during construction work and site accidents. Chan et al. (2004) state that the coordinating skills of the project team leader affects the construction of a project. Kazaz and Ulubeyli (2003) are of the view that assignment decisions of resources such as labour, equipment and materials control the overall duration and cost of a project. Additionally, a good inventory system must be put in place for recording materials on site for each section, for example, concreting, carpentry, reinforcement works and mechanical and electrical work. The materials movement schedule should be developed alongside the work schedule sheet. This will afford effective coordination of resources with respect to materials in stock, materials needed and ordering dates. Together these will ensure a smooth flow of activity and timely delivery of the project. Jha and Iyer (2005) maintain that coordination among project participants and resources positively influence the delivery of projects.

2.3.8 Development of an appropriate organisation structure to maintain workflow

Bassioni et al. (2005) say that the involvement of leaders in ensuring that management systems are developed for operations is an important performance factor for success. For an organisation to function effectively there should be an organogram showing the hierarchy of authorities and the various departments in the organisation. Duties and responsibilities are spelt out to each department which assist with accountability.

3 Research Methodology

A study titled influence of management style and quality of management during construction was undertaken to identify and assess factors influencing the delivery of project relative to schedule. The study was conducted in Port Elizabeth in South Africa. The sampling frame consist architects 1149 (SAIA); master builders 320 (MBA); clients 161 SAPOA); structural engineers 43 (CESA - East Cape), and *quantity surveyors 473 (ASAQS). From these* the calculation of the sample size *were made questionnaire response rate according to* *professional is given as:* architects (9), master builders (18), quantity surveyors (23), and structural engineers (23), clients (12) and others (3).

Probability sampling technique was employed for sample selection. For the Architects, Master Builders, and the Clients random sampling was used. Systematic sampling techniques was used for the quantity surveyors, and for the structural engineers and other the entire sample were surveyed based on the recommendation of Leedy and Omrod (2005). The research instrument for this study was a questionnaire survey, which was administered to respondents through post (Architects, MB, Structural engineers, and others) and e-mail (Quantity Surveyors). These were received through the same means. Cronbach's coefficient test and validity test were performed and were found satisfactory. Cronbach's alpha of ≥ .97 and factor loading of >.60 for samples sizes 85-89 were obtained.

A total of eighty-eight (88) questionnaires representing 6.1% response rate achievement recorded on questionnaire administration. Inferential analysis was used to statistics statistical tool was used for data analysis.

A five-point Likert scale adjoined with 'Unsure' and 'Does not' options was employed to analysis summated scores of the respondent's responses. Given that there are five points on the scale, and that 5 – 1 = 4, the ranges were determined by dividing 4 by 5 which equates to 0.8. Consequently the ranges and their definitions are as follows:

- > 4.20 ≤ 5.00 between a near major to major / major influence;
- > 3.40 ≤ 4.20 between moderate influence to a near major / near major influence;
- > 2.60 ≤ 3.40 between a near minor to moderate influence / moderate influence;
- > 1.80 ≤ 2.60 between a minor to near minor influence / near minor influence, and
- > 1.00 ≤ 1.08 between a minor to near minor influence.

Majority of the respondents belong to the private sector (74%), their average working years is 17, and over the age of thirty (30). Respondents with Bachelor's degree 25% predominate, and respondents have handled not less than six (6) types of projects. Based on these data obtained can be deemed reliable.

4 Findings and Discussion

4.1 Management style adopted

Table 1. The influence of management style factors on project delivery time

Factor	Response (%)								
	Unsure	DN	Minor	....	............Major			Mean score	Rank
			1	2	3	4	5		
Set time lines	2.3	0.0	3.5	0.0	14.9	37.9	41.4	4.13	1
Specify goals people are to accomplish	4.6	0.0	1.1	5.7	10.2	40.9	37.5	4.06	2
Require regular reporting on progress	2.3	1.2	2.3	3.5	17.4	37.2	36.1	3.97	3
Provide specific direction	3.5	0.0	2.3	4.6	17.2	37.9	34.5	3.96	4
Organise the work situation for people	4.6	1.2	2.3	9.2	12.6	41.4	28.7	3.79	7
Involve team members through discussion of work	2.3	1.2	1.2	4.8	20.2	35.	34.5	3.93	5
Provide support and encouragement	3.5	1.2	1.2	4.7	23.5	34.1	31.8	3.85	6
Organise the work situation for people	4.6	1.2	2.3	9.2	12.6	41.4	28.7	3.79	7
Seek people's opinion and concerns	5.0	1.3	2.5	12.5	27.5	25.0	26.3	3.54	8

Table 1 presents the respondents' rating of the influence of management style factors on project delivery time in South Africa. It is notable that all factors in this category have MSs > 3.40 ≤ 4.20, which indicates that these factors have between a moderate to near major / near major influence on project delivery time.

The factor that has the most influence on project delivery time in this category is setting time lines. This is close in agreement with the view of Rojas and Aramvareel (2003) that out-of-sequence scheduling of work may result in a loss of momentum (rhythm).per time and subsequently lost in production. In order to achieve meaningful progress, managers need to define the number of tasks to be performed within a specified time. The lack of specification of time lines for the performance of activities may have an adverse effect on the delivery of projects. Construction activities have been described as difficult and masculine in nature. There are measures such as setting time lines which need to be applied for meaningful productivity to be achieved.

The next significant factor is specifying the goals that people are to accomplish. Construction projects consist of activities and these activities need to be specified to workers and supervisors through information given by management for monthly, weekly or daily task executions until project completion. This is partly the reason for the need to provide a work schedule. When these details are not adhered to, it may have an adverse effect on the delivery time of projects. This agrees with the declaration of Pheng and Chuan (2005) that the defining of goals affects project performance positively.

The least significant factor in this category, is sorting peoples' opinions and concerns. It is a managerial tool used for higher productivity, which is often not utilised. Workers are not very skilful in contributing ideas to improve work execution. Most of the workers are afraid to speak to their supervisors. These are the most likely reasons for this factor having the lowest impact on project delivery time.

4.2 Quality of management during construction

Table 2. The contribution of quality of management during construction factors on project delivery time

Factor	**Response (%)**								
	Unsure	**DN**	**Minor.............................Major**					**Mean score**	**Rank**
			1	**2**	**3**	**4**	**5**		
Effectively coordinating resources	3.5	0.0	2.3	4.7	19.8	36.1	33.7	3.92	1
Developing an appropriate organisational structure to maintain workflow	3.5	1.2	1.2	5.8	19.8	361	32.6	3.88	2
Forecasted planning date, e.g. activity duration, resource quantities required, etc.	4.7	1.2	4.7	4.7	16.3	37.2	31.4	3. 80	3
Responding to recover from problems or taking advantage of opportunities presented	6.9	0.0	2.3	6.9	21.8	32.2	29.9	3.77	4
Monitoring and updating plans to appropriately reflect work status	2.4	0.0	3.5	10.6	29.4	23.5	30.6	3.66	5
Analysing of work sequencing to achieve and maintain workflow	2.4	0.0	3.5	10.6	29.4	23.5	30.6	3.66	6
Analysing resource movement to and on site	3.6	1.2	1.2	13.1	29.8	32.1	19.2	3.50	7
Analysing construction methods	2.4	3.5	4.7	7.1	35.3	28.2	18	3.38	8

Respondents were required to rate the influence of quality of management during construction factors on project delivery (Table 2). Seven out of eight factors have MSs > 3.40 ≤ 4.20, which indicates that factors have between a moderate to a near major / near major influence on project delivery time.

The most influential factor in this range is effectively coordinating resources. The lack of effective control of resources, namely machines, materials and human resources may lead to disorder on construction sites. A clash of activities, which may in turn lead to a lack of materials on site and a shortage of labour on site, may in turn result in low productivity. These all have an adverse cumulative effect on delivery time of project. This factor concur with the findings of Chan et al. (2004) that the coordinating skills of the project team leader affects the construction of a project and Kazaz and Ulubeyli (2003) who are of the view that assignment decisions of resources such as labour, equipment and materials control the overall duration and cost of a project.

The next significant factor is developing an appropriate organisational structure to maintain workflow. Construction activities are carried out by issuing instructions, and providing guidance and support. Instructions are given by superiors to subordinates. The labourers and supervisors must be aware of whom they must take instructions from and to whom to report to. A situation where these are not well defined may lead to poor performance on the project. A well-defined organisational structure will assist in the maintenance of steady workflow. This finding is in line with the finding of Bassioni et al. (2005) declaring that the involvement of leaders in ensuring that management systems are developed for operations is an important performance factor for success

The factor with the lowest MS in this range is analysing movement of resources to and from the site. The various times resources are required on site should be estimated in order to avoid idleness which engenders waste. These could be in the form of time losses, which is indirectly wasting money, and may lead to bankruptcy and abandonment of the project. Koushki and Kartam (2004) declare that late delivery and damaged materials to site cause project delays.

The findings of this study agrees with most findings of studies that have being conducted in different countries in the world. With respect to management style adopted on workers specification of goals workers are to achieve was declared by Pheng and Chuan (2005) as adversely affect workers productivity when they are not set. Relative to quality of management during construction these were found: effectively coordinate resources (Tam et al., 2002); develop appropriate organization structure (Bassiani et al., 2003), and forecasted planning date (Arditi and Mohammed, 2002) as having adverse effect on project delivery time, when adequate measures are not in place to mitigate their effect on project delivery time.

5 Conclusion and Further Research

5.1 Conclusions

The study reached these conclusions, that the following adversely affects project delivery time when attention are not given to them: set time lines, specify goals people are to accomplish, require regular reporting on progress, effectively coordinating resources, developing an appropriate organisational structure to maintain workflow, and forecasted planning date, e.g. activity duration, resource quantities required, etc. In order to mitigate the effect of the findings, it is recommended that weekly planning of resources and gang size should be developed. This is relative to mitigating materials shortages and achievement of target output of production, and ensuring correct activity sequencing. In addition, selecting adequate gang sizes to task.

Identification of key performance factors such as physical and socio-cultural factors that could impede on construction speed are recommended for further research.

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7 References

Andawei, M. M. (2003) Critical Path Method: A tool for project Delay Control. *The Quantity Surveyor*, 44 (3), 2-5.

Bassioni, H. A., Price, A. D. F. and Hassan, T. M. (2005) Building a Conceptual Framework for Measuring Business Performance in Construction: An Empirical Evaluation. *Construction Management and Economics*, (23), 495-507.

Belout, A. and Gauvreau, C. (2004) Factors influencing project success:The Impact of Human Resource Management. *International Journal of Project Management,* 22 (1), 1-11.

Chan, A. P. C., Scott, D. and Chan, A.P.L. (2004) Factors Affecting The Success of a Construction Project. *Journal of Construction Engineering and Management,* ASCE 130 (1), 153-155.

Dai, J., Goodrum, P. M. and Maloney, W. (2007) Analysis of Craft Workers' and Foremen's perceptions of the Factors Affecting Construction Labour Productivity. *Construction Management and Economics*, (25), 1139-1152.

Dainty, A.R.J., Cheng, M. and Moore, D.R. (2003) Redefining Performance Measures for Construction Project Managers: An Empirical Evaluation. *Journal of Construction Management and Economics*, (21), 209-218

Edum – Fotwe, F.T. and McCaffer, R. (2000) Developing Project Management Competency: Perspective from the Construction Industry. *International Journal of Project Management*, 18 (2), 111-124

Fox, S., Marsh, L. and Cockerham, G. (2003) Assessing the Capability of Construction Processes to Realize Building Designs. *Construction Management and Economics*, (21), 7-10.

Fryer, B. (2004) *The Practice of Construction Management. 4th Ed*, Oxford: Blackwell Publishing.

Griffith, A. and Watson, P. (2004) *Construction Management Principles and Practice. 1st Ed*, New York: Palgrave Macmillan.

Hardie, N. (2001) The Prediction and Control of Project Duration: A Recursive Model. *International Journal of Project Management*, 1, pp. 401-409.

Jha, K.N. and Iyer, K.C. (2006) Critical Determinants of Project Coordination. *International Journal of Project Management*, l24 (4), 314-322

Koushki, P. A. and Kartam, N. (2004) Impact of Construction Materials on Project Time and Cost in Kuwait. *Engineering, Construction and Architectural Management*, 11 (2), 126-132.

Lantelme, E. And Formoso, C. T (2000) Improving Performance Through Measurement: The Application of Lean Production and Organisational Learning Principles. *Proc. IGLC – 8. International Group for Lean Construction*, Brington.

Lee, H., Yu, J. and Kim, S. (2004) Impact of Labour factors on Workflow. *Journal of Construction Engineering and Management*, 130 (6), 918-923.

Leedy, P. D. And Ormrod, J. E. (2005) *Practical Research: planning and design*. 8th Ed. New Jersey: Pearson Prentice Hall.

Ogunsemi, D. R. and Jagboro, G. O. (2006) Time - Cost Model for Building Projects in Nigeria. *Construction Management and Economics*, (24), 253 – 258.

Perttula, P., Merjuma, J., Kiurula, M. and Laitinen, H. (2003) Accidents in Materials Handling at Construction Sites. *Construction Management and Economics*, (21), 729-736.
Pheng, L. S. and Chuan, Q. T. (2006) Environmental Factors and Work Performance of Project Managers in The Construction Industry. *International Journal of Project Management*, 24 (1), 24-37.
Ponpeng, J. and Liston, J. (2003) Contractor Ability Criteria: A Review from the Thai Construction Industry. *Journal of Construction Management and Economics*, (21), 267-282
Proverbs, D.C. and Holt, G.D. (2000) A Theoretical Model for Optimum Project (Time) Performance Based on European Best Practice. *Construction Management and Economics*, (17), 652-665.
Rees, W. D. and Porter, C. (2001) *The Skill of Management*. 5th Ed. Publishers: Thomas learning, London.
Scott-Young, C and Samson, D. (2009) Team Management for Fast Projects: An Empirical Study of Process Industries. *International Journal of Operations and Production Management*. 29 (6), 612-635.
Sing, T. F. (2002) Time to Build Options in Construction Processes. *Construction Management and Economics*, (20), 119-130.
Smallwood, J.J. (2006) The Practice of Construction Management. *Acta Structilia*, 13 (2), 25-42.
Walker, D. H. T. and Shen, Y. J. (2002) Project Understanding, Planning, Flexibility of Management Action and Construction Time Performance: Two Australian Cases Studies. *Construction Management and Economics*, (20), 31-44.

IDENTIFYING HAZARDS FACING WORKRS IN CEMENT FACTORY IN PRETORIA

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Abstract
The purpose of this study is to minimize the major hazards encountered by the cement factory workers. Cement workers are prone to hazards and these has potential cause to injury or illness which is the basic motive for this study. Hazards was identified and assessed, qualitative and quantitative methods are used in collecting data in this study. Data collection method are based on individual interview with the management, workers and the labour contractors in the factory. The researcher was able to get good response from the workers by assuring them that the information obtained from them would only be used for the study and that their employer will not have access to it. Some events photographs was taken as it buttress the authenticity of the study findings. The findings shows that workers encounter risks of throat cancer, reddish eyes skin problems and breath problem which was attributed to inadequate provision of PPE by the management and the contractors that directly employed these workers. The study recommended that safety performance should be improved by the stakeholders in the cement industry through effective monitoring visit by the department labour to cement factory, provision of PPE by the management, safety training programmes for workers, employment of competent safety personnel will enforcement safety compliance in the factory.

Keywords: Cement, Factory, Hazards, PPE, Safety

1 Introduction

Cement factories represent one of the most important strategic basic elements in the economic development of any country. Workers in this sector constitute an important productive aggregate in the community (David and Hamdy, 2005; and Baskett, 2007:7). Furthermore for period of time the national development was measured by production and consumption size of the cement (Pipilikaki, 2009). The cement industry operates in virtually all countries around the world; however more than 70 percentages of the global cement are produced and consumed in the developing countries where the cement development is much higher pace (John, 2003). This industry has all the features to be a successful sector especially in some developing countries, like South Africa.

Portland cement is the most commonly used today and is successor to hydraulic lime. The invention of Portland cement is usually attributed to Joseph Aspdin, who took out a patent in 1824 for a material that was produced from a mixture of limestone and clay. It is called "Portland" because the concrete made from it looks like natural stone from the Isle of Portland. Since Roman times, cement has been one of the synthetic materials with the largest production and widest usage by mankind. Its properties have allowed fascinating works till date. In the cement factory sector, workers exposed themselves to many occupational hazards that might contribute to diseases and injuries at the cement factory but a considerable interactive effort with exchange of ideas in many organisations within and outside the cement industry have been trying the need of stressing on how to improve occupational health and safety performance for workers. Furthermore a periodic check-ups and early detection of hazards to monitor the health status of every cement factory work-related accidents and diseases continue to be a major problem in the world today, because the human and economic costs of occupational accidents and diseases remain high major tieback for cement factory (Abongomera, 2008:46). Working is viewed as important part of one's life experience of all adults, as most people spend about one third of their lives at work. About 45% of the world's population and 58% of the population over ten years of age constitute the global workforce Rogers (2005) and Gupta *et al.* (2007).

El - Sobky (2008), indicates that workers are exposed to many health hazards which are tremendously harmful on their health, these hazards may result from physical, chemical and mechanical agents, which could have a detrimental influence on their health. Cement can cause ill health in workers through skin and eye contact or inhalation. The risk injury attached to the cement factory workers depends on the duration and level of exposure and individual sensitivity. (Saucier and Jane, 2004:45). The term "cement" was derived from the Latin word cementum, which means stone chippings that were used in Roman mortar. This hydraulic cement was discovered during ancient Greece and Rome where it was made from volcanic ash mixed with slaked limes, and the Roman engineer Vitruvius describes the surprising properties of this mixture differed completely from all other materials and was even able to set under water by Smeaton, 1758. There are difficulties to determine the extent of work-related illnesses and diseases because of the delayed period of most occupational diseases on workers in the cement factory. Environmental Health and Safety Management (2009) explains that some of the diseases do not emanate on the workers' health quickly as expected. When the diseases finally manifest it is often difficult to trace the root causes to the workers' past exposure (El-Sobky, 2008:46). The International Labour Organisation (ILO) observed in 2008 that more than two million workers die each year from work-related accidents and diseases, and added that this is probably an underestimation. The ILO estimates that workers suffer 270 million accidents and at least 335 000 fatal injuries annually, while avoidable occupational diseases affect 160 million people every year. The results of a study by (McCann and Babin 2007:10) show a need for good dilution ventilation and additional protective gear such as goggles and NIOSH-approved toxic dust masks for workers in the chemical industry. This is very important for the cement chemical section; as such masks will protect the workers from hazardous toxic materials. Many cement factories around the globe are re-examining their factory operations in a fundamental way.

Many health and safety legislative and regulatory frameworks specify, in clear terms, how the employer must address any given condition. Taylor (2003:12) explained that the standards and regulations tend to support the traditional command-and-control, deemed to comply or prescriptive approach of addressing unsafe situations as well as existing and potential hazards, while ignoring the responsibility of the employer in addressing unsafe worker behaviour, cement Factory have started making significant changes to their policies and commitments to health and safety strategies to improve the sustainability of cement production, providing and enforcing prescriptive rules and procedures that promote the safe behaviour of workers (Haupt, et al, 2001:3).

1.1 Research Problem Statements

The cement is mostly found everywhere in everyday life and it is hard to imagine a modern society without it. But workers in these cement factory are exposed to many occupational hazards which contribute to work injuries, while some workers become allergic to chromium content in cement component. A significant percentage of all workers in cement factory are allergic to chromium dust particles in cement, these cement dust particles symptoms ranging from a mild rash to severe skin ulcers. (Zuskin, et al., 2007), reported that cement, had a significantly higher prevalence of chronic cough, chronic bronchitis, hearing disorders and chronic sinusitis attacking workers health in workplace.

In order to achieve comprehensible understanding of the cement industry features, and all effective factors during the production process; this attempts give a clear picture of the cement production problems occurrence. Furthermore it shows that both workers and people living in the vicinity of cement factories are at risk, as it has been suggested that the components of cement dust can be airborne and inhaled. When the cement dust enters the bloodstream it is transported to the different tissues of the body, including the liver, spleen, heart, bone, and muscles. This could affect the physiological micro-structure and performance, and if an irritation of the eyes is not treated immediately, chemical burns leading to blindness can be caused (Saucier and Janes, 2004). According to Baletic, et al., (2005), indicated in their study that most of the avoidable hazards were caused by level of workers education that made most of them not understanding the safety rules in the safety hand book given to them at the commencement of their duty at the cement factory, 86% of workers had primary education, while 1% is semi-qualified and 13% are qualified workers in cement factory. As such the study shows workers' exposure to various occupational health hazards that causes various kind of illness in the cement factory workers' health, these are physical, chemical or accidental due to mechanical hazards and other health problems. The physical hazards show that ear problems are the most common physical hazards observed in the cement factory, this was followed by high blood pressure of the workers. Slightly less than one quarter of the studied sample were exposed to fractures because of accidents, followed by falling object. Also, slightly less than one fifth of the studied samples were exposed to eye problems, followed by haematological disorders. However, it is very difficult to convince employee, management and sub-contractors that the improvement of working conditions could be profitable and that the improvement of health and safety at work could generate enormous economic benefits; not only for the factories, but also for society as a whole (Mansour, 2008:9).

The primary objective of the study is to improve management awareness of workers' health and safety in the cement factory.

The secondary objectives of the study are as follows:

- To investigate how management can improve workers' health and safety.
- To identify the hazards that workers are exposed to at work.
- To evaluate the magnitude of the hazards that workers are exposed to.

To improve management's accountability for supervision health and safety issues among workers, and management improvement on the health and safety issues in the cement factory. Major Key of the study is the health hazard to which workers are exposed to and how cement factory management deals with this issue, is a challenge. The implementation of health and safety policies, as well as the accountability of management toward the health of workers that relate to cement factory, this hazard requires study.

2 Literature Review

Cement can be defined as the critical ingredient in concrete, locking together the sand and gravel constituents in an inert matrix; it can be referring to as 'glue' which holds together modern society infrastructure. The cement industry is one of the oldest industries in the world. The demand for the cement has risen rapidly over the last decades to become the second substance after water (Hsiao & Armstrong, 2012: 28). The industry is high intensively of raw materials and energy with fuel accounting for 30-40% of the production costs. Cement has been made since Roman days, but over time the recipes used to produce cement have been refined and earliest cements were produce from lime and pozzolana called volcanic ash, containing significant quantities chemical mixture with ground brick and water. Moreover this cement was not improved until 1758, when Smeaton" noticed that using a limestone that was 20 - 25 % clay and heating the mixture resulted in cement could harden under water. He called this new cement 'hydraulic lime. Furthermore when the mixture was heated, a small quantity of it was sintered. Normally this was discarded as waste, but in the 1800s Aspdin and Johnson, discovered that when the entire batch was sintered and then ground superior cement was formed and produce. This further research substance became designated as Portland cement after the region in which they were working; today this is the most common cement in use.

Production of cement deals with raw materials and the main raw materials used in the cement manufacturing process are, limestone, sand, shale, clay, and iron ore. Another source of raw materials is industrial by-products to replace natural raw materials this is key element in achieving sustainable development of cement production. Cement is produced through a series of processes including quarrying, crushing, milling, blending and kiln burning, to form clinker cement. During all this processes accidents cannot be avoided, due to the ever-increasing pace of production activities. There are two main types of cement, natural and artificial. The natural cement is obtained from natural material having a cement-like structure and requires only calcining and grinding to yield cement powder, while artificial cement is also called Portland cement, there are different types of Portland cement such as Ordinary or Rapid hardening, Sulphur resisting, White coloured, Low heat, Masonry, Hydrophobic, Water replant, Expanding and non-Shrinking, High aluminium, Blast furnace and Oil well. All these are produced under consideration of different substances especially the limestone and clay, which are heated into a chemical reactions which take place, during heating process this produces four major phases which are known as Tri-calcium silicate, Di-calcium silicate, Ferrite phase and Tri- calcium aluminates phase (Hsiao and Armstrong, 2012:7).

Hamdy (2007) in his own research revealed that Cement mill workers are exposed to dust at various manufacturing and production processes, such as quarrying, handling of raw material, grinding clinker, blending, packing and shipping of the finished product, he also submitted that those workers who are exposed to such hazards in their workplace are more exposed to health hazards. In recent times the disastrous accidents in Bhopal (India) and Chernobyl (Ukraine) had a death toll of an estimated 4 000 and 10 000 persons respectively in 2000. In addition, there were around 5 200 workplace fatalities and 3.9 million workers suffered disabling injuries in the United States. This clearly demonstrates that the problem of workplace accidents and safety is a pressing issue. Noise is also major hazard encounter during the production of cement; milling plants used in grind the cement product causes high tension of noise this can simply damage someone hearing Levels, maintenance and cleaning personnel worker are mostly at risk. Improved noise personal protective equipment is also helping reduce the effects of exposure, and a whole body vibration is another issue in cement factories. (Beach, 2009), explains that age actually had stronger effect upon accident rate in the workplace. The United States Department of Health and Human Services (USDHHS, 2000), reported that workers having years of experience more than 10 years were more exposed to hearing serious effects. Though work-related diseases are amenable to prevention through recognition, evaluation and control of the hazards in an ideal world and effective practice of occupational health and safety has yet to be fully adopted in these developing countries. Baloyi (1991) identified the following as some of the main reasons for not implementing the safety policy by most developing countries: lack of effective enforcement system, lack of information and accurate records of occupational diseases and accidents with lack of basic professional training lack of risk management, risk engineering, risk control in occupational health and safety of cement factory.

Evelyn, Florence and Adrian (2005), presented the results of a postal survey of contractors in Singapore, where the findings revealed that factory accidents are more likely to happen when there are inadequate factory policies. Moreover, the health and safety policy statement should contain the aims which are not measurable and objectives which are measurable of the organisation or factory. The aims will probably remain unchanged during policy revisions, whereas objectives will be reviewed and modified or changed each year. These statements should be written in clear and simple language so that it is easily understandable (Phi Hughes *et al.,* 2001).These following points should be considered when a health and safety policy statement is drafted:

- The aims should cover health and safety welfare and relevant environmental issues.
- The position of the senior person in the organisation or company who is responsible for health and safety (normally the chief executive).
- The names of the health and safety adviser and any safety representatives.
- A commitment to the basic requirements of the Health and Safety at Work Act, for example, risk assessments, safe plant and systems of work, transport and handling of articles and substances, information, training and supervision.
- Using a safety committee or plant council.
- Specific policies of the organisation.

Risk engineering is one of the department found in the cement factory, generally it involves the use of engineering measures to reduce or eliminate risk in any factory sector. The control measures used by management as a link between risk control and risk engineering take into account that if hazards are controlled then the associated risks will be minimised. A range of counter measures is available to lower workers' risks. They involve reviewing the tasks, engineering, guarding, methods, training, Personal Protective Equipment policy, substitution, shielding, practices, information, and worker behaviour (Flanagan, as cited by Radevsky, 2011:3). Risk engineering is also a process in which a risk engineer undertakes surveys at regular intervals during the project life cycle. The main purpose of the process is the prevention of losses by examining the performance and progress of the works, identifying key areas of risk, providing recommendations, analysing losses and sharing lessons learned with the operational teams. This is achieved through regular visits to the site and a discussion of the recommendations with the workers (Radevsky, 2011:4). Another purpose of risk engineering is that of reporting the progress to the management, including recent or imminent changes and highlighting problems that have been encountered, discussing delays that have been faced and how the workers responded to them; and noting the responses to any recommendations made during previous surveys. To accomplish this, information is gathered before, during and after cement factory visits. Subsequently, a report is produced which is sent to the workers and the management (Radevsky, 2011:5).

It is important to imbibe risk control by eliminating or reducing the risk of a person being injured or harmed. The order in which controls should be considered is elimination, substitution, isolation, engineering control, administration control, and personal protective equipment. It should be noted that more than one control can be used at any given time to reduce the exposure to a hazard resulting from manual handling (DoL, 2011:8). The management of Health and Safety at Work Regulations 1999 of the UK states that risk assessment should include, firstly, a record of the preventative and protective measures that are in place to control the risks, and, secondly, what further actions, if any, are to be taken to reduce risk sufficiently (Cooke and Williams, 2009: 247).

Preventative and protective measures are often referred to as control measures; the purpose of this is to reduce worker risk. This is not always achievable; therefore, further measures may need to be implemented to control any residual risks (Chihuri and Pretorius, 2010: 57). For example, a measure might be to provide workers that work at heights with safety harness for a particular work. However, there is still the risk that the workers will not use the tool correctly. The residual could be minimised to an acceptable level by employing a foreman to supervise the task of ensuring that the worker safety regulations are adhered to (Cooke and William, 2009: 248). Risk cannot be eradicated, but it can be managed (Chihuri and Pretorius 2010: 69). Furthermore, it is better to be proactive than reactive. Risks have to be identified, quantified and understood for them to be effectively managed (CIDB, 2004:1). Risk management now serves as an iterative process consisting of distinctive steps which, taken in sequence, support better decision-making by contributing a greater insight into risks and their impacts. The risk management process can be adopted in any situation where an undesired or unexpected outcome could be important or where opportunities are identified (Dey, 2010:69). These address the importance of risk identification and risk analysis in the cement factory. The cement factory is ideal example of the continuous industry sector and it will be used to demonstrate that the lean philosophy is applicable to all deferent organisation types. There are numerous challenges facing the cement factory in today's competitive environments; one of the major challenges is the capability of the cement factory to adopt safety enforcement to sub-contractors and introduce the improvement approaches and techniques by which the overall enhancement can be achieved.

3 Research Methodology

To achieve the objective of this research qualitative and quantitative method was used, 48 workers, 10 contractor and 15 management staff were interviewed. This method offers sufficient flexible results for all the research questions and objectives of the study were addressed, the relevant areas of data collection, the interviews were tape-recorded to secure an accurate account of the conversations and avoid losing data since the entire conversation cannot be captured during an interview by other means. Observations was also made by the researcher so as to obtain useful information that will proffer result that can address the problem identified in the study. The researcher observed both physical setting and environment within which the cement factory workers activities took place.

4 Data Collection

Data was collected through interview and observation from the cement factory, workers, contractors and management were randomly interviewed on different days based on the activities of each worker on their workplace, the qualitative method was used in collecting information from the targeted group; observations are also importantly made on the attitude of workers and their employers concerning the safety of the workers on the cement factory used in this study. Interviews and observations are popular means of obtaining information from people (Noor, 2008: 1603). The interviews was tape-recorded to secure an accurate account of the conversations and avoid losing data as stated above since the entire conversation cannot be captured during an interview by other means, journal and textbook to find answer to the objective of the study and explain improvement to workers about health and safety. The approach used in this study was qualitative in nature. The researcher made use of the simple random sampling within the category of the probability sampling methods. According to Ogbeide (1997), the justification for this kind of technique allows every subject in the sampling frame an equal opportunity to be selected without bias in an organized manner.

5 Findings and Discussion

It was observed that the management provided PPE to the permanent workers but left out other subcontractors` workers believing that their employer will provide them with PPE, the management provided: Nose guard, Hand glove, Safety Hat, Safety Boot, Safety Gurgle and Ear noise guard The researcher also noticed that some of the PPE given to the workers employed by the management are not properly used by their worker. Contractors hardly provide proper PPE stated above to their workers especially those workers at the production floor where there are inhaling of dust that affect workers' health. Out of the 48 workers interviewed 17 of them agreed that the management provided proper and adequate PPE while 10 workers neutrally agreed that management provided PPE but was not adequate and the remaining 21 workers believed that management did nothing in respect of the workers protection against hazards. The research sampling shows that workers that agreed to management provision of PPE but not enough are those contractors` workers that were opportune to get some of the PPE provided by the management and those workers that disagree are the workers that hardly get some of these PPE. In conclusion the following finding were made:

- Poor supervision of the workers at workplace;
- Risky behaviour of workers at the factory;
- Inadequate safety education, illustration and proper use of safety harnesses;
- Inadequate provision of safety harnesses;
- Employment of incompetent safety officers by the sub-contractors;
- The attitude of the management towards workers employed by subcontractors in respect of their H&S at the factory premises;
- Improper use of PPE by the workers;
- Provision of defective PPE by the sub-contractors to the workers;
- Improper use of workplace equipment (e.g., steel ladders) by the workers;

The demographic analysis below could also explain the numbers of the respondents in this study and their response to questions asked. On the side of the workers in respect of their responsibility to their health and safety protection at work, the following histogram in Figure 1 shows that large percentage of the workers did not comply with the health and safety at work.

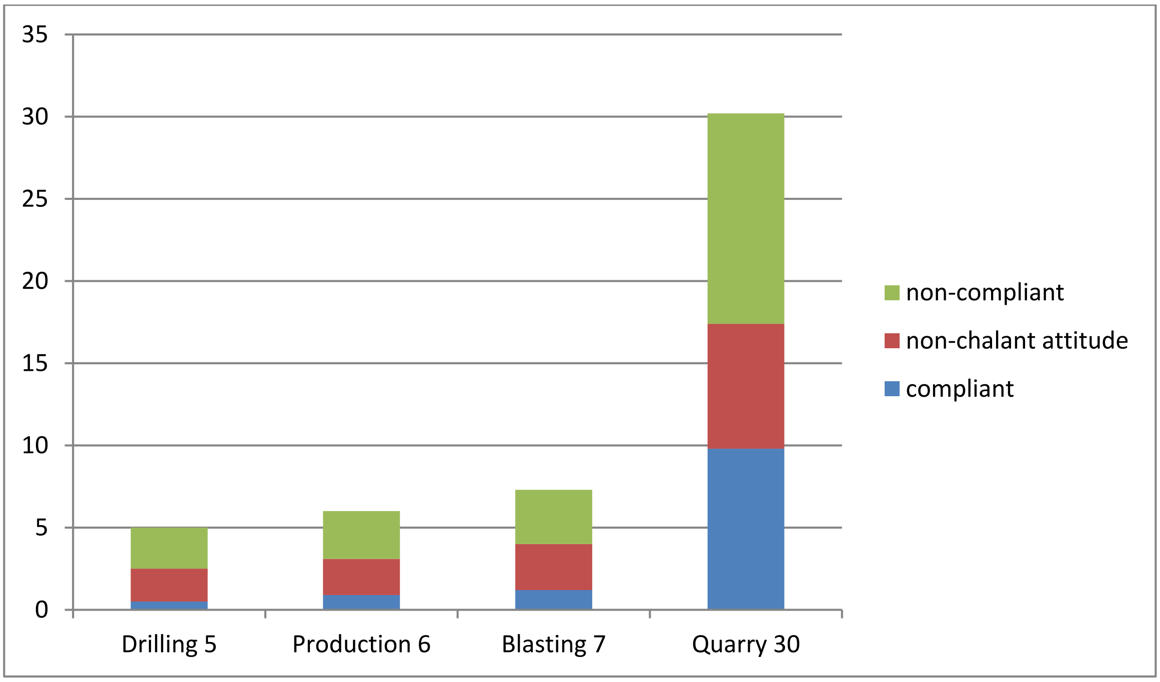

Figure 1. Workers attitude towards their personal protection

This question was asked and the sample result shows with the aid of histogram that out of the 48 workers interviewed 30 workers from the quarry as the highest percent of non-compliant in using the proper PPE while the others are in between. This shows that according to the result and observation in the factory contractors are the non-compliant figures in the issue on ground because they focus mainly on their daily target when job are being awarded to them.

6 Conclusion and Further Research

The data obtained in this research were based on the personal views of the participants, the observations of the researcher and not on any assumptions that may have been made by researchers about what the causes the workers hazards. The results indicated that serious injuries and death among the cement factory workers are caused by the findings mentioned above. Based on the above findings it appears that the major stakeholders concerned with the workers hazards at the factory workplace need serious redress, the shortcomings on workers hazardous issues at the workplace. Further research is being recommended by the researcher.

7 References

Abdelhamid, T.S., Narang, P & Schafer, D, (2011). Quantifying Workers' Hazard Identification Using Fuzzy Signal Detection Theory: The Open Occupational Health & Safety Journal

Abongomera, A. (2008). Identified the human and economic occupational cost accident diseases.

Alphonse, T. (2008). Decent work and global strategy on occupational safety and health On Guard Sustainable. *Safety and Health Practice*, 15 (1): 7-13

Akpan, E. I. (2009). Participative goal-setting: A strategic approach to achieving increased productivity in contemporary organizations. Oxford Mosai. Journal of Business Strategy, 1: 37-47.

Andi (2008). Civil Engineering Dimension, 10(1):1-6.

Ayodele, R. B. and Olubayo-Fatiregun, M. A. (2010). Workability of safety education and training for workers' strategy in accident induction in selected manufacturing industries in Lagos. International Journal of Sustainable Development,, 3:8-14.

Baby, S., N. A., Singh, P., Shrivastava, S. R., Nath, S. S., Kumar, D. S. and K. Vivek (2008). Impact of dust emission on plant vegetation vicinity of cement plant" Environmental Engineering and Management Journal 7(1): 31-35

Zhi, H. (1992). Risk management for construction projects.International Journal of Project Management

Baloyi, (1999). Identified some of the reason why industries are not implementing safety policy

Besides, T and Spilka, M. (2010). Achievement in materias. *Journals of Achievements in Materials and Manufacturing Industry*, 39(1):95-102. C., M. 2008. In: Asia Construct Conference [Online]. Available from: [Accessed: 21/02/2015]

Chao, C.J., Wang, H.M. and Cheng, F.-Y. (2008). A study for safety and health management problem of semiconductor industry in Taiwan. Industrial Health, 4, 575–581.

Cooke, B. and Willimas, P. (2009). Construction Planning, Programming and Control: Wiley-Blackwell.

Christian, M., Brandley, J., Wallace, J. C. and Burke, M. (2009). Workplace safety: a metaanalysis of the roles of person and situation factors. Journal of Applied Psychology, 94 (5), 1103–1127.

Dey, D. (2010). Making work safer: Testing a model of social exchange and safety managemen. *Journal of Safety Research*, 41:163-171.

Eklof, M. (2008). The impact of systematic health and safety management for occupational disorders and long-term work attendance. *Social Science and Medicine*, 67, 965-970.

El-Sobky, M.K. (2008). Study of accidents among workers Helwan cement factories. MD Thesis, Faculty of Medicine, Cairo University Egypt.

Flanagan, R and Norman, G. (2001). Risk Management of Construction. ASC Proceeding of the 37th Annual Conference University of Denver- Denver, Colorad.,April 4-7 2001,(95-100).

Grant, A., Christianson, M. and Price, R. (2007). Happiness, health, or relationships Managerial practices and employee well-being tradeoffs. *Academy of Management Perspectives*, 21 (3) (51-63).

INFLUENCE OF CONSTRUCTABILITY AND QUALITY OF MANAGEMENT DURING DESIGN FACTORS ON PROJECT DELIVERY

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Abstract
Constructability, the integration of construction techniques at the stage in the development of designs has impact on the rate of construction. When this is absent it normally results in a negative impact. The aim of the study is to identify influencing factors of constructability and quality of management during design have on project delivery time with a view to alleviating their impact. A questionnaire survey was conducted among professionals in the Building Construction Industry to access influencing factors of constructability and quality of management during design. A total of eighty-eight questionnaires were analysed before reaching conclusion relative to the study. Inferential statistics was employed in the analysis of data. Finding relative to constructability factors include that participation in site inspection and control, knowledge of performance of materials and components, and appropriateness of working space and for quality of management during design, conflicting design information, missing information and timeliness of revised drawings are the factors that most influences project delivery time The recognizing of influencing factors of constructability and quality of management during design, could result in according more priority to them with a view to developing measures to mitigate their effects on project delivery. Based on the finding of the study, ways to mitigate poor constructability reviews and quality of management during design were highlighted.

Keywords: Construction, Constructability, Delivery time, Design, Management quality

1 Introduction

Clients expects the briefings of their intended facility to the designer to be accurately reflected in design and so built by the constructor. Client's desire is to procure a facility that is performing optimally. Contrary to these, dissatisfaction results, which may lead to litigation, extension of time, no returns on investment as planned by the client, and so on.

The ease of construction of a design is referred to as constructability. Constructability indicates the following: corresponding dimensions of design, adequate and accurate design information, and design void of omissions, which ultimately leads to delivery of facility as schedule, facility performing optimally to the satisfaction of the client.

The contrast is the case, relative to poor design and non-constructible design necessitating late delivery of projects, with a lot of problems associated to it. This study aims to identify and assess factors of constructability issues and quality of management during design that could adversely influence project delivery time, with a view to suggesting mitigating factors.

2 Literature review

2.1 Importance of the study

The non-delivery of a project as at when specified causes unhealthiness in a contract and may lead to abandonment, disputes and litigation, increased project duration and cost resulting from inflation, bad image of contractor, client and consultants, and so on. Delay is associated with diverse issues, which are traceable to the contribution of the client, contractor, and consultant – designer, with respect to this study (Niazai and Gidado, 2012). Contribution from the designer could relate to issues of constructability of the design and quality of management during design. Some authors have identify factors relating to design that causes project delay. They are: design complexity (Sullivan and Hans, 1986); changes in scope of work (Assaf et al., 1995); waiting for information (Chan and Kumaraswamy, 1997) and design delay (Ogunlana et al., 1996); design changes (Kaming et al., 1997); Trigunarsyah (2004) identifies four stages of constructability implementation on a project. The stages are: during conceptual planning, during design, during procurement and during the construction stage, and each having sub-factors for consideration; late preparation and approval of drawings (Faridi and El-Sayegh, 2006); design (Long et al., 2008); late approval of shop drawings (Assaf and Al-Hejji, 2008), and ambiguities, mistakes, and inconsistencies in specification and drawings (Shehu; Endut, and Akintoye (2014). Based on these gaps, this study was initiated in South Africa, in addition that building construction processes are the same worldwide, to assess the factors that most influence delivery time of project based on issues of constructability of design.

2.2 Constructability of design

Mbamali et al. (2005) define the extent to which a building design facilitates the ease of construction as buildability: a British term or constructability: an American term which is defined as the grouping of similar work components and the use of modular dimensions in design to reduce construction cost. The constructability requirement is, however, one of the major factors necessitating the integration of construction experience into building designs. Oyedele and Tham (2005) provide a list of factors that could be used to assess constructability inter alia: flexibility of design to changes; dimensional coordination of elements; knowledge of performance of materials and components; effective constructability review of design, and effective participation in site inspection and control. The following factors are employed in the assessment of design constructability: the scope of off-site fabrication; complexity of offsite fabrication components; appropriateness of design tolerances; appropriateness of working space; implication upon trade coordination; impact of materials storage and movement, and impact on smooth activity workflow and activity sequencing.

2.2.1 Extent of grouping simultaneously

The extent to which similar kinds of work can be grouped together is an indication of how fast a design can be constructed. Works such as fixing of electrical wires into pipes for switches and sockets allow projects to gain time, because the wires to many switches and socket outlets can be contained in one pipe, with minimum cost. The extent to which a design can easily be changed also reflects how easily it can be constructed. Designs that are not subject to changes could have an adverse effect when errors are committed during construction. These errors could be design or construction related errors.

2.2.2 *Extent of modular dimension in design*

The utilisation of modularity in design facilitates easy and fast construction. The use of standard modules promotes standard sized materials and mitigates cutting. When standard items are customised in this way, projects may be completed more speedily. Additionally, the incorporation of these standard units in design can eliminate the delays relative to cast in-situ operations.

2.2.3 *Knowledge of performance of materials and components*

The knowledge of performance of materials and components provides opportunities for alternatives. Trigunarsyah (2007) suggests that the concept of constructability revolves around optimising the use of construction knowledge and experience provided by knowledgeable and experienced construction personnel who are part of the project team. The project managers, engineers, architects, and contractors should be knowledgeable about the characteristics and performance of materials and components integrated in the construction. This eliminates possible situations of delay which would have been caused by the non-availability of materials and also remedies the situation through informed substitution of materials and components.

2.2.4 *Effective constructability review of design*

Yates and Battersby (2003) suggest that designers must receive construction training prior to starting their design careers. This will aid the integration of construction experience into their designs for buildable designs. Designs should be reviewed to check for conformance with constructability. This process should be carried out at the design stage, so that the constructability count / rate of design is known before the contract is awarded. The process eliminates delay in project delivery.

2.2.5 *Participation in site inspection and control*

Effective participation in site inspection by parties involved in the project relative to their discipline is important. This process helps to discover the conformity of the construction to specifications and identify deviations. In this way errors are discovered early and are dealt with promptly.

2.2.6 *Scope of site fabrication*

The scope of off-site fabrication is an indication of the extent to which design could be easily constructed. A large scope of off-site fabrication is a likely indication of delays to the delivery of the project. Attributes such as fixing problems and delivery of prefabricated components to the site may constitute delay.

2.2.7 *Complexity of off-site fabrication components*

Arditi et al. (2002) declare that the probability of a problem occurring on a less complex project is low compared to a complex project. Complexity refers to the intricacy of construction and associated problems. Probable problems include design mistakes, poor quality and inaccuracy of dimensions. These associated problems may lead to delays in the delivery of the project. Trigunarsyah (2007) is of the opinion that constructability is enhanced when designs are simplified to enable efficient construction. This allows good planning of work and site layout.

2.2.8 *Appropriateness of working space, its impact on smooth activity workflow and sequencing*

Overcrowded work sites may cause conflicts in the work process, which may result in the decline of the effectiveness of operators. The lack of appropriate working space and congestion on the site can contribute to the slow progress of work.

2.2.9 Implications upon trade coordination

Congestion on site may lead to difficulty in the coordination of trades. During the process of planning work activities, mistakes might be made in the form of two different trade activities occurring simultaneously in the same work area with no space to work. This may lead to a delay in the project.

2.2.10 Appropriateness of design tolerances

Trigunarsyah (2007) posits that constructability will be enhanced when owner, designer, and constructor personnel review the construction specification in detail. The major factor to note during off-site fabrication is the provision of allowances for on-site fixing. In situations where the tolerance provided is not appropriate, two steps might be taken: re-fabrication or forging to allow for appropriateness. These two activities require time which is additional to the initial estimated period and may constitute delays when there is a large volume of such work. Arditi et al. (2002) suggest that faulty working drawings and incomplete specifications are the major constraints relative to constructability of designs.

2.2.11 Impact of materials storage and movement

Materials should be available when required in order to enhance production or maintain a constant production level. Storage for materials should be away from production points, but not too far. Interruptions of the smooth activity workflow and activity sequencing may negatively affect production levels when storage places are close to the production area. Activity sequencing is the particular arrangement of activities in such a way that the activities are executed chronologically without delay and the construction team can meet the completion deadline. When activities on a critical path of a project are disrupted, the project is bound to take longer than estimated to complete. Congestion on site is one factor that constrains adherence to activity sequencing. Sites should be well laid relative to movement of materials.

2.3 Quality of management during design

Project success is dependent on inter alia, the performance of the design team. Defective designs adversely impact on project performance and the participants and are responsible for many construction failures (Andi and Minato, 2003). Failure at the conceptual planning and design stages may lead to significant problems in successive stages of the project. Design inefficiencies could lead to redesign and rework or poor quality of products. Oyedele and Tham (2006) provide a listing of clients' ranking of designers' performance criteria among which were those that relate to quality of design coordination, smooth flow of work, vis-à-vis conflicting design information, timeliness of issuing of revised drawings, missing information, dimensional inaccuracies as well as delay of release of shop drawings.

2.3.1 Conflicting design information

Acharya et al. (2006) declare that ambiguous specifications are one of the six critical construction conflicting factors in the Korean context that affect project delivery time negatively. This refers to an item having double representation either in numerical value or in statement. For clarity and smooth flow of work, designs should be checked more than once before they reach the contractor. It is also advised that designs should be checked by the contractor for clarity and to avoid ambiguity upon receiving the award. If these exercises are not conducted, it may lead to delays.

2.3.2 Timeliness of issuing of revised drawings

According to Yakubu and Sun (2009), design change(s) is the most influential factor inhibiting the delivery of projects on time in the United Kingdom construction industry from the perspective of the contractor and the consultants. Walker and Shen (2002) declare that a delay in design documentation was ranked the second most influencing factor that negatively affects project delivery. Time should not be wasted in the process of issuing revised drawings. The joint contract tribunal (JCT, 2005) specifies that revision of drawings should not take more than three days after which the contractor can claim for extension of time.

2.3.3 Missing information

Andi and Minato (2003) say that poor design and documentation quality negatively affect the construction process. Alaghbari et al. (2007) identify incomplete documents as one of the top ten factors causing delay in the delivery of projects in the Malaysian construction industry. Missing information interrupts the smooth flow of work. Contractors are employed to build in such a way that they adhere to design and specification. Assumptions should not be made while constructing, therefore missing information should be brought to the notice of the designer and a quick response should be given to address this.

2.3.4 Dimensional inaccuracies

Walker and Shen (2002) say that mistakes in design form part of the contractor-related factors which were ranked second in contributing to delays in the delivery of projects. Acharya et al. (2006) determined that design errors are one of the six critical construction conflicting factors in the Korean context. Dimensional inaccuracies are to be brought to the notice of designers and these should be resolved promptly, to avoid delays in the delivery of project. Joint Building Contract Committee (JBCC, 2000) clause 17.1.2 bestows the responsibility on the principal agent to issue the contractor instructions with regards to the rectification of discrepancies, errors in description or omission in contract documents other than this document.

2.3.5 Expediting shop drawings

Out of forty-four causes of delays identified by Faridi and El-sayegh (2006) in the United Arab Emirates, preparation and approval of drawings is the most influential. Delay in the release of shop drawings could affect speedy completion of work sections. Shop drawings should be delivered to the contractor whenever the need arises with no delays. Clause 32.5.1 of the JBCC states that the failure to issue or the late issue of a contract instruction following a request from the contractor entitles the contractor to claim for the expense in loss incurred, having notified the principal agent within forty working days from becoming aware or from when he / she ought reasonably to have become aware of such expense and loss.

3 Research Methodology

This section describes the procedure for data collection and the survey techniques used in the study. The study is titled influence of constructability and quality of management during design was undertaken to identify and assess factors influencing project delivery time. The study was conducted in Port Elizabeth in South Africa. The sample frame for the practitioners are: architects 1149 (SAIA); master builders 320 (MBA); clients 161 SAPOA); structural engineers 43 (CESA - East Cape), and quantity surveyors 473 (ASAQS). The sample consisted of industry practitioners who are: architects (9), master builders (18), quantity surveyors (23), and structural engineers (23), clients (12) and others (3).

Probability sampling technique was employed for sample selection, having calculated sample size based on the sample frame. Random sampling technique was employed for all professionals except the quantity surveyors and structural engineers. Systematic sampling techniques was used for the quantity surveyors, and for the structural engineers the entire sample, because they are few, based on the recommendation of Leedy and Omrod (2005). The study research instrument was a questionnaire survey, which was administered to respondents through post (Architects, MB, Structural engineers, and others) and e-mail (Quantity

Surveyors). These were received through the same means. Cronbach's coefficient test and validity test were performed and were found satisfactory. Cronbach's alpha of ≥ .97 and factor loading of >.60 for samples sizes 85-89 were obtained.

A total of eighty-eight (88) questionnaires representing 6.1% response rate achievement recorded on questionnaire administration. Simple statistical tools such as mean score, percentages and so on were used for data analysis.

A five-point Likert scale adjoined with 'Unsure' and 'Does not' options was employed to analysis summated scores of the respondent's responses. Given that there are five points on the scale, and that 5 – 1 = 4, the ranges were determined by dividing 4 by 5 which equates to 0.8. Consequently the ranges and their definitions are as follows:

- > 4.20 ≤ 5.00 between a near major to major / major influence;
- > 3.40 ≤ 4.20 between moderate influence to a near major / near major influence;
- > 2.60 ≤ 3.40 between a near minor to moderate influence / moderate influence;
- > 1.80 ≤ 2.60 between a minor to near minor influence / near minor influence, and
- > 1.00 ≤ 1.08 between a minor to near minor influence.

Most of the respondents belong to the private sector (74%), their average working years is 17, and over the age of thirty (300. Respondents with Bachelor's degree 25% predominate, and respondents have handled not less than six (6) types of projects. Based on these, data can be deemed reliable.

4 Findings and Discussion

4.1 Constructability of design

Table 1. The influence of constructability factors on project delivery time

Factor	**Response (%)**								
	Unsure	**DN**	**Minor.............................Major**					**Mean score**	**Rank**
			1	**2**	**3**	**4**	**5**		
Participation in site inspection and control	3.8	2.5	1.3	7.5	18.8	27.5	38.8	3.86	1
Knowledge of performance of materials and components	4.7	1.2	3.5	10.5	18.6	38.4	23.3	3.62	2
Appropriateness of working space. Its impact on smooth activity workflow and sequencing	2.4	2.4	2.4	11.8	27.1	27.1	27.1	3.56	3
Effective constructability review of design	7.1	2.4	3.6	10.7	25.0	29.8	21.4	3.44	4
Impact of materials storage and movement	3.5	0.0	7.1	7.1	32.9	34.1	15.3	3.42	5
Implication upon trade co-ordinations	8.4	3.6	1.2	8.4	28.9	32.5	16.9	3.40	6
Appropriateness of design tolerances	7.1	1.2	6.0	15.5	21.4	34.5	14.3	3.29	7
Extent of modular dimensions in design	11.6	3.5	4.7	14.0	23.3	29.1	14.0	3.17	8
Complexity of off-site fabricated components	14.1	4.7	4.7	14.1	15.3	32.9	14.1	3.16	9
Scope of site fabrication	21.2	2.4	4.7	11.8	22.4	27.1	10.6	3.09	10
Extent of grouping simultaneous	12.9	3.5	4.7	11.8	32.9	24.7	9.4	3.05	11

Table 1 presents respondents' rating of the influence constructability of design factors have on project delivery time. It is observed that all factors in the category have MSs > 2.60 ≤ 3.40, which indicates that these factors have between a near minor to moderate / moderate influence on project delivery time.

The most significant of these factors is the scope of site fabrication. One of the quickest ways of identification and correction of problems on site is the participation of the project team during site inspections. Owing to the large pool of knowledge available when the project team is involved in inspections, their wealth of experiences and knowledge provide a platform for immediate solutions to identified problems on site, and therefore engender processes that minimises or eliminate project delays.

The next factor is knowledge relative to the performance of materials and components. In the instance that a project manager or a contractor lacks adequate knowledge of material and component performance, it implies that when a material is not available for construction purposes the project will have to stop until such time that it would be available because alternatives cannot be suggested as a result of lack of knowledge of material performance.

The third most significant factor is the appropriateness of working space. When the space available on site to carry out construction tasks is limited, it adversely impacts the smooth flow of activities and reduces the number of activities that can be done at any time. Where the working space is adequate numerous activities can be carried out simultaneously, thereby increasing the rate of building. All of these factors agrees with Trigunarsyah (2004) stated factors for consideration during design and construction of a project relative to constructability issues.

The least significant factor in this category is the extent of grouping simultaneously. This factor is most effective relative to electrical installations. When comparing other sections of work with the impact this factor could have in speeding up work, it is negligible. Therefore, on the average, it could be deemed that it has a negligible effect on project delivery time.

4.2 Quality of management during design

Table 2. The influence of quality of management during design factors of project delivery time

Factor	**Response (%)**								
	Unsure	**DN**	**Minor..............................Major**					**Mean score**	**Rank**
			1	**2**	**3**	**4**	**5**		
Conflicting design information	2.3	1.2	13.8	9.2	23.	24.	26.4	3.36	1
Missing information	1.2	2.3	11.6	15.1	25.6	20.9	23.3	3.22	2
Timeliness of revised drawings	8.1	1.2	14.0	12.8	23.3	21.0	19.8	3.17	3
Expediting shop drawings	5.8	4.7	14.0	18.6	18.6	29.1	9.3	2.84	4
Dimensional inaccuracies	2.3	3.5	20.9	12.8	32.6	11.3	16.3	2.78	5

Table 2 presents the respondents rating regarding the influence of quality of management during design, on project delivery time. All factors in this category have MSs > 2.60 ≤ 3.40, which indicates that these factors have between a near minor to moderate / moderate influence on the project delivery time.

The factor that has the most significant influence in the category of quality of management during design is conflicting design information, this corroborates with Shehu and Endut, (2013) finding. The probable reason for this is the process it will take to correct a mistake. It may require checking the design from the beginning, which may take longer than expected. The second most significant factor is missing information. This factor also agrees with Chan and Kumaraswamy (1998) finding of waiting for information. This factor may lead to delays as a result of carelessness or incompetence in design. Missing design information will inhibit the smooth flow of operations on site, therefore introducing delay to the scheduled project completion date.

The least significant factor in this category is dimensional inaccuracies. Although this factor is the least influential in this category, it does not imply that its effect is negligible because of the time it takes to clarify inaccuracies may result in delay in the delivery of the project.

5 Conclusion and Further Research

Conclusion to this study is in two parts, relative to influencing factors of constructability and quality of management during design on project delivery. With respect to influencing factors of constructability: that appropriateness of working space may negatively impact on the smooth activity workflow and sequencing, non-effective constructability review of design leads to revisions and time wastage, which negatively affects project delivery time, and materials shortage adversely affects project delivery.

Relative to influencing factors of quality of management during design, conflicting and missing information adversely affect project delivery time.

Based on the conclusion reached in this study, it is evident that the non-effective conduction of constructability reviews of design may lead to conflicting and missing of information, and inaccurate dimensional coordination of designs information, that could engender delay in the delivery of project. Therefore, it is suggested that the construction industry should provide quality management guidelines and should be enforced by consultant on projects. Stakeholders relative to design should be committed to quality management during designer. Designers' quality management should focus on the following:

- Committed to providing a quality service;
- Production of correct and complete drawings and specifications;
- Coordinating and checking of design documentation;
- Conducting design verification through design analysis reviews, and
- Conducting constructability reviews.

It is hereby recommended that further study be conducted on the extent of constructability reviews on design and quality of management during design

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7 References

Acharya, N.K., Lee, Y.D. and Im, H. M. (2006) Conflicting Factors in Construction Project: Korean Perspective. Engineering, *Construction and Architectural Management, 13(6), 543-566.*

Alaghbari, W.; Razah, M.; Kadir, A; Salim, A., and Ernawati,. (2007) The Significant Factors Causing Delay of Building Construction Projects in Malaysia. Engineering, *Construction and Architectural Management. 14 (2), 192-206.*

Andi and Minato, T. (2003) Representing Causal Mechanism of Defective Designs: A System Approach Considering Human Errors. *Journal of Construction Management*

and Economics, 21, 297-305
Arditi, D; Sikangwan, P.; and Tokdemir, O. B. (2002) Scheduling System for High Rise Building Construction. *Construction Management and Economic. 20(4), 353-364 (12)*
Assaf, S.A., Al-Khalil, M. and Al-Hazmi, M. (1995) Causes of Delay in Large Building Construction Projects. *ASCE Journal of Management in Engineering, 11(2), 45-50*
Assaf, S.A. and Al-hejji, S. (2006) Causes of Delay in Large construction Projects. *International Journal of Project Management, 24(7), 349-357*
Chan, D.W.M. and Kumaraswamy, M.M. (1997) An evaluation of construction time performance in the building industry. *Journal of Building and Environment, 31(6), 569-578.*
Faridi, A.S. and El-Sayegh, S.M. (2006) Significant Factors Causing Delay in the UAE Construction Industry. *Journal of Construction Management and Economics, 24, 1167-1176*
Kaming, P.F., Olomolaiye, P.O., Holt, G.D., and Harris, F.C. (1997) Factors Influencing Construction Time and Cost Overruns on Highrise Projects in Indonesia. Journal of *Construction Management and Economics, 15(1), 83-94.*
Leedy, P. D. and Ormrod, J. E. (2005) *Practical Research: Planning and Design*. 8th Ed. New Jersey: Pearson Prentice Hall.
Long, L.H., Lee, Y.D. and Lee, J. Y. (2008) Delay and Cost Overruns in Vietnam Large Construction Projects: A Comparison with Other Selected Countries. *Journal of Civil Engineering, 12(6), 367-377.*
Mbamali, I., Aiyetan, A.O. and Kehinde, J.O. (2005) Building Design for Buildability: An Investigation into the Current Practice in Nigeria. "*Building and Environment V" South Africa, 40, 1267-1274*
Niazai, G.A. and Gidado, K, (2012) Causes of Project Delay in the Construction Industry of Afghanistan. *3rd EPPM International Conference of Engineering, Project, and Production Management, Held on the 10 Sept. – 11 Sept. at the University of Brighton, UK, 63-74.*
Ogunlana, S.O., Promkuntong, K. and Jearkjirm, V. (1996), "Construction Delays in Fast-growing Economy: Comparing Thailand with other Economies". *International Journal of Project Management, 14(1), 37-45.*
Oyedele, L.O. and Tham, K.W. (2006) Clients' Assessment of Architects' Performance In Building Delivery process: Evidence from Nigeria. *Building and Environment, 42(5), 2090-2099.*
Shehu, Z.; Endut, I.R., and Akintoye, A. (2014) Factors Contributing to Project Time and hence Cost Overrun in the Malaysian Construction Industry. *Journal of Financial Management of Project and Construction, 19(1), 55-75.*
Trigunarsyah, B. (2007) Project Designers' Role in Improving Constructability of Indonesian Construction projects. *Journal of Construction Management and Economics Vol 25: 207-215.*
Walker, D. H. T. and Shen, Y. J., 2002. Project Understanding, Planning, Flexibility of Management Action and Construction Time Performance: Two Australian Cases Studies. *Construction Management and Economics, 20, 31-44.*
Yakubu, A. O. and Sun, M. (2009) Cost Time Control Construction Projects: A Survey of Contractors and Consultants in the United Kingdom (UK). *Construction Information Quarterly, 11 (2), 52-59.*
Yates, J. K. and Battersby, L. C. (2003) Master Builder Project Delivery System and Designer Construction Knowledge. *Journal of Construction Engineering and*

Management, 129(6), 635-644.

WOMEN HEALTH AND SAFETY IN CONSTRUCTION INDUSTRY

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Abstract
The research investigates the impact of ergonomics on health and safety of women in the construction workplace. Increased participation of women in the construction industry has been observed over the century. However, recent trends reveal a decline in women participation in the construction industry. Women participation in the broader economy is associated with economic growth. The argument makes a strong case for an investigation into women health and safety status and its impact to the construction industry. A quantitative study was done to give the discussion a local perspective with the objective to assess the impact of materials and tools handling over the health and safety status of women. The study surveyed a representative sample of 60 women found in 11 construction sites in Klerksdorp. Descriptive and inferential statistical tools were employed using the SPSS program to analyze the data and reach the study's conclusion. The research found that the women construction workforce is unhealthy and significant influence poor work ergonomics. The status quo impedes women's participation in the construction industry worsening the outcomes of poverty, unemployment and inequalities. The study concludes that health and safety education (HSE) programs need revamping to focus on long term goals that reduce health and safety outcomes for women. Progress made on tools and construction equipment design to improve work ergonomics has a limited impact without relevant HSE programs in place.

Keywords: Construction, Ergonomics, Health and Safety, Women, Workforce

1 Introduction

Ergonomics of the construction sector invokes the notion that construction work demand must not exceed the capacity of workers. Exceeding the capacity of workers has negative consequences for the health and safety of the workers. The negative consequences are severe particularly for women construction workers whose social burden is higher in the South African social context were 62% of households are women ran (Statistics South Africa (2014). This study investigates the effects of health and safety of women in construction industry. The global participation of women in the construction sector over the century has been observed to have risen according to U.S Bureau of Labour Statistics (2012) and locally confirmed by the South African Statistics of labour (2014). The increased participation of women construction workers in the construction sector and economies has also been linked to the economic progress of countries (IMF, 2010). However current global and local trends do show a decrease in the participation of women (Plascon, 2012). Part of the change in trends is explainable through the recent global recession and the post-world cup decline of the construction sector of South Africa. Empirical evidence suggests that a significant part of the decline in women construction worker participation is also linked to bad ergonomics and the subsequent poor health and safety outcomes. OICI (2003) argued that construction work demands tremendous physical input to do the job. Schneider & Susi (1994) had also proffered that construction work is problematic for ergonomics as it involves handling of materials and tools which may not been suited for women.

Furthermore, the construction sector in South Africa is going through a recovery (Plascon, 2012). If this recovery is to be deepened towards economic inclusivity, ergonomics of the construction workplace particularly for women must be actively managed to obtain positive outcomes of health and safety. IMF (2012) associates women participation in the economy to the economic growth of a country. South Africa has launched the national blueprint National Development Plan (NDP2030) which hinges its success on the attainment of inclusive economic growth. The findings of this study would aid the efforts. This studies hypothesized that active management of the impact of construction workplace ergonomics positively influences women participation and subsequent productivity. Productivity and participation of women in the construction sector has positive outcomes for the economic growth of the country and in turn better outcomes of poverty, unemployment and inequalities.

2 Literature Review

Construction work is a problem for women as it involves handling of materials and tools which may not been suited for women (Schneider and Susi, 1994). According to Gibbons and Hacker, (1999) numerous construction tasks pose significant ergonomic risks to women workers. According to Safety and Health (2002), in 1999 the Bureau of Labor Statistics Advisory Construction Committee on Safety and Health found productive hazards ,ergonomic concerns, lack of adequate sanitary facilities, hostile workplace culture and ill-fitting personal protective equipment (PPE) and clothing as compassing issues in construction sector for women.

Kaminskas and Antanaitis, (2010) argue further that the high physical work demands are considered the primary risk factor for work-related injury disorders. In particular, the manual handling of materials in different awkward postures increases the risk of women injury disorders (Marras, 2000). Injury disorders cause sickness and decreased work capacity, thereby increasing the costs for trade site and interfering in social security systems on a national scale. Worldwide, the prevalence of muscle and tissue injury symptoms involving one or more body regions and occupational injuries among women bricklayers and bricklayers' assistants is higher than it is among construction workers in general. Interventions into the physical work demands placed on these workers are necessary in order to reduce the risk of injury disorders (Goldsheyder, 2002, Chau, 2004 & Rwamamara, 2006).

Recent studies had shown that to reduce work-related muscle and tissue disorders, tools, materials, and equipment should be designed based in part on ergonomic considerations (Schneider,1994).Tools and equipment are often designed to be used by normal sized men. Do not make hand tools for women, and women have different sizes, just like men (Morse & Hinds, 2000). OSHA, (1999), noted that designing equipment and tools to help women work more effectively can improve the health and safety of both men and women in construction workplace and points to the invention of a tool to lift manhole covers as one illustration of this. For women it was really difficult to lift them, but it was also very physically challenging for men. In this case, if we are concentrating on protecting women, we are also securing the entire construction workplace (NSC, 2010).

Women's size and body require reconsideration of methods for lifting and handling material. Not only that woman come in all sizes and with various degrees of muscular strength, but their pelvic structure is different and their Centre of gravity is lower than men's. This would impact jobs that require standing at a work station. Lower equipment handles would facilitate the use of body weight in pushing and pulling jobs. Women's muscular strength is more equal to men's in their legs. Women will have more equal footing with men if the work load could be moved downward, with less confidence on the strength of hands and arms (OSHA, 1999). Women tend to have less upper body strength than men; they cannot use all of the methods men use for lifting and handling material. Out of necessity, construction women have to develop ways that make the job possible and safer for a woman. Personal protective equipment is intended to protect workers from hazards on the job. But PPE cannot perform normally if it does not fit properly. According to the 1999 report of OSHA’s Health and Safety of Women in Construction workgroup and the Advisory Committee on Construction Safety and Health, ill-fitting PPE was a major problem for women in construction workplace. As surveyed and reported on PPE, women in construction used to wear multiple pairs of socks to fit into work boots designed for men, and women also used to roll up sleeves and hind legs on overly large protective clothing. Ever since 1999 report of OSHA`s, the issue of properly fitting personal protective equipment has been generally acknowledged (NSC, 2014).

Ergonomic risk factors are characteristics of a job that facilitate ergonomics stress on the body (Miosha, 2010). Risk factors occur at different jobs and tasks. The more women are exposed to these risk factors the greater the probability of ergonomics injury and what is called work related musculoskeletal disorders .According to Hagberg et al. (1995), ergonomics and human factors are often used interchangeably in workplaces. Both describe the interaction between the worker and the job demands. The difference between them is ergonomics focuses on how work affects workers, and human factors emphasize designs that reduce the potential for human error. Bongers et al. (2002) stress that by addressing traditional and environmental risk factors, it can keep workers injury free. Risk factors are defined as actions or conditions that increase the likelihood of injury to the musculoskeletal system. Applied ergonomics literature recognizes a small set of common physical risk factors across many occupations and work settings. The relationship between risk factor exposures and the level of musculoskeletal injury risk is not easily defined. Although physical risk factors are important first-line risk factors, there are other plausible factors such as organizational and psychosocial factors that may provoke a disorder or indirectly influence the effect of physical risk factors (Bongers et al., 2002).

Bongers and Kremer (2002) went on to identify the three categories of risk factors as biomechanical exposures, psychosocial stressors and individual risk factors. Biomechanical exposures include factors such as poorly designed workplaces and biomechanical exposures such as repetitive motion, high forces and deviations from neutral body alignments (National Research Council & the Institute of Medicine, 2001). Psychosocial stressors at work include factors such as high-perceived workplaces stress, low-perceived social support, low perceived job control, and time pressure (Bongers and Kremer, 2002; Huang et al., 2003). Individual factors include gender (female), age, negative stress reactions-especially stomach reactions, and unsatisfactory leisure time and/or additional domestic workload.

Williams and Wiehagen (2004), argue that although the causes of any particular case of a MSD are exceedingly difficult to identify with complete accuracy, certain risk factors are typically discussed in the field of ergonomic studies. Musculoskeletal disorder is a condition or disorder that involves the muscles, nerves, tendons, ligaments, joints, cartilage, or spinal discs. These disorders are not typically the result of a distinctive, singular event, but are more gradual in their development. Thus, MSDs are cumulative-type injuries. It is essential to understand just what a risk factor is, or what is not. A risk factor itself is not necessarily a causation factor for any particular MSD. Many times it is not simply the presence of a risk factor, but the degree to which the risk factor is expressed that may lead to MSD. Similarly, to the extent a MSD case is attributable to a risk factor, often it will be a combination of multiple risk factors, rather than any single factor, which contributes to or causes an MSD. The next section discusses the methodology adopted to investigate the effects of the health and safety outcomes to the construction industry in the context of this study.

3 Research Methodology

Data was collected from a sample of 60 women construction workers around construction sites found in the Klerksdorp town. Questionnaires were administered to willing participants. Response rate was maintained at 100% as the sampling design was designed to continuously visit construction sites until 60 willing participants were reached as the targeted sample. However, the researcher recorded all attempted and failed access to sites in addition to sites that did not have women these had implications on the study. The implication on the study is apparent 5 sites out of 11 sites visited had no women as construction workers: suggesting a significant strained women participation in the construction sector. The data collected were tabulated into SPSS and analysed. The likert scaled questions were checked for internal consistence using the Cronbach's alpha analysis.

The questionnaire was divided into three sections. One section is for the demographic data of the sample. The other two sections profiling the workplace ergonomics of the sample proceeded from the anchor questions that sought to establish the health and safety status of the sample prior to joining the construction sector and after engaging with the tasks of the construction workplace. The analysis work sought to establish whether the health and safety outcomes had substantial linkages with workplace ergonomics of the sample and what statistical conclusions regards the participation and productivity of women can be made between the ergonomics profiles and the health and safety outcomes. In the process reveal the impact of ergonomics on the sample.

4 Data collection

The data obtained in this research is based on the primary sources as well as secondary Sources. Primary sources includes sampled women construction worker participants were the survey questions collected data on the impact of ergonomics on their health and safety, their attitude towards the contribution of their work environment to the problems. Primary data was sourced from the field of study through structured interviews. This study employed the interview technique, specifically the structured interview technique. A questionnaire was designed incorporating a mix of structured questions, open ended questions as well as in depth analysis questions. These were filled in by the interviewer with the information obtained from the face to face interviews with the participants from targeted construction sites. Additionally the researcher was able to observe and record site specific data concerning the working environment for women working at the construction site. Secondary sources of data include the monetary and the fiscal policy statements from the Reserve Bank of South Africa and the Ministry of Finance respectively. The qualitative interviews also favour the explanatory and the exploratory research approaches which aided data collection. These interviews were completed in a space of three months.

Each interview took on average 20minutes. Responses were directly recorded on questionnaire through a local language interpreter. Each response was read backward for verification and confirmation of the responses given.

5 Summary and Research Findings

5.1 Demographics information

Age distribution was an important consideration as a crude indicator of women construction workers participation in current recovery. Any evening out of the age groups across the sample would suggest continued participation and inclusion of women in the construction sector. The age groups that are dominant can also suggest changes and the period when these changes took place. The 45 to 54 year age group represented majority of the sample women participants. The age distribution shows the impact of the World Cup and the preceding contraction. The generation that benefitted from the construction boom was more likely to be in this age group having joined as 34 year olds and less. The 25-34 age groups joined the construction sector during the depression but only the minority of the boom time employment for the same age group. The 11.4% composition in the random sample represents a 36% of the boom time employment of women in the construction sector may signal the recovery which is underway. These statistics can be enhanced to demonstrate the elasticity of women employment in the construction sector as the economies move from boom times to deeps. The 14% composition of the 25 to less age represents a possible 8% current recovery in the participation of women in the construction sector.

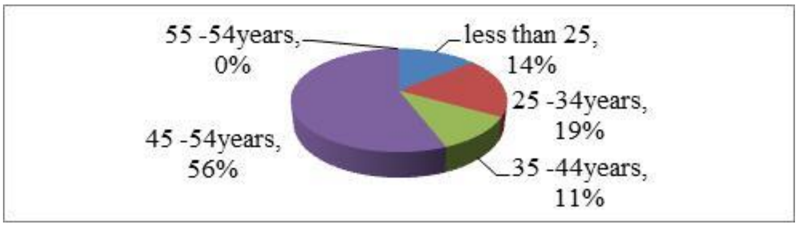

Figure 1. Age distribution

5.2 Health and safety outcomes

The impact of ergonomics of the construction workplace is apparent in the massive shift of health outcomes from the point of employment up to the point of the field work of this study.

Only 10% of the sample participants were nursing different illnesses under investigation in this study at the point of their employment in the construction sector.

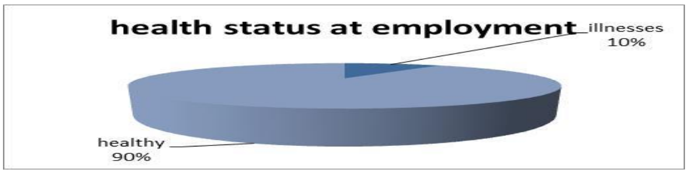

Figure 2. Health status at employment

At the point of the field study 72% had joined in with new illnesses with higher chance of having getting these illnesses from the ergonomics of the construction workplace.

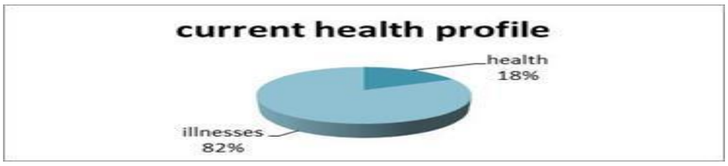

Figure 3. Current health profile

From a safety outcomes point view 56% of participants had been involved in some accident of some sort leaving them with different illnesses. For those who were involved in accidents none had been involved in similar accidents prior to joining the construction sectors.

Figure 4. Safety profile

If the impact of confounding factors such as aging and other diseases are factored in the figure is still excessive pointing to an unhealthy women construction workforce. These outcomes have a direct negative impact on women participation and subsequent productivity in the sector. The outcome partly explains why 5 out of 10 construction sites had no women employee. Negative health and safety outcomes amongst women employees of the construction sector are also driven by poor ergonomics according to literature. The literature review process for the study identified ergonomics risks in working postures, work surfaces, tools and equipment. These risks manifest in employees picking up ailments in different parts of their body depending on their assigned tasks. Active management of ergonomics by the employee, the construction company and any other stakeholder is paramount to the arrest of the negative effects for this socially important and burdened demographical group. The ergonomics profiles for the sample where investigated as follows:

5.3 Working Surface Causing Injuries

Participants mostly felt safe working on the ground as shown by a skew of the responses; to the left. The roof top was also considered safer with responses skewed to the left. The respondents were unanimous in the identification of risks with working on stair cases, scaffolds and on construction ladders. The study adds percentages from the sometimes vote, the often vote and the always vote, to give the risk factor for a particular working surface. This is illustrated below:

Sometimes1/2 (%) +often (%) +always (%) =Discomfort factor ( )

Never (%) + Seldom (%) +sometime1/2(%) =comfort factor ( )

Ergonomic Risk factor = decision between (-) risk factor & comfort factor

Table 1. Working surface

	Discomfort factor	Comfort factor	Ergonomic risk factor
Stairs	½(.10)+.267+55=**.867**	.4+.07+1/2(12)=**.013**	**-.867**
Ground	.3255	.6745	**.6745**
Ladder	.8745	.1255	**-.8745**
Scaffold	.767	.233	**-.767**
Roof	.3745	.6255	**.6255**
Perfect discomfort(-5)	**-3.2085(-64.17%)**		**-1.209 (-24%)**
Perfect comfort(5		**1.7915(35.83%)**	
deviation			**2.66**

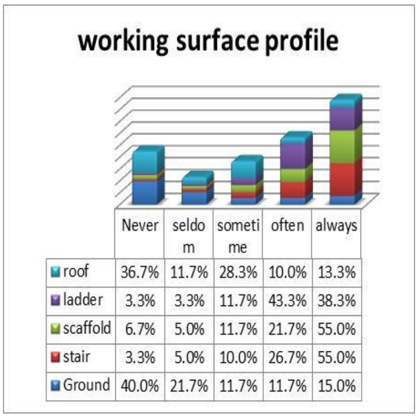

Figure 5. Working surface

The samples show a higher discomfort factor for an exhaustive list of the surfaces that women work in the construction sector. The findings show that 64% of the women were uncomfortable and at risk of either getting an injury or illnesses associated on this basic working surface with a 2.66 deviation on the downside. Six women construction workers in every ten were likely to come off worse by simply engaging in their daily tasks which involves working on the ground, the roof, stairs, scaffolds and construction ladders. The outcome puts pressure on women participation in the construction sector and subsequently negatively affects their productivity. This is further highlighted by the finding that out of the targeted sites 46% of the sites did not employ women. If out of 10 women construction workers 9 are going to end up with some ailment of some sort this place a dumper on the overall productivity in the sector and employers are likely to hold back on employing women. The recovery in the construction sector, therefore, risks the exclusion of women and may not result into an inclusive economic growth for South Africa.

5.4 Working Postures

The common work postures profile confirms a finding that identifies awkward postures, reaching away, lifting/bending, twisting/pulling, kneeling/holding and standing as the common risk factors for ergonomics in the construction work. The sample, however, reflects twisting and pulling not being part of the common task assigned to these women construction workers. The sample shows an almost perfect discomfort of 80.5% with the different postures required to complete the construction work tasks.

Table 2. Working posture

	Discomfort factor	**Comfort factor**	**Ergonomic risk factor**
Awkwar posture	½(.333)+.25+25=**.6665**	.05+.083+1/2(.333)=**.3335**	**-.6665**
Reaching Away	-.7165	.2835	**.-7165**
Lifting/bending	.-8335	.1665	**-.8335**
Twisting/ pulling	.-8415	.1585	**-.8415**
Kneeling/holding	.-7995	.2005	**.-7995**
standing	**-**.975	.025	**-.975**
Perfect discomfo(-6)	**-4.8325(-80.5%)**		**-4.8325(-80.5%)**
	Perfect comfort(6)		
		1.1675(19.6%)	
deviation			**0.06**

5.5 *Women Construction Worker Opinions*

There is a lack of consensus in the data in terms of whether these employees believe that tools, materials and equipment expose them to risks on their work places. An agreement factor of 57.5% does not put a convincing agreement amongst the sample participants as to the effect of these risk factors to their ergonomics. Most were neutral (undecided) as revealed by the tower in the middle. This outcome means the sample members had not been adequately educated so as to engage with their environment from a point of knowledge. Active management and engagement with the ergonomics risk factors in construction workplace has been found to cause a reduction in outcomes of health and safety. The finding went against literature findings that had proffered that the design of tools and equipment were heavily contributory the negative outcomes in the ergonomics of the construction workplace.

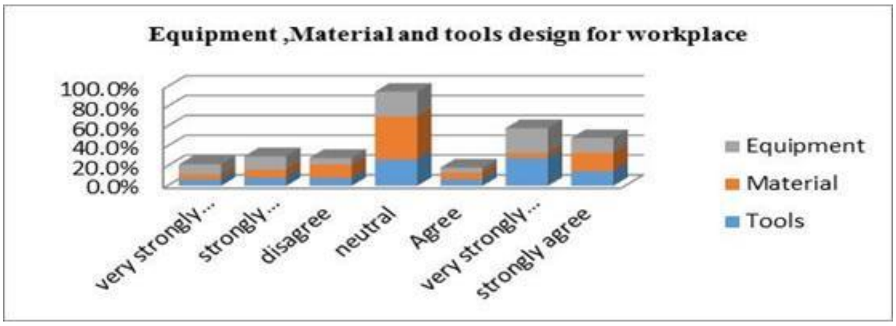

Figure 6. Equipment, material and tools

5.6 *Common Tools causing Injuries*

The data on common tools causing injuries shows a left skew on the responses suggesting that respondents do not find tools as causing harm to their health and safety. The problem with their workplace ergonomics is probably somewhere else. Crudely, the data suggests and confirms progress in the design of tools to actively manage ergonomics at the workplace. If such an outcome is held true attention then centres on ability of the workers to use the tools ergonomically. Tools recorded a comfort factor of 76.5% with a 0.01 deviation.

Table 3. Tools causing injuries

	Discomfort factor	**Comfort factor**	**Ergonomic risk factor**
Hammer/nail	½(.25)+.1+.83=**.-309**	.283+.283+1/2(.25)=**.691**	**-.691**
Pliers/screw driver	.2585	.7415	**.7415**
Hand saw/ hand drills	.-2085	.7915	**.7015**
Shovel/mixers	.-192	.808	**-.808**
Chisels/ trowel	.-2085	.7915	**.7915**
Perfect discomfo(-5)	**-1.177(-23.53%)**		**3.8235 (76.5%)**
Perfect comfort(5		**3.8235(76.5%)**	
deviation			**0.01**

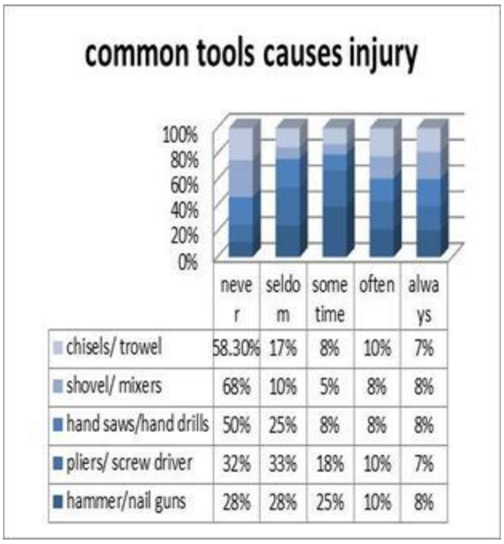

Figure 7. Tools causing injuries

5.7 Areas of Common Injury

Distribution of responses on the common types of injuries show a decisive right skew in line with literature findings that identified sprain/strain, neck/shoulder/back, hand/wrist and knee/foot/ankle as the common types of injuries arising from poor ergonomics of the construction workplace. An agree factor of 60% is decisive that these injuries are prevalent and still pause significant risks for their sample in the ergonomics of their workplace.

Table 4. Areas of common injury

	Discomfort factor	**Comfort factor**	**Ergonomic risk factor**
Sprain/ strain	½(.267)+.20+.167=**.-0.5005**	.117+.25+1/2(.267)=**.4995**	**-.5005**
Neck/back	.-2665	.7335	**.7335**
Hand/wrist	.-3755	.6245	**-.575**
Knee/foot/Ankle	.-459	.541	**-.541**
Perfect discomfo(-4)	**-.16015(-40%)**		**-1.209 (-24%)**
Perfect comfort(4		**2.3985(60%)**	
deviation			**0.9568**

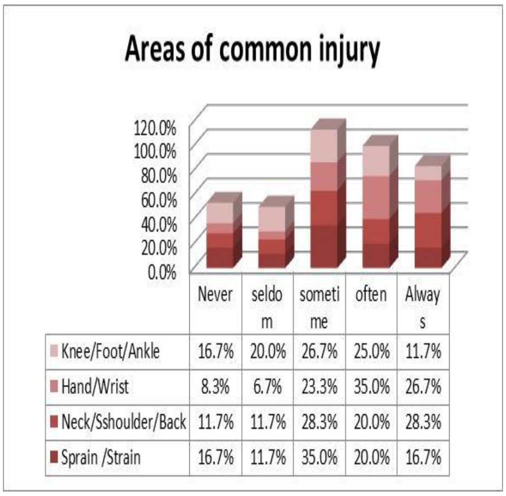

Figure 8. Areas of common injury

5.7 Construction Equipment causing injury

As confirmation of prior findings that participants do not find the design and their interaction with construction equipment in handling materials as resulting in significant risks for their health and safety, a 0.96 deviation and a decisive left skew with a higher (71.9%) disagree factor is found. While this result maybe evidence for progress in the design of the equipment for good ergonomics of the construction workplace, the higher outcomes for health and safety for the sample is still suggestive of problems regardless.

Table 5. Construction Equipment

	Discomfort factor	**Comfort factor**	**Ergonomic risk factor**
Crane	½(.172)+.18+.57=**.-0.836**	.067+.11+1/2(.172)=**.164**	**-.0.836**
Concrete pump	.-7915	.2085	**.7915**
Wheel loader	.-808	.192	**-.808**
Scaffolding/dumper	.-459	.541	**-.541**
Concrete mixer	-.7	.3	**-.7**
Perfect discomfort (-4)	**-.3.5945(-71.9%)**		**-1.349 (-33.7%)**
Perfect comfort(4		**2.3985(28.1%)**	
deviation			**0.96**

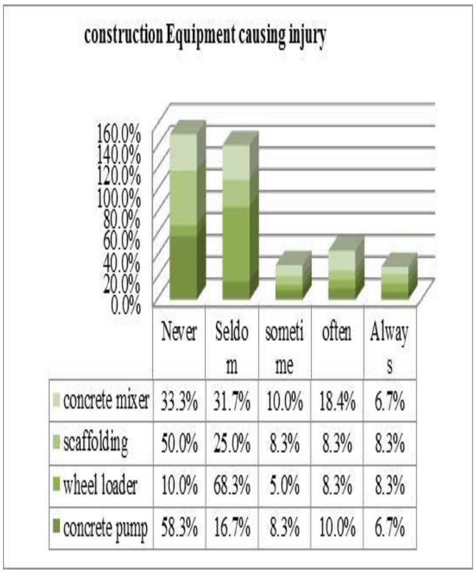

Figure 9. Construction equipment

6 Conclusion and Further Research

The study concludes that material handling in the construction sector still pause significant risks for women construction workers. The risks are having a negative influence on their productivity in the construction sector hence their participation has stayed very low. The findings are not consistent with a developing inclusive economy or a deep recovery in the construction sector. A divergent outcome for women and men emerges particularly when the sector is faced with headwinds. Women construction workers are far more severely affected by problems in the construction sector than their male counterparts. The situation is making a negative contribution to the social ills of poverty, unemployment and inequalities among women who seem to carry a larger social burden.

Sector wide efforts to curb the effects of material handling on women ergonomics include tools and equipment design, safety and health education and awareness programs to ensure active management of ergonomics. The study concludes that the design of tools and equipment is running in the right direction. HSE programs have, however, waned in their efficacy and require reinvestment and refocusing to target longer term objectives which secures participation and productivity for women in the construction sector. Without these programs coming on board to complement efforts elsewhere, the risks for women remain and the long term outcomes on women productivity and participation remain depressed to positively influence the economy and society.

The implications of these findings are that the inclusivity of the construction sector greatly impacts the inclusivity of the national economy. The construction sector contributes about 10% of the national GDP (Plascon, 2012). Current recovery in the construction sector runs the risk of excluding women construction workers if the negative impact of materials handling on work ergonomics for women workers are not actively managed to significantly reduce the associated risks. New and emerging construction companies must be convinced and even incentivized to make HSE investments. The sample could be enlarged and extended to increase the study’s utility. The impact of ergonomics on the health and safety of women construction workers would be better concluded on from the viewpoint of men construction workers, construction sector management and the women construction sector to give balance and rigor to the study. Future studies could be enhanced to investigate these key players as well by:

1. Enlarging the representation made in the study such that it could be generalized over the whole construction sector in South Africa under reasonable error margins.

2. The impact of ergonomics on the health and safety of women construction workers would be better concluded on from the viewpoint of men construction workers, construction sector management and the women construction sector to give balance and rigor to the study. Future studies could be enhanced to investigate these key players as well.
3. Further investigations maybe conducted to find the discrepancies between men and women on their exposure to accidents and the equipment putting them at risk of accidents.
4. The study could be enhanced by recording the number of HSE programs these workers were exposed to and investigating the relationship between health and safety impact and number of HSE programs attended.
5. This conclusion can be enhanced by removing any confounding factors in the women construction workers varying lifestyles but what the study finds is still catastrophic especially if generalized on the population of women construction workers in the country.

7 References

Jaffar, N., H, a. -t., Mohd- Kamar, I. F., and Lop, N. S. (2011). A literature review of ergonomics risk factors in construction industry. *The 2nd international building control conference.* www.sciencedirect.com.

James, T. A. (2007). ergonomics for construction workers. *National institute for safety and health (NIOSH).*

Plascon (2012). *The state of the South African construction Industry.* Gauteng: industry - insight-2nd quarter.

Schneider, S and Susi, P. (1994). Egonomics and construction: A reveiw of potential hazards in new construction. *American Industrial Hygiene Association Journal.* , 55 (7), 635-649.

US, BLS. (2012). Ergonomics Challenges for women construction workers. *Bureau of Labour Statistics, United States Department of Labour.*

William, S., and Marras, W.K. (2003). Ergonomics working for cement and concrete construction labourers. *Occupational and Industrial Orthopaedic Centre (OIOC).2003*.

The Occupational and Industrial Orthopaedic centre .(2003), NYU Hospital for Joint Diseases Orthopaedic Institute and Graduate Program in Ergonomics and Biomechanics 2003, ergonomics working for Heavy and Highway Construction Labourers.

IMF (2010). *World Economic outlook: a survey by the International Monetary Fund.* Washington, DC: IMF.

Statistics, S. A. (2012; 2014). *Quarterly Labour Force Survey.* Pretoria.

Creamer, M. (2015). *Construction 2015: A review of South Africa construction sector,* South Africa.

Bongers, M. P.; Kremer, A.; and Ter Laak, J (2002). Are psycosocial factors risk factors for symtoms and signs of the shoulder, elbow or hand/wrist? *A review of the epidemiological literature. American Journal of Industrial Medicine*, 41 (5), 315-342.

Gibbons, B. and Hecker, S. (1999). Participatory approach to ergonomic risk reduction: case study of body harnesses for concrete work. . *Second lnternational conference of CIB working commission W99 Implementation of safety and health on construction sites,* (pp. 373-380). Honolulu, Hawaii.

Hagberg, M. B., Silverstein, R., Wells, J., Smith, M. ., Hendrick, P., and Carayon, J. (1995). Work related muskelosketal disorders (WMSDs). *Taylor and Francis, Inc*.
Huang, G., Feuerstan, M. J., Kop, W. K., Schor, and Arroya, F. (2003). Individual and work organisation factors in work-related musculosketal symtoms. *American Journal of Industrial Medicine*, (43), 495-506.
Miosha. (2010). MIOSHA fact sheet construction safety and health division. *Ergonomics in construction*.
Occupatinal safety and health Administration (OSHA) (1999). Women in the construction workplaces: providing equitable safety and health protection . *Advisory Committee on construction safety and health (ACCSH).* Department of labour: OSHA.
Occupatinal safety and health Administration (OSHA) (1999). Women in the construction workplace . *providing equitable safety and health protection.*
Occupatinal safety and health Administration (OSHA) (2010). Protecting workers from Effects of heat (Extreme temperature). *http:// www.osha.gov*, *OSHA fact sheet*.
Rani, M. R. (2003). Managing ergonomics risk factors at workplace. *Paper presented at NIOSH 6TH National Conference and Exhibition on Occupational Safety and Health,.* Sunway, Pyramid Convention Centre, Petaling Jaya, Malaysia.: NIOSH.
William, J., Wiehagen, T., and Fred, C. (2004). *Ergonomics assessment of muskelosketal risk factors art Four Mines States.* Underground Coal, Surface Copper, Surface phosphate and underground limestone.

EVALUATION OF HEALTH AND SAFETY PLANNING PROCESS ON CONSTRUCTION SITES IN KADUNA METROPOLIS, NIGERIA

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Abstract
Workers are exposed to new hazards due to the changing nature of construction projects. When an integrated approach of good safety planning process is adopted accidents are prevented and the outcome is an assurance that the project delivery process will be safe. Hence, this paper evaluates the health and safety (H&S) planning process on active construction sites in Kaduna Metropolis, Nigeria. A survey research approach was used in the study. Forty-two active construction sites were visited for both the self-administration of structured questionnaires and personal observations. The study found that respondents considered factors such as the positioning of the access roads, the type of the project, the location of the project to highly influence health and safety planning at the pre-tender stage,. In addition, the study revealed that out of the 11 parameters measured to know the extent of health and safety planning put in place before the construction stage, eight can be deemed to support health and safety representative at management level. Based on the findings, it can be deduced that although all the factors affecting H&S are considered at the planning stage and H&S practices are highly applied on projects by the firms studied, high levels of accidents are still reported on construction sites. Further research is therefore required to match the frequency of accidents to factors considered and H&S practices applied during the project planning phase, to see whether significant results would be obtained.

Keywords: Accident, Construction sites, Health and Safety, Kaduna-Nigeria, Planning

1 Introduction

Construction workers lose their lives while others are injured on construction sites on an annual basis. Accidents happen daily which give rise to increase in death rate; in the year 2005, there were 4.2 million on the job non-fatal injuries and 5,702 fatalities recorded in the United States alone (Bureau of Labour Statistics, 2006; Bureau of Labour Statistics, n.d). The construction industry is known to be one of the riskiest industries in most countries (Edmonds and Nicholas, 2002). The fatalities recorded in developing countries such as Nigeria (see Windapo and Jegede, 2013) are worse than what exists in more developed countries due to lack of concern, precise records, inadequate planning and legal regulations on health and safety. Onyejeji (cited in Adeogun and Okafor, 2013) asserts that Nigeria lacks legal regulations on health and safety and that those regulations that serve as reference point are the British ones. This has however changed with the introduction of National Building Code in 2006; it should be noted that the adoption of this Code by the States in Nigeria has been very slow.

A report by the International Labour Organisation (ILO, 1999) states that contributing to the high rate of accidents are those characteristics of the construction industry, which distinguishes it from the rest of the manufacturing sector. These are: the number of small firms and of self-employed workers; the variety and comparatively short life of construction sites; the migrant nature of the workers leading to high turnover; and the vagaries of the weather. Others include a badly planned and untidy site, which is the underlying cause of many accidents resulting from falls of material and collisions between workers and plant or equipment.

Planning aims to lay down the direction in which a move is made forward taking into account the resources that are available. Planning used in the construction industry is varied and considerable e.g. policy planning, pre-tender planning, pre-contract planning and contract planning. Health and safety planning is found in all of these planning types. Health and safety planning according to Saurin *et al.* (2003) is *sine qua non* to the requirements in safety regulations and standards. In a related development Okongwu (2010) stated that when an integrated approach of good production planning and accidents preventive mechanism is adopted, the outcome is quality assurance of the project delivery process.

Cooke and William (2009) stated that without adequate planning, it would be difficult to envisage the successful completion of any project. The following are the reasons for planning: to set a realistic time framework for the project; to establish realistic standards and avoid wishful thinking; to aid control during the project; and to review progress and take action when necessary to correct the situation.

According to Burke (2010) a change in one parameter may change other parameters as planning process not only establishes what is to be done, but also smoothens the way to make it happen. To this extent, planning asks questions, encourages participation, creates awareness, prompt action, solves problems and formalizes decisions based on consensus. Alhajeri (2011) posits that improvement can be made on health and safety by seeking to address construction problems in many different ways as long as it interrogates the crux of the research efforts in health and safety in construction. The Malta Occupational Health and Safety Authority (2006) report that many accidents in the construction industry are due to bad planning lack of organization and poor co-ordination on construction sites.

In a related study, Laufer *et al*. (1993) points out that the planning process is an area that limited research has been carried out unlike planning tools and techniques; twenty-two (22) years on, has anything changed? It is with this in mind that this study evaluates the health and safety planning process on construction sites in Kaduna Metropolis of Nigeria towards understanding the health and safety practices on projects. Answers were sought to the following research questions:

- What are the factors considered during the pre-tender stage planning for health and safety?
- What is the extent of health and safety issues put in place during planning at the construction stage?

2 Health and Safety Planning Process Stages

Health and safety planning process can be looked at from three interrelated stages.

2.1 Pre-tender Stage Planning for Health and Safety

Site Safe (1999) states that pre-tender stage plan contains information about the health and safety hazards of the project that will have to be managed during the work. The purpose of this plan is: to bring germane health and safety matters of design to the notice of those that are directly concerned and to ensure that contractors tendering have adequate knowledge of the project's health, safety and welfare requirements.

Health and safety planning is largely dependent on the nature, scope and complexity of the project to be undertaken. In spite of this, answers will still have to be sought to the following questions during pre-tendering health and safety planning (Site Safe, 1999): What is the nature of the project in terms of location, the type of construction etc.? What is the site location and local environment like? Are there any existing drawings and what is the importance of the drawings in relation to the project? What is the extent of information that is available on hazards that are difficult to avoid? Will clients own activities disrupt the free flow of work during the project especially if the project is to take place within the client's environment?

2.2 Areas to be Checked and Action to be taken during Pre-construction Stage Planning for Health and Safety

According to Mulinge (2014), construction health and safety management deals with actions that managers at all levels can take to create an organizational setting in which workers will be trained and motivated to perform safe and productive construction work. Prior to the commencement of work, the following are to be in place in order to reduce the occurrence of accidents to their minimum. Primary factors considered during the preconstruction stage planning for H&S are location of the project; type of project (scope – high rise/low rise); complexity of the project; the local environment; design information available, relevant to H&S; client needs; and site access routes (see Table 2). In addition, the following provisions are made:

2.2.1 Personal Protective Clothing (PPE)

Occupational Safety and Health Administration (OSHA, 2007) requires the use of personal protective equipment (PPE) to reduce employee exposure to hazards when engineering and administrative controls are not feasible or effective in reducing these exposures to acceptable levels. If PPE is to be used, a PPE programme should be implemented.

2.2.2 First aid kits

Construction sites are dangerous places, and first aid and rescue equipment should always be available. What is needed depends on the size of the site and the numbers employed, but there should be a blanket and a stretcher. On large sites with more than 200 people are employed, there should be a properly equipped first aid room.

2.2.3 Safety warning signs

Safety signs and signals are one of the main means of communicating health and safety information. This includes the use of illuminated signs, hand and acoustic signals (e.g. fire alarms), spoken communication and the marking of pipe work containing dangerous substances. If too many signs are placed together there is a danger of confusion or of important information being overlooked (Health & Safety Executive HSE, 2009).

2.2.4 Safety training

Occupational Health and Safety training consists of instruction in hazard recognition and control measures, learning safe work practices and proper use of personal protective equipment, and acquiring knowledge of emergency procedures and preventive actions.

2.2.5 Safety audits

Safety audits are used for gauging the extent to which an organization's policies and procedures are being followed and how they might be improved. They provide the organization with feedback, which enables the organization to maintain, reinforce and develop its ability to manage and reduce risks.

2.2.6 Safety policy

Hassanein and Hann (2007) established that construction site accidents are more likely to occur when there are poor company policies. The health and safety policy affirmation must incorporate the aims, which are not quantifiable, and objectives, which are quantifiable of the organization. Construction safety policy therefore is something that must be developed by each site manager and operating company prior to starting construction on site.

2.2.7 Site meeting

Site meetings are used for sensitizing workers on health and safety procedures on site and should therefore be held frequently. The absence of site meetings implies that workers are not given a forum to learn about various risks on the sites and supervisors equally do not have opportunities to communicate important health and safety matters to the workers.

2.3 The Construction Stage Site-Specific Planning for Health and Safety

This entails the process of setting out the arrangements for securing the health and safety of everyone carrying out the work and all others who may be affected by it (Site Safe, 1999). The issues that are found at this planning stage include: the mechanisms for the management of health and safety of the site in terms of identifying hazards, evacuation, and frequent site safety checks; the evaluation and monitoring systems for checking that the health and safety plan is being followed.

In order to realize the above, the following questions should be answered:

- How should health and safety responsibilities for implementation on site be assigned?
- How should the various methods for hazard be identified?
- How should incident and accident investigation and reporting methods be carried out?
- What are the strategies for site meetings and information sharing?

3 Research Methodology

The study reported adopted a quantitative research approach, wherein a questionnaire survey was used for data collection. Collis and Hussey (2003) describe a survey as a positivistic methodology that draws a sample from a larger population in order to draw conclusions about the population. The non-probability convenience sampling technique was used in identifying the study respondents. According to Collins, Onwuegbuzie, and Jiao (2007) this is a sampling method that involves choosing from a sample that is not only accessible but the respondents are willing to take part in the study. The study was such that the respondents were asked questions based on the projects they were found handling during the self-administration of the questionnaires. This may explain why the responses obtained were limited to 42 and invariably 42 construction projects were examined. Hence, the unit of analysis was the construction project handled by each respondent. A unit of analysis according to Collis and Hussey (2003) refers to the phenomenon under study, about which data is collected and analysed. The data was analysed using descriptive statistics.

4 Findings and Discussion

The study sought to find out the level of experience of the respondents. Data collected in this regard is presented in Table 1.

Table 1. Years of experience of respondents

Years of experience	Respondents	Percentage
1-5years	21	50.0
6-10years	13	31.0
11-15years	5	11.9
16-20	3	7.1
Total	**42**	**100.0**

(Source: Field survey, 2015)

Table 1 indicates that 50.0% of the respondents have between 1-5 years of experience, 31.0% have between 6 - 10 years of experience, 11.9% of the respondents have between 11-15years of experience and 7.1% of the respondents have between 16- 20years of experience and above. Based on the result, 50% of the respondents had amongst them 6-20 years of experience in the construction industry; this is an indication that their responses can be deemed to be reliable as they should have the requisite knowledge of health and safety issues.

The study sought to know the factors considered during the pre-tender stage planning for health and safety. Table 2 shows the factors considered during pre-tender stage planning for health and safety on site, these were measured using a five point Likert scale with scores from 1= No Influence, 2=Little Influence, 3=Moderate High Influence 4= High Influence, 5= Very High influence.

Table 2. Factors considered during pre-tender stage planning for health and safety

S/N	Factors	NR	TS	MS	RANK	Decision
A	The positioning of the access or existing point	42	173	4.11	1st	Hi
B	The type of the project	42	165	3.93	2nd	HI
C	The location of the project	42	164	3.90	3rd	HI
D	The local environment	42	164	3.90	3rd	HI
E	The complexity of the project	42	161	3.88	4th	HI
F	Specific client needs	42	157	3.74	5th	HI
G	Existing planned design and information that cannot be avoided	42	149	3.55	6th	HI

Key: NR=Number of responses; TS=Total score; MS=Mean score; RNK=Rank; HI=High influence
(Source: Field survey, 2015)

The result presented in Table 2 reveals that from a ranking perspective, that an existing planned design and information that cannot be avoided or changed has the least mean score of 3.55 and was ranked 6th followed by the specific client needs ranked fifth with (MS of 3.74). Some of the other factors that received the highest consideration are: The complexity of the project ranked fourth with (MS 3.88), the location of the project and the local environment which ranked third with (MS 3.90), the type of the project ranked second with (MS 3.93), and the positioning of the access or existing point ranked first with (MS 4.11). Based on Morenikeji (2006) cut-off points, it can be concluded that all the 7 factors have high influence and are considered during pre-tender stage planning for health and safety on those construction sites studied.

Table 3. H & S Practices used at the pre-construction planning stage

Health and safety planning practices	NR	TS	MS	RANK
Making arrangements to control the level at which visitor access construction site to minimize accident	42	161	3.83	1st
Ensuring the competency of the subcontractors in providing suitable provision for safety	42	158	3.76	2nd
Making arrangement to pass on information regarding safety issues from the client or designers/ adviser to other subcontractors and employees	42	156	3.71	3rd
Obtaining and checking the site specific safety plans from subcontractors	42	153	3.64	4th
Developing and carrying out site specific health and safety planning process	42	151	3.60	5th
Ensuring that incident and accident are reported	42	151	3.60	5th
Developing a designated safety budget as part of the normal operating budget.	42	150	3.57	6th
Ensuring the arrangement for discussing health and safety matters with people on site	42	148	3.52	7th
Ensuring the coordination and cooperation of subcontractors for information and on site for safety	42	143	3.40	8th
Making sure that training for health and safety is carried out	42	143	3.40	8th
Making arrangement to monitor health and safety performance	42	141	3.36	9th

Key: NR=Number of responses; TS=Total score; MS=Mean score; RNK=Rank
(Source: Field survey, 2015)

The study found out that all documented H&S practices available to the researchers have a very high level of application on the construction projects examined with Mean Scores above 3.30 From a ranking perspective, making arrangements to pass on information regarding safety issues from the client or designers/ adviser to other contractors and employees was ranked 9th with (MS 3.36);, making sure that training for health and safety is carried out and ensuring the co-ordination and co-operation of subcontractors for information and on-site safety were ranked 8th with a mean score value of 3.40; ensuring the arrangement for discussing health and safety matters with people on site was ranked 7th with a mean score of 3.53.

In addition, making arrangements to control the level at which visitors' access construction sites to minimize accident; ensuring the competency of the subcontractors in providing suitable provision for safety; and making arrangements to pass on information regarding safety issues from the client or designers/adviser to other subcontractors and employees were ranked 1st, 2nd and 3rd respectively with mean score values of 3.83, 3.76 and 3.71. These findings are consistent with the results of earlier studies by - Okongwu (2010) who found that construction firms do not comply with health and safety provisions; Windapo and Jegede (2013) echoing the same thing stated that compliance level of indigenous construction firms in terms of health and safety policies and procedures was low; Alkilani *et al.* (2013) who established that there were inadequate training and education programmes; and Shibani *et al.* (2013) who report that workers are not trained and firms do not have safety officers which results in poor health and safety policies. In a related study, Jimoh *et al*. (2014) found that contractors' level of compliance regarding the provision of training and orientation on health and safety issues to workers in Ilorin-Nigeria was low.

Adapting one of the total quality management practices (commitment and leadership by top management at location) produced by the European Construction Institute as indicated in Harris and McCaffer (2005), it can be concluded that eight of the issues considered during the pre-construction planning stage for health and safety having mean score values greater than 2.50 are perceived by the respondents to support health and safety at the management level of all the construction firms studied. Conversely, the remaining three issues interrogated are perceived by the respondents to provide spasmodic support to health and safety during pre-construction planning due to their mean score values of 3.36 and 3.40 as shown in Table 3.

5 Conclusion and Further Research

The paper evaluates the health and safety planning process on construction sites in Kaduna Metropolis in Nigeria with a view to improving health and safety practices. Answers were sought to the factors that affect health and safety planning during pre-tender stage and the extent of health and safety planning put in place before the construction stage. The results showed that all the seven factors considered as the factors that affect health and safety planning during pre-tender stage, all had high influence on the planning process but the positioning of the access or exit point was ranked first with mean score of 4.11. In a related development, it can be concluded that eight of the issues considered during pre-construction planning stage for health and safety having mean score values greater than 2.50 are perceived by respondents to support health and safety at management level for all the construction firms studied. Conversely, the remaining three issues can be deemed to provide spasmodic support to health and safety during the pre-construction planning stage due to their mean score values of 3.36 and 3.40. Based on these findings, it can be concluded that accidents still happen on construction sites, despite the fact that construction companies consider all the factors affecting H&S at the planning stage and adopt appropriate H&S practices on projects during construction. Further research is therefore required that would match the frequency of accidents to factors considered during the project planning phase, and H&S practices applied during the project execution phase.

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7 References

Adeogun, B.K. and Okafor C.C. (2013). Occupational Health, Safety and Environment (HSE) Trend in Nigeria. *International Journal of Environmental Science, Management and Engineering Research*, 2 (1), 24-29.

Alhajeri, M. (2011). Health and safety in the construction industry: challenges and solutions in the UAE. Unpublished PhD Thesis. Coventry: Coventry University.

Alkilani, S.Z., Jupp, J. and Sawhney, A. (2013). Issues of health and safety in developing countries: A case of Jordan. *Australasian Journal of Construction Economics and Building*, 13(3), 141-156.

Bamisile, A. (2004). *Building Production Management*. Lagos: Foresight Press Ltd.

Bureau of Labour Statistics (n.d). Number of fatal work injuries, 1992-2005.

Bureau of Labour Statistics (2006). Workplace injuries and illnesses in 2005.

Burke, R. (2010). *Project Management Techniques*. South Africa: Burke Publishing.

Carter, G. & Smith, S. (2001). Construction safety risk: Improving the level of hazard identification. *Proceeding of European Safety and Reliability International Conference (ESREL 2001)*, Torino, Italy.

Collis, J. and Hussey, R. (2003). *Business research: A practical guide for undergraduate and postgraduate students,* 2nd edition. New York: Palgrave Macmillan.

Collins, K.M.T., Onwuegbuzie, A.J. and Jiao, Q.G. (2007). A mixed methods investigation of mixed methods sampling designs in social and health science research. *Journal of Mixed Methods Research,* 1 (3), 267-294.

Cooke, B. and William, P. (2009). Construction Planning, Programming and Control, 3rd Edition. Oxford: Wiley-Blackwell.

Edmonds, D. J. and Nicholas, J. (2002). The state of health and safety in the UK construction industry with a focus on plant operators. *Structural Survey,* 20(2), 78-87.

Fang, D.P., Xiea, F., Huang, X.Y. & Lic, H. (2004). Factor Analysis-Based Studies on Construction Workplace Safety Management in China. *International Journal of Project Management 22, 43-49.*

Harris, F. and McCaffer, R. (2005). *Modern Construction Management*, 5th Edition. Massachusetts: Blackwell Publishing.

Hassaneiin, A,G., and Hanna, R.S. (2007). Safety programs in Large-Size Construction Firms in Egypt. *Journal of Safety, Health and Ergonomics Research,* 4(1) 1-33.
Health and Safety Executive, (HSE).(2009).The Construction Intelligence Report. Available to download from: http://www.hse.gov.uk/construction/pdf/conintrep0405.pdf

International Labour Organisation (ILO, 1999). *Safety, health and welfare on construction sites: A training manual.* Geneva: ILO.

Jimoh, R.A., Ijigah, A.E. & Nuah, M. (2014). "Health and safety management practices level of compliance on construction sites in Ilorin Metropolis, Nigeria". *Proceedings of the International Conference on Infrastructure Development and Investment Strategies for Africa*, Livingstone, Zambia, 25th – 26th September pp. 229-241.

Kheni, N.A., Gibb, A.G.F. & Dainty, A.D.F. (2006). The management of construction site health and safety by small and medium-sized construction businesses in developing countries: a Ghana case study. *In:* Boyd, D (Ed.) *Proceedings of the 22nd Annual ARCOM Conference,* 4-6 September 2006, Birmingham, UK, Association of Researchers in Construction Management.

Laufer, A., Shapira, A., Cohenca-Zail, D. and Howell, G.A. (1993). Prebid and preconstruction planning process. *Journal of Construction Engineering & Management, 119(3),* 426-444.

Malta Occupational Health and Safety Authority (2006). *Code of Practice for the Construction Industry part 1.* Malta: Malta Occupational Health and Safety Authority.

Morenikeji, W. (2006). *Research and Analytical Methods (for Social Scientists, Planners and Environmentalists).* Jos: Jos University Press Limited.

National Occupational Safety & Health Information Centre (2006) Report of the National Occupational Safety & Health Information Centre, Geneva, Switzerland.

Okongwu, S.E. (2010). Effective safety and health planning on construction sites in Onitsha and Awka of Anambra State. Unpublished MSc thesis submitted to the Department of Building, Nnamdi Azikiwe University, Awka.

Onyejeji N., (2011), Nigeria Public Policy. Global Policy Brief, No 18, January 2011.
Saurin T.A, Formoso, C.T and Guimaraes, L.B.M. (2003). Safety and production: an integrated planning and control model. *Construction Management and Economics*, 21, 1-11.

Shibani, A., Saidani, M. and Alhajeri, M. (2013). Health and safety influence on the construction project performance in United Arab Emirate. *Journal of Civil Engineering and Construction Technology*, 4(2), 32-44.

Site Safe (1999). *Construction Safety Management Guide: Best Practice Guidelines in the Management of Health and Safety in Construction.* Wellington: Site Safe.

Windapo, A.O. and Jegede, O.P. (2013). A study of health, safety and environment (HSE) practices of Nigerian construction companies. *The Professional Builder*, 4(1), 92-103.

IMPACT OF ACQUISITION ON EMPLOYEE AND MANAGEMENT OPERATION – THE CASE OF EPCM ORGANISATION IN RSA

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Abstract
Merger and acquisition (M&A), an emerging trend within organization practice as preferred vehicle for expansion and enhancing company performance. Past research conducted shows that cultural fit and change management plays a significant role in M&A success. It further posited that high failure rate of Merger and acquisition results from companies failing to critically examine the ramifications of cultural fit and appropriate change process. This paper examines the impact of the acquisition of Engineering Procurement Contract Management South Africa (EPCM SA) by an international entity on the employees and management operations. The research objectives are to conduct a literature review to explore the existing knowledge about the impact of acquisitions on employees and management and an empirical study on the impact of EPCM SA’s acquisition on its employees and management. This paper draws on primary data from a sample of 300 employees of the newly formed entity through the use of self-administered questionnaire and data statistical in nature. Findings revealed that, acquisition negatively impacts employee’s job satisfaction, operation performance, resulting in large employee turnover. Further research is suggested in the areas of cultural bridging and whether the nature of an organisational culture influences the type of change model and the change process that are adopted for acquisitions.

Keywords: Acqusition, Cultural fit, Change process, Employee satisfaction, Merger

1 Introduction

In general, organisation seek merger and acquisition as the preferred vehicle for growth strategy and market competitiveness. According to UK Construction news (2000), the Egan Report (1998) is commended for driving M&A activity in the construction sector in the past two decades despite the effects of the global recession. Trend towards consolidation in construction businesses is growing stronger with notable high-profile UK acquisitions including Scott Wilson by URS, Eaga by Carillion, and Davis Langdon by AECOM.

According to Cartwright (2006:1-5), organisation in seek to increase their market share either through organic growth or by means of merger and merger and acquisition (M&A).In South Africa(SA),M&As emerged after the Post-post-apartheid era. This includes trends like hosting of the 2010 Soccer in South Africa. Construction activities i.e., modern stadia, roads and hotels that were constructed in preparation for the FIFA World Cup, resulted in numerous mergers in the construction sector. Prominently in the construction sector was strategic decision of Group Five South Africa to acquire Quarry Cats, a construction material business sector (Group5 annual review 2009:4). The intent of the acquisition was twofold: firstly, to increase the multiple margin stream baskets and secondly, to enhance the group performance (Group5, 2009). Bandrick and Karpaty (2010:211-224) state that researchers have mixed reactions to the effects of acquisitions. On the one hand, authors such as Conyon et al. (2000) argue that acquisitions lead to job losses and a cultural misfit within the acquired firms because the international entity tend to be less committed to the host economy's labour requirements. On the other hand, an alternative school of thought, as posited by Carrillo (2011), maintains that acquisitions strengthen the competitiveness of the acquired firm because it benefits from technology transfer, which in turn improves the management, operations performance, growth and profitability of the firm. Clearly, this contradiction needs further examination. Against the background of this contradiction, in the literature, it is important that managers and policymakers understand the effects of M&As on employees and business.

EPCM SA is of the concern that the acquisition by the international entity lacks full alignment of a proper acquisition procedure and strategic plan, which resulted in lack of commitment and productivity. For this reason, this study analyzed the impact of an international entity acquisition of Engineering Procurement Contract Management South Africa (EPCM SA).The main objective of the study is to assess the impacts of the acquisition of EPCM SA by an International entity on employees and management operations. However the study identities the following specific objectives which are: investigate the importance of cultural due diligence between the acquiring company and the target company; investigate if the transition was understood and owned by all the employees and evaluate the relationship between changes in the organisational structure and the management leadership style of EPCM SA.

The study however intends to answer the following specific research question:

(i) Is there any cultural relationship between EPCM SA and the International entity?

(ii) How was change communicated and managed during the acquisition process?

The authors adopt a triangulation research method approach for the study using a predefined group of 300 participants considered more appropriate for the study and a sample from various disciplines in the new entity. A self-administered questionnaire is adopted and data obtained is analysed using a descriptive and inferential statistics. The results of this study clearly reveals that M&A impacts negatively on cultural fit and change process, and if not critically examined by the parties concerned, it may impact on the success of the M&A. It is imperative that Leaders of organisation embarking on M &A within the construction sector need to take cognisance of cultural fit and change process required between two entities before embarking on M&A.

2 Theory and Practice of Mergers and Acquisition

In general, organisations worldwide seek to increase their market dominance and competitiveness through Merger and Acquisition, a growing strategy for organizations. It is critical and timely to identify key planning steps that will assist organisation leaders and companies' boards to achieve M&A success. There are four types of acquisitions, namely: horizontal, vertical; conglomerates and congeneric acquisition (Green and Cromley, 1982:359).

Different acquisition is used to achieve different objectives or strategies.

2.1 Types of acquisition

2.1.1 Horizontal acquisitions

This takes place to expand control over business activities in the same industry segment and leading to a simultaneous increase in market share and the elimination of competition. Horizontal acquisition gives higher edge over competition (Green and Cromley, 1982:539; Wesston, Chung and Siu, 1990:5).

2.1.2 Vertical acquisition

This occurs when a company acquires another company that is in different stages of its production operations (Weston et al., 1990:5). It can be further classified as backward and forward acquisition (Brealey et al., 2008:883).

2.1.3 Congeneric acquisition

This can be defined as acquiring a company that is in the same industry, but is neither in the same line of business nor a supplier or customer (Giltman, 2009:767). This occurs between two companies in unrelated lines of business (Brealey *et al*., 2008:883; Giltman, 2009:767).

2.1.4 Conglomerate acquisition

This is expansion by acquiring companies into new and different product lines (Green and Cromley, 1982:359). One of the objectives of a conglomerate acquisition is to reduce business risk by acquiring companies through diversification of its interest.

The authors view that the horizontal acquisition definition best describes the acquisition between EPCM SA and the international entity acquisition process. Hill et al (2003) document the following as reasons why organisations take part in Conglomerate acquisitions as: Increase market dominance, Overcome entry barriers, Increase diversification, Merger for risk spreading and defensive drivers.

2.2 Challenges Facing M&As

Hill et al. (2003) mention some of the inherent challenges of the acquisition process include: lengthy acquisition processes; integration difficulties; and inadequate evaluation of targets. Gilkey (1991) argues that the high failure rate of M&As is mainly because they are still designed with business and financial fit as the primary condition, leaving psychological and cultural issues as secondary concerns. Some studies have focused on identifying the specific reasons for the failure of mergers or acquisition, for example Gadiesh and Ormiston (2002) list five cause of acquisition failure as: Poor strategic rationale; Mismatch of cultures; Difficulties in communicating and leading the organization; Poor integration planning and execution; and Paying too much for the target company.

Giving the importance of aligning strategic planning policy to M&A strategy, it is crucial to ensure a diligent process between organisation strategic plan and M&A plan. Sinickas (2004) defines due diligence as where each party tries to learn all it can about the other party to eliminate misunderstanding and ensure the price is appropriate. The author’s view is that effective due diligence should be a comprehensive analysis of the target company’s entire business, not just an analysis of their cash flow and financial stability has traditionally been the case.

2.3 Impact of acquisitions

Bajaji (2009) argued that, the role of the Human Resources Department (HR) teams in acquisition integration is encapsulated in two sub-processes: The first sub-process enables the integration of people through culture-building exercises, communication and facilitation of learning. The second sub-process enables the integration of the human resource practices and processes through a combination of structures, reward systems, service conditions and policies on employee relations.

2.3.1 Employees

Froses et al. (2008) found that employee satisfaction during an acquisition depends on the strategy that is used during the integration process and whether the integration meets their standards or expectations solely depends on the level of their resistance to the change.

According to a survey conducted by Chambers and Honeycutt (2009 :17), an acquisition causes low morale among employees, which in turn leads to reduced levels of commitment. This further confirms Conyon et al. (2000) views on acquisition.

2.3.2 Management

Angwin and Meadows (2009) found that acquisitions have long-term effects and significant impact on executives who were hired after the acquisition, and a significant portion of the incumbent executives who departed after the acquisition left involuntarily. Krug and Aguilera (2005:121-151) attest that in the long run, acquisitions create long periods of instability in the target company's top management team.

2.4 Organizational culture and acquisitions

Culture is defined differently in various disciplines Robbins and Stylianou (2003) as: "A set of values that influence societal perceptions, attitudes, preference and responses." Mercer (2006:1365) indicates that cultural integration is aimed at shaping a new culture through mutual absorption and strengthening of the various cultural strains via effective communication. According to Froses et al (2008: 97-108), it has been observed that cultural integration is closely related to personnel issues and employee change is crucial in an organisational culture.

The post-acquisition culture must be determined in the beginning, and then the integration process can be implemented by using the best path to reach the desired goal (Dunaway, 2008).Cultural integration is not merely merging different cultures into one; it is a process of establishing the new organisation model by absorbing, selecting and integrating the cultures of two different organisations that are becoming one organisation. Culture mapping is also used to understand the similarities and gaps between national and corporate styles. A fundamental element of cross-culture management, as further argued by Abel (2007:1-5), is respecting and understanding another culture, attaching importance to communication and adapting to new tools. A survey conducted among senior executives worldwide who were involved in acquisitions revealed that 47% considered achieving cultural alignment a critical people issue, while 62% thought that ensuring effective communication was the most valuable human factor for acquisition success.

2.4.1 Organization change management

According to Peterson and Voules (2007), different paces and patterns of change and change management give rise to different kinds of internal and external difficulties and resistance to change during an acquisition process. Changes create the impression that employees and management will lose their jobs, as a result of a new strategic direction that the organisation takes. Kotter (2007) state that if change management is poorly handled, change impact employee and management productivity and erode employee and management engagement. The literature documents several models of change management, three of which can be summarised as follows: Kotter's eight-step model (1995) change process allows an organisation to develop a consistent planning and implementation framework that sets out clear objectives for the relevant stakeholders; Adakal's model (1999) an outcome-oriented approach to facilitate individual change to help leaders realise their objectives quickly and completely; Lewin's three-step model (1943). Prior to a change process, the change agent should understand why change must take place.

3 Research Methodology

The combination of a quantitative and qualitative approach was adopted in this study. Leady and Ormrod (2010) argue that the mixed method design with both qualitative and quantitative elements often provides a more complete particular phenomenon than either approach could have done alone. This methodological design is particularly useful in expanding our understanding and knowledge of merger and acquisitions in term of its impact on human behaviour and the issues surrounding cultural integration. This exploratory study uses both the qualitative and the quantitative method implying that the research provides a more complete picture of a particular phenomenon, often referred to Mixed-method (Leedy and Ormrod 2002:97).The self-administered questionnaire interviews a target sample of three hundred participants consisting of three distinct groups within the entity: employees, human resources and management of both entities. The various strata considered for sampling was determined by taking into account all the departments that constituted the core business of EPCM SA. Table 1 below shows the proportions and numbers of respondents from all the major business units.

The major topic covered in all the interviews is (i) How is change communicated and managed during the acquisition (ii) examine if the transition was understood and owned by all the employees (iii) Is there any cultural relationship between EPCM SA and the International entity? (iv) Identify if the M&A experience was satisfactory (v) Is there a cultural relationship between EPCM SA and the international entity.

Table 1. Sample selection of participant Interviewed

Business unit	Total population	Sample size
Engineering	200	50
Project management	40	26
Procurement and Contracts	35	24
Operations	925	191
Total	1200	291

4 Findings and Discussion

The research present the synthesis and analysis of the findings of the study, building on the statistical analysis and data obtained from the acquisition themes as used in the questionnaire. Table 2 below is centred on level of satisfaction and further discuss the impacted on employees and management operation post acquisition between EPCM SA and the international entity.

Table 2. Acquisition themes used in questionnaire and level of satisfaction

Acquisition factors affecting employee and management operations	Level of satisfaction	Mean satisfaction level
Organisational Culture	Low satisfaction	22%
Communication	Low satisfaction	48%
Departmental integration	Dissatisfied	39%

** Low satisfaction 0% -50%*

4.1 Organisational culture

The cultural fit after the acquisition was unsatisfactory for 78% of the respondents, while 22% was moderately satisfied with it. The new company’s policies and procedures were unsatisfactory to 42% of the respondents and the majority (56%) of the respondents were moderately satisfied .on the overall, the data collected showed the cultural assessment was not effective and the cultural integration plans put in place were misaligned. It is evident from the above that there was no cultural relationship between the two organisations.

4.2 Communication

The major weakness in the acquisition process was lack of adequate communication, which was evident in the comments of the majority of the respondents who indicated that they had learned of the acquisition through informal meetings and discussions. 51% of the respondents were unsatisfied, 48% was moderately satisfied and only 3% found the communication model very satisfactory. There were no trust, transparency and engagement on the part of management and HR.

4.3 Departmental integration

EPCM SA's employees' levels of satisfaction and morale were low as a result of that the instability of the business created by the acquisition. The integration of co-workers was unsatisfactory for 59% of the respondents and 39% was moderately satisfied. The levels of job security were low for 57% of respondents, while 2% was very satisfied with their levels of job security after the acquisition and little clarity on employee roles and responsibilities has resulted in the inability of employees to adapt to the new culture and systems of the new entity.

4.4 Change management and time frame

Change could either be planned or emergent, the psychological challenges that was noticeable among co-workers because of the acquisition include the threat of job loss was highest (93%), followed by a sense of insecurity (89%) and job changes (71%). A sense of uncertainty was noticed by 39% of the HR respondents and social welfare concerns were noticed least (7%). Evidently, the assimilation time frame was not enough to give EPCM SA ample time to understand the new entity systems before they were implemented. The project delivery assimilation time was overrun due to the little or no time allowed for employees to adopt the new project integrated system, this indicates that Adakal's model (1999) was adopted and explains why the rapid integration and assimilation process was misaligned as shown in table 3 below. Before the acquisition, investment was between 31% and 45% (as mentioned by 39% of the managers); and foundation building investment was between 46% and 60%, rapid integration and assimilation investment between 31% and 45% according to 39% and 55% of managers respectively.

Table 3. Time resources invested in the transition process

Modal classes	Pre-acquisition	Foundation building	Rapid integration	Assimilation
31%–45%	45%		39%	
46%–60%		52%		55%

Furthermore, given that the acquisition is still on-going after two years, the level of uncertainty regarding the roles of management and employees of EPCM SA within the new entity further support Conyon et al. (2000)'s view on acquisition.

5 Conclusion and Further Research

The main purpose of this study was to determine and evaluate the impact an international entity acquisition of EPCM SA had on employees and management operations. The research paper conducts a literature review to explore the existing knowledge about the impact of acquisitions on employees and management and an empirical study on the impact of EPCM SA's acquisition on its employees and management operations, analysing the research result and their outcomes built on the data obtained through the survey questionnaire.

M&As have a very long history; and has been in existence at least since the 1900s.The introduction of globalisation has strengthened corporate companies emphasis on the need to create a multi-national organisation. However, many organisations are under the impression that implementing the M&A process is quick and easy and they often underestimate the level of due diligence, power of cultural fitness and change management required to integrate organisations in a way that impacts positively on employees and management operations. It is important that organisations assess culture fitness, systems integration and the prevalent communication model and planned change management. The following findings and conclusion can be drawn from this study:

5.1 Existing organisational culture post acquisition

The study found that, the current culture of the organisation is a “misfit culture”. This means that the integration of the two cultures into the new organisation has not yielded employee and management satisfaction. The management of the new organisation has failed to focus more on bringing about cultural integration through an effective change process in the new organisation by focusing on and planning market penetration and diverting risk. It is recommended that the management of EPCM SA revisit the three key themes of cultural bridging fundamentals (legitimacy, effectiveness and the future) as it is in these three areas that leaders must develop an understanding, not only of the approach favoured in their own corporate culture but also of that of their future partners.

5.2 Existing employee satisfaction

The study found that, the overall employee level of satisfaction within the organisation is very low. This was the dominant view obtained from the research findings and based on the continuous drift of the acquisition process across the organisation over the last two years. The study recommends that, in changing employees’ perceptions for stability and commitment within the new entity, HR implements an awareness programme for employees on the opportunities that are available within the new entity and what makes the new entity a great organisation to work with.

5.3 Relationship between organisational culture and employee and management productivity

The results revealed that there is no relationship between culture and productivity among the employees and management in the new organisation. The research results show that the management’s leadership style was weak and contributed to the poor cultural integration. It can be assumed that similar organisations that undertook an acquisition in the South African construction sector will have the same result for cultural integration, indicating no relationship between the organisational culture and employee and management productivity

5.4 Effect of organisational culture on employee productivity

Organisational culture was found to influence and impact employee productivity. In the study, management witnessed reduced levels of productivity and instances of sabotage. This means that the organisation’s culture influences the productivity rate of employees and plays a role in whether the organisation can execute its projects timeously and within the stated budget. It can be assumed that a similar organisation in the South Africa engineering consulting sector will have the same result – that organisational culture influences employees’ productivity.

5.5 Effect of communication on employee and management operations

The study found that, the organisation’s communication model influences and impacts employee and management operations. The communication model in the new organisation reflects a bureaucratic leadership style. Communication flow is under strict control and this causes employees and management operations to be easily questioned. An open democratic communication model is the most suitable model for an organisation that strives to be the leading engineering and consulting company in South Africa.

6 Recommendations for future research

1. Future studies can examine how government regulations and policy influence the success and failure of M&A’s and strategic alliances between multinational organisations and organisations in South Africa.
2. Future research can focus on the impact that cultural fit will have on a strategic alliance/partnership, instead of an M&A, in similar industries in South Africa.
3. Future studies can focus on determining if the nature of an organisational culture influences the type of change model and change process that should be adopted for M&A.

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8 References

Amaratunga, D, Baldry, D, Sarshar, M and Newton, R (2002). Quantitative and qualitative research in the built environment: Application of "mixed" research. *Work Study,* 51(1):17–31.

Abel, MR (2007).*The importance of leadership and culture to Merger and Acquisition success*. Human capital institute, pp1-5

Angwin, D and Meadows, M (2009). The choice of insider or outside top executive in acquired companies. *Long Range Planning*, 42 (3) pp.35-389.

Bajaji, H 2009. *The process of HR intergration in mergers and acquisition*. Unpublished MPhil dissertation, Tata Institute of Social Sciences, Mumbai.

Brealey,R.A., Meyers, S.C. and Allen, F (2008). *Principles of corporate finance*. New York: Mcgraw Hill.

Cartwright, S. and Schoenberg, R (2006). 30 years of merger and acquisition research: recent advance and future opportunity. *Journal of Management*, 17(1) pp. 1–5.

Conyon, M, Girma, S and Thompson, S (2000). *The impact of merger and acquisitions on company employment in the UK*. Nottingham: Centre for Research, School of Economics, University of Nottingham.

Daniel, TA and Metcalf, GS (2001). The *management of people in mergers and acquisition*. Westport, CT: Quorum.

Froses, FJ, Pak, YS and Chong, LC (2008). Managing the human side of cross-border acquisition in South Korean. *Journal of World Business,* 43 pp.97–108.

Green, MB and Cromley, RG (1982). The horizontal merger: Its motives and spatial employment impacts. *Economic Geography*, 58(4):358–370.

Gilkey, R (1991). *The psychodynamics of upheaval*: *Intervening in merger and acquisition transactions*. San Francisco, CA: Jossey-Bass.

Gitman,LJ (2009). *The principle of managerial finance*. Boston: Pearson prentice hall.

Kotter, JP (2007).Leading change, Why transformation efforts fail. *Harvard Business Review*, pp 92.107

Leedy, PD and Ormrod, JE (2010). *Practical research: planning and design.* Upper Saddle River, NJ: Pearson Education.

Kotter, JP (2007). Leading change, ‘Why transformation efforts fail’ *Harvard Business Review*,85 (1) pp. 96-103.

Pearson,B(1999). *Successful acquisition of unquoted companies: A practical guide*. Brookfield, VT: Gower.

Pearson, L and Voules, S (2007).*Reflection on M & A: The human capital*

*dimension.*NewYork: Mercer Human Resources Consulting.
UK Construction news (2000): M&A boom: Http//www.ft.com/cmc/s/o/a8a71814-560b-11dabo0000e25118chtml#axzz3QZejjNpF.(Access 23rd September 2015)

PUBLIC PRIVATE PARTNERSHIPS FOR ROADS MAINTENANANCE AS A VEHICLE FOR SKILLS TRANSFER AND ENTREPRISE DEVELOPMENT IN SOUTH AFRICAN RURAL COMMUNITIES

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Abstract
This paper outlines the justification for a doctoral study on PPPs for road maintenance as a vehicle for skills transfer and enterprise development. South Africa's rural communities' struggles with three main problems, lack of skills, low private sector investment and poor infrastructure, which undermines investments in rural communities. Even those with basic skills, the lack of opportunities undermine their ability to deepen their skills and improve their earning potential. The aim of the study is to develop small scale PPP framework that is appropriate for rural road maintenance in rural communities that have as part of their core purpose, a specific emphasis in fostering enterprise development and skills transfers to develop sustainable businesses within those communities. The paper looks at the current level of infrastructure and skill deficits in SA rural communities and the role that well maintained roads can have on improving the delivery of public goods and service, as well as improving access to economic activities. The review concludes with an evaluation of the extent to which road maintenance can contribute to skills transfer and enterprise development and whether the current PPPs models and policy can be modified to foster economic development and skills transfers in SA rural communities.

Keywords: Enterprise development, PPPs, Roads, Rural skills transfer

1 Introduction

This study is on PPPs for road maintenance as a vehicle for skills transfer and enterprise development. South African faces a high unemployment rate of 25% (Stats SA, 2014). One of the causes cited for this high unemployment rate has been the lack of skills and less formal entrepreneurships (Ibid), as the high levels of unemployment co-exist with reports of skilled vacancies by employers (Ibid) and low levels of entrepreneurship compared to other middle-income countries (Styles et al, 2006). This picture however is particularly concentrated in rural communities, in part a historical legacy of apartheid policies of using rural communities as reservoirs of cheap labour (Gibbs, 2014). The apartheid government's explicit policy was to undermine the rural economies to force men from those communities to migrate and work in the mines and cities (Binns and Nel, 1999). Woman and children were mostly left in the villages surviving on remittances from male migrant labour, preventing the establishment of any sustainable economic activity in the rural areas (Ibid).

The incidence of unemployment is across education, age and race. About 58% of those formally employed have at least matriculation level education (12 years of schooling), compared with only 38% of the total working-age population (McGrath and Okooje, 2007). Since 1994, the African National Congress (ANC) government has launched a number of interventions to address the skills gap, develop rural communities and foster SMMEs (Small Micro and Medium Enterprises). More recent initiatives targeted at the rural areas to offer skills and employment include the National Rural Youth Service Corps (NARYSEC) through the Department of Rural Development and Land Reform (DRDLR), National Youth Service (NYS) and the Extended Public Works Programme (EPWP) operated through the National Department of Public Works (NDPW).

2 Literature Review

2.1 State of infrastructure

Infrastructure is defined as the services drawn from the set of public works that traditionally have been supported by the public sector, although in many cases the infrastructure services may be produced in the private sector (Fox and Porca, 2001). Water, sewerage, solid waste management, transportation, electricity, and telecommunications are examples (Ibid).

South Africa boasts a much-advanced infrastructure in it urban centres, however the picture is a different one in the rural areas (Bogetik and Fedderke, 2005). South Africa's critical infrastructure needs are in part the outcome of two decades of underinvestment (Ibid). South Africa experienced under investment public infrastructure spending between the early 1980s and until mid-1990s (Ibid). After this point, government began to increase capital spending, with a sharp rise after 2003 as prudent management of the economy created the fiscal space for long-term investment (National Treasury, 2012). Private-sector capital formation has also increased strongly, rising by 84 per cent between 2002 and 2008 (Ibid).

According to the SA Treasury, South Africa needs to invest at least 25 percent of its Gross Domestic Product (GDP), to address its infrastructure deficit (Treasury, 2012). The experience of other developing countries shows that capital investment equivalent to about 25 per cent of GDP is generally needed for a substantial rise in per capita income (DoT, 2012). In recent years, government has sought to accelerate public infrastructure spending, while also encouraging greater private-sector investment (Ibid). South Africa's public- sector capital investment stood at 7.4 per cent of GDP in 2010, while investment by private enterprises amounted to 12.2 per cent of GDP (Treasury, 2012).

South Africa experienced a massive rise in infrastructure spending in the run up to the hosting of the 2010 FIFA World Cup (DoT, 2012), however since the soccer tournament the expenditure has fallen off (Ibid). The decrease in public investment in public infrastructure is because of the country trying to address other social needs such as welfare, healthcare and education (National Treasury, 2012). Because of South Africa's rising debts, other funding models such as PPPs are required to finance the country's infrastructure deficit.

The experience of other developing countries shows that capital investment equivalent to about 25 per cent of GDP is generally needed for a substantial rise in per capita income. In recent years, government has sought to accelerate public infrastructure spending, while also encouraging greater private-sector investment (National Treasury, 2012). South Africa's public- sector capital investment stood at 7.4 per cent of GDP in 2010, while investment by private enterprises amounted to 12.2 per cent of GDP (Ibid). Government and state enterprises are expected to allocate funding of R262billion over the next three years to transport and logistics infrastructure (Ibid). These investments will improve public transport and the mobility of people and services, overcome spatial inequalities, boost the economic potential of certain regions, and increase domestic and international trade capacity (DoT, 2012).

2.2 State of road infrastructure

The challenge with regards to transport infrastructure is not only limited to the physical deficit but also lack of linkages between roads and rail lines, and poor connectivity to ports (ADP, 2010). This has resulted in Africa being the world's worst rated region in the Logistics Performance Index (LPI) in 2009, even though the picture varies considerably across countries (Ibid). While African governments and development partners are investing more in roads and rails infrastructure much more needs to be done for any meaningful socioeconomic impact to be made (Ibid).

According to South African National Roads Agency (Sanral), South Africa's total road network is about 747,000km the most extensive is Africa (Sanral, 2014). Roads in SA are controlled by the Department of Transport, however the department is primarily responsible for policy development. The actual building and maintenance of roads is split amongst the 3 spheres of government (national, provincial and municipal) and the responsibility of national (undertaken by Sanral) and the provincial and municipal road agencies.

According to the South African Institute of Civil Engineering (SAICE), Sanral is responsible of 16,200km, provincial agencies for 185,000km and the local municipalities responsible for 66 000km (SAICE, 2014). Around 19% of the national road networks are toll roads, most of which are maintained by Sanral, while the rest have been concessioned to private companies to develop, operate and maintain.

2.3 Skills and Enterprise development

One of South Africa greatest causes of its high levels of poverty is unemployment and low paid work (Ray et al., 2014). Government's position is clear: the new development and growth path for South Africa requires the participation of all economically active South Africans in productive activity. Our policy levers to achieve faster growth, higher employment and reduced levels of poverty include skills development which must assist support the formal private sector growth but also labour-intensive industries, infrastructure investment, public service delivery and rural development. Quality education and training is needed at all levels.

2.3.1 Skills Development

Skills Development means developing yourself and your skill sets to add value for the organization and for your own career development. Fostering an attitude of appreciation for lifelong learning is the key to workplace success. Continuously learning and developing one's skills requires identifying the skills needed for mobility at Cal, and then successfully seeking out trainings or on-the-job opportunities for developing those skills (Berkeley. Edu. n.d.).

The role of skills development is central – but anticipating what skills will be needed, and when, is no easy matter (Lassnig, 2006). Careful planning is needed to support the human development needs necessary to fuel our aspirational growth path (Ibid). Sector Skills Plans (SSPs) are expected to anticipate and promote sectoral economic growth trajectories and constitute our best guess at the skills needs of an essentially unknowable future.

Analysis of economic development and employment trends includes a consideration of national and sector growth and development strategies, particularly those related to the National Economic and Development Strategy, the National Human Resources Development Strategy and those related to the Industrial Policy Framework, innovation and technology and Rural Development. In accordance with the requirements of the Skills Development Act (1997) as amended (December 2008).

2.3.2 *Enterprise Development*

Enterprise development is defined as the act of investing time and capital in helping people establish, expand or improve businesses. Enterprise development helps people to earn a living; it helps them out of poverty; and it leads to long-term economic growth for themselves, their families and their communities (USB-ED, n.d.).

Since the advent of democracy in 1994, the national government of South Africa has implemented a range of new national support programs designed to assist entrepreneurship development and the upgrading of the Small, Medium and Micro-enterprises (SMMEs) (Mathibe, 2010). SMMEs are recognized as an important vehicle to address the challenges of job creation, economic growth and equity in South Africa (Ibid). Governments throughout the world are focusing on the development of the SMME sector to promote economic growth (Mago and Toro, 2013).

The definition of SMME used by the DTI in South Africa is any business with fewer than 200 employees and an annual turnover of less than 5 million rands, capital assets of less than 2 million rands and where the owner is directly involved in the management of the business (Cronje *et al.,* 2000). SMMEs in the South African context are classified into five categories:

a. Survivalist enterprises;
b. Micro enterprises;
c. Very small enterprises;
d. Small enterprises; and
e. Medium enterprises.

The survivalist enterprise is generally seen as providing an income below the poverty line (Chalera, 2007). Micro-enterprises are considered as businesses with a turnover of below the VAT registration limit of R300, 000 (Ibid).

In post-apartheid South Africa, major policy significance is attached to the promotion and support of the small, medium and micro-enterprise (SMME) sector (Mathibe, 2010). A radical policy shift has occurred from the apartheid period when the SMME economy was either largely neglected by policy makers or, in the case of black-owned enterprises, actively discouraged by an arsenal of repressive measures (Rogerson, 1999). In the changed policy environment of the 1990s, promotion of the SMME economy is linked to a range of new policy objectives, including poverty alleviation and enhancement of national economic growth (Agupusi, 2007). The National Project on Poverty and Inequality highlights the importance of assisting the SMME economy as part of a package of integrated strategies for poverty alleviation in urban and, more especially, in rural areas (Ibid). Programs for nurturing the SMME economy are seen as offering a basis for addressing poverty and inherited apartheid inequalities through strengthening existing coping strategies of poor households or by offering alternative livelihoods to those individuals engaged in the survival informal economy (May 1998). By contrast, in South Africa's new macroeconomic strategy, the Growth Employment and Redistribution (GEAR) programme, the strengthening of the SMME economy is identified as one of the core elements for achieving a medium-term improved growth and employment performance as well as for enhancing the long-term competitive capacity of the economy (Republic of South Africa, 1996).

2.4 *Impacts of roads in delivering public good and services in rural communities*

The World Bank defines the rural population as referring to people living in rural areas as defined by national statistical offices. It is calculated as the difference between total population and urban population (World Bank, n.d.).

Rural African communities are largely characterised by high levels of unemployment and poverty, low skills levels and a heavy reliance on natural resources (Milborne, 2004) Increasing populations, together with the impacts of climate change, are putting pressure on natural resources and the issue of sustainable land use is becoming critically important (Thomas and Twyman, 2005).

Besides road maintenance being crucial in creating work, road also contribute in enhancing and facilitating market interdependencies and promoting economic development (Hill et al., 2012). Foreign Direct Investment (FDI) flows to developing economies reached a new high of US$759 billion, accounting for 52% of global FDI inflows in 2013. At the regional level, flows to Latin America and the Caribbean, and Africa were up; developing Asia, with its flows at a level similar to 2012, remained the largest host region in the world (UNCAT, 2014).

It is argued that improving road and rail systems in Africa will boost the transportation of goods and raw materials; facilitate transactions and negotiations, boost tourism and positively impact ordinary lives in diverse ways such as ensuring that people get to the hospital quickly during emergencies. Countless other activities depend on reliable transportation (Teravaninthorn and Raballand, 2008). As a result, transport costs alone are higher in Africa than in developed countries, hampering Africa's competitiveness in both international and local markets (Ibid). Before addressing the focal challenges of documenting the economic, social development, and poverty reduction impacts of road projects specifically, it is useful to briefly outline the impacts of major infrastructure investments in general. Recent reviews have shown that the impacts of one type of infrastructure (e.g., roads) on economic development, poverty reduction (Fan and Chang-Kang, 2005). The changing structure and increasing sophistication of the economy have altered the pattern of transport demand, with rapid growth in the demand for road transport compared with other modes (Ibid). The link between road development and poverty reduction is supported by studies and the evaluation of several completed road projects financed by ADB4 and the World Bank (Ibid).

From consultation with the poor, several studies have found that adequate transport infrastructure is a prerequisite for reducing poverty, and involving the participation of local communities increase the likelihood of success of road projects (Setboonsarng, 2005). Benefits for poor rural areas include lower transport costs; lower cost of inputs, expanded agricultural support services; improved farming practices; greater access to employment opportunities in urban areas; and better access to health, education, and social services (Ibid).

Rural poverty is linked to the exposure of the households to economic vulnerability, through their chronic dependence on small-scale agriculture for income generation. A starting point in mitigating this vulnerability would be a comprehensive improvement in accessibility. This would substantially reduce transportation cost and thereby lessen the isolation of rural communities from basic welfare services. Economic growth is endogenous. This means that growth levels are driven by the public expenditures including infrastructure investments but at the same time, public expenditures are driven by economic growth. Studies showed that countries with more developed infrastructure see a disproportionately greater impact of infrastructure on foreign direct investment, domestic investment, and growth (Globerman and Shapiro, 2002).

Reduced sensitivity to transport costs and time when marketing their own produce (Thomas, et al., 2005). Poor people near the poverty line are mobile and express demand for transport services (Velaga et al., 2012). They share equally in the qualitative benefits of improved access to health, education, social and community services, increased safety and security, and access to information (Ibid).

Government policy, initially through the Rural Development Strategy (1995) and the Rural Development Framework (1997), initiated the process of prioritising the transformation of rural areas from ‘surplus labour reserves’ into dynamic local economies that are able to provide sustainable self-employment opportunities and remunerative jobs (RDF, 1997).

The purpose of this branch is to create an enabling institutional environment for sustainable rural development and to provide for social and economic development in rural communities and sustainable livelihoods. Its functions are based on the social mobilisation of communities to ensure that rural communities take ownership of rural development projects and programmes (DLRD, 2012).

2.5 Current SA PPP policies and their focus skills transfer and enterprise development

Public-Private Partnership can be described as legal binding agreements, which the public sector enters with the private companies as a tool in providing the statutory public infrastructure and/or management of public infrastructure. The characteristics of the partnership is that is it a legal transaction, longer duration, infrastructure provided can be lease property; sale, renovated or new and the service provided is normally a function of the public sector (Grimsey and Lewis, 2004).

South African Treasury defines PPPs or public private partnerships as long-term contracts between the public and private sector. The main objective of PPPs internationally is to ensure the delivery of well-maintained, cost-effective public infrastructure or services, by leveraging private sector expertise and transferring risk to the private sector (National Treasury, 2007). In 1999, South Africa launched is PFMA regulation and public private partnerships (PPPs) are regulated under this regulation. This regulation based on transparent public procurement of goods and services with its private sector partners (Ibid). This framework encourages mutually beneficial relationships between private and public sectors when government enters commercial transactions for the public good (SA Treasury, 2007).

Public Private Partnership (PPP) principles in South Africa have grown over recent years as the merits of blending private sector resources and skills, with the public ones has become evident (Wattenhall, 2003). It has also become clear that the PPP architecture is complex and such projects require a detailed understanding of their design and implementation (Ibid). A number of PPP projects have been facilitated and these projects have been followed by many public debates over the efficiency and efficacy of such a finding and delivery mechanism (Findlers, 2005). Debates have focused on issues including the death of the public sector ethos (Ibid); PPP is driven by political motive to control public spending rather than delivering better public services (Ibid); PPP projects actually cost more than conventionally procured assets (Hogde, 2004); and many others. South Africa is the leading sub-Saharan African country with respect to PPPs and, like most developing countries yet despite this relatively few PPP projects have achieved financial close and was classified by Deloitte and Touché (2006) as being only at the first stage of the PPP maturity scale (Bond et al, 2012).

Countries worldwide daily confront the Africa’s high infrastructure deficit (Yepes et al., 2009). Evidence of the sizeable and burgeoning disparity between actual infrastructure needs and the resources that governments have historically invested in attempting to meet those needs is universal: congested roads; antiquated bridges in need of repair; poorly maintained transit systems and recreational facilities; and hospitals, schools, and waste treatment facilities all in varying stages of deterioration and urgently in need of restoration (Eggers and Startup, 2007). The SA Government acknowledges that public-sector capacity to implement projects is presently inadequate, and is taking steps to strengthen planning and implementation capacity at all levels (National Treasury, 2012).

South Africa is among the leading nations in policy, systems and law on the PPPs (Farlam, 2005). Through previous PPPs experiences the public service delivery has benefited through this model and it enhances the efficient delivery of services at minimal costs. To show the private sectors confidence on the PPPs, they have been an increase of pipeline for projects and increased appetite from the private sector (National Treasury, 2012). South Africa boasts a well-developed policy and regulatory framework, which act as a guide on how all sphere (national, provincial and municipal) government can enter in to a PPP.

3 Expected Contribution of the Study

The aim of the study is to develop a PPPs framework that will be used for roads maintenance in rural communities that have as part of their core purpose, a specific emphasis in fostering enterprise development and skills transfers. Rural communities in South Africa have been marginalised from skilled work opportunities and formal business activities. Because of lack construction activities in rural areas even those who acquires skills through extended public works initiatives, they lack opportunities to deepen their skills. Roads in rural areas happen to be managed by local authorities, and rural local authorities experience a challenge in recruiting and retaining skilled workers.

4 Conclusion and Way Forward

For this study, an analysis of current policies on PPPs, skills transfer and enterprise development will be evaluated. This will helps in understanding current PPPs framework, strength and challenges. And current policies on skills transfer and enterprise, his will help us in finding current trends, success and challenges. Evaluating current policies will provide crucial data and statics on government targets and actual in areas of skills transfer and enterprise development. Interviews will be done with senior public officials in the economic, transport and PPP unit within the South African government. This will help in finding the reaction on developing new PPPs framework and in locating the most suitable stakeholder's with SA government. And lastly case studies on skills transfers and enterprise development will be used, to evaluate the current road maintenance regime against skills and enterprise developments.

- Reducing the transaction costs, and the skills and knowledge required – transaction costs have been an issue increasing the scope of PPPs to include municipal infrastructure.
- Expanding scope of projects – PPPs in South Africa has mainly be on office accommodation national government departments and national highways which falls under SANRAL
- Potentially applicable to a wide range of infrastructure – possibilities for a potential to foster PPPs model that can be in wide ranging infrastructure maintenance projects.
- Applicable to other rural environments in Africa and the developing countries – develop a best practice for rural roads PPPs that will be applicable to other developing nations.

5 References

Agupusi, P. (2007). Small Business Development and Poverty Alleviation in Alexandra, South Africa, Paper prepared for the second meeting of the Society for the Study of Economic Inequality (ECINEQ Society, Berlin; July 12–14 2007) School of Development Studies, University of East Anglia, Norwich, UK

Deloitte & Touche (2006). Closing the infrastructure gap: the role of public–private partnerships. [Online] Available at http://www.deloitte.com/assets/dcom-shared%20 assets/documents/dtt_ps_closing gap 061307.Pdf. Accessed: 08 May 2015.

Fan, S and Chan-Kang, C. (2005). Road Development, Economic Growth, and Poverty Reduction in China International Food Policy Research Institute

Findlers, M. (2003). The politics of Public Private partnerships

Framework for the National Skills Development Strategy, 2011/12-2015/16, First Draft for Construction , 29 April, 2010.
Hodge, G. (2004). The risky business of Public Private Partnership, Australian J ournal of Public Administration
http://data.worldbank.org/indicator/SP.RUR.TOTL, accessed 08 May 2015
http://hrweb.berkeley.edu/learning/career-development/skill-development
http://www.theafricareport.com/North-Africa/transport-infrastructure-before-development.html
http://www.usb-ed.com/content/Pages/The-impact-of-enterprise-development-in-South-Africa.aspx#1BU3uHksZS4lz6f3.99
Kathryn, R., Sissons, P. Katy J. and Vegeris, S (2014). Employment, Pay and Poverty: Evidence and policy review for the Joseph Rowntree Foundation
Lassnig, L. (2006). Approaches for the anticipation of skill needs in the "Transitional Labour Market" perspective – the Austrian experience
Mathibe, M. (2010). An Evaluation of Business Support Services to SMEs in the Free State, A Dissertation submitted University of Free state.
Rogerson, M. (1999). Small enterprise development in post-apartheid South Africa: Gearing up for growth and poverty alleviation,
Yepes, T, Pierce, J, Forster, V. (2009), Making Sense of Africa's Infrastructure Endowment: A Benchmarking Approach, World Bank Policy Research Working Paper No. 4912 Vol. (issue no.), pp. 11-25.

EFFECTIVENESS OF ELECTRONIC TENDERING FOR CONSTRUCTION PROJECTS

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Abstract

Historically, the construction industry being fragmental in nature is dominated with a wide range of technologies and e-activities with e-tendering at the forefront. However, e-tendering is the issuing and receiving of tender documents via internet based platform which makes the procurement of a construction project easier and faster. Despite the benefits that could be derived from the use e-tendering, many construction practitioners are still reluctant to fully use electronic tendering. Therefore, this study is aimed at exploring the factors affecting the wide use of e-tendering, effectiveness of e-tendering infrastructures and awareness level of e-tendering within the South African construction industries. Owing to the nature of the research questions the quantitative approach was used for this study. The questionnaire survey method is the research instrument used. The questionnaire survey was conducted among construction stakeholders actively involved in the planning of construction projects. Using a survey research type of research design, data was sought from quantity surveyors, architects, engineers, project manager and other construction stakeholders in the industry using survey research method. The results of this survey shows that no quantifiable measurement of e-tendering success, once-off nature of construction projects, limited knowledge of legal and security policies governing e-tendering and misunderstanding within the fragmented supply chain management system rank highest among the factors affecting it wide use and e-tendering effectiveness.

Keywords: Construction, E-tendering, Industry, Infrastructure, Practitioners

1 Introduction

The construction industry being fragmental in nature is dominated with a wide range of technologies and e-activities with e-tendering at the forefront. However, e-tendering is the issue and receipt of tender documents through an internet based system which facilitates the procurement of a construction project. The present paper based means of tendering has been used significantly over a number of years within the construction industry, and this method is faced with challenges which affect construction projects in terms of cost and timely completion of a project. The need to minimise and eradicate these challenges gives rise to the adoption of e-tendering and adjudication processes. Which would result in improve productivity, greater quality of work during the planning stage of a project, higher profitability and delivery of a construction project.

The construction industry is classified as an information intensive sector and described as one of the crucial industries in developed and developing countries facing a rapid and uneven change in the economy (Kajewski and Weippert, 2004:2). Tendering as related to construction is the process by which tenders are invited from interested or competent contractors to undertake certain or specific packages of construction work.

Planning for construction projects involving large sum of money is a challenging and complex chore faced by both internal and external stakeholders involved in a project. According to Mohemad *et al.* (2010), a construction project life cycle consists of three phases, namely as pre-construction, construction and post construction. The pre-construction phase involves the planning and tendering process (Mohemad *et al.*, 2010:35). The tendering stage in construction industry is considered a crucial and important stage throughout the project lifecycle (Vee and Skitmore, 2003, p.118). This stage forms the contractual and legislative agreements between client, design engineer, contractor and other stakeholders of the project (Choen and Alshawi, 2009:101).

Tendering in construction was portrayed simply by Connell (2010) as a process that connects the client to the construction firm. Tendering is carried out most importantly to adjudicate competent contractor to undertake specific construction and design activity at the best reasonable cost, realistic time and acceptable quality.

Decision making during tendering has great impact in the successful execution of a construction project (Mohemad *et al.,* 2010, p.35). Mohemad *et al.* (2010) proceeded to say that managing tender is very cumbersome and uncertain. It involves the coordination of several activities and tender participants with different priorities and objectives. Bias and inconsistent decision are unavoidable during tendering if decision making system is dependent on intuition, subjective judgement or emotion (Mohemad *et al*., 2010:35). This unavoidable decision is one of the major reasons why e-tendering should be encouraged and widely used by construction practitioners.

1.1 Problem statement

In spite of the fact that previous researchers generally conclude that e-tendering system is effective, the question is why tendering process is still based on manual activities i.e. traditional tendering system. Despite the benefits of e-tendering and the contribution to the procurement phase of a project, there are factors and challenges that affect the wide use of e-tendering. One of the factors that hinder the used of e-tendering is the isolated nature of processes without extensive integration prior or after tendering (Chilipunde, 2013). However, majority of the construction and consultancy firms are still sceptical of the potential benefits mainly due to limited human resources as regards the operation of the e-tendering process. These includes, financial resources, accessibility of internet, computer literacy amongst tendering participants, e-tendering software not user friendly, ineffective e-tendering infrastructure, legal and security issues, lack of government policy and the people. These are the main factors that hinder the use of e-tendering in the developed countries (Mohemad *et al*., 2010:35). Research has shown that no extensive study has been conducted on this ineffectiveness and wide use of e-tendering in the South African construction industry.

2 Literature Review

Oyediran and Akintola (2011) noted that African countries such as South Africa and Nigeria lack comprehensive technological development and standards which affect the use of the system with all tendering participants on board. Construction practitioners are also lacking the initiative in changing practice to embrace e-tendering for the procurement of a project (Eei et al., 2012:17). Poole (2010) argued that Supply Chain Management (SCM) is the management of interconnected businesses involved in the manufacturing of a product or service required by customers. Poole (2010) continue to state that construction supply chain management consists of the planning and management of all construction activities involved in sourcing, procurement, monitoring and logistics management. Procurement as related to construction is a step-by-step process that typical involves; determining project criteria, setting contractual framework, setting tender and adjudication processes, inviting tenders and finally award of tender (Masunda, 2014:2). In simple definition, procurement also means how to execute a project. This definition show e-tendering is a crucial section of the procurement system. Black, Rong and Gonzalez (2005) according to the findings proposed a typical e-tendering processes generally engaged by most systems which include Pre-qualification and registration, Public invitation, Submission of tender, Close of tender, Evaluation of tender, Award tender and Archiving. . The above mentioned processes will facilitate the successful completion of a project. The effectiveness and factors affecting the wide use of e-tendering cut across the above listed processes. E-tendering is receiving more attention these years most especially as an isolated solutions to problems related to traditional tendering system (Jacobsen and Koch, 2013). The need to have a secured, simple, standard, efficient, cost effective and curbing corruption stems governments of many African countries to adopt and implement e-tendering. Despite the benefits (both managerial and administrative) e-tendering offers to the procurement of construction projects in the South African construction industry, there are still several put offs in the South African construction industry (Oyediran and Akintola 2011:561). The examination of these put offs is what this study is all about.

From the literature review conducted by Laryea and Ibem (2014) few empirical studies have been done on the barriers to e-procurement in the AEC industry. Laryea and Ibem (2014) proceeded to set South African construction industry as an example, the magnitude of barriers to e-procurement up-take has not been examine and properly put into words in the literature; leading to inadequate understanding of the factors that affects the wide use of e-tendering in the construction industry of this country. Prior to the implementation of e-tendering into any construction industry worldwide, electronic readiness need to be investigated and the level of e-readiness among individual, societies, companies and nations should be critical examined (Cheon, 2007). World Information Technology & Service Alliance (WITSA) stated that e-ready country requires end user trust in e-commerce security & privacy, improved security technology, well trained workers & low training costs, minimal restrictive public policy, latest business environment and reduced costs for e-tendering technology. Drawing from the survey conducted by Laryea and Ibem (2014) and relating the survey findings to the standards established by WITSA, it could be vividly seen that the ICT environment in developing countries are not e-ready for the wide use of e-tendering into the operations of the construction industry. Lavelle and Bardon (2009) concluded based on his findings that there is existing recognition of the benefits but several factors affecting the wide use of e-tendering are presently responsible for the slow uptake and limited use of e-tendering.

3 Research Methodology

This section emphasizes the method used in this study. Owing to the nature of research topic, quantitative research methodological approach was adopted which embraces literature findings and industry based questionnaire survey. The research instrument suitable for this study is the questionnaire survey which was prepared and designed according to the Tshwane University of Technology ethical committee. Data are obtained through the use of survey questionnaire amongst construction practitioners actively involved in the planning of construction projects and the researcher distributed the questionnaire via hand and email. Random sampling technique was used during the data collection stage of the study. The professional Association within the South African construction industry (South African institute of Civil Engineers SAICE, Engineering Council of South Africa ECSA, The South African Council for the Project and Construction Management Professions SACPCMP, and Association of South African Quantity Surveyors ASAQS) serve as the data base for this study. The descriptive analysis was conducted to analyse and interpret data collected. The statistic package for social science

(SPSS) was used to analyse collected data. The descriptive analysis used in this study comprises of frequencies test, percentages, standard deviation and mean.

4 Data Collection

The primary data adopted in this research were acquired and collected via the administering of a structured industry based questionnaire to construction practitioners within the Tshwane Districts of Gauteng Province of South Africa. Total numbers of 80 questionnaires were distributed to construction practitioners and of these 80, 56 were returned, showing a response rate of 70%. From the questionnaires returned, 5 were unusable as information supplied was non-conforming to require standards and some had incomplete data. The questionnaires were passed out by hand (hardcopy) and via email (soft copy). This was facilitated as follows:

1. The questionnaires were sent via email to the sample population and were supported with introductory letter.
2. Reminder emails were sent to the targeted respondents who did not return the questionnaire after two weeks.
3. Another reminder email was sent to the respondents who did not return the questionnaire after two weeks.
4. The researcher made sure the questionnaires administered by hand were returned immediately after completing the questionnaire, they were picked up by the researcher.

5 Summary and Research Findings

The survey questionnaire was used for data collection. A five point likert scale ranging from not suitable to extremely suitable was used to determine the building procurement method best suitable for the use of e-tendering. Also a five point likert scale ranging from strongly disagree to strongly agree was used to determine the challenges of traditional tendering system, factors affecting the wide use of e-tendering and challenges of e-tendering infrastructures. Finally a five point likert scale ranging from never to always was used to measure the awareness level of e-tendering amongst construction practitioners in the Tshwane district of Gauteng Province.

5.1 Factors affecting the wide use of E-tendering

This section was based on a 5 point Likert scale ranging from 1-stongly disagree to 5-stronlgy agree. The descriptive analysis was used to indicate how respondents answered the questions relating to the factors affecting the wide use of e-tendering. The average of answers for each construct was given by the mean as indicated in Table 1. Furthermore, the standard deviation indicates how much variation occurred from the average mean. A high standard deviation indicates that the data is spread across a large range of values, while a low standard deviation indicates that the data points tend to be very close to the mean.

Table 1. Descriptive statistics of factors affecting the wide use of E-tendering

Descriptive Statistics							
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
People are intimidated by technology	51	1.00	5.00	3.7647	1.19312	-.773	.333
Lack of awareness	51	2.00	5.00	4.2941	.75615	-.844	.333
No quantifiable measures/ indicator of success	51	1.00	5.00	3.1373	1.07740	.116	.333
Poor Cross Communication between stakeholders	51	1.00	5.00	3.0000	1.14891	-.494	.333
Misunderstanding within the fragmented supply chain management system	51	1.00	5.00	3.1569	1.08393	-.815	.333
Inadequate Industry standards for sharing information.	51	1.00	5.00	2.6471	1.09222	.374	.333
Once-off nature of construction projects	51	3.00	5.00	4.5882	.53578	-.773	.333
Low awareness level of government policy guidelines for e-tendering within construction industry	51	1.00	5.00	3.4902	.98737	-.620	.333
No quantify information technology systems	51	1.00	4.00	2.5490	.85589	-.357	.333
Limited Internet coverage for all geographical regions	51	1.00	5.00	3.1961	.98020	-.810	.333
E-tendering portal is not user friendly	51	1.00	5.00	2.2353	1.25838	.537	.333
Difficult to convert paper base documents	51	1.00	5.00	3.6275	.89355	-1.276	.333
Limited knowledge of legal and security policies	51	1.00	5.00	3.3333	.86410	-.330	.333
Limited Human Resources and operators	51	3.00	5.00	4.1373	.40098	1.149	.333
Financial resources for	51	1.00	5.00	4.0588	.73244	-2.635	.333

initial installation of e-tendering infrastructures							
Not all Forms of contracts used in the construction industry is e-tendering supportive	51	1.00	5.00	3.5098	1.02708	-.719	.333
Low level knowledge about e-tendering benefits	51	1.00	5.00	3.3922	1.04074	-.864	.333
Inadequate e-tendering infrastructure	51	1.00	5.00	2.9412	1.02785	.236	.333
Total average mean	51	2.00	4.00	3.4314	.53870	-.116	.333
Valid N (listwise)	51						

The conducted analysis on the factors affecting the wide use of e-tendering as shown in the table 1 presents the results that indicated people Intimidation by technology, lack of awareness, once-off nature of construction projects, difficulty in converting paper base documents, limited Human Resources, financial resources for initial installation and contracts that are not in support of e-tendering resulted in an average mean ranging between 3.5 and 4.7. The mean values were 3.7647, 4.2941, 4.5882, 3.6275, 4.1373 and 4.0588 respectively. The result shows that participants are in agreement on the factors affecting the wide use of e tendering. Once-off nature construction projects had the highest mean of 4.5882, which shows that participants strongly agree that once off nature construction project is the main factor affecting the wide use of e-tendering. The following are disagreement among the participants in this study: unquantifiable measures, poor cross communication, misunderstanding, government policy, inadequate industry, inadequate quantified information technology, limited internet, limited knowledge of legal and security policies, low level knowledge about e-tendering and inadequate infrastructure had their mean values oscillating between 2.5 and 3.4. Furthermore, the average mean for portal not user friendly is 2.2353 which suggest that most participants strongly disagree to e-tendering system are not user friendly. The study also investigated the collected mean of all factors affecting the wide use of e-tendering (Total average mean), the results in the table 1 show that the mean value is 3.4314, this value is equivalent to 3 when rounded off to the nearest whole number. This means, not all investigated factors affects the wide use of e-tendering in the South African construction industry.

5.2 E-tendering infrastructures

Table 2 shows the descriptive statistics of challenges of e-tendering infrastructure. The results show that the average mean of e-tendering Server Operating system hinders tenderers from submitting tenders and tenderers do not get confirmation after submitting tenders was below an average mean of 3.000 with the following values respectively; 2.2549 and 1.9804. While with Portal does not support all formats of tender documents, poor data control and management of data Traffic, High internet connectivity rate to operate e-tendering portals, Have difficulties accessing and updating submitted tenders and Issuing the same login details to more than one tenderers, their average mean was 2.9020, 3.2353, 3.0588, 3.3529 and 3.1569. These mean values indicate that participants are generally neutral and unsure to the following questions: Portal does not support all formats of tender documents, poor data control and management of data Traffic, High internet connectivity rate to operate e-tendering portals, Have difficulties accessing and updating submitted tenders and Issuing the same login details to more than one tenderers. On the other hand; submission of tender do not reflect on the e-tendering portal, limited trained technical staff with ICT support skills and no knowledge on electronic signature capturing and encryption system had an average mean of 3.8824, 4.2157, and 3.8235. This means most of the participants agree to the listed questions above. The total effect of challenges of e-tendering infrastructure was computed, and its average mean was found to be 3.3333 which means generally all respondents are evenly distributed around the neutral to e-tendering having challenges with infrastructure.

Table 2. Descriptive statistics of Challenges of E-tendering Infrastructure

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Submission do not reflect on e-tendering server	51	1.00	5.00	3.8824	1.03242	-1.005	.333
Management of data traffic	51	1.00	5.00	2.9020	1.00509	-.166	.333
Server Operating system hinder tenderers from submitting tenders	51	1.00	5.00	2.2549	1.05533	.417	.333
Tenderers do not get confirmation after submitting tenders	51	1.00	5.00	1.9804	1.17457	.964	.333
Limited training technical staff	51	1.00	5.00	4.2157	.94475	-1.491	.333
e-tendering portal does not support all formats of tender documents	51	1.00	5.00	3.2353	1.25838	-.152	.333
High internet connectivity rate	51	1.00	5.00	3.0588	.92546	.038	.333
Little knowledge on electronic signature capturing	51	2.00	5.00	3.8235	.88783	-.174	.333
Tenderers have difficulties accessing and updating submitted tenders	51	1.00	5.00	3.3529	1.23002	-.317	.333
Issuing the same login details to more than one tenderers	51	1.00	5.00	3.1569	1.20619	-.385	.333
TChalETenderingInfrastructure	51	2.00	5.00	3.3333	.65320	-.017	.333
Valid N (listwise)	51						

5.3 Awareness level of E-tendering

The results of Table 3 illustrates that a good number of 52.9% of respondents are aware of e-tendering, this is followed by 23.5% of the respondents who rarely know e-tendering. 17.6% of the respondents frequently know e-tendering. These results show that more than half of the respondents are quite aware of e-tendering.

Table 3. Awareness of E-tendering

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	2.0	2.0	2.0
	Rarely	12	23.5	23.5	25.5
	Occasionally	2	3.9	3.9	29.4
	Frequently	9	17.6	17.6	47.1
	Constantly	27	52.9	52.9	100.0
	Total	51	100.0	100.0	

Figure 1 below shows the distribution of the respondent's awareness to e-tendering, and it is clear that more respondents are aligned to the right of the graph which shows that majority of the participants who participated in the study are aware of e-tendering.

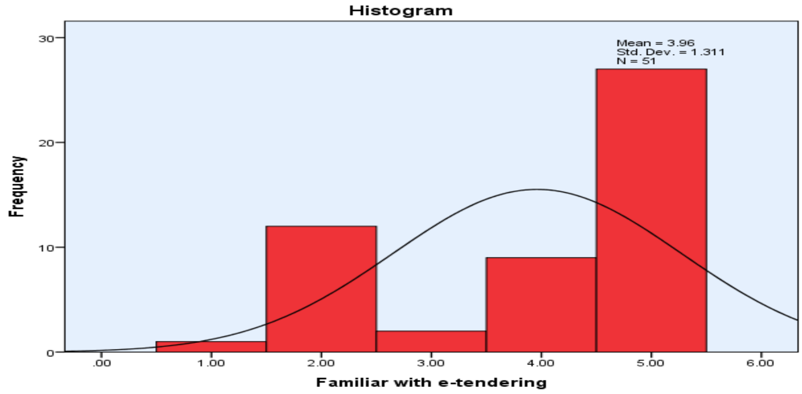

Figure 1. E-tendering awareness

6 Conclusion and Recommendations

6.1 Factors affecting the wide use of e-tendering

The following conducted analysis on the factors affecting the wide use of e-tendering indicates that:

- people are Intimidated by technology,
- lack of awareness,
- once-off nature of construction projects,
- difficulties in the conversion paper base documents to electronic formats,
- limited Human Resources and operators of e-tendering portals,
- financial resources for initial installation of e-tendering infrastructures, and
- Not all forms of contracts supports the use of e-tendering.

Based on the above listed factors, participants agreed that these factors are responsible for the limited use of e-tendering. Once-off nature of construction projects rank the highest factor that affect the wide use of e-tendering. In spite of these factors identified, the prospect of e-tendering in the South African construction industry is high. This could be assumed true since all the factors identified can be eradicated or managed without posing serious obstacle to the wide use of e-tendering. The only factor which seems to be inevitable is the once-off prototype of construction projects.

6.2 Challenges with E-tendering infrastructures

The basic infrastructures necessary for e-tendering are computer hardware, computer software, the internet connectivity and the human resources (operator). This study critically examined these infrastructures to obtain findings based on the challenges of e-tendering system as these challenges will affect the wide use of the system.

From the investigation conducted around the e-tendering infrastructures, results shows that the following challenges have been encounter by construction practitioners who have being used the e-tendering in the tendering stage of construction projects:

- submission of tender do not reflect on the e-tendering server,
- limited trained technical staff with ICT support skills,
- no knowledge on electronic signature capturing and encryption system,
- e-tendering portal do not support all forms of tender documents,
- tenderers have difficulties accessing and updating submitted tenders.

Of all the identified challenges of e-tendering infrastructures, limited trained technical staffs with ICT support skills and construction practitioners having no knowledge on electronic signature capturing system and encryption system were seen to be the most important challenges of the infrastructures. The signature capturing and encryption is very important in electronic transaction as it serves as a means of authenticating exchanged documents between construction stakeholders.

High level of trained technical staff with ICT skills proficient skills in signature capturing system and encryption system is required in order to increase the wide use of e-tendering system amongst construction practitioners.

6.3 Awareness level of e-tendering

According to the finding obtain from the survey conducted around the awareness of e-tendering in the South African construction industry, the result illustrates that a good number of participants are fully aware of e-tendering system and benefits that can derive from the wide use of the system. Specifically 52.9% of the participants are adequately aware of e-tendering while the other participants are not well knowledgeable of the e-tendering system. With this level of awareness amongst construction practitioners e-tendering is definitely gaining attention and this will eventually lead to the wide use of the system in the nearest future.

Though it is evidential that significant numbers of the participants are adequately knowledgeable of e-tendering the usage of the system is notably elementary. Practitioners in the quantity surveying profession have participated in the use of e-tendering than any other practitioners. It is confidently seen that the quantity surveyor are more aware of the e-tendering system than other stakeholders in the South African construction industry.

Based on the research findings the following recommendations are suggested by the researcher:

- Proper briefing on the use of e-tendering should be done during the planning stages of construction projects.
- The adoption of e-tendering, training, education and support from senior management are important requirements for the effectiveness of the system.
- Government being the largest construction clients should develop more competent e-tendering platforms and enforce the use of e-tendering.
- The sales of e-tendering infrastructures especially the software infrastructure monopolised in order to reduce purchase price and installation.
- Effective means of communication should be established to minimise the fragmented nature of the industry.

7 References

Black, P., Rong, D. and Gonzalez, J. (2005) E-tendering – Security and legal issues: Research Report, Research number: 2002-067-A, published by CRC Construction Innovation, January 2005.

CHILIPUNDE, R. (2013) Electronic tendering in Malawian construction Industry: the dilemmas and benefits. *Journal of Modern Education Review*, ISSN 2155-7993, USA. Vol. 3. No. 10, pp. 791-800. Available from: http://www.academicstar.us. [Accessed date: 22nd April 2015].

Choen Weng Lou E, and Alshawi, M. (2009) Critical success factors for e-tendering implementation in construction collaborative environments: People and process issues, *Journal of Information Technology in Construction (ITcon)*, Vol. 14, pg. 98-109.

Connell, L. Electronic Tendering: Recognising a More Effective Use of Information Communications Technology in the Irish Construction Industry, submitted in fulfilment

of Magister degree (M.Sc.) at Dublin Institute of Technology, January 2010. [Accessed date: 12/01/2015].
Eei, K.S. Husain, W. and Norlia, M. (2012) Survey on Benefits and Barriers of E-Procurement: Malaysian SMEs Perspective. *International Journal on Advanced Science Engineering Information Technology,* Vol.2, p. 14-19.
Jacobsen, K. and Koch, C. (2013) E-tendering - an emerging design- construction IT-bridge. *Journal of Construction Engineering and Management*, 29(4): pp. 578-585.
Kajewski, S. and Weippert, A. (2004) E-tendering: Benefits, Challenges and Recommendations for practice, published by QUT, in proceedings CRCCI International Conference: Clients Driving Innovation, surfers Paradise, Australia.
Laryea, S. and Ibem, E. (2014) Barriers and prospects of e-procurement in the South African construction industry. Research paper: school of construction and management, University of the Witwatersrand, Johannesburg, South Africa.
Lavelle, D. and Bardon, A. (2009) E-tendering in construction: time for a change. *Built Environment Research Papers*. Vol. 2 No. 2, 2005, pp.104-112.
Mohemad, R., Abdul, R H., Zulaiha, A O. and Maizura, M N. (2010) Decision Support Systems (DSS) in Construction Tendering Processes. *International Journal of computer science*, Vol. 7, no. 1, March 2010.
Oyediran, S O. and Akintola, A A. (2011) A survey of the state of the art of e-tendering in Nigeria, *Journal of Information Technology in Construction (ITcon)*, Vol. 16, pg. 557-576.
Poole, C.W. (2010) Supply chain principles and applications. HEFMA conference. University of Kwazulu Natal, South Africa.
Vee, C. and Skitmore, C M. (2003) Professional Ethics in the Construction Industry. *Engineering, Construction and Architectural Managemen*t, Vol. 10 (2), pp. 117-127.
World Information Technology and Services Alliance (WITSA) (2004). The WITSA public policy report 2004, 2004, WITSA, Geneva.

THE ASPECT OF LABOUR IN HYBRID AND IN-SITU CONCRETE CONSTRUCTION IN SOUTH AFRICA

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Abstract
In this research programme labour has been identified as one of the aspects of the decision-making process between in-situ and hybrid concrete construction (HCC). The construction industry is ranked as the employer with the fifth highest number of employees in South Africa, which is currently experiencing a 25.4% unemployment rate. This highlights the importance of the construction industry as an employer in South Africa. Labour is considered as one of the areas of highest concern in the South African construction industry. This concern is intensified when the shortage of skilled labour in the industry is taken into account. A labour hour comparison between an in-situ and HCC project were conducted to provide information regarding the amounts and types of labour used in both construction techniques. The comparison showed that HCC employs low-skilled labour more effectively and in larger percentages of total labour than the in-situ alternative. However, the in-situ alternative is better for job-creation considering the total number of employment opportunities. Nevertheless, the HCC alternative has a quicker return rate due to shorter construction periods, therefore labourers are available at an earlier stage for employment on subsequent projects. It is recommended that the use of HCC be promoted to employ larger percentages of low skilled workers and to improve product delivery durations.

Keywords: Hybrid concrete construction, Labour, In-situ concrete

1 Introduction

Hybrid concrete construction (HCC) is a construction technique combining precast concrete elements and in-situ concrete by making use of the best attributes of each to construct buildings and other structures. Several factors can play a role when a decision is required for the most appropriate construction technique to be used on a project. Projects teams need to consider the effect of time and cost, construction safety and quality, technical capability of the designers and contractors, aesthetics, sustainability and labour related issues. This research investigated specifically the aspects of labour and how this would be impacted by a choice for a construction method. The objectives of the study were thus to make a comparison between the two construction methods by considering the types of labour and labour hours spent on each.

2 Literature Review

Precast elements are manufactured in a controlled environment, enabling the production of higher quality products than in the in-situ environment (Elliott, 2002). The controlled environment enables project parties to provide a safer environment for the workforce and to give them better job security (Lombard, 2011). South Africa strives to create 11 million jobs by 2030 (National Planning Commission, 2013). These job creation schemes are described by the *National Development* Plan (NDP). This programme has a direct influence on the construction industry as it is expected from construction companies and other labour-based industries to provide job opportunities to the unskilled and unemployed labour market. Civil construction projects are ranked amongst the best areas to promote good economic growth and to create job opportunities since it is considered as a labour-intensive environment (National Planning Commission, 2013). Interviews with individuals from the South African construction industry concluded that job creation is considered as one of the barriers for the implementation of HCC in South Africa (Schreuder, 2015). Considering the NDP, in-situ construction may provide more employment opportunities, but it is of a more temporary nature than that of HCC projects. Also, according to (Piek, 2014), in-situ concrete construction requires skilled labour, making the use of unskilled temporary labourers a concern for meeting quality requirements.

The *Expanded Public Works Programme* (EPWP) provides a platform to carry out the projected milestones of the NDP. This programme also strives to promote skills development at a sub-programme level, as they are familiar with the current low skills of labourers in South Africa (Department of Public Works, 2013). Considering the objectives of the NDP and EPWP regarding job creation and skills development, HCC does not seem as the ideal solution upfront as it is often postulated to utilize fewer labourers and also for a shorter period (Irish Concrete Federation, 2014). Information on the extent and type of labourers used in this environment will provide relevant support regarding the validity of this opinion. For this reason an investigation was carried out to investigate these aspects of labour by means of a case study.

3 Research Methodology

3.1 Techniques

This study made use of several techniques to satisfy the required research objectives. It was decided to divide the study into two sub-divisions. These were:

Socio-economic aspects of labour in both construction techniques.

Labour productivity and its effect on both construction techniques.

The research process of this study is based on triangulation, which is defined as the use of two or more points of reference to enhance the accuracy of findings. The following paragraphs give a brief description of the research methods applied.

A literature study was first conducted, combining international and local information regarding this investigation to gain background knowledge and to guide the remainder of this study. Semi-structured interviews were also performed involving representatives from various organisations in the South African construction industry. These interviews served as the primary data source regarding socio economic aspects of labour in both construction techniques. It also served as guideline for the set-up of the case study. Ten individuals were interviewed and were asked similar questions. Asking similar questions to various people provides a good point of reference and gives a better understanding of the topic.

Site visits were conducted to enrich the researcher's practical knowledge regarding the two construction methods under consideration. These visits were conducted at the following construction sites:

- In-situ construction sites: New Panorama hospital building - (NMC)
- Hybrid Concrete Construction sites: CPUT hostel building - (NMC)
- Prefabricated elements manufacturing plants: Cobute, Concrete Units, Portland Hollowcore

In a case study a labour hour comparison between an in-situ and hybrid concrete construction project was done to investigate job creation in both the considered construction methods. According to the *Fundamentals of quantitative research*, quantitative methods are normally used to test hypothesis and theories (Sukamolson, 2012). This labour hour comparison compares the labour hours of an in-situ building with a similar HCC building. The labour hours spent to manufacture the precast concrete elements used at the HCC project were also considered. The case study was conducted to help with the setup of the research. The interviews were mainly conducted with individuals from the construction companies providing the labour execution rates. A representative from the precast manufacturing industry was also interviewed to obtain labour hour rates regarding the precast concrete element manufacturing process.

Previous similar (construction related) qualitative and quantitative studies by Jin and Ling (2006) and Lam, Chan and Chan (2007) made use of surveys to successfully answer research questions (Jin and Ling, 2006; Lam, Chan and Chan, 2007). Furthermore, Chan and Chan (2004) also used semi-structured interviews to assist with primary data collection (Chan and Chan, 2004). In addition, research by Ogunlana (2010) determined how various participants on large-scale construction projects perceive performance on projects, by using both semi-structured interviews (a total of 35 interviewees) and a survey questionnaire (a total of 76 respondents).

3.2 Case study

The following paragraphs provide information on the case study.

3.2.1 Structural systems and projects used in this comparison

The structural systems used in the case study were a function of the availability of data from the individuals interviewed for this case study. The construction company which provided the researcher with the labour hour rates of execution predominantly use hollow core floor slabs on loadbearing brick walls in their HCC projects. In their in-situ projects they predominantly use the first two techniques shown in Figure 1.

Project-specific labour hours of activities for post-tensioned flat slabs and conventional flat slabs on in-situ concrete columns as shown in Figure 1 were obtained through site visits and through meetings with the project manager and quantity surveyor of an example project. Information regarding the labour hours of a hybrid concrete construction project was also gathered through meetings with the on-site project manager and quantity surveyor and through a meeting with the director of an anonymous precast manufacturer in South Africa.

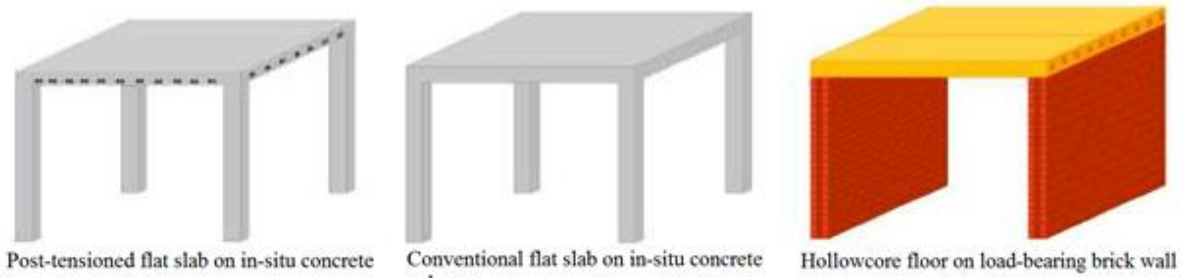

Figure 1. Structural systems used in this case study (Lombard, 2011)

In order to enable a labour hour comparison between the two construction methods, similar in-situ and HCC projects had to be compared. Information for a HCC project was available, but an in-situ replica of the HCC project was not.

A construction company was able to provide the rates of an HCC four storey student residence building. The building was constructed using loadbearing masonry walls with hollow core floor slabs, as shown by the third concept in Figure 1. The floor plan of the student residence building is shown in Figure2.

For the in-situ building improvisation was required. This was done using the available in-situ construction rates from the construction of a multi-storey hospital building. The project manager of the in-situ project was able to provide the construction rates of execution for the two in-situ structural systems shown in Figure 1**Error! Reference source not found.**. It was decided to use these rates as basis for the in-situ project and to apply them to an in-situ concept of the HCC example project. This was possible, as the spans between supports of the in-situ design could be applied to the HCC design.

By conceptually placing columns in the residence building as shown in Figure 3, a floor span configuration reasonably similar to that of the hospital building could be obtained. Also, the floor loadings of imposed load and masonry walls would be reasonably similar. By applying the in-situ execution rates (from the hospital building) to the configured residence building (Figure2), it provided an in-situ alternative for comparison with the HCC example building.

Due to the symmetrical design of the residence building, Figure2 only shows one half of the in-situ structural concept of the residence building. It is important to note that the masonry walls for the in-situ design of the residence building is non-loadbearing and all the inner walls are single-layered, which is similar to the hospital concept from where the in-situ execution rates were obtained. On the other hand, the outer brick walls of the HCC design are loadbearing together with the thicker inner walls which are also double-layered loadbearing walls.

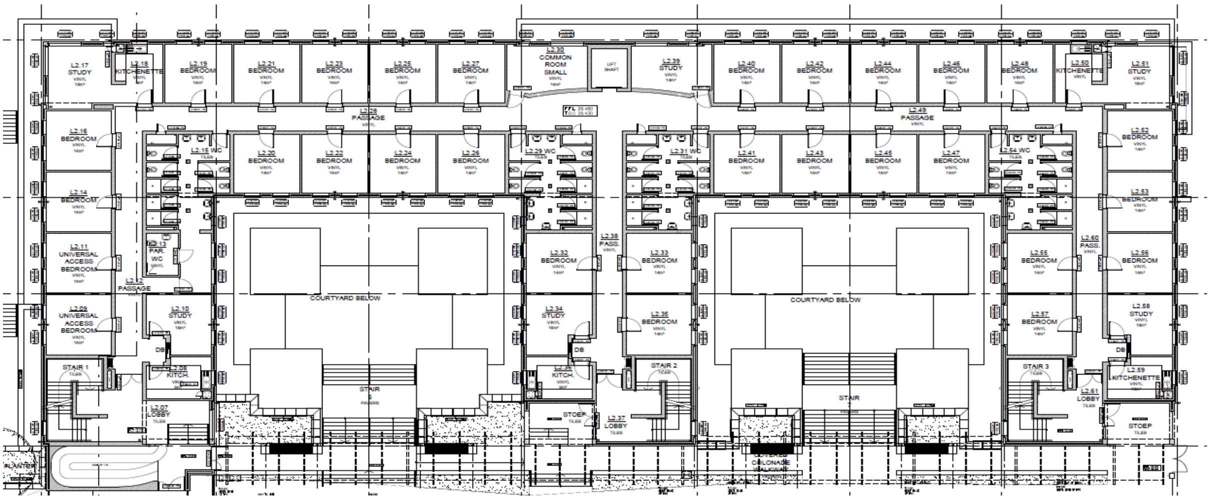

Figure 2. Original floor plan of the HCC student residence building

Both projects were constructed by the same construction company in the same year. This ensured minimal labour execution rate fluctuations between the two considered projects. The precast floor slabs used in the HCC project were manufactured using the extrusion process which is a highly mechanized manufacturing process. The precast manufacturer who provided the precast element manufacturing rates is a well-recognised hollow core floor slab manufacturer in South Africa, which contributes to the reliability of the rates.

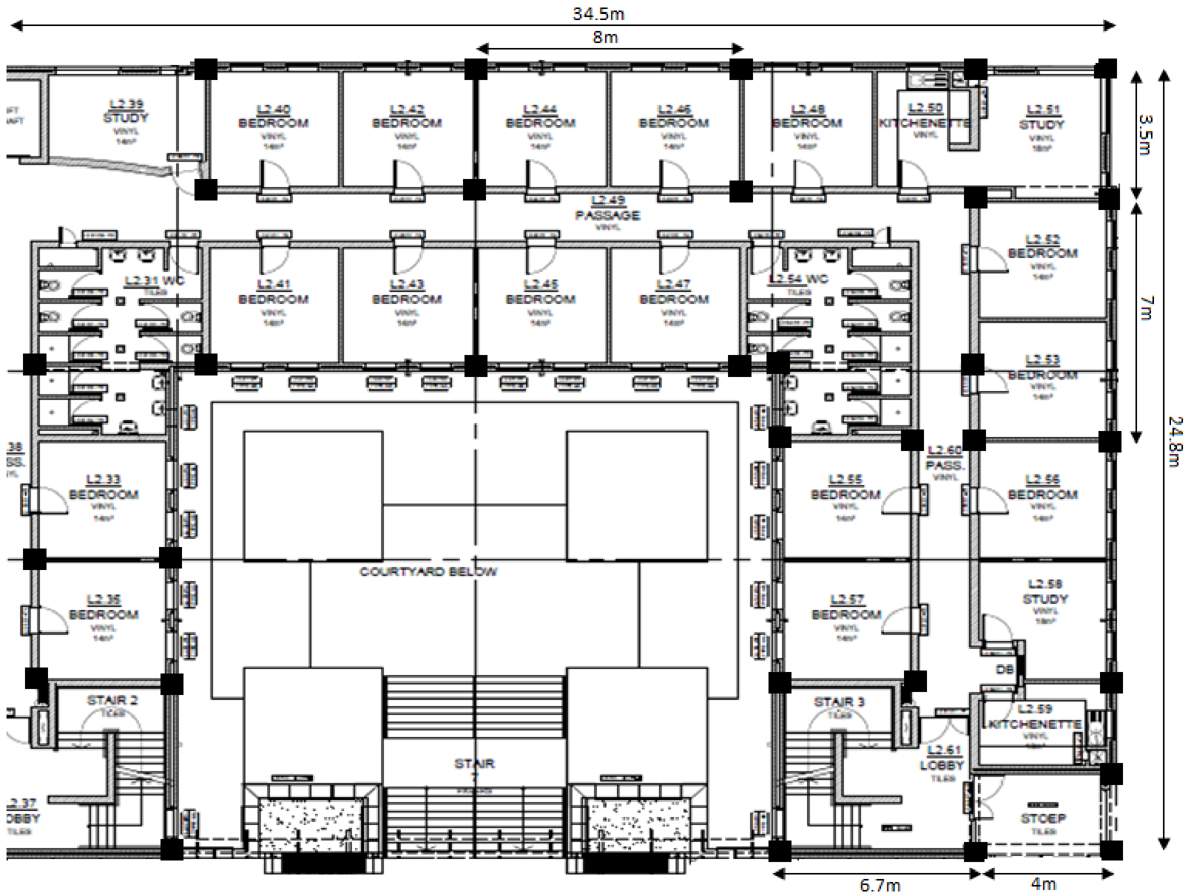

Figure 3. In-situ structural concept of student residence building

4 Findings and Discussions

The labour hour case study was carried out on a project in the structural building industry, and conclusions drawn are therefore only applicable to this industry. The comparison provides relevant information on the construction technique which best promote job creation according to the EPWP as well as the technique which best suit the current labour environment of the South African construction industry.

4.1 Labour rate estimates

The labour rates of execution as received from the project managers of both projects were a function of the labour teams used. These execution rates were simplified to units per hour for a corresponding labour team, where the unit is a function of the type of activity.

The in-situ construction unit rates from the hospital project, with the corresponding labour teams as obtained from the project managers, are shown in Table. Table2 shows the HCC rates of the student residence building with the corresponding labour teams.

The execution rates of the precast manufacturing plant and related labour teams are shown in Table3. This information was obtained from an interview with the director of a precast manufacturing plant.

Table 1. In-situ construction labour rates with corresponding labour teams (Hospital building project)

Unit rates for each activity				Related labour teams				
	Activity	Rate of execution	Production Unit	Supervisor	Operator	Skilled	Semi-skilled	General labour
Columns	Erect formwork	24.19	m^2/h	1	-	-	2	4
	Re-bar	1.57	m^3/h**	1	-	-	3	-
	Cast concrete	4.18	m^3/h	1	-	-	1	2
	Dismantle formwork	30.24	m^2/h	1	-	-	-	4
Deck (Flat slab-250mm)	Erect formwork	15.63	m^2/h	1	-	-	5	8
	Stop-ends	50.00	m^2/h	-	-	-	2	-
	Re-bar	20.83	m^2/h	1	-	-	10	-
	*Install post-tensioned cables	2.63	cables/h	1	-	-	6	-
	Concrete placement	25.00	m^3/h	1	-	-	2	6
	Powerfloating (concrete)	83.33	m^2/h	-	-	3	-	-
	Curing compound (concrete)	166.67	m^2/h	-	-	-	-	2
	Remove stop-ends	62.50	m^2/h	-	-	-	-	4
	*Stressing of post-tensioned cables	4.20	cables/h	1	-	-	3	-
	Strip formwork	20.83	m^2/h	1	-	-	-	6
Masonry Walls	Single layer	14.42	m^2/h	1	-	-	10	6
	Double layer	7.21	m^2/h	1	-	-	10	6

Note: For the deck, the rates for the stop-ends and the re-bar are given as per the area of the floor

* Activities only related to the post-tensioned (PT) flat slab alternative

** The rebar for the column is given as the volume of concrete reinforced per hour

4.2 Employment opportunities in both environments

4.2.1 Legislation requirements

HCC does not seem as an ideal construction method in South Africa due to the reduced labour requirements as shown in Table 4. However, programmes such as the EPWP and NDP do not restrict the use of HCC in the structural building environment.

In the case where a project in this environment is subject to the EPWP, the only activities required to be done using labour intensive techniques are the excavation of foundation trenches by hand and the manufacturing of masonry elements on site (Department of Public Works, 2012). Both these activities can thus be done in a labour intensive manner, even when using HCC as a construction alternative.

Table 2. HCC on-site labour rates with corresponding labour terms (Student residence project)

Unit rates for each activity				Related labour teams					
	Activity	**Rate of execution**	**Production Unit**	**Supervisor**	**Operator**	**Skilled**	**Semi-skilled**	**General labour**
Deck (Structural topping -60mm)	Precast element placement	31.25	m^2/h	1	1	-	-	4
	Formwork to edges	50.00	m^2/h	1	-	-	2	4
	Props	62.50	m^2/h	-	-	-	2	2
	Mesh instalment	20.58	m^2/h	-	-	-	-	4
	Concrete placement	12.43	m^3/h	1	-	-	2	6
	Powerfloating (concrete)	83.33	m^2/h	-	-	3	-	-
	Curing compound (concrete)	166.67	m^2/h	-	-	-	-	2
	Strip formwork	2.25	m^2/h	1	-	-	-	4
	Strip props	62.50	m^2/h	-	-	-	-	4
Masonry Walls	Single layer	14.42	m^2/h	1	-	-	10	6
	Double layer	7.21	m^2/h	1	-	-	10	6
Note: The rates for the formwork to the edges and for the props are given as per the area of the floor								

Table 3. Labour manufacturing rates at precast plant

Unit rates for each activity				Labour teams			
	Activity	**Rate of execution**	**Production Unit**	**Supervisor**	**Operator**	**Semi-skilled**	**General labour**
Production	Cable placement and stressing	86.67	m^2/h	-	1	2	-
	Casting	130.00	m^2/h	1	4	-	4
Stripping	Measure and cutting	130.00	m^2/h	1	2	4	-
	Removal from cast bed	65.00	m^2/h	-	1	-	4
	Move from stockyard onto truck	65.00	m^2/h	-	1	-	4
Note: All the rates in Table 3 are given per area of the floor							

4.2.2 Labour hour comparison

A labour hour comparison between the three alternatives shown in Figure 1 was conducted. The comparison relies on the labour hour rates as received from the project managers and the quantity surveyors.

The floor slab is the only structural element constructed using precast elements in the HCC alternative. Therefore, this activity will be compared in isolation. The labour requirements for the HCC alternative are 1385.6 hours (1030.3 + 355.3), while the conventional method requires 3117.3 hours. This indicates a 55.6% reduction in labour for the construction of the floor slab when using HCC. However, in the structural building industry, all the components are rarely constructed using only precast elements, therefore considering the construction of all the components will provide a better indication of the labour requirements for both techniques.

Table 4. Labour requirements in different construction alternatives

Labour requirements, in man hours per floor level			
Activities group	In-situ concrete construction		Hybrid concrete construction
	Post-tensioned floor slab	**Conventional floor slab**	**Precast floor slabs and bearing walls**
Walls	1898.3	1898.3	2397.3
Columns	377.4	377.4	-
Floor slabs (on-site)	2805.7	3117.3	1030.3
Floor slabs (plant)	-	-	355.3
Total	5081.5	5393.1	3782.9

Considering the total labour requirements as shown in Table 4, it is evident that HCC only requires between 70.1% and 74.4% of the labour force used in the two in-situ alternatives. This comparison includes the floor system, floor supports and supporting walls. Thus, considering the labour requirement reduction of the HCC alternative, it follows that this alternative is more labour effective since it uses less labour to construct the same building (Table 5). However, referring to these values, the use of HCC implies loss of employment opportunities which is considered as a disadvantage considering the current unemployment rate of South Africa. Although HCC utilizes less labour, it has a faster turnover, which means that labourers are available for new employment opportunities at an earlier stage. Another important factor to consider is the type of labour used in each alternative.

Table 5. Man hours required per square meter

Floor slab	Rate (Man hours/m^2)
In-situ (conventional)	4.68
HCC	3.28

4.3 Types of labourers used in both environments

The comparison of the types of on-site labour used in the in-situ and hybrid concrete construction projects, as provided by the project managers, will address the validity of the HCC technique to serve as solution for the current shortage of skills of South African labourers.

Table 6 shows the on-site labour skills breakdown of the construction of the floor systems shown in Figure 1 for the two construction types (In-situ and HCC). These values were compiled from the information obtained from Tables 1, 2 and 3. The labour information of the in-situ conventional floor system (Figure 1) were used for the in-situ construction type shown in Tables 5 and 6, as this technique is more commonly used in South Africa than the post-tensioned (PT) flat slab system.

Table 6. On-site labour skills breakdown for the construction of the floor slab

Construction type	Labour skills						
	General		Semi-skilled		Skilled		Total
	Number	**% of total**	**Number**	**% of total**	**Number**	**% of total**	
In-situ	26	45.6	28	49.1	3	5.3	57
HCC	30*	75.0	6**	15.0	4	10.0	40

*Example - General labour (Table) 4+4+2+4+6+2+4+4 = 30

**Example – Semi-skilled (Table) 2+2+2 = 6

Note: Machine operators are considered as skilled

Note that supervision was not considered in this comparison as they were not considered as part of the workforce in the research. Also, the number of supervisors used in the considered techniques was relatively similar.

Table 7 shows the on-site labour hour breakdown of the various types of labourers. This comparison should be read together with the on-site labour skills breakdown shown in Table 6.

Table 7. On-site labour hours per type of worker

Construction type	Labour skills						
	General		Semi-skilled		Skilled		Total
	Hours	% of total	Hours	% of total	Hours	% of total	
In-situ	1004.5	36.2	1728.0	62.3	41.5	1.5	2774.0
HCC	713.5	80.5	94.1	10.6	78.3	8.8	885.9

Note: Supervisors were not considered in this comparison, therefore the total hours is less than that of Table .

The in-situ labour breakdown shown in Table 6 consists of 45.6% *general* and 49.1% *semi-skilled labourers*. Whilst for the HCC alternative, 75% of the labour consists of *general labourers*. Thus, the majority of HCC's labour force is low-skilled labour.

Table 7 shows that *general labour* conduct 80.5% of the work in the HCC alternative, whilst in the in-situ alternative, *general labour* only conduct 36.2% of the work. Also, important to note is that *semi-skilled labour* conduct 62.3% of the work in the in-situ alternative. Thus, the HCC alternative requires limited skilled and semi-skilled work on-site compared to the in-situ alternative.

Thus from the comparisons presented in Tables 5 and 6 HCC comes across as the ideal solution to the current low skills of labour in South Africa, as it largely relies on *general labour* to conduct the majority of the work.

5 Conclusion and Further Research

From the comparisons conducted in this case study it is concluded that HCC utilizes unskilled labour (conduct 80.5% of concrete work) to greater effect than how the in-situ alternative utilizes semi-skilled and skilled labour (conduct 63.8% of concrete work) considering the productivity of each alternative as shown in Table 5. Thus, considering the effective use of unskilled labour in the HCC environment, this alternative can serve as the ideal solution for the current shortage work for un-skilled labour in South Africa.

It should be kept in mind that HCC creates less job opportunities considering the number of labour hours required for each alternative. However, more job opportunities can be promoted in the local communities as HCC utilizes higher percentages of unskilled labourers than the in-situ alternative. Nevertheless, considering the project as a whole, the HCC alternative would create less job opportunities in total. HCC would not be penalised for creating less job-opportunities as tender requirements usually primarily encourage percentages of job creation amongst local communities. By promoting HCC more projects can be completed at a shorter delivery time providing higher percentages of low skilled employment opportunities.

6 Acknowledgements

The support of the anonymous individuals and construction companies who gave time and information to assist with this investigation is most appreciated.

7 References

Chan, A.P. and Chan, A.P. 2004. Key Performance Indicators for Measuring Construction Success. *Benchmarking: an international journal,* Vol 11(2).

Department of Public Works. 2013. EPWP Background Information. http://www.epwp.gov.za/, 2015, 2 February.

Department of Public Works. 2012. EPWP Large Projects Guidelines. 1http://www.epwp.gov.za/documents/Infrastructure/Large%20Projects/EPWP_Large_Projects_guidelines.pdf, 2015, 20 February.

Elliott, K. 2002. *Precast concrete structures*. Oxford, Elsevier.

Irish Concrete Federation. 2014. *Benefits of precast.* [Online]. Available: http://www.irishconcrete.ie/benefits_of_precast.html [2015, 27 January]

Jin, X. and Ling, F.Y.Y. 2006. Key Relationship-Based Determinants of Project Performance in China. *Building and Environment,* 41(7).

Lam, E.W., Chan, A.P. and Chan, D.W. 2007. Benchmarking the Performance of Design-Build Projects: Development of Project Success Index. *Benchmarking: An International Journal*, 14(5).

Lombard, A. 2011. Decision making between hybrid and in-situ concrete construction in South Africa. Stellenbosch: Stellenbosch University. MEng(Civil).

National Planning Commission. 2013. National Development Plan Vision 2030.

Ogunlana, S.O. 2010. Beyond the 'Iron Triangle': Stakeholder Perception of Key Performance Indicators (KPIs) for Large-Scale Public Sector Development Projects. *International Journal of Project Management,* Vol. 28(3).

Piek, P.J. 2014. An Investigation into the Time and Cost Factors for a Decision between in-Situ and Hybrid Concrete Construction. Stellenbosch: Stellenbosch University. MEng(Civil)

Schreuder, J.M. 2015. The aspect of labour in hybrid and in-situ concrete construction in South Africa. Stellenbosch: Stellenbosch University. MEng(Civil)

Sukamolson, S. 2012. *Fundamentals of quantitative research.* Chulalongkorn University. Ph.D.

ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE DEVELOPMENT OF INTELLIGENT BUILDINGS

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Abstract
This Study examines innovative ways of supporting the application of Artificial Intelligence (AI) to achieve sustainable development of intelligent buildings. On 25 September 2015,193 countries of the UN General Assembly adopted a proposal on Sustainable Development Goals (SDGs) consisting of 17 goals with 169 targets as the 2030 Development Agenda titled 'Transforming our world'. Goal 4 is Make cities and human settlements inclusive, safe, resilient and sustainable. Goal 5 is Take urgent action to combat climate change and its impacts. Massive population growth in slums, built environment degradation, pollution from industrialization and global warming in Africa must be addressed. The main aim of this study is to evaluate ways of using artificial intelligence combined with green architecture to achieve sustainable intelligent buildings in smart cities. The objectives include examining the relationships between Artificial intelligence, Nanotechnology, Lean Construction and Green Architecture. Methodology involves literature reviews on Artificial Intelligence and BIM with primary and secondary data collection on Green Architecture in Lagos. The Study found that green building materials were the main aspect of green architecture in use and prefabricated system of construction was the main aspect of Lean construction technique in use in Lagos. The Study recommends Integrated Project Delivery and Building Information Modeling (BIM). This study is important in that it provides information on intelligent buildings and Smart Cities that will combine advanced technology with green, Lean buildings to achieve the SDGs.

Keywords: Artificial Intelligence, Green architecture, Integrated Project Delivery, Intelligent buildings

1 Introduction

Building Automation refers to the use of computer and information technology to control building appliances and features as well as the advanced functionality provided by the control system of an automated building (Gerhart, 1999). A building that is controlled by a building automation system is often referred to as an intelligent building or a smart home/smart house (Wikipedia, 2013). 'Smart' planning of the urban environment has significant potential to improve quality of life and to reduce the carbon footprint of cities (Falconer and Mitchell 2012). Innovation can be viewed as the application of better solutions that meet new requirements, unarticulated needs, or existing market needs (Maranville 1992). Artificial intelligence (AI) in buildings is the intelligence exhibited by electronic devices and software driven systems which perceive their environment in buildings and take actions to optimize performance effectively within a given context or constraints. The central goals of AI research include reasoning, knowledge, planning, learning, natural language processing (communication), perception and the ability to move and manipulate objects. An intelligent building is a dynamic and responsive

Architecture that provides every occupant with productive, cost-effective and environmentally approved conditions through a continuous interaction among its four basic elements: places (fabric, structure, facilities); processes (automation, control, systems); people (services, users); and management (maintenance, performance) and the interrelation between them (Clements-Croome 2004). An intelligent building is one in which the building fabric, space, services and information systems can respond in an efficient manner to the initial and changing demands of the owner, the occupier and the environment. High performance, green buildings are energy and resource efficient, non-wasteful and non-polluting, highly flexible and adaptable for long term functionality; they are easy to operate and maintain, and are supportive of the productivity and wellbeing of the occupants (Traugott, 1999). An Intelligent building is a highly resource efficient, technologically advanced structure that provides a responsive support and effective environment for optimal performance and can accommodate future changes in use. The future drivers for intelligent buildings include information and communication technologies, robotics, smart materials, sustainable issues technology and social change. Building Energy Management System (BEMS) is an example of efforts aimed at achieving Artificial intelligence in intelligent buildings. The development of powerful microprocessors introduced Direct Digital Control (DDC) to building services and replaced analogue Electromechanical Devices. Nanotechnology is the engineering of functional systems at the atomic and molecular scale which involves manipulation of matter with at least one dimension sized from 1 to 100 nanometers thus giving people the ability to construct items from bottom up.

1.1 Problem Statement

The United States Green Building council (2016) states that the commercial and residential building sector accounts for 39% of carbon dioxide (CO2) emissions in the United States per year, more than any other sector. U.S. buildings alone are responsible for more CO2 emissions annually than those of any other country except China. Most of these emissions come from the combustion of fossil fuels to provide heating, cooling and lighting, and to power appliances and electrical equipment. By transforming the built environment to be more energy-efficient and climate-friendly, the building sector can play a major role in reducing the threat of climate change. Despite great advancement in technology for buildings, there is still a concern for global warming as buildings contribute significantly to pollution of the eco-system. It is therefore important that the use of advanced technology in buildings should be linked with sustainable development in line with SDGs.

This paper is important in that it examines support systems for Artificial intelligence in buildings as part of smart cities. This can help to minimize negative impacts such as built environmental degradation and global warming due to pressure from rapidly growing global populations.

1.2 Main objective

The main aim of this study is to evaluate ways of using artificial intelligence combined with green architecture to achieve sustainable intelligent buildings in smart cities. The objectives include examining the relationships between Artificial intelligence, Nanotechnology, Lean Construction and Green Architecture.

Figure 1. External view of the Endless City (Source: SURE Architecture Company, 2014)

Figure 2. Internal view of the Endless City (Source: SURE Architecture Company, 2014)

A good example where advanced technology is combined with sustainable development is “The Endless City”. The “Endless City” proposal drawn up by Beijing-based SURE architecture Company is a 300 meters tower in Shoreditch, England (see figures 1 and 2). The proposed structure, which won the super skyscrapers award in 2014, has two continuous ramps, or “streets”, spiralling up through the building, each lined with shops, apartments, parks and offices. Space between the ramps widens near the top of the building, letting in light and ventilation to filter down and save on energy costs, while rain water is collected and recycled.

Six big vertical tubes support the ramps and provide transport spaces for people, energy, waste, water and prefabricated modular steel elements for the skyscraper's ongoing growth.

2 Overview of Architectural Intlemelligence (AI)

The field of AI research was founded at a conference in the summer of 1956. AI involves the use of Machine perception – the ability to use input from sensors such as cameras, microphones, tactile sensors, sonar and others more exotic, to deduce aspects of the world; Computer vision – the ability to analyze visual input; Speech recognition, facial recognition and object recognition. Affective computing is the study and development of systems and devices that can recognize, interpret, process, and simulate human affects. These are aspects of AI for buildings. Intellectual capacities are grouped into practical, analytic and Creative. Hawking (2014) posits that success in creating AI would be the biggest event in human history and notes that it might also be the last, unless humans learn how to avoid the risks. Emotion and social skills play two roles for an intelligent agent or machine. First, it must be able to predict the actions of others, by understanding their motives and emotional states. This involves elements of game theory, decision theory, as well as the ability to model human emotions and the perceptual skills to detect emotions. Also, in an effort to facilitate human-computer interaction, an intelligent machine might want to be able to display emotions, even if it does not actually experience them itself in order to appear sensitive to the emotional dynamics of human interaction. A straightforward, specific task like machine translation requires that the machine read and write in both languages (Natural Language Processing), follow the author's argument (reason), know what is being talked about (knowledge), and faithfully reproduce the author's intention (social intelligence). In the 1990s, AI researchers developed sophisticated mathematical tools to solve specific sub-problems. These tools are truly scientific, in the sense that their results are both measurable and verifiable, and they have been responsible for many of AI's recent successes. The simplest AI applications can be divided into two types: classifiers ("if shiny then diamond") and controllers ("if shiny then pick up"). Controllers do, however, also classify conditions before inferring actions, and therefore classification forms a central part of many AI systems. A derivative of the Turing test is the Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA). As the name implies, this helps to determine that a user is an actual person and not a computer posing as a human. If research into strong AI produced sufficiently intelligent software, it might be able to reprogram and improve itself. The improved software would be even better at improving itself, leading to recursive self-improvement. The new intelligence could thus increase exponentially and dramatically surpass humans.

Quality Environment Fundamental Modules are Green Index, Space Index, Comfort Index, working Efficiency Index, Culture Index, High-tech Image Index, Safety and Security Index, Construction Process and Structure Index, Cost Effectiveness Index and Health and Sanitation Index. Four Main Aspects Of Hardware Components are – a- Facility management - Take care & maintain various functions for occupant comfort & operation; b- Information management - Office automation (OA), LAN, wiring; c- Communication - Tel/Fax, e-mail, video telecommunication and d- Control - DDC, building automation system. Common needs of intelligent building tenants include Built-in Internet wiring, LAN/WAN connectivity, Conduits for cabling, High-tech HVAC and Wiring for high-speed networks.

2.1 Nanotechnology for new building materials

Nanotechnology is taken as the scale range from 1 to 100 nm (National Nanotechnology Initiative) Materials reduced to the nanoscale can show different properties compared to what they exhibit on a macroscale thus enabling unique applications. For instance, opaque substances can become transparent (copper); stable materials can turn combustible (aluminium); insoluble materials may become soluble (gold). A material such as gold, which is chemically inert at normal scales, can serve as a potent chemical catalyst at nanoscale. Nanoscale materials such as nanopillars are sometimes used in solar cells which combats the cost of traditional Silicon solar cells. Development of applications incorporating semiconductor nanoparticles are to be used in the next generation of products. Such products include display technology, lighting, solar cells and biological imaging. Other applications are coating the surface of the wash hand basins and toilet bowls (minimizes surface tension thus reducing the possibility of particles adhering to the surface), preventing the steaming up of mirrors and tiles and preventing condensation droplets forming on their surfaces. On the surface of Active glass, grime is broken down by a daylight-activated reaction with a surface coating of titanium dioxide. The glass is also hydrophilic, which means that water spreads across it rather than forming droplets and thus can take the dirt with it. Rain effectively can thus clean the glass. Nanotechnology has led to developments in the science of photonics which is linked with opto-electronics and production facilities to make fibre-optic communication and switching devices. Cars are being manufactured with nanomaterials so they may need fewer metals and less fuel to operate in the future. There are however calls for stricter application of the precautionary principle, with delayed marketing approval, enhanced labelling and additional safety data development requirements in relation to certain forms of nanotechnology.

2.2 Building Information Modeling (BIM)

Building Information Modelling (BIM) is a set of interacting policies, processes and technologies generating a “methodology to manage the essential building design and project data in digital format throughout the building's life-cycle” (Penttilä, 2006). It is made of intelligent building components which include data attributes and parametric rules for each object. For instance, a door of certain material and dimension is parametrically related and hosted by a wall. Furthermore, BIM provides consistent and coordinated views and representations of the digital model including reliable data for each view. This saves a lot of designer’s time since each view is coordinated through the built-in intelligence of the model. BIM is the process and practice of virtual design and construction throughout its lifecycle. It is a platform to share knowledge and communicate between project participants. High quality 3D renderings of a building can be generated from Building Information Models.

A collaborative BIM approach enables the sharing of the model between the engineer, architect, construction manager, and subcontractors. At the BIM meetings, the construction manager and subcontractor can provide their expert construction knowledge to the design team. Moreover, the construction manager can use the building information models to generate constructability reports, coordinate, plan, schedule and cost estimate. Traditional Design-Bid-Build, Design & Build and Integrated Project Delivery (IPD) methods are popular project delivery approaches that the industry currently practices. Construction managers can use BIM to extract quantities of work to prepare cost estimates. Construction managers can use BIM to coordinate work with subcontractors. They can also update schedule and costs with BIM. Lastly, they can turn over an as-built building information model to the owner’s maintenance team.

2.3 Lean Construction

Lean construction is concerned with the alignment and holistic pursuit of concurrent and continuous improvements in all dimensions of the built and natural environment: design, construction, activation, maintenance, salvaging, and recycling (Abdelhamid et al., 2008). This approach tries to manage and improve construction processes with minimum cost and maximum value by considering customer needs (Koskela et al., 2002). The term "Lean Construction" was coined by the International Group for Lean Construction in its first meeting in 1993 (Gleeson et al., 2007). It accomplishes these objectives through the use of Supply Chain Management (SCM) and Just-In-Time (JIT) techniques as well as the open sharing of information between all the parties involved in the production process. Womack and Jones (1996) identified the key principles for lean construction systems as value; value stream (by mapping the whole value stream, establishing cooperation between the participants, and identifying and eliminating waste, the construction process can be improved); flow (business flow includes project information, job site flow involves the activities and the way they have to be done, while supply flow involves the materials used in a project); pull (the efforts of all participants stabilize pulls during the construction process); and perfection (work instructions and procedures are developed, quality control mechanisms are established).

Four main principles of Lean construction system are the minimal use of building materials; minimal cost for affordability; maximum quality of building; minimal wastage of building materials and energy. These principles are examined from the design stage and through the whole management process. Ballard and Howell (1994) designed the Last Planner System as one method for applying lean techniques to construction. It provides productive unit and workflow controls and facilitates quick response to correct for deviations from expected outcomes by using root cause analysis. Control is defined as causing events to conform to plan as opposed to the construction tradition of monitoring progress against schedule and budget projections.

2.4 Green Architecture

Green Architecture basically refers to environmentally friendly buildings with these characteristics: 1- Ventilation systems designed for efficient heating and cooling. 2- Energy-efficient lighting and appliances. 3- Water-saving plumbing fixtures. 4- Landscapes planned to maximize passive solar energy. 5- Minimal harm to the natural habitat. 6-Alternate power sources such as solar power or wind power. 7-Non-synthetic, non-toxic materials.8-Responsibly-harvested woods and stone. 9- Adaptive reuse of older buildings. 10 - Use of recycled architectural salvage. 11- Efficient use of space. While most green buildings do not have all of these features, the highest goal of green architecture is to be fully sustainable. Green Architecture is also Known As: Sustainable development, eco-design, eco-friendly architecture, earth-friendly architecture, environmental architecture, natural architecture.

Green building (also known as green construction or sustainable building) is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: design, construction, operation, maintenance, renovation, and demolition. Criteria for sustainable buildings are as follows 1- Natural light (level of natural light enhancement) - does the building enhance quality natural light for comfort and power efficiency? 2- Environmental impact (level of "greenness") - how environmentally friendly is the building on the eco-system? 3- Architectural design (level of flexibility and versatility) - how innovative is the architectural design of the building? 4- Thermal comfort (level of resistance to heat load) - how resistant is the building to heat load? 5- Water cycle (enhancement of water cycle) - does the building enhance reuse of water? 6- Appropriate technology (level of efficient usage and availability) - can the building be built using appropriate technology which is readily available locally? 7– Waste management (cradle to cradle concept) - does the building generate waste over the years that can be recycled and re-used? 8- Feedback (level of affordability and cultural acceptability) - do people generally like the building? 9- Air quality (level of impact on human health with proper ventilation) - how toxic is the building to living creatures? 10- Durability (level of resistance to climate and usage) - is the building resistant to corrosion, wear and tear, warping, fading, leaking and tropical ocean-salty climate?

3 Integrated Project Delivery

Integrated Project Delivery (IPD) is a collaborative alliance of people, systems, business structures and practices into a process that harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction. There are eight main sequential phases to the integrated project delivery method: conceptualization (expanded programming); criteria design (expanded schematic design); detailed design (expanded design development); implementation documents (construction documents); agency review; buyout phase; construction; and closeout phases. Facilities management is the final part. IPD contractually requires designers, construction manager, subcontractors and owners to share the project risks. If the project stays within budget, then all the project participants receive their share of the profits. Otherwise, they all lose their fees. This incentive promotes all the participants to work together towards a common goal. They share all the Building Information Model data, share decision-making, and share responsibilities. This joint project management approach results in pure collaboration and no litigation. BIM facilitates IPD by uniting all professionals involved in the project. The new focus in IPD is the final value created for the owner, the finished building. Rather than each participant focusing exclusively on their part of construction without considering the implications on the whole process, the IPD method brings all participants together early with collaborative incentives to maximize value for the owner. (See Figure 4) This collaborative approach allows informed decision-making early in the project where the most value can be created. The close collaboration eliminates a great deal of waste in the design, and allows data sharing directly between the design and construction team eliminating a large barrier to increased productivity in construction. Research Methodology

Methodology involves a literature survey on Artificial Intelligence and BIM with primary and secondary data collection on Green Architecture in Lagos, Nigeria. The method of primary data collection involved site visits to four sites in order to identify the green building materials used (such as expandable polystyrene cement sandwich wall panel). Green building material is one of the main aspects of green architecture in use in Lagos. Prefab system of construction is one of the main aspects of Lean construction technique in use in Lagos.

4 Findings and Discussions

The study found that Lightweight concrete foam is used in expandable polystyrene (EPS) cement sandwich wall panel. Advantages are that EPS foam is an excellent energy efficient thermal insulation material; it is non-toxic, safe and contains no chlorofluorocarbons or hydro-fluorocarbons so as not to damage the ozone layer; EPS foam can be recycled in a number of ways; Minimal waste with pre-punched openings for electrical and plumbing; pre-cut and preassembled headers and jambs; sustainable material that does not rot, rust or decompose; it requires no maintenance; it is mold, insect and rodent resistant; doesn't support mold growth; excellent resistance to moisture absorption; good sound insulation and sound-absorbing functions; good seismic performance; space saving, thickness of 60mm-180mm; and cost effective.

Figure 3. Service duct being inserted on site as worker on the right hammers box and barrel into each other

Innovative use of PVC and concrete a prefabricated system of construction by Royal Sanderton at Yaba College of Technology site (see Figure 3) provides evidence that the use of concrete and PVC casing (box and barrel) is three times faster than the conventional use of sandcrete blocks; waste on site is eliminated, thus the system is environmentally friendly; there is no need for columns and painting thereby reducing cost when mass produced; the quality of finished work is higher than conventional use of sandcrete blocks facilitating neater mechanical and electrical installations; the thermal comfort is better than conventional construction; the durability of PVC ensures that there is no need for painting in future thus saving maintenance cost; the PVC used comes in various tasteful colours which enhance the use of natural light; the building materials used are non-toxic to human beings and animals thus having a positive environmental impact with reference to air quality; the building materials used can be recycled and used again; the building materials can be used with any architectural design thus enhancing flexibility and innovative designs; the building materials used can be utilized on site by trained local workforce using appropriate technology; and this system of prefabricated housing construction is gaining popularity among investors in housing estates in Lagos

5 Conclusion and Recommendations

This study examines Artificial intelligence, Nanotechnology, Lean Construction and Green Architecture in order to find out whether these forms of technology and building materials are interrelated and used in the delivery of Green Architecture Projects in Lagos. The study found that there is an interconnection between advanced technologies (AI with Nanotechnology) and sustainable building construction, and Green Architecture, and the use of Integrated Project Delivery and BIM to form sustainable intelligent buildings and smart cities (see figure 4). The study identified the green building materials (such as expandable polystyrene cement sandwich wall panel) as one of the main aspects of green architecture in use and that the main aspect of Lean construction technique in use in Lagos is the prefabricated system of construction. However, Artificial intelligence nor nanotechnology and BIM were used on the project sites studied.

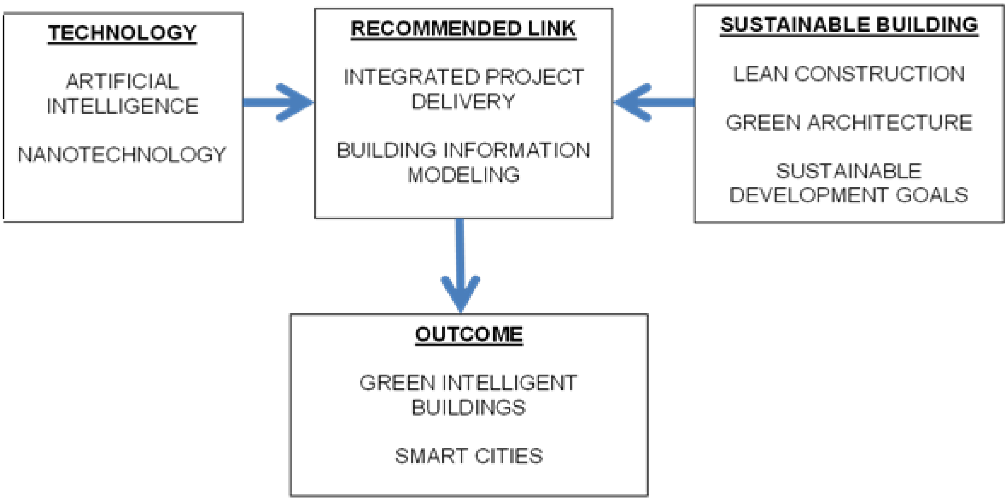

Figure 4. IPD and BIM bring together advanced technology with sustainable building to form smart cities

6 References

Abdelhamid, T.S., El-Gafy, M., and Salem, O. (2008). “Lean Construction: Fundamentals and Principles.” American Professional Constructor Journal.

Ballard, G., and Howell, G. (1994). Implementing Lean Construction – Stabilizing work flow. “Conference on Lean Construction” at Santiago, Chile. September 1994

Building automation - Wikipedia, the free encyclopedia, http://en.wikipedia.org/wiki/ Building automation (Accessed: 6 November 2013)

Clements-Croome, D. 2004. Intelligent Buildings – Design, Management and Operations. ISBN: 0 7277 3266 8. Published by Thomas Telford books, London E14 4JD.

Falconer, G. & Mitchell, S., 2012. Smart City Framework: A Systematic Process for Enabling Smart Connected Communities. /web/about/ac79/docs/ps/motm/Smart-City-Framework. (September).

Gerhart, James., 1999, Home Automation and Wiring. McGraw Hill

Gleeson, F. and Townend J. (2007). "Lean construction in the corporate world of the U.K. construction industry", University of Manchester, School of Mechanical, Aerospace, Civil and Construction Engineering.

Hawking, S. (2014) Hawking warns on rise of the machines. Financial Times.com-Companies - Technology, December 2, 2014. http://www.ft.com/intl/cms/s/

Koskela, L.; Howell, G.; Ballard, G.; Tommelein, I. (2002). "Foundations of Lean Construction". In Best, Rick; de Valence, Gerard. Design and Construction: Building in Value. Oxford, UK: Butterworth-Heinemann, Elsevier. ISBN 0750651490.

Maranville, S (1992), Entrepreneurship in the Business Curriculum, Journal of Education for Business, Vol. 68 No. 1, pp.27-31

Penttilä (2006) Describing the changes in architectural information technology to understand design complexity and free-form architectural expression ITCON 11 (Special Issue The Effects of CAD on Building Form and Design Quality) (2006), pp. 395–408

Traugott, A. 1999. Green Building design equals high performance building design. Consulting specifying engineer. January. 68 – 74

United States Green Building council (2016). Buildings and Climate Change. www.eesi.org/files/climate.pdf. Assessed on 11th January, 2016.

Wikipedia. 2013. Building Automation Systems. Accessed 6th Nov 2013

Womack, J. P, Jones, D. T. (1996). Lean Thinking: Banish Waste and Create Wealth in your Corporation. New York: Simon & Schuster.

CATEGORIZATION OF THE DUTIES AND REQUIRED COMPETENCIES OF A MANAGEMENT CONTRACTOR

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Abstract
Although, the traditional procurement system is more understood and more popular in usage when compared to other construction procurement systems, evidence from previous studies has reveals that management contracting procurement system is most suitable for large and complex projects, when projects are required to be delivered on time and when flexibility is desired during construction. It can be argued that the reported benefits of the management contracting system may as a result of the roles and duties performed by the management contractor. However, limited attention has been given to these duties performed by the management contractor which has resulted in the reported benefits of the system and also the required competencies for a management contractor to performing these duties. The aim of the study was to create a better understanding on the duties of a management contractor and the required competencies for a management contractor to perform these duties. Using documentary analysis and semi-structure interviews, data for this study will be collected from key roles players of management contracts in South Africa. The contribution of this study will help construction clients and the construction industry in the recruitment, selection, performance management and evaluation of management contractors. And, also add to the knowledge base for continuous professional development and training for aspiring management contractors. In addition, this study is also being used in establishing a scope for an ongoing PhD research.

Keywords: Construction procurement, Duties of a management contractor, Management contracting, Required competencies for a management contractor

1 Introduction

In recent years, the increasing needs for integration of project team, improved collaboration, risk sharing, early contractor's involvement and more relational relationship in construction project delivery system, project sizes and complexities as well as the need for enhancing the achievement of project outcomes of time, cost and quality, together has contributed to the development and adoption of other procurement system from the most common traditional procurement system. As indicated in the study by Al-Harthi et al. (2014), the shift from the traditional system has resulted in several changes to the organization, roles and systems adopted for development schemes. And, in conformity, management contracting procurement system has continued to gain more adoption by construction clients for their construction project delivery. The Chartered Institute of Building (CIOB, 2010) survey report on procurement in the construction industry indicated that as construction projects increases in complexity and value, the management contracting system tends to be the preferred choice of construction procurement adopted by construction clients. As well, in a Survey on construction industry indicators by the Construction Industry Development Board (CIDB, 2014: 17) management contracting system was indicated to be the second mostly used procurement system by national and provincial departments together after the traditional system.

The management contracting system has been adjudged to be most suitable for large and complex projects, and when projects are required to be delivered on time and flexibility of construction is desired. In a study evaluating management contracting and investigating the significant difference in clients perspective of performance criteria between management and traditional procurement systems by Sidwell (1983) and Naoum (1994) respectively; the benefits in management contracting system were attributed to the improved integration of project team members, flexibility of the system, breaking down of work into packages with total competition of work packages, improved collaboration, risk sharing, early contractor's involvement and more relational relationship enhanced by the management contractor.

The distinguishing feature in the management contracting system from the traditional system is the introduction of a management contractor at an early stage of the project. According to Murdoch and Huges (2008: 59), the introduction of the management contractor allow for the contribution of the management contractor's experience and expertise in the design and construction management of projects. Therefore, it may be argued that the reported benefits of the system are as a result of the roles and duties performed by the management contractor. While research continuous to emphasize on the benefits and suitability of using the system (see Naoum, 1994; Naoum and Langford, 1987; Sidwell, 1983; Ward et al., 1991). However, limited attention has been given to the duties performed by the management contractor which has resulted in the reported benefits of the system and the required competencies by the management contractor in performing these duties.

The focus of this research therefore is to analyze the duties performed by management contractors and investigate the required competencies for management contractors to perform their duties effectively, when a construction client decides to entrust the management of construction project to a management contractor (Indicating the choice of a management contracting procurement system).

2 Management Contracting Procurement System

Management contracting is an established procurement system in the construction industry which is said to evolved from the United Kingdom (UK) (Sidwell, 1983). According to Murdoch and Huges (2008) the system has been in use for considerable time even though it is only in 1987 there has been a standard form of contract for it. The horizon factory in Nottingham for John payer limited designed by Arup and Associates and built by Bovis limited, as well as the British library in London where among the earliest projects built using this system (Murdoch and Hughes, 2008; Sidwell, 1983).

The international standard organization (ISO 10845-1 2010) describes a management contracting system as a contract in which a contractor provides consultation during the design stage and is responsible for planning and managing all post contract activities and for the performance of the whole contract. Several studies have described the system as consisting of 100% sub-contracting since every item of the work is subcontracted to the works contractors (see Al-Harthi et al., 2014b; Murdoch and Hughes, 2008; Naoum, 1994; Sidwell, 1983; Ward et al., 1991). However, in the guidance on procurement and contract strategies provided by the Institute of Civil Engineers (ICE, 2005: 7) management contractors may also participate in actual construction of some of the construction works. Whatever the case however, there is a consensus report that only the management contractor goes into construction work contract with the client for the entire works, and then takes responsibility for the administrative and operational works of the contract, as against the case in a construction management system or a traditional system, where work contractors also goes into direct contract with clients.

2.1 Difference between Management Contracting and the Traditional Procurement System

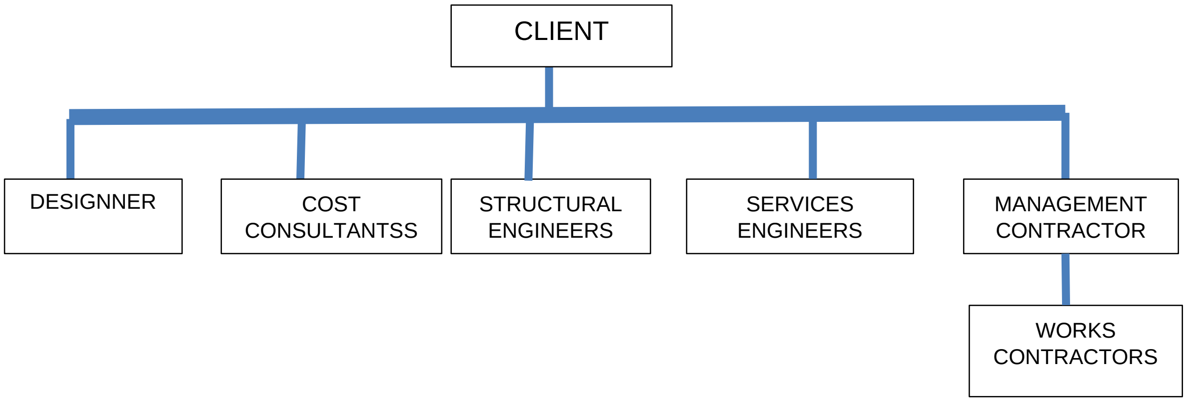

Figure 1. The management contracting system

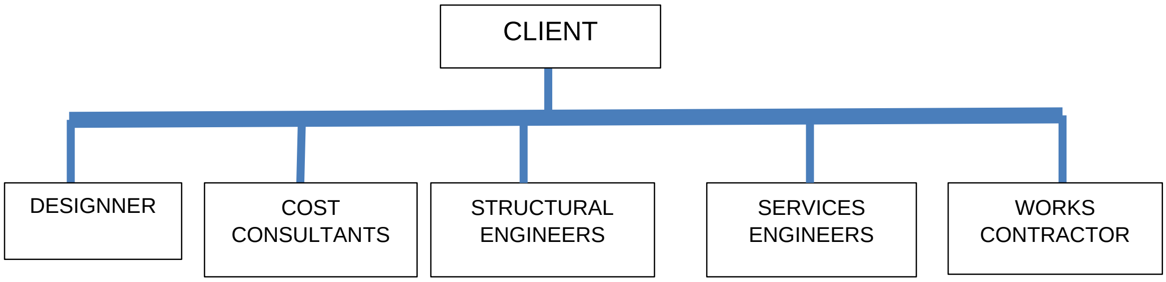

Figure 2. The traditional system

On review of organization structure and contractual relationships of management contracting and the traditional system of procurement as provided by (Al-Harthi et al., 2014b; Murdoch and Hughes, 2008; Naoum, 1994; Naoum and Langford, 1987; RICS, 2013; Sidwell, 1983; Ward et al., 1991), Figure 1 and 2 was developed to illustrates the contractual relationship and organization structure in expressing the differences of a management contracting and traditional procurement system respectively.

As indicated in the figure 1; considering the management contractor and work contractors, only the management contractor have a contractual relationship with the client and then appoints and manages the work contractors who are contractually accountable to the management contractor. In figure 2, the work contractor has direct contractual relationship with the client. this will result in a more active role by the client unlike in a case of management contracting where clients take a more detached role as suggested by (Naoum and Langford, 1987).

Also, the management contractor is indicated to be elevated to the same level as the consultants enabling him offer services both at the design stage and as well at construction stage. With this arrangement, the consultants will be having access to the expertise and experience of the management contractor at the design stage which may result in an improved consultancy services from the consultants. According to Murdoch and Hughes (2008) the opportunity provided for contractors to have the same status with the consultants is the major reasons why contractors favoured a management contracting system to the traditional system, where contractors are directly placed under the scrutiny of consultants or the project principal agent, which usually are architect's depending on the type of project.

In addition, in management contracting, management contractors are engaged at the early in the project and facilitate the overlap of designs and construction being a member of the design team as well as the construction team as oppose to the traditional system in which there is separation of design and construction and designs are usually completed before construction commences. This has been attributed to the flexibility and early completion feature of a management contracting system(see Naoum, 1994; Sidwell, 1983 and Ward et al., 1991).

Furthermore, in management contracting system, sub-contracting is a major distinguishing feature. The management contractor does no construction works but rather subcontract all the works, which are usually broken down into work packages to the work contractors as submitted by (Al-Harthi et al., 2014b and Murdoch and Hughes, 2008). Contrary to the traditional system, where the work contractor is responsible for the actual construction of the construction work and may use subcontracting as well. However, according to ICE (2005:7) guidance on procurement and contract strategies, management contractors may also participate in actual construction work. Also, in management contracting, management contractors usually goes into a fee contract and are usually paid a prime cost of all works done plus the fee. Although, Murdoch and Hughes (2008) argued that certain direct works such as site staffing, provision of labour and materials and sundry cost services provided by the management contractor should be dealt with on a lump sum basis instead of cost reimbursement. But contractors in a traditional system are often paid a lump sum for the contract.

From the foregoing, these differences in management contracting from the traditional system appear to be responsible for the added advantages of that have been attributed to the system over the traditional procurement system. Thereby, making management contracting a more suitable procurement route particular for large and complex projects, and when early completion and flexibility during construction is desired.

2.2 Duties of a Management Contractor

In a case study involving 39 management contracts and 30 traditional contracts in UK, to investigate whether the means of procurement influenced project performance, Naoum (1994) reported that management contractor's liability and responsibility is not clear and there is no enough evidence to support how management contracting reduces overall building cost and quality of projects. This report may be an indication of a gap in knowledge on the duties performed by management contractors. However, Murdoch and Hughes (2008: 64) asserted that due to the duties performed by the management contractor, the roles of a contract administrator and a quantity surveyor may not be defined in a management contract.

Also, from the foregoing on the differences between management contracting and a traditional system, the benefits in management contracting could be attributed to the duties performed by the management contractor as a result of transition of responsibility of the management contractor in being a consultant as well as a contractor, providing services at the preconstruction stage and at the construction stage.

Owing to the different roles and responsibilities of the management contractor in a management contracting system, the duties performed by the management contractor can be argued to be clearly distinct from that of a general contractor in a traditional system. This calls for clarification of the duties of the management contractor and to categorize them accordingly in the different phases of a construction project.

Essentially, the duties performed by the management contractor maybe divided into pre-construction period duties and construction period duties as suggested by Murdoch and Hughes (2008: 64) with the management contractor carrying out duties such as professional team integration, advising on breakdown of work packages and assisting with negotiations at the pre-construction stage; and duties such as programming and planning, monitoring off-site preparation work, instituting effective cost control techniques, labour relations and site management at the construction stage as well as providing site facilities and services. Sidewell (1983) in his study submits that the two most important duties of the management contractor may be in subcontractors control and design team integration. Similarly, Ward et al (1991) has reported coordination of work responsibilities and liabilities and control functions as the duties performed by a management contractor. These identified management contractor duties appears comparable to management duties as identified by Mintzberg (1973: 92) which includes interpersonal role of figurehead, leader and liaison; informational role of monitor, disseminator and spokesman; and decisional role of entrepreneur, disturbance handler, resource allocator and negotiator. Earlier view on managerial duties were described by Henry Fayol in 1916 (Fayol, 1954)to include Planning, organizing, controlling, commanding and coordinating.

2.3 Required Competencies of a Management Contractor

Competency has been described as the knowledge, skills, and behaviours required to performing well and keep up with the culture of an industry (Delo et al., 2010). Similarly, Mirabile (1997) earlier describes competency as the “knowledge, skill, ability or characteristic associated with high performance on a job, such as problems solving, analytical thinking, or leadership”. For a management contractor to perform required duties in management contracting effectively, it can be argued that there are required competencies the management contractors should possess. A number of studies have sought to identify required competencies and their relationship to positions and performance in different jobs.

Meredith and Mantel Jr (2011:142) in their book on “ Project management a managerial approach” categorizes project management required competences into six key skill areas, to include, communication, organization, team building, leadership, coping and technological skills. According to Delo et al (2010) recurring themes of competencies include behaviours such as self-control, resilience, communication, self-assurance, and those related to team leadership. Dainty et al (2005) suggest that Construction project managers have to combine technical knowledge and expertise with behaviours that engender effective multi-organisational teamwork and communication if successful outcomes are to be achieved. They further identified the competencies for project management performance to include the following: achievement orientation, initiative, information seeking, focus on client’s needs, impact and influence, directedness, teamwork and cooperation. Others are team leadership, analytical thinking, conceptual thinking, self-control and flexibility; with self-control and team leadership being the core competencies. In a report evaluating management contracting in the UK, builders management, construction, estimating, buying and planning are identified competencies made available to design teams by management contractors which brings the benefits of speed, economy and construction method (Sidwell, 1983).

Owing to the increased responsibility management contractors are expected to perform, undoubtedly the knowledge of their required competencies may provide clients with informed information for appropriately selecting a management contractor that will perform towards achieving expected project outcomes.

3 Research Methodology

The aim of the study was to contribute to the body of knowledge for a better understanding of the duties of a management contractor in a management contracting procurement system and the required competencies for a management contractor to perform these duties. This will require a comprehensive and inductive study of management contracts.

In view of this, the study adopted the descriptive survey method, involving the use of qualitative study via semi structure interview and documentary analysis of projects wherein management contracting was adopted. According to the CIDB (2014:17) report on construction industry indicators in South Africa, management contracting system was adopted for 34 projects across all employers category with the National and Provincial department being the main employer. Negotiation is ongoing to identify these projects for the purpose of case studies and to obtain relevant data from the key role players involved in such contract as part of an ongoing PhD research in management contracting. However, for this study due to time constraint, 3 recent cases of management contracts have been identified; upon which documentary analysis and semi structure interview with key role player was carried out.

4 Findings and Discussion

The data collection involved an examination of project tender documents and semi structure interview with key role player of three case studies of management contracting contracts.

From the examination of the project documents for the three case studies, the specific duties performed by the management contractor are presented in Table 1.

Table 1. Duties of Management Contractor

Duties	Description	Case study 1	Case study 2	Case study 3
Manage	Manage the procurement process, the implementation of project programme s, perform duties relating to overall management of contract, site administration and provide progress reports,	✓	✓	✓
Co-ordinate	Co-ordinate a considerable number of subcontractors, service providers and suppliers and supervises the work of the subcontractors	✓	✓	✓
Plan	Planning at a package level including development of maintenance plan and condition assessment and preparing forecast to define cost of work at intervals			✓
Direct	Direct the project team	✓	✓	✓
Design	Oversee development of design			✓
Facilitate	Early start of work to meet deadlines	✓	✓	✓
Procure Resources	Procure resources that are necessary to provide the required works and related professional design and condition assessment services			✓
Execute limited portion of the work	Execute limited portion of the work with own workforce, site establishment and de-establishment and provision of site facilities such as latrines, water and electrical services	✓	✓	✓
Contracting	Contracting, pricing and targeting strategy, and procurement procedure for the portfolio of projects administer package on behalf of the client, handover completed works and close out of projects and packages	✓	✓	✓

In addition, the findings from the semi- structure interview, from responses to the question on duties performed by the management contractor and required competencies to perform these duties are summarized as follows:

Duties

- The management contractor puts all service together like a turnkey development where everybody reports to the management contractor who integrates all everyone.

- The management contractor update scope and concept to construction drawings and the pre-construction stage
- Contribute in ironing out design issues, reviewing drawings, constructability issues and issues on how to get stuff delivered.
- Active partners as part of the development and planning of design team and up to delivery
- The management contractor manage and control subcontractors and other occupations and big size labour force during the construction process
- Carry out induction, safety and access arrangement
- Programming of works, getting people on time
- Ensuring site safety, managing the whole occupational safety, ensuring work is being secured on time in a safe and timely manner and save working environment
- Provides training, induction and ensuring everyone has tools and equipment to work with
- Motivate people: keeping people up motivated
- Managing clients in controlling changes to scope as it affects cost and deadlines

Competencies

- Sound knowledge of construction and building techniques and construction methodology such that will enable achieving same outcome but in a better way and cheaper cost. If something is not working the management contractor should be able to come up with a solution.
- Construction methodology: knowledge of what is new in the market, what is best in the market, the ability to take a drawing and say something is missing or that doesn't tie properly, there is need for more information. Ability to interpret designs, schedule and manage work flows
- Leadership qualities
- Knowledge of construction business
- Analyzing skills: be able to analyze projects and say this is the sequence of events, this is how I can afford these things, these are the different activities step and resources I will need.
- Construction management: Site administration, procuring subcontractors and then managing and coordinating their work quality and productivity. Being proactive solution driven on getting the job done as a team.
- Contract management: there will be a lot of contract relationship with suppliers, subcontractors which need to be managed.
- Conflict resolution: things are going to go wrong on site, you have to have the ability to manage them and go forward.
- Relationship formation : providing a link and relationship among the professional team
- Financial management: you need to manage cash flow so that you don't run out of cash by proper forward projecting

5 Discussion of findings

The aim of the study was to create a better understanding on the duties of a management contractor and the required competencies for a management contractor to perform these duties.

Duties refer to roles, responsibility or functions that management contractor has to perform. And competencies, according to Delo et al. (2010) has been described as the knowledge, skills, and behaviour required to perform well and keep up with the culture of an industry.

From the tender document analysis (table 2.) and summary of the semi-structure interview the duties performed by the management contractor can be seen to be multitasking covering both the preconstruction and construction stage of construction projects, as against what is obtainable in a traditional procurement system where the contractors only perform duties at the construction stage. These duties can be categorized into:

Construction management duties: here the management contractor performs management functions which Henry Fayol in 1916 (Fayol, 1954) describes to include Planning, organizing, controlling, commanding and coordinating. The management contractor is responsible for the overall management of the contract by putting and integrating all services together, he consult with and coordinates the professional team at the preconstruction stage and the work contractors at the construction stage. Management contractor carries out planning, organize, scheduling and programming of designs, work packages and site administration. Other construction management duties performed by management contractor are supervision, monitoring and quality control duties, to ensure that works are being constructed correctly. He also carries out reporting and provision of required project information and facilitates early completion of projects. Management contractors may also

Leadership duties: The management contractor plays an interpersonal role of figurehead. He directs the project team and work contractors as well as keeps people motivated in the course of executing the project. He also acts as the liaison; spoke person and resource allocator of the project.

Cost Control duties: here management contractors provides cost information to client and design team, prepares forecast to define cost of work at intervals, carry out cost estimation of work packages, manages clients and the design team in controlling changes to scope as it affects cost and formulate the most cost effective plan that will deliver the project within budget.

Buildability assessment duties: buildability assessment duties were adjudged as one of the core duties performed by the management contractor (Murdoch and Hughes, 2008; Sidwell, 1983). The management contractor becomes an active partner of the design team and uses his experience and expertise in construction to contribute in ironing out design issues, reviewing drawings and designs alternatives, construction feasibility issues, availability of labour, materials, plants and equipment, and issues on how to get stuff delivered. He updates scope and concept of the construction drawings, provides information on cost and materials, construction methodology, what is new and best in the market, and implications of various decisions in the course of the project.

Purchasing duties: here the management contractor purchases and order materials, supplies and resources that is necessary to provide the required works.

Contracting duties: the management contractor is responsible for evaluating, selecting, negotiating and going into contract relationship with a number of subcontractors, suppliers and other service providers in the client's interest. He is also responsible for the establishment and de-establishment of site at completion of project.

Conflict resolution duties: A management contractor manages disputes that may arise on site, and drafts and negotiates contracts properly to avoid ambiguities and dispute.

Relationship formation duties: Management contactors provide and facilitate links and relationship among project team as well as cooperate and seek cooperation with all persons involved in the project.

Health and Safety duties: here management contractors carryout duties ensuring site safety, manages the whole occupational safety and ensuring work is being secured on time in a safe manner and in save working environment. Also they have to ensure compliance to health and safety codes and regulations.

5.1 Required Competencies

According to Delo et al (2010), competency is the knowledge, skills, and behavior required to perform well and keep up with the culture of an industry. Owing to the increased responsibility of a management contractor in a management contracting procurement system as indicated in the duties of a management contractor from the foregoing, the competencies required to perform as a management contractor may be argued to be discern from that required to perform as a general contractor in traditional procurement system. The typical competency required for management contractors to perform their duties identified in the study includes the following:

1. Sound knowledge of construction techniques
2. Sound knowledge of construction methodology
3. Leadership skills including good temperament and self-control
4. Knowledge of construction business
5. Construction management skills including programming, planning, organizing, coordinating, supervising and monitoring skills
6. Analyzing skills
7. Financial management skills
8. Sound knowledge of contract management including knowledge of bid evaluation, negotiating power
9. Relationship formation skills
10. Conflict resolution skills

6 Conclusions

Management contracting procurement system is an option in construction procurement in which a management contractor is engaged at the early stage of a project, to contribute his experience and expertise in the management and delivery of the project. The system has been adjudged to have exhibited several benefits over the other procurement option particularly the traditional system. As a result, has been suggested to be most appropriate for large and complex projects, when timely completion and flexibility of construction is desired. These benefits may be attributed to the duties performed by the management contractors.

The knowledge of these duties and required competencies to perform management contracting duties by management contractors will help construction clients and the construction industry in the recruitment, selection, performance management and evaluation of management contractors. And, also add to the knowledge base for continuous professional development and training for aspiring management contractors. This study is also being used in establishing a scope for an ongoing PhD research on developing a decision support model for selecting a management contractor.

7 References

Al-Harthi, A., Soetanto, R., Edum-Fotwe, F.T. (2014). Revisiting client roles and capabilities in construction procurement.

Chartered Institute of Building (2010). A report exploring procurement in the construction Industry, Ascot: CIOB, Available at: http://www.ciob.org/procurement

Construction Industry Development board (2014). Construction Industry Indicators. Available

at http://cidb.org.za/publications/Pages/Construction-Industry-Indicators.aspx (accessed 9.19.15).
Dainty, A.R., Cheng, M.-I., Moore, D.R. (2005). Competency-based model for predicting construction project managers' performance. J. Manag. Eng.
Delo, A., Hepworth, P., Hepworth, A. (2010). Assessing the competent project manager. Proj. Manag. Today 1–6.
Fayol, H. (1954). General and industrial management.
Institution of Civil Engineers (2005). NEC3 Procurement and contract strategies, ISBN: 0727733818
ISO 10845, 1, (2010). ISO 10845-1:2010 - Construction procurement -- Part 1: Processes, methods and procedures. http://www.iso.org/iso/catalogue_detail?csnumber=46190 (accessed 9.18.15).
Meredith, J.R., Mantel Jr, S.J. (2011). Project management: a managerial approach. John Wiley & Sons.
Mintzberg, H. (1973). The nature of managerial work.
Mirabile, R.J. (1997). Everything You Wanted to Know about Competency Modeling. *Training Developmet*, 51, 73–77.
Murdoch, J.R., Hughes, W. (2008). Construction contracts: law and management, 4th ed. ed. Taylor & Francis, London ; New York.
Naoum, S.G. (1994). Critical analysis of time and cost of management and traditional contracts. *Journal of Construction Engineering and Management*, 120, 687–705.
Naoum, S.G., Langford, D. (1987). Management contracting-the client's view. *Journal of Construction Engineering and Management*, 113, 369–384.
Sidwell, A., 1983. An evaluation of management contracting. *Construction Management and Economics*, 1, 47–55.
Ward, S.C., Curtis, B., Chapman, C.B., 1991. Advantages of management contracting-critical analysis. *Journal of Construction Engineering and Management,* 117, 195–211.

FORMULATING AN EFFECTIVE PUBLIC PRIVATE PARTNERSHIP POLICY FOR HOUSING PROVISION IN NIGERIA URBAN CENTRES: A CONCEPTUAL APPROACH

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Abstract
The argument in the recent time was that the past strategies of the government in housing provision were obviously in favour of high income groups as the low-medium groups are victims of housing inadequacy in cities. The corollary to the situation resulted to the call for the adoption of public private partnership (PPP) initiative in order to accomplish the broad goal of housing-for-all in Nigeria. Most recent studies have established that there is no substantial contribution reported from the initiative, as the housing outputs are only affordable at present by high income groups, thus there is a need for a policy framework to ensure an effective PPP in urban housing provision. The aim of this paper is to suggest a policy framework for the way forward- the approach that is based on both theoretical and conceptual model, as related to Nigeria housing provision structure. This study utilises existing empirical studies, reports and theoretical concepts. *It also utilises the responses from housing professionals on modalities of enhancing urban housing provision through PPP model in Nigeria.* It was confirmed that the PPP model for housing provision in Nigeria is an emerging concept that lacks a specific policy and has little contribution in urban housing provision. Hence, the paper opines that the context for ensuring an effective collaboration that will make a PPP model is by incorporating all the institutions (poles), interests (motivating factors), norms, values (cultural practices), property rights and transaction costs. It is concluded that all the income groups should be considered as parts of the stakeholders in the formulation of a better PPP policy framework that addresses the housing needs of the majority of the dwellers in cities. This conceptual idea is referred to as New Institutional Economics (NIE) Approach.

Keywords: Housing, Institution, Nigeria, PPP, Urban Centres

1 Introduction

Housing is a fundamental need that currently constitutes a significant problem for the urban low income class especially in Sub-Sahara Africa (SSA). Although, an issue of inadequate housing provision is universal, the dimension of deficit in the urban centers in the developing Africa countries is becoming unbearable (Tipple, 1994). For instance, Olotuah and Bobadoye (2009) revealed that Nigeria housing shortage has reached an alarming state that almost 75% of the urban dwellers live in slums and in conditions that are degrading to human dignity. Between 1991 and 2001, housing deficit was estimated at about 8 millions (Achunine 1993; UN-HABITAT, 2001). In 2006, Nigeria housing deficit was estimated around 16 million units and required more than N56 trillion to bridge the housing deficit at a conservation cost of N3.5 million per unit (World Bank, 2013).

In the recent time, Government of the Federal Republic of Nigeria recognized the impact of private providers and inaugurated a concept referred to as enabling framework. This is a PPP framework that government serves as the enabler and private developers as the providers. Good examples are the Abuja Mass Housing Provision and other outputs across the nation. Though housing is not expressly stated as part of the infrastructure in the PPP legal instrument in Nigeria, but it is impliedly opined that housing constitutes part of the infrastructure in urban centres. Infrastructure procurement through PPP in Nigeria is legally backed up with Infrastructure Concession Regulatory Commission (Establishment, etc) Act of 2005 and subsequent establishment of Infrastructure Concession Regulatory Commission. The original intention of private integration into housing provision in Nigeria was to address the huge urban housing shortage. However, *despite the acclaimed PPP model (enabling framework) and the promising notions of housing for all, why is it that most of the outputs by the providers are out of reach of the low income groups? How can an effective policy measures be formulated to make a functional PPP structure for urban housing provision in Nigeria?*

In order to address this question, this paper is structured into six sections. In section 1.0, an introductory background is provided. Section 2.0 describes the methodology of this work. Subsequent sections provide a review on housing situation and vulnerability in Nigeria, national housing policy (NHP) and the idea of PPP for housing provision in Nigeria: The inputs and findings. In the penultimate section, the policy way forward as the central and unique purpose of this paper is provided. *This study is concluded on the summary of findings and recommendations.*

2 Methodological Approach

This study adopted a review of existing empirical and non - empirical studies, position papers, theoretical concepts and documents on PPP model for housing provision in Nigeria. It also utilised the responses from housing experts on modalities to enhance housing provision in cities through PPP model in Nigeria. In the review, the contribution and the challenges of PPP are examined in Nigeria. Considering the state of the art in housing provision, this article advanced to suggest a bottom-up and pragmatic approach referred to as New Institutional Economics which takes into consideration the incorporation of both formal and informal institutions in PPP policy formulation in order to ensure an effective policy for PPP adoption in Nigeria.

3 Housing Situation and Vulnerability in Nigeria

Nigeria experience of socio – demographic and political changes could be argued as the root cause of the challenging housing situation in cities. The high rate of population and urbanization in Nigeria is not left out among the influencing factors that cause overcrowding and inadequate resources. World Bank (2013) reports that almost 55 % of total population growth in Nigeria account for urban population, as a result of people’s quest to achieve better lives in cities. This is also a clear evidence of income disparity, widening the gap between the rich and the poor in Nigeria (Centre for Affordable Housing Finance in Africa, CAHF, 2014) per capital income in Nigeria is low and this influences the purchasing power of the urban dwellers on housing acquisitions (Tipple, 1994; UN-HABITAT, 2010). These confirm the opinions of several authors that in the developing countries *(*World Bank Development, 2002; Department of International Development DFID, 2005; Kissick, Leibson, Kogul, Bachmann, Anderson and Eckert, 2006; Rashidi, Aukd and Mohammadian, 2012) and in the developed countries (Boelhouwer and Van der Heijden,1992; Haffner, Hoekstra, Oxley and Van der Heijden, 2009 and Boelhouwer & Priemus, 2012), housing provision exhibits interactive and influential relationship with socio-economic, demographic, institutional and political environments.

In Nigeria, the state of the art on housing can be attributed to four main issues (Agunbiade, 1983, Ndubueze, 2009; Olotuah and Bobadoye, 2009; Oni, 2011; Ojo et. al., 2015) (Figure 1).

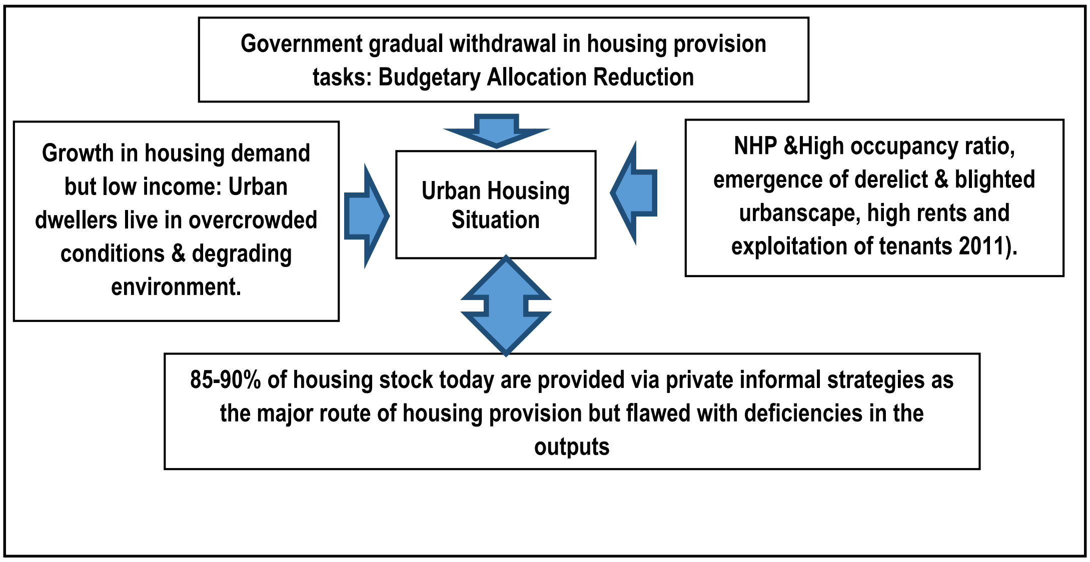

Figure 1. Description of urban housing situation in Nigeria (Authors, 2015)

In Figure 1, urban housing situation is described as the expression of the gradual withdrawal of government from housing provision, increase in housing demand and the existing housing policy that does not help to resolve the huge housing challenges. Consequent to the situations is the emergence of various strategies adopted by the private individual/ household to provide housing. This led to the emphasis that PPP could offer a possible solution in the country as mentioned in the national housing policy.

4 National Housing Policy and PPP for Housing in Nigeria: The Inputs and Findings

Housing - for - all has been the emphasis of NHP since 1991. In Nigeria, housing policy seemingly lies at the intersection of welfare and economic aspect of housing which realistically makes housing neither a universal service of the government nor the full free market output in Nigeria. It implies that these systemic attributes manifest in neo-liberal market ideology within the context of institutionalism (conventional and unconventional) that involves all actors in the sequences of events, property rights and transaction costs (Mooya and Cloete, 2007).

The encouragement of private involvement in housing delivery in Nigeria commenced in the year 2000, though in a more market oriented approach. In this approach government serves as the enabler and the organised private developers as the main providers. The initiative started from allocation of land and arrangement of finance with mortgage institutions: prominent among the initiatives is Abuja Mass Housing Scheme. The project was launched with an objective of providing adequate and affordable housing accommodation for the growing population within the territory. The procedure for allocation of large expanse of land for masses at low prices was incorporated with it. A study by Ukoje and Kanu (2014) identified that plots of land were allocated for the scheme in some districts in the federal capital territory (FCT), Abuja. According to Ukoje and Kanu (2014), lands were allotted for the schemes in different districts such as Dakwo, Wumba, Kafe, Karsana, Dutse, Bunkoro, Lokogoma, Galadimawa and other locations. As stipulated in the in the Official Gazette No. 84, Vol.96 of 2009, it is required that the developers comply with the city's regulations, standards and specifications during construction of the housing units (FRN, 2009).

In Lagos area, Ibem (2011a) examined that the least price of the housing produced was within the range of $21,000-$22,000[1]. This is extremely high in the society where there is a high income disparity and low per capital income (Ibem and Aduwo, 2012) The pattern of PPP operation in Nigeria has no specific policy as it is purely based on memorandum of understanding (Ibem, 2011b). Again, in the study by Ibem (2011b), in six cities in Nigeria, it was found that the PPP approach has not made any significant contribution to housing low-income earners; rather it is skewed towards providing housing for high- and middle-income earners. According to Ibem (2011a, 2011b and 2012) , there is a need for a specific policy framework on PPP, proper land arrangement at low cost, reform inbuilding standard and incorporation of informal housing provision.. However, the foregoing studies failed to demonstrate conceptually the modalities for an effective PPP policy framework. This is the essence of this article.

Umoh (2012) revealed that the mass housing concept of federal government is a variant of PPP model designed with intention to provide housing in large- scale for low-medium income groups which constitutes 65% of the population. However, the realisation of the aim is constrained by numbers of barriers that can be described as transactional costs (Van Ommeren and Van Leuvensteijn, 2005; Van Ommeren, 2008; and Marinescu, 2012). Mode of transaction of housing units produced through PPP model today is characterised with unequal and uneven distribution across the income groups (Ndubueze, 2009). In the study conducted by Ibem (2011a), numbers of PPP housing units were identified that are far beyond the affordability limit of the majority of the cities dwellers. Table 1 provides the details.

Table 1. Some PPP contributions to housing projects in Nigeria

Housing schemes	**Location**	**Partnership Agency**	**Units per target income group**		
			Low	**Middle**	**High**
Lekki Apartment	Lagos MCR	LSPDC	-	-	126
OGD-Grant	Lagos MCR	GCDCL	-	60	100
OGD-Sparklight	Lagos MCR	GCDCL	150	250	-
Paradise City	Lagos MCR	GCDCL	-	100	200
Ewu Elepe Housing Estate	Lagos MCR	LSPDC	50	119	50
Ikeja GRA	Lagos MCR	LSPDC	-	-	36
Housing Estate Ilupeju	Lagos MCR	FHA	-	-	26
DN Meyer	Abeokuta	FHA	-	50	-
Trans Amadi	Port Harcourt	FHA	100	200	171
Trinity Gardens	Port Harcourt	RSHPDC	-	-	32
New Rainbow Town	Port Harcourt	RSHPDC	-	-	704
Ehimiri Housing Estate	Umuahia	ASHPDC	-	200	300
APICO- Shelter Afrique	Uyo	APICO	-	335	-
Total			**300**	**1,314**	**1,745**

(Source: Ibem, 2011a; 2011b)

[1]1 Dollar = 199 Naira as at December, 2015.

Information in the Infrastructure Concession Regulatory Commission (ICRC) (2013) document, as reported by Dominic et al. (2015) indicated that private partnership with federal housing authority has also delivered some housing units across the country. Table 2 presents details of PPP housing projects recently documented.

Table 2. PPP housing projects - federal housing authority and private companies

S/N	Name of Partnership	Location	Output Units
1	FHA/CITEC International	Gwarinpa, Abuja	300
2	FHA/ADKAN Services	Gwarinpa, Abuja	351
3	FHA/BAUHAUS Int. Ltd	Isheri-Olofin, Lagos	554
4	FHA/BAUHAUS Int.Ltd	Trans-Amadi, PortHarcourt	288
5	FHA/PRINCE & PRINCESS Properties Limited	Lugbe, Abuja	70
6	FHA/ OHMS Limited	Gwarinpa, Abuja	20
7	FHA TANGENT	Irette, Owerri	140
8	FHA/Tangent Partnership	Irette, Owerri	201
9	FHA/ Bauhaus Partnership	Irette, Owerri	150
10	FHA/Zincspace Partnership	Lugbe, Abuja	54
11	FHA/Good Homes Ltd	Egan, Lagos	349
12	FHA/ENL Partnership	Apo, Abuja	923
13	FHA/ Bauhaus Partnership	Apo, Abuja	523

(Source: ICRC, 2013; Dominic et al., 2015)

It was also reported that PPP contractor – financed initiative programmes, sponsored by the federal ministry of land, housing and urban development (FMLHUD) have also delivered units of housing across some states in the federation. The then Minister of the ministry, Pepple (2012) presented the achievements in 2012 annual report. Table 3 shows the details.

Table 3. PPP contractor-financed initiative programmes

S/No	State	No of developers	Size of land (hectares)	No of houses realizable	Type of building technology	Completion period
1.	Adamawa	2	13	260	Traditional	20 months
2.	Cross river	18	250	5,000	advanced bamboo product/nibrri bricks/traditional	“
3.	Delta	11	25	500	Plasswall/traditional	“
4.	Edo	5	184	3,680	Plasswall/insulated concrete forms/traditional	“
5.	Enugu	4	30	600	Nibrri bricks/traditional	“
6.	Katsina	1	5	100	traditional	“
7.	Kogi	4	21.15	423	American building system/traditional	“
8.	Lagos	1	1.04	24	traditional	24 months
9.	Nassarawa	28	109	2,180	Hydraform/nibrri bricks/western form tech/traditional	20 months
10.	Ogun	15	224	4,500	American building system/insulated concrete form/traditional	20 months
	Total	**89**	**889.54 hectares**	**17,267**		

(Source: Pepple, 2012; Federal Ministry of Land, Housing and Urban Development)

In a related study by Ojo, Olatoye-Ojo and Gbadegesin (2015), PPP is viewed as an avenue to bridge the finance gap in infrastructure provision. It was also explained from the perspective of PPP variants including Build-Operate-Transfer (BOT) as an antidote to address deficit (Gbadegesin, Aluko and Nuhu, 2012; Gbadegesin and Aluko, 2014; Gbadegesin and Oyewole, 2014). It is found that the practice, referred to as PPP are often investment-oriented rather than welfare oriented scheme in Nigeria (Ibem and Aduwo, 2012).

The implication is that in a partnership or collaboration arrangement, if transaction costs (requirements) hinder low class citizens from acquiring housing right in the model, the effectiveness is not guaranteed. Williamson (1985), North (1990) and Coase (2005) posit that transaction costs are key elements in any institutional arrangement which cannot be overlooked. This is because uncertainties in partnership could be resolved in the process of coordination to achieve the output (housing).This is true of the key concepts of New Institutional Economics (NIE) as examined by Mooya and Cloete (2007), Wakely (2014) and Karrina (2013).

5 The Policy Way Forward: Institutional Approach (New Institutional Economics – NIE)

The importance of New Institutional Economics (NIE) in the collaborative scheme for housing provision is that all stakeholders (housing provision actors) are integrated with the understanding of the cultures, norms, values, regulations, rights and costs (Pratiwi, 2005). According to the author, the approach would be of immense contribution in exploring the nature and circumstances in the course of the partnership in housing provision. *Identifying the inputs of all poles (institutions) that entail the interests, norms, regulations, challenges, financial status and cultural orientations are fundamental to form a workable partnership as embedded in NIE.* Table 4 provides the details of the housing studies that have adopted the NIE theoretical and conceptual approach to resolve urban policy issues in the developed nations.

Table 4. Summary of housing and properties studies that are based on Institutional Theory

Serial No	Authors	Year	Study Focus	Institutional Analytical Concepts Used or Recommended
1.	Morgan	2010	Residential property development in urban centre	Agency Model
2.	Healey and Barrett	1990	Urban development process with the involvement of key actors	Structure –Agency analytical approach
3.	Ball	1998	Commercial property research in Britain.	Structure-Agency and Structure of Building Provision
4.	Guy and Henneberry	2000	Urban property development	Systematic provision structure & Actor-Network Approach
5.	Healey	2006	Governance Transformation for new space	Actor- Networks
6.	van Bortel and Elsinga	2007	Social housing in The Netherlands	Network Perspective of Policy Environment Actors
7.	Knight and Boyd	2008	Property development and developers' action	Social and formal networking via semi-structured interview
8.	Zhang and Rasiah.	2015	Urban housing market	Structure–Agency Institutional (SAI) model and the Institutional Analysis and Development (IAD) via both qualitative and Quantitative Approaches
9.	Healey and Davoudi.	1993	Urban Development	Systemic and Agency based approaches
10.	Healey.	1994	Behaviour of agencies in urban policy and development	Analysis of agencies behaviour based on structure of provision in the system
11	Healey	2003	Collaborative planning for in development	process', the use of 'social theory', and 'power', and the development of 'institutionalist' analysis
12.	Adams, Leishman and Watkins.	2012	House builder networks and residential land markets	Actor-Network Approach
13.	Pratiwi.	2005	Urban Housing Problem	Institutional analytical framework modified or adapted to the subject system
14.	Tang	2006	Urban Housing	Market Structure and Players interaction
15.	Han and Wang	2003	Urban Development projects	A framework of institutional analysis
16	Doak & Karadimitriou.	2007	Property development process	Network analytical approach
17.	Triantafyllopoulos	2008	Property ownership and land market	Diachronic analysis
18.	Manzi and Jacobs.	2008	Urban housing involving both formal and informal	New institutionalism, Grid-Group and Actor-Network Approaches are suggested
19	Maginn, Thompson & Tonts	2008	Urban housing analysis	Systematic reviews, meta-ethnography (if applicable) and realist synthesis
20	Karruna	2013	Land and Housing Market	Case study analysis of both formal and informal settlements
21	Woolthuis, Hooimeijer, Bossink, Mulder and Brouwer	2013	Sustainable Urban Development in Dutch.	Analysis of interactive framework of both formal and informal sectors
22	Van der Krabben and Lambooy	1993	Functioning of Dutch property market	Institutional Organisational approach of real estate study

(Source: Authors, 2015)

Extant literature indicates institutional analysis as a pragmatic approach which would enable details of relationship in the negotiation of development under different conditions *(Healey, 1991;* Manzi and Jacobs, 2008; Maginn, Thompson and Tonts, 2008*)*. The key concepts of the institutional approach are described in Figure 2.

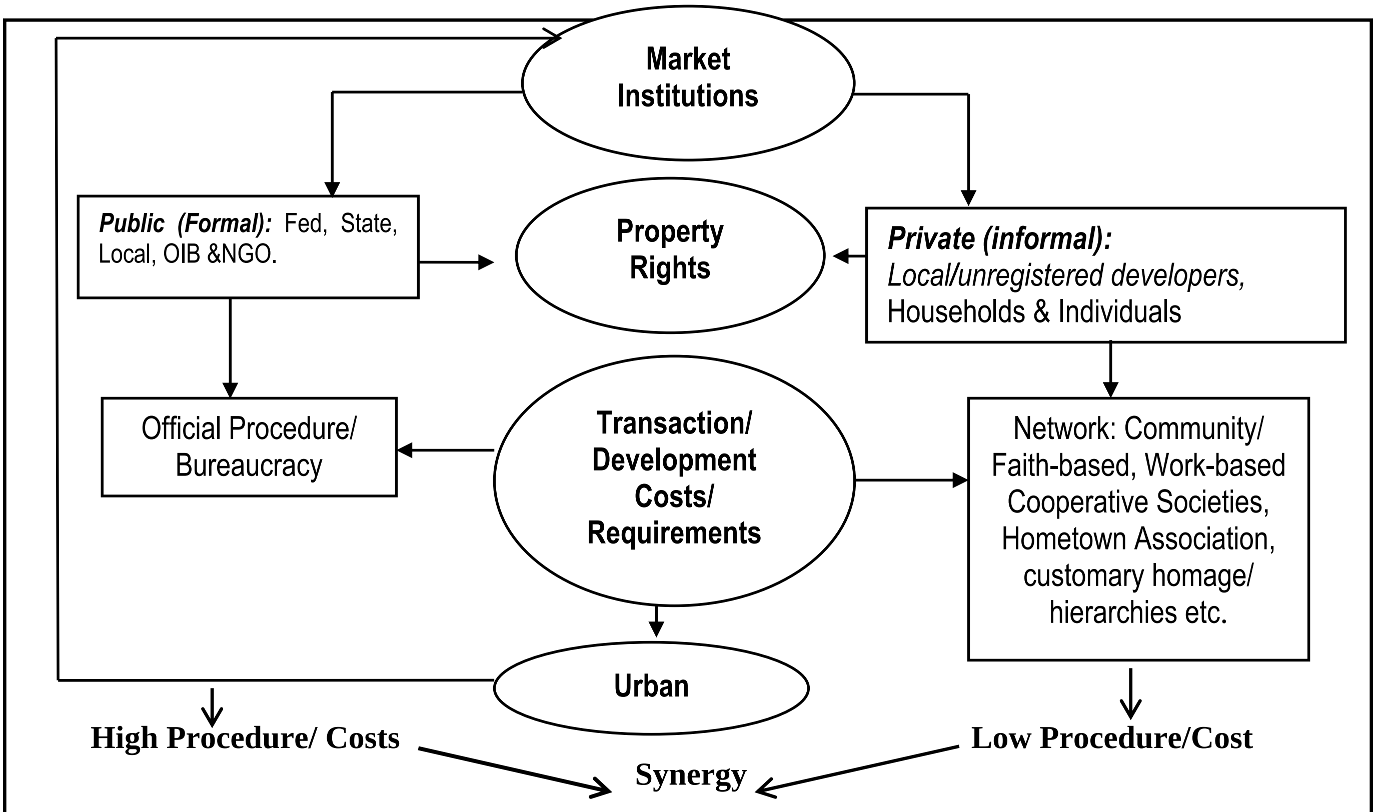

Figure 2. Key Concepts of New Institutional Economics Approach

The emphasis in Figure 2 is that, transaction costs are viewed in terms of processes, protocols, procedures, bureaucracy and financial requirements, agency costs (search and information), legal costs, costs of title procurement (property rights) (Karruma, 2013; Smith, Munro and Christie, 2006). Property rights are described as people's access to land resources and the regulatory frameworks that enable both housing providers and consumers to harness interest (quantum of rights) and security in property (Whinston, 2003). Property rights and transactions are a key element of institutional approach in order to enhance housing market because if the rights (sufficient legal power and security such as rights to transfer- let/ lease, sale, acquire, mortgage, transfer or assign) are in place and enforceable, then transaction costs (requirements) would be reduced and therefore eliminate barriers to entry to the market properly (Karruna, 2013). The opinions of the housing experts solicited also revealed that PPP concept can only be functional in Nigeria if all the stakeholders' needs, voices, conditions and aspirations can be evaluated and put into consideration.

6 Conclusion

In this paper, it has been noted that there is no effective and efficient PPP model for housing due to the lack of a specific policy to that effect, especially for low-income earners. The implication is that as the housing debacle in Nigeria remains the problem and the PPP conceptual objectives have not been significantly achieved, there is a need for a clear policy for collaborations that will consider all institutions (poles) rules, interest, norms, culture for secured (reliable) housing rights at a less stringent costs (requirements) and boost the housing provision in cities. Therefore, to *avoid the future risks of neglecting low-medium income groups' interest and ideologies, a reform in policy approach of the PPP model is indispensable* through a collective approach that incorporates all groups.

7 References

Achunine, B.O. (1993). National trends in housing production practices in Nigeria-, case Study prepared for UNCHS (Habitat), Nairobi.

Adams, D. Leishman, C. and Watkins, C.(2012),Housebuilder Networks and Residential Land Markets. *Urban Studies*. 49(4) 705–720.

Aluko, B.T. and Amidu, A.(2005). Corporate business valuation for mergers and acquisitions. *International Journal of Strategic Property Management*, 2005, 9(3), pp. 173-189

Ball, M. (1998). Institutions in British Property Research: A Review. *Urban Studies, 35*(9), 1501- 1517.

Berger, P. and Luckmann, T. (1967) Social Construction of Reality. New York: Anchor Books.

Boelhouwer, P. and Priemus, H. (2012). Housing system reform: the opinion of advisory boards versus political reality in the Netherlands. Policy & Practice. *Journal of Housing and the Built Environ* DOI 10.1007/s10901-012-9288-3

Boelhouwer, P. and Van der Heijden, H. (1992). Housing systems in Europe part 1: a comparative study of housing policy," *Housing and Urban Policy Studies*, Delft University Press, Delft.

Boelhouwer,P. and Hoekstra J.(2012): Agents and Regulators. In: Susan J. Smith, Marja Elsinga, Lorna Fox O'Mahony, OngSeowEng, Susan Wachter, Richard Ronald, editors. International Encyclopedia of Housing and Home, Vol 3.Oxford: Elsevier;pp.585-589

Coase, R. (1998). The New Institutional Economics. The *American Economic Review*, 88 (2) 72-74.

Coase, R.H. (2005). The institutional structure of production. In: Menard C. and Shirley M.M (eds) Handbook of New Institutional Economics. Berlin: Springer. pp. 31-39.

Doak, J. and Karadimitriou, N. (2007). (Re)development, Complexity and Networks: A Framework for Research". *Urban Studies*, 44(2), 209–229.

Dominic, C. M.U., Ezeabasili, A., Okoro, B.U., Dim, N.U. and Chikezie, G.C.(2015). A Review of Public Private Partnership on some Development Projects in Nigeria. *International Journal of Application or Innovation in Engineering & Management*. Vol. 4. Iss. 3.

DFID (2005). Making Market Systems Work Better for the Poor (M4P) – An Introduction to the Concept. Discussion Paper prepared for the ADB-DFID 'learning event', ADB Headquarters, Manila.

FRN (2009). Guidelines for Housing Development in the Federal Capital Territory (FCT), Abuja. FCTA, Abuja.

Gbadegesin, J.T., Aluko, B.T. and Nuhu, M.B. (2012), Enhancing Students' Housing through Build-Own-Transfer (BOT) Mechanism in Nigerian Tertiary Institutions. *The Estate Surveyor and Valuer. The Journal of Nigerian Institution of Estate Surveyors and Valuers*, Lagos. 36(2), pp.170-182.

Gbadegesin, J.T and Aluko, B.T.(2014). Public Private Partnership/Private Finance Initiative for Financing Infrastructure in Public Tertiary Institutions in Nigeria. *Journal of Built Environment Projects and Asset Management*. 4(2).

Gbadegesin, J.T. and Oyewole, M.O. (2014). Is Build-Operate-Transfer (BOT) system an effective initiative compared with traditional procurement method in student housing provision in an emerging economy? *Journal of Construction Project Management and Innovation,* 4 (1), 809-825, pp. 2223-7852.

Guy, S. and Henneberry, J. (Eds.) (2002). *Development and Developers: Perspectives on Property*, Oxford: Blackwell Science.

Haffner, M. Hoekstra, J., Oxley, M, Van der Heijden, H. (2009). Bridging the Gap between social and market rented housing in six European countries? Housing and housing policy studies 33. IOP Press.

Han, S.S. and Wang, Y. (2003).The Institutional Structure of a Property Market in Inland China: Chongqing. *Urban Studies, Vol. 40, No. 1, 91–112*.

Healey, P. (1994). Urban policy and property development: the institutional relations of real-estate development in an old industrial region. *Environment and Planning A*, 26, pp. 177-198

Healey, P. (2003). Collaborative Planning in Perspective. *Planning Theory.* Vol 2(2): 101–123 .SAGE publications(London, Thousand Oaks, CA and New Delhi).[1473-0952(200307)2:2;101–123;035447].www.sagepublications.com

Healey, P. (2007). An institutional model of the development process" *Journal of Property Research*, 9(1), pp. 33-44

Healey, P. (1991). Models of the development process: a review. *Journal of Property Research* 8 219-238.

Healey, P. & Barrett, S. M. (1990). Structure and Agency in Land and Property Development Processes: Some Ideas for Research. *Urban studies,* 27**,** 89-104.

Healey and Davoudi (1993). The Development Industry in Tyne and Wear. Working Paper. No.21. Department of Town and Country Planning. University of Newcastle Upon Tyne, UK.

Ibem, E.O. (2011a) 'Public-Private Partnership (PPP) in Housing Provision in Lagos Megacity Region, Nigeria. *International Journal of Housing Policy,* 11: 2, 133 — 154

Ibem, E.O. (2011b). The Contribution of PPPs to improving accessibility of low-income earners to housing in southern Nigeria. J*ournal of Housing and the Built Environment*. 26: 201-217.

Ibem, E.O. and Aduwo, E.B.(2012) Public-Private Partnerships (PPPs) in Urban Housing in Nigeria: Evidence from Ogun State. *International Journal of Architecture and Urban Development*, 2(2), Spring 2012

Karruma, R. (2013). Institutional Ignorance in an urbanising World: Does new institutional economics provide a useful tool for understanding the provision of land and housing to the poor? DPU Working Paper No.154. The Bartlett Development Planning Unit. UCL.

Kissick, D, Leibson, D, Kogul, M, Bachmann, J., Anderson, J. and Eckert, J. (2006). Housing for all: Essential to economic, social and civic development. The World Urban Forum III, Vancouver, PADCO/ AECOM

Knight, J. (1992). *Institutions and Social Conflict*, Cambridge: Cambridge University Pres.Knight, T and Boyd, D. (2008). An investigation into how property developers use their social networks to drive development. *In:* Dainty, A (Ed) *Procs 24th Annual ARCOM Conference,* 1-3 September 2008, Cardiff,.UK, Association of Researchers in Construction Management, 567-576.

Maginn, P. and Thompson, S. and Tonts, M. (2008). Qualitative Housing Analysis: A Meta-Framework for Systematizing Qualitative Research. In Paul J. Maginn, Susan M. Thompson and Matthew Tonts. Qualitative Housing Analysis: An International Perspective. Volume 10, First Edition. Emerald Group Publishing Ltd, UK.

Manzi, T. and Jacobs, K. (2008). Understanding Institutions, Actors and Networks: Advancing Constructionist Methods in Urban Policy Research. In Paul J. Maginn, Susan M. Thompson and Matthew Tonts. Studies in Qualitative Methodology. Qualitative Urban Analysis: An International Perspective. Volume 9, First Edition. Elsevier Ltd, UK.

Marinescu, C. *(2012).*Transaction Costs and Institutions' Efficiency: A Critical Approach. *American Journal of Economics and Sociology, Vol. 71, No. 2.*

Mooya, M.M. and Cloete, C.E. (2007). Informal Urban Property Markets and Poverty Alleviation: A conceptual Framework. *Urban Studies.* 44 (1) 147-165.

Morgan, F.J. (2010). Residential property developers in urban agent-based models: Competition, behaviour and the resulting spatial landscape. A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Geography. University of Auckland

North, D. (1991). Institutions. *Journal of Economic Perspectives* 5 (1) 97 – 112.

Ndubueze, O.J. (2009). Urban housing affordability and housing policy dilemmas in Nigeria. A thesis submitted to the University of Birmingham for the degree of Doctor of Philosophy. Centre for Urban and Regional Studies School of Public Policy the University of Birmingham.

Ojo, O., Olatoye-Ojo, O. and Gbadegesin, J.T. (2015). Bridging the Finance Gap in Housing andInfrastructure Provision through Private Finance Initiatives in an Emerging Economy. *Real Estate Finance,* 32(1), pp.16-22.Summer.

Olotuah, A. O. and Bobadoye, S.A. (2009). Sustainable Housing Provision for the Urban Poor: A Review of Public Sector Intervention in Nigeria. *The Built & Human Environment Review*, 2, 51- 63.

Oni, A.O. (2011). Harnessing real estate investment through proper tenant selection in Nigeria", *Property Management*, 29(4), pp. 383 – 397.

Pepple. A.I. (2012). Achievements (29^{th} May, 2011 –May 2012) Development of Enabling Sector Policies--National Housing Policy and National Urban Development Policy. Presentation on the ministerial platform of Federal Ministry of Lands, Housing and Urban Development, Abuja, Nigeria

Pratiwi, D.D. (2005). Land Development Theories and Institutional Analysis: The operationalisation in housing and traditional communities. *Working Paper 2005*. Housing and Settlement Research Group. School of Architecture, Planning & Policy Development.

Rashidi, T., Aukd, J. and Mohammadian, A. (2012). A Behavioural Housing Search Model: Two-Stage Hazard-Based and Multinational Logit Approach to Choice-Set Formation and Location Selection. *Transportation Research.*46, 1097-1107

Smith S. J, Munro M. and Christie H.(2006). Performing (housing) markets. *Urban Studies* 43: 81-98

Tang, Z. (2006). The Urban Housing Market In A Transitional Economy: Shanghai As A Case Study. Thesis Submitted to the Faculty of the Graduate School in partial fulfilment of the requirements for the degree Doctor of Philosophy in the Department of Geography, The Indiana University.

Triantafyllopoulos N. (2008). A Heterodox Economics Approach of Property Market Efficiency. In *17th Annual American Real Estate and Urban Economics Association International Conference: Istanbul*, Turkey.

Tipple, G. (1994). The Need for New Urban Housing in Sub-Saharan Africa: Problem or Opportunity".*African Affairs*, 93(373), pp. 587-608. http://www.jstor.org/stable/723668.

Ukoje J.E. and Kanu, K.U.(2014). Implementation and the Challenges of the Mass Housing Scheme in Abuja, Nigeria. *American International Journal of Contemporary Research Vol. 4, No. 4; April 2014.*

Umoh, N. (2012). Exploring the Enabling Approach to Housing through the Abuja Mass Housing Scheme. Thesis Submitted to the Department of Urban Studies and Planning in partial fulfilment of the requirements for the degree of Master in City Planning. The Massachusetts Institute Of Technology.

UN HABITAT. (2001). National Trend in Housing Production Practices (Vol. 4, pp. 60–69). Nigeria: United Nations Centre for Human Settlements. http://www.chs.ubc.ca/archives/files/HS-313.pdf

UN-HABITAT (2006). *National Trends in Housing –Production Practices Volume 4: Nigeria,* United Nations Centre for Human Settlements: Nairobi.

UN-HABITAT (2010). The State of African Cities 2010: Governance, Inequality and Urban Land Markets. Nairobi: UN Habitat

van Bortel, Gerard and Elsinga, M. (2007). A Network Perspective on the Organization of Social Housing in the Netherlands: the Case of Urban Renewal in The Hague, Housing. *Theory and Society,* 24(1), 32-48.

van der Krabben, E.& and Lambooy, J.G.(1993). A Theoretical Framework for the Functioning of the Dutch Property Market". *Urban Stud*ies. vol. 30 no. 81381-1397

Van Ommeren, J.N. and M. Van Leuvensteijn (2005). New evidence of the effect of costs on residential mobility, *Journal of Regional Science*, 681-702.

Van Ommeren, J. (2008). Transaction Costs in Housing Markets: the Role of Government Policy. VU University, FEWEB, De Boelelaan, 1081 HV Amsterdam, the Netherlands.

Wakely, P. (2014). Urban public housing strategies in developing countries: whence and whither paradigms, policies, programmes and projects. DPU60 Working paper Series: Reflections, N0.163/60. The Bartlett Development Planning Unit**.**

Whinston, Michael D. (2003). On the Transaction Cost Determinants of Vertical Integration." *Journal of Law, Economics, and Organization*, 19(April), 1-23.

Williamson, O. E. (1985). *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*, New York: The Free Press.

World Bank (2002). Brazil: Progressive Low income Housing: Alternatives for the poor.

World Bank (2013). Africa Development Indicators.2013 International Bank for Reconstruction and Development / The World Bank 1818 H Street NW, Washington DC 20433.

Woolthuis, R.K., Hooimeijer, F., Bossink B, Mulder, G., and Brouwer, J. (2013). Institutional entrepreneurship in sustainable urban development: Dutch successes as inspiration for transformation. *Journal of Cleaner Production,* 50 (2013), pp. 91-100.

A FACTORIAL ANALYSIS OF SAFETY PERFORMANCE MEASURES: A STUDY AMONG CONSTRUCTION WORKERS IN GAUTENG, SOUTH AFRICA

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Abstract
The health and safety (H&S) of construction workers has been a subject of much deliberation for decades. However, there is scant literature focusing on aspects of workers' safety performance (SP) relating to their unhealthy and unsafe eating behavior. The paper presents findings on an exploratory factor analysis of H&S performance measures. A 10-item questionnaire which was developed after an extensive literature review was used to collect empirical data on SP of construction workers in the Gauteng Province of South Africa. Results showed that SP could be reasonably measured by two constructs. The two constructs were clearly defined as trailing and prevailing. The emerged trailing measures were named lagging indicators while the prevailing ones were designated as leading indicators. The results lend support to extant literature which advocates the use of both leading and lagging safety performance indicators for effectively assessing construction workers' safety performance. The study provides evidence which could be beneficial in psychometric evaluation of construction workers' safety performance and behaviours on construction sites.

Keywords: Construction workers, Exploratory Factor Analysis, Gauteng, Safety performance

1 Introduction

The construction industry is fraught with accidents and deaths on an unacceptable level. This is in spite of its recognized contribution to socio-economic development with regard to contribution to Gross Domestic Product (GDP) and improvement in the quality of lives of an economy's citizens through job provision (Khan, 2008; Ofori, 2012). Although a decline in the number of fatal injuries in recent years has been indicated, statistics still report unacceptably high rates of accidents, injuries and fatalities (Musonda, 2012; Health and Safety Executive (HSE), 2014). The number and cost of injuries and deaths in the construction industry are deplorable and many of them are preventable (Janackovic et al., 2013). It is necessary to improve the H&S system continually in order to reduce the costs and increase companies' competitiveness and efficiency (Janackovic et al., ibid.).

Furthermore, attention to construction workers' H&S is crucial since they are at the centre of construction activities and as such are indispensable. Individual workers and their supervisors must make daily decisions about safety at work because it influences or competes with other performance facets of the job. These can be related to the task itself (e.g., safety vs. on-time delivery or productivity), or to the worker performing the task (e.g., safety vs. personal discomfort or extra effort) (Huang et al., 2013). Poor safety at work could result from workers' unhealthy eating behaviours, among other things (Melia & Becerril, 2009; Lingard & Turner, 2015). In addition, the nature of construction work predisposes construction workers to hazards which pose a threat to their H&S. Such hazardous conditions may include extreme heights, machinery failure, welding emissions, unguarded machinery, which may lead to falls, being struck by heavy construction equipment, electrocutions, silica dust, asbestos, lead, accidents, structure collapses, and so on (ElSafty et al., 2012). Continuous attention to and integrated management of safety and health increases operational excellence and profitability in the sense that the occurrence of injuries and deaths is reduced, avoidable expenditure on on-site exigencies is reduced, productivity is increased, and in fact, morale and motivation among employees as well as implications of H&S are realised (Janackovic et al., 2013).

Much research has been conducted on H&S measurement and management (Lin et al., 2009) and in the construction industry specifically (Hinze et al., 2013; Lingard et al., 2013). However, most literature focused on the work environment, managerial and organizational aspects of H&S. Few studies have been devoted to safety performance measures related to the lifestyle behaviours of the workers which have been suggested to be unhealthy (Melia & Becerril, 2009). The present study identifies safety performance measures which could be related to workers' unhealthy eating behaviours and explores underlying structures of the measures. The objective of the current paper is to analyse the structure of the safety performance measures used in the study. The study could be useful to researchers and employers in the construction industry in assessing safety behaviours and performance of the workers.

2 Measuring Health and Safety Performance

According to Dingsdag et al. (2008), one of the most practical guiding principles of the measurability of safety performance is given in the Australian/ New Zealand Standard, *AS/NZS 4804: 2001 Occupational health and safety management systems—General guidelines on principles, systems and supporting techniques* (AS/NZS 4804) which defines safety performance as "the measurable results of the occupational health and safety management system related to the organisation's control of health and safety risks, based on its OHS policy, objectives and targets" and measuring performance includes measurement of OHS management activities and results. This section discusses measures of assessing workers' safety activities and results.

It has been generally acknowledged that the traditional metric used to measure H&S performance is a record of accidents, injury and ill-health statistics (Musonda, 2012). However, some researchers argue that measuring H&S performance by the frequency of accidents and injuries is sometimes inappropriate, unreliable and deceptive as gross under-reporting could occur (Musonda, ibid.). In addition, injury rates often do not reflect the potential severity of an event, merely the consequence; they reflect outcomes, not causes (Hinze et al., 2013).

In addition to injury and accident statistics, other measures reveal the state of safety performance of workers in an industry. ElSafty et al. (2012) opined that an Occupational Safety and Health Administration (OSHA) recordable injury is an occupational injury or illness that requires medical treatment more than simple first aid. First aid involves a particular level of treatment (such as cleaning and covering of wounds, use of non-prescription medication, etc; whereas medical treatment occurs when an injury or disease requires a higher degree of care and management to ensure a full recovery, for instance, treatment of fractures, suturing of wounds and prescribing and providing drugs to manage symptoms (Biggs et al., 2009; International Council on Mining and Metals (ICMM), 2014).

Other recordable criteria include death, restricted work, days away from work, significant injuries or illnesses diagnosed by physician and lost work day incidents (ElSafty et al., ibid.). Days away from work, restricted duty and transferred duties are related to injuries which are severe enough that workers are away from work, placed on restricted duty or assigned a lighter job because of the injury. Supporting this view, the ILO stated that loss of working capacity or inability to perform normal or routine work functions on the next calendar day after an injury reflects poor worker safety performance (ILO, 2003). Statistics on the days away from work or on restricted duty due to an injury are useful when analyzing how much loss is incurred from injuries (ElSafty et al., 2012). Lost work day or lost time injuries are also useful in interpreting solutions to lowering the number of injuries and fatalities per year (Dingsdag, 2008; ElSafty et al., 2012). Absence from work due to an injury, for more than three consecutive working days is considered serious and compensable (ILO, 2003; Cameron & Duff, 2007).

According to Farooqui et al. (2008), the use of personal protective equipment (PPE) is one of the basic practices required for safety on construction sites. It is a performance issue which belongs to self-protection category and can be used to indicate safety performance levels of firms (Farooqui et al., ibid.; Biggs et al., 2009; Construction Industry Institute (CII), 2014). Workers face bodily harm when they do not wear (correctly) PPE. For instance, falls from heights could occur with weak scaffolding and lack of safety belts; cement burns could be sustained without protective gloves and boots while cementing; injuries could be sustained on fingers, eyes, head, or feet due to absence of PPE, and so on (Farooqui et al., 2008).

Another performance issue which is critical is the assessment of risks involved in a given task before embarking on it. The identification of the tasks, hazards and the risks of a job prior to work enables implementation of protective measures to ensure that work is done safely (Campbell Institute, 2014).

Furthermore, near-misses or close calls were shown to be indicators of safety performance ((Biggs et al., 2009; Hinze et al., 2013; CII, 2014). Reporting of the near-misses and/or accidents is also crucial in reflecting workers' attitude and commitment to safety at the workplace. However, according to Masood et al. (2014), the workers may be uncertain about reporting accidents or near-misses because sometimes there is no mechanism for compensation for injuries, and/or they may blame their luck which made them victims of the accident.

The above-mentioned indicators relate to construction workers, prior to or after an incident, and were therefore adopted as the indicators of worker safety performance, in the current study. This implies that some indicators may be trailing (also called lagging indicators), providing data about incidents after the fact (Hinze et al., 2013), whereas others may be prevailing (called leading indicators), potentially leading to an injury or incident (Biggs et al., 2009). Both leading and lagging indicators reflect safety performance (Hinze et al., 2013; Lingard et al., 2013). According to Atkins (2011), the use of a set of safety performance indicators provides a greater indication of safety performance than concentrating on one measure in isolation (or indeed a small number of random measures). Good safety performance indicators should be quantifiable and permit statistical inferential procedures and should be valid and representative of what is to be measured (Roelen and Klompstra, 2012). The interpretations should relate to the system and its operational context (Herrera, 2012).

3 Research Methodology

To achieve the objective of the study, a review of literature related to safety performance of workers in general and construction workers in particular was conducted. Various sources including academic and professional journals, books, government reports, newspapers, magazines, theses and dissertations were consulted. A 5-point likert-scale questionnaire was thereafter developed to elicit information workers' safety performance on construction sites. The identified items related specifically to those measures which could be associated with unhealthy eating, since this was the purpose of the main study. The questionnaire, which consisted of 10 items, was pilot-tested, reviewed and revised by experts (consisting of the researcher's supervisors and a statistician). The final questionnaire had response categories were assigned 1, 2, 3, 4 and 5, for "on every project", "more than two times", "two times", "once before" and "never", respectively. Therefore, higher scores were meant to represent higher safety performance.

The questionnaire was self-administered to construction workers on building and civil engineering construction sites in Midrand, Samrand, Johannesburg and Centurion. The participants, selected through heterogeneity and convenience sampling, included workers who were actively engaged in the physical construction activities as opposed to the site managers and supervisors. This group was chosen as they were the most susceptible to poor safety performance on construction sites. A cover letter accompanied the questionnaire to explain the purpose of the study and obtain informed consent. The respondents participated voluntarily and anonymously. Out of a total of 220 questionnaires, 183 were completed and used for the empirical analysis.

The raw data were analysed using Statistical Package for Social Sciences (SPSS) version 22. The Cronbach's alpha and mean inter-item correlations were used to assess the internal consistency reliability of the scale. Factor analysis using principal axis factoring and oblimin rotation was then conducted to examine underlying structures of the theorized variables. However, prior to the factor analysis, preliminary considerations for the factorability of data were assessed. The sample size requirement of 150+ was met (Pallant, 2013). The Kaiser-Meyer-Olkin (KMO) and Bartlett's sphericity tests were also used to assess factorability. Missing data were excluded using listwise deletion. The data were however skewed, concentrating on the "never" category. Outliers were identified and removed before analysis The Kaiser's criterion (retaining eigenvalues above 1), scree test (retaining factors above the "breaking point") were used to determine the emerging components or empirical constructs.

3.1 Validity and Reliability

Various measures were taken to ensure that the variables developed from extant literature (termed theoretical constructs in the current study) and those realised after the factorial analysis (termed empirical constructs) were valid and reliable. Through an extensive and thorough literature review and synthesis, expert reviews and validation as well as pilot-testing, construct validity of the theoretical variables was achieved (Olson, 2010). The Cronbach's alpha internal consistency reliability test was used to statistically assess the internal consistency of the ten theoretical variables as well as the two empirical constructs including lagging indicators (comprising absence from work for more than three days due to an injury, medical treatment beyond first aid, restricted work, near-misses, injury and sickness at work, and reporting of accidents) and leading indicators (consisting of risk assessment prior to performing a task, accepting any kind of work regardless of risks involved, and failure to wear PPE).

The resulting values, presented in table 1, indicated good internal consistency of the constructs. Before factor analysis, the scale was considered to be reliable and representative of what is to be measured, with a good alpha index of 0.83 (Roelen and Klompstra, 2012; Pallant, 2013). After analysis, the internal consistency reliability of the constructs, tested using both the Cronbach's alpha and mean inter-item indices, was equally good. Cronbach's alpha values of above 0.7 indicate acceptable internal consistency reliability and mean inter-item coefficients ranging from 0.2 to 0.4 indicate good internal consistency (Pallant, 2013).

Table 1. Internal consistency reliability of empirical constructs

	Cronbach's alpha	Mean inter-item correlations	Number of items
Lagging measures	0.885	0.530	7
Leading measures	0.763	0.521	3

4 Findings and Discussion

Prior to performing the factor analysis, suitability of the data for factor analysis was tested. The KMO value was 0.832, exceeding the recommended value of 0.6 and the Bartlett's test of sphericity reached statistical significance at $p = .000$ ($< .05$), supporting the factorability of the data. The correlation matrix which showed the presence of many coefficients of 0.3 and above also supported the suitability of data for factor analysis.

Factor analysis of the ten items revealed that only two components had eigenvalues above 1 (4.511 and 1.885) as shown in Table 2, and the results of the scree test (Figure 1) also supported that only the first two components accounted for approximately 64% of the variance. The two components were thereafter rotated to reveal their item-loadings (Table 3). Seven of the factors strongly loaded on the first component, while the remaining three loaded on the second. The two components were then adopted as the empirical constructs.

Table 2. Percentage variance explained by the safety performance measures

Factor		Total	% of Variance	Cumulative %
1	been away from work for more than three days due to an injury	4.511	45.106	45.106
2	been treated medically for injuries (more than simple first aid) on site	1.885	18.851	63.958
3	been asked to do limited work after an injury	.815	8.148	72.106
4	been involved in incidents or near-misses	.710	7.097	79.202
5	been injured at work	.594	5.938	85.141
6	been sick at work	.451	4.506	89.647
7	failed to report an accident or incident	.330	3.297	92.944
8	failed to consider the possible risks in a particular task	.296	2.959	95.903
9	accepted any kind of work, not minding the danger/risk involved	.235	2.353	98.256
10	failed to wear personal protective equipment (PPE)	.174	1.744	100.000

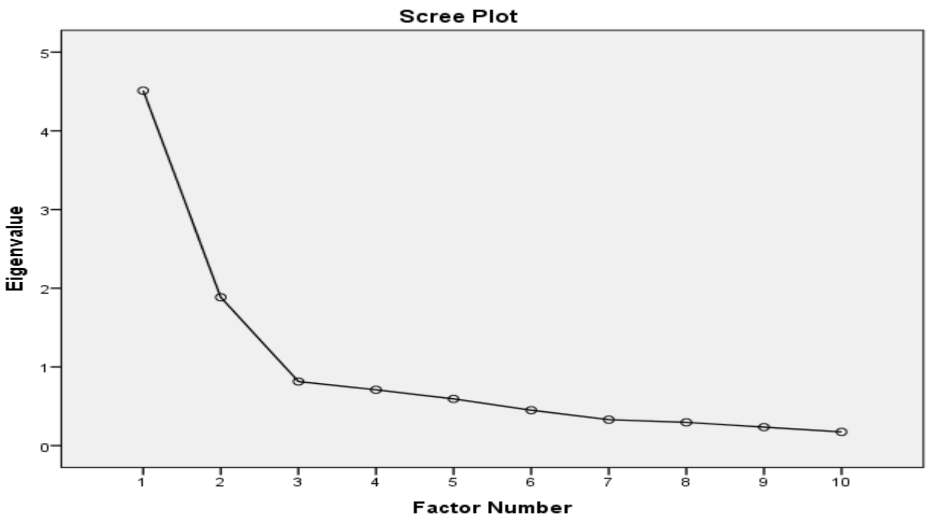

Figure 1. Scree plot showing constructs above the breaking point

Table 3. Loading matrix of the safety performance measures

	Measures	**Component**	
		1	**2**
1	been away from work for more than three days due to an injury	.946	-.119
2	been treated medically for injuries (more than simple first aid) on site	.872	-.009
3	been asked to do limited work after an injury	.813	-.177
4	been involved in incidents or near-misses	.670	.011
5	been injured at work	.651	.289
6	been sick at work	.613	.049
7	failed to report an accident or incident	.465	.258
8	failed to consider the possible risks in a particular task	-.073	.850
9	accepted any kind of work, not minding the danger/risk involved	-.036	.704
10	failed to wear personal protective equipment (PPE)	.124	.564

The interpretation of the two components showed that positive measures clumped together and negative measures did the same, consistent with positive and negative schedule scales used in extant literature (Pallant, 2013). Hence, the first component with negative items was named *lagging indicators*, while the second component with positive items was named *leading indicators* (ICMM, 2014).

In relation to construction safety performance, prevailing performance measures are leading indicators which provide information that prompt actions to achieve desired outcomes and/or avoid unwanted outcomes whereas trailing performance measures are lagging indicators that provide safety results, for instance, the extent of worker injuries (Hinze et al., 2013). Differentiating and using both indicators provide a more reliable and/or accurate measurement of safety performance (Lingard et al., 2013). Leading metrics can be useful in predicting future levels of safety performance, thereby providing information which could guide implementation of interventions to improve and impact positively on the safety process, before any negative (trailing) incidences occur (Hinze et al., ibid.).

The study provides support to extant literature which advocates the use of both leading and lagging indicators to measure safety performance in the construction industry. Traditional measures of safety, which are after-the-fact measures that assess safety after injuries occur, has a shortcoming in the sense that it bases measurement on failure of the system (Dingsdag et al., 2008; Farooqui et al., 2012). Pre-emptive actions need to be taken before accidents occur. Leading indicators can help to predict safety levels to engender the necessary pro-active measures before the occurrence of accidents. Therefore, leading indicators should ideally be included in assessing of worker safety performance levels. This is even more important for assessing construction worker safety performance in order to reduce the risks associated with working in an inherently unsafe environment. In addition, the attitude and behaviour of construction workers with respect to safety is influenced by their trepidations of risk, safety, rules, procedures and management (Masood et al., 2014). Although leading indicators may be cumbersome to collect and measure, may not directly reflect actual success in preventing injury and/or disease, and may be subject to random variation (Dingsdag et al., 2008), they are increasingly becoming adopted (Lingard et al., 2013; Hinze et al., 2013). Equal consideration should be given to leading measures. A combination of both classifications to support behavioural changes can lead to sustainable worker safety levels in the long run. The use and adoption of both should be encouraged to drive H&S continuous improvement (Construction Owners Association of Alberta (COAA), 2011).

5 Conclusion and Further Research

The study sought to explore the underlying structure of safety performance measures. Safety performance was found to be measured by two components. The components had positive and negative safety performance measures, respectively. They were therefore named leading and lagging measures, accordingly. Lagging and leading measures should therefore be used to evaluate and effectively manage safety performance of construction workers.

The study provides evidence which could be useful in psychometric evaluation of construction workers' safety performance and behaviours on construction sites. By highlighting safety performance/behaviours of the workers, construction stakeholders could be enabled to make informed decisions regarding improving H&S performance of the workers, and thus improve the productivity, profits and competitiveness in their establishments. The limitations of the current study warrant mention. Firstly, the study was conducted in only one province in South Africa and may not be generalized to workers in the entire country or other countries. Secondly, the method of data collection was quantitative. More in-depth information could have been elicited with a follow up qualitative technique such as interviews, especially to shed more light on the "never" category responses. Future studies could therefore attempt the study using a different approach to extract more information or determine if dissimilar results would be obtained.

6 Acknowledgement

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7 References

Atkins, W. S. (2011). Development of suitable safety performance indicators for level 4 bio-containment facilities: Phase 2. Health and Safety Executive (HSE).

Biggs, H. C., Dingsdag, D. P., Kirk, P. J. and Cipolla, D. (2009). Safety Culture Research: Leading indicators and the development of safety effectiveness indicator in the construction sector. *Proceedings of the 5th International Conference on Knowledge, Technology and Society,* 30Jan – 1 Feb., 2009. Huntsville, Alabama: Unites States of America.

Cameron, I. and Duff, R. (2007). A critical review of safety initiatives using goal setting and feedback. *Construction Management and Economics,* 25(5):495-508.
Campbell Institute. (2014). Practical guide to leading indicators: Metrics, case studies and strategies. National Safety Council: United States of America.
Construction Industry Institute (CII). (2014). Measuring safety performance with active safety leading indicators. CII.
Construction Owners Association of Alberta (COAA). (2011). Workplace health and safety performance improvement guideline: A best practice of the COAA. Canada: COAA.
Dingsdag, Donald P. and Biggs, Herbert C. and Cipolla, Dean. (2008). Safety effectiveness indicators (SEI's): Measuring construction industry safety performance. *Proceedings Third International Conference of the Cooperative Research Centre (CRC) for Construction Innovation – Clients Driving Innovation: Benefiting from Innovation*, Gold Coast, Australia.
ElSafty, A., ElSafty, A. and Malek,, M. (2012). Construction safety and occupational health education in Egypt, the European Union and United States firms. *Open Journal of Civil Engineering,* 2:174-182.
Farooqui, R. U., Arif, F. and Rafeeqi, S. F. A. (2008). Safety performance in construction industry of Pakistan. *Proceedings of the First International Conference on Construction in Developing Countries,* August 4-5, Karachi, Pakistan.
Health and Safety Executive (HSE). (2014). Statistics on fatal injuries in the workplace in Great Britain. HSE Books.
Herrera, I. A. (2012). Proactive safety performance indicators. *Unpublished Doctoral Thesis*. Norwegian University of Science and Technology, Norway.
Hinze, J., Thurman, S and Wehle, A. (2013). Leading indicators of construction safety performance. *Safety Science*, 51(1):23-28.
Huang, Y. Zohar, D., Robertson, M. M., Garabet, A., Lee, J. and Murphy, L. A. (2013). Development and validation of safety climate scales for lone workers using truck drivers as examplar: Transportation research part F. *Traffic Psychology and Behaviour,* 12:5-19.
International Council on Mining and Metals (ICMM). (2014). Health and safety performance indicators. ICMM, London: United Kingdom.
International Labour Organization (ILO). (2003). Safety in numbers: Pointers for global safety culture at work. ILO, Geneva.
Janackovic, G. l., Savic, S. M. and Stankovic, M. S. (2013). Selection and ranking of occupational safety indicators based on fuzzy AHP (Analytical Hierarchy Process): A case study in road construction companies. *South African Journal of Industrial Engineering,* 24(3):175-189.
Khan, R. A. (2008). Role of construction sector in economic growth: Empirical evidence from Pakistan economy. *Proceedings of the First International Conference on Construction in Developing Countries,* August 4-5, Karachi, Pakistan.
Lin, S., Tang, W., Miao, J., Wang, Z and Wang, P. (2008). Safety climate measurement at the workplace in China: A validity and reliability assessment. *Safety Science,* 46:1037-1046.
Lingard, H and Turner, M. (2015). Improving the health of male, blue collar construction workers: A social ecological perspective. *Construction Management and Economics,* 33 (1):18-34.
Lingard, H., Wakefield, R. and Blismas, N. (2013). “If you cannot measure it, you cannot improve it”: Measuring health and safety performance in the construction industry. *Proceedings of the 19th CIB World Building Congress*, 5-9 May, Queensland University of Technology, Brisbane: Queensland.

Masood, R., Mujtaba, B., Khan, M. A., Mubin, S., Shafique, F. and Zahoor, H. (2014). Investigation for safety performance indicators on construction projects. Sci. Int.(Lahore),1403-1408,2014

Melia, J. L. and Becerril, M. (2009). Health behaviour and safety in the construction sector. *Psicothema*, 21(3): p.427+

Musonda, I. (2012). Construction health and safety performance improvement: A client-centred model. *Unpublished Doctoral Thesis.* University of Johannesburg, South Africa.

Ofori, G. (2012). New perspectives on construction in developing countries. Routledge.

Olson, K. (2010). An examination of questionnaire evaluation by expert reviewers. *Field methods*, 22(4):295-318.

Pallant, J. (2013). SPSS survival manual: A step by step guide to data analysis using IBM SPSS. 5th edition. Allen and Unwin, Australia.pp. 101, 193, 199 and 207.

Roelen, A. L. C. and Klompstra, M. B. (2012). The challenges in defining aviation safety performance indicators. Preprint for PSAM II and ESREL, 25-29 June, 2012, Helsinki: Finland.

QUALITY MANAGEMENT A FUNDAMENTAL BUSINESS IMPERATIVE FOR CONSTRUCTION COMPANIES

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Abstract
The quality of construction projects in South Africa has long been below par which is evident in the reports of poor project performance, poorly implemented construction processes or worse projects delivered at an unexpected cost to the client. Private and public sector clients are dissatisfied with the quality of work produced by contractors, the rectification of substandard construction work on many of the low-cost housing projects throughout South Africa has left the state with a bill of around R50 billion. As a result this research suggests that company's implement quality management systems as a means to differentiate themselves from current industry performance. The research inquiry was conducted through the use of a case study (Bay West City Mall). Data was collected primarily through participant observation and survey questionnaire with the various participants of the Bay West City Mall project. The collected data were extracted, errors eliminated/accounted for, coded and entered onto an excel spreadsheet for easy reference and analysis. For the interpretation of the data the researcher used the bivariate tabulation method where categorical data is measured using ordinal and nominal scales. The study concluded that the employment of quality management systems should no longer be seen as optional but as fundamental to the continual improvement of construction companies, those organizations that fully institutionalise the principles of quality management will have a strong chance of improving their project performance, reducing project costs, getting repeat business and increasing profits on projects. It is the recommendation of this study that more research be conducted into how quality management, in the construction industry, can assist in alleviating other problems that plague the South African construction industry such as poor performance relating to health & safety, cost, time, low profit margins and poor cultural practices.

Keywords: Business management, Construction; Project pPerformance; Quality management; South Africa

1 Introduction

During the past decade the construction industry has been criticised for its poor performance and productivity in relation to other industries (Honnakker, 2010: 953). The Construction Industry Development Board (2010: 2) study *Construction Quality in South Africa: A Client Perspective* revealed that public sector clients were neutral or dissatisfied with the quality of construction on around 20% of all projects surveyed in 2009. While the CIDB Construction Industry Indicators (CII's) reported that for the year 2008 around 18% of the projects surveyed had levels of defects which are regarded as inappropriate, and clients were neutral or dissatisfied with the quality of work delivered on 20% of projects, in 2010 clients were neutral or dissatisfied with 15% of projects surveyed and around 12% of projects surveyed had defects which are regarded as inappropriate and a noticeable decrease in satisfaction among clients was observed with increasing project size.

The Movement for Innovation (2010) found that construction industry clients want their projects delivered on time, on budget, free from defects, efficiently, right the first time, safely and by profitable companies. While regular clients expect continuous improvement from their construction team to achieve year on year reductions in project cost and reductions in project time. Therefore as Seneratne and Jayarathna, (2012: 101) put it, the construction industry needs to move towards higher quality, and contractors need to upgrade the quality of their services. In order to make this move organisations in other industries turned to quality management as a reliable management tool in the competitive market environment that leads to higher project performance (Seneratne and Jayarathna, 2012: 101). Sullivan (2011: 212) describes Quality Management as any approach to achieve and sustain a high quality output by conforming to requirements and meeting customer satisfaction requirements. Much research has been done with regard to the implementation of Quality Management Systems (QMS) and Elwary and Shabayama (2008: 156) believe that an organisation experiences the benefits of higher customer satisfaction, better quality products, and higher market share after the adoption of a QMS. According to Elwary and Shabayama (2008: 156) a QMS has the single purpose of improving the performance of one’s business.

With the changing construction environment and the reported cases of dissatisfied clients it is necessary that studies be conducted to reveal the importance of Quality Management Systems and how they can not only turn around the trajectory of a single organisation, but that of the industry as a whole. A failure to conduct these investigations presents a risk to business in that it will be difficult to rectify poor quality on projects so that companies can eliminate cost overruns, improve client satisfaction and increase turnover. Thereby making the construction sector a less favourable investment solution for investors.

Construction Industry Development Board, (2011: 41) suggests that industry regulation bodies’ and Government advocate for and strengthen the requirements for the appointment of professional services and contractors based on quality criteria.

2 Literature Review

The modern quality movement has only been with us for a few decades, it still has far to go before becoming widely operational among world economies (Maguad, 2006: 201). Therefore, it will probably take many more decades if not a century for the quality management discipline to mature and for nations and economies to digest this change (Magaud, 2006: 201). Nevertheless Maguad (2006:201) is confident quality will continue to become an imperative for the survival of organizations and national economies. He further asserts that the 21st century may well become known to historians as the Century of Quality.

2.1 Performance improvement and why it is important

Construction Industry Indicators (2010: 3) report that the contractor’s survival depends on repeat work from clients, which is linked to the contractor’s performance in past projects, contractors need to provide value for money to the client, as existing clients award contracts on the performance of the contractor on past contracts. Gharakhani et al., (2013: 46) observe that improving the quality with which an organization delivers its products and services is crucial for competing in an expanding global market. As the construction industry is now a highly dynamic sector, industry structures and product characteristics are changing at an ever-increasing pace (Seneratne and Jayarathna, 2012: 101).

With the changing economic environment, managers of construction companies and projects need to look for emerging construction management philosophies to keep up with the demands of the industry and its clients' (Seneratne and Jayarathna, 2012: 101). Hoonakker et al., (2010: 953) report that many of the management practices used to support construction organisations are being challenged, the industry's clients are moving forward, clients demand improved service quality, faster delivery and more innovative buildings.

2.2 The role of QMS in performance improvement

Delagado-Hernandez and Aspin (2008: 919) conducted a study called *Quality Management Case Studies in the UK Construction Industry* and found, that companies that have Quality Management Systems in place have won repeat business, increased their market shares and improved their customer satisfaction levels. Cagnazzo et al., (2010: 312) found strong evidence that ISO 9000 certification leads to improved performance, improved management and operational processes, which results in less waste of time and material, increased productivity, and cost saving. While Din, et al., (2011: 1047) report that quality management systems are not limited to influencing production based processes, but lend themselves to the improvement of financial procedures, risk management practises and information management among others. It is evident from studies by Cagnazzo (2010), Taticchi and Fuiano (2010), Chachadinha 2009, Coffey (2011), Willar and Trigunarsyah (2011), and Seneratne and Jayarathna (2012) that the use of ISO 9000 is associated with an increase in financial performance that brings benefits to companies' and stakeholders. Ghodbane, (2014: 68) confirms that QMS help organisations to optimize operations and increase sales, improve quality, provide cost savings and strengthen customer satisfaction.

To improve the performance of construction organisations and reduce project costs Davis et al. (1989), Abdul-Rahman (1993; 1995), Low and Yeo (1998), Love and Li (2000) stressed the need to measure quality costs. Costs associated with failure arise both from internal and external sources. Internal poor quality costs increase an organisation's cost of operations, for example, rework and material waste. External poor quality costs, however, result in loss of profits through contractual claims, defect rectification (rework), and the loss of future business (Jafari and Love, 2013: 1245). QMS provides a framework for measuring quality costs. Certified quality management systems can provide a solution for several issues in a construction company; it constitutes a good opportunity for restructuring and modernization, as well as changes in traditional ways that have been accepted without in depth analysis (Chachadinha, 2009: 245).

2.3 Quality Management and its impact on the business

Cagnazzo et al. (2010: 313) reports that the adoption of QMS yields visible concrete benefits to organisations in the form of increased customer satisfaction. He further writes that certified organisations are praised by researchers and scholars alike for being aware of customer requirements, having processes/activities that are designed to increase customer satisfaction, have systems to avoid misunderstandings about client instructions, systematically review contracts, and have systematic process for handling complaints.

Prince (2008: 15) discovered that QMS had the following long term effects on organisations that implement them;

- Improvements in product and service quality
- Production system improvements
- Productivity improvements
- Cost reductions in material and labour
- Reduction in cycle times and improved delivery

- Maintaining an “improvement” culture

Sidumedi (2006: 17) found that the dominant South African firms have recognized the benefits that could be derived from certified Quality Management Systems and have relentlessly pursued and have subsequently been awarded ISO 9000 certification.

2.4 Importance of certification

In his study, Sidumedi (2006: 16) observed that inspections were the dominant measure of addressing quality problems. However, Gharakhani et al., (2013: 48) states that in order to achieve quality on construction projects contractors must do more than conduct inspections, inspections are an inadequate control measure as they fail to address the root of the problem. Gharakhani et al., (2013) add that the inspection stage is too late; contractors must aim to reduce defects during production and eliminate mass inspection through the use of structured quality management systems.

Cagnazzo et al. (2010: 314) and (Ghodbane, 2014: 68) discovered that ISO 9000 certification increases a firm’s revenue as firms are able to enter new markets, increasing their potential to get new contracts and their ability to enter international markets. Din et al., (2011: 1044) observed that the advantages of a certified QMS clearly outweighed the inconveniences and the investment of resources involved as ISO 9000 certified companies’ have enhanced levels of performance in their projects compared to those that are not certified.

Results of a study by Liu (2003) on quality implementation in public housing projects in Hong Kong showed increased customer satisfaction after ISO 9000 implementation. Furthermore, the average number of defects in housing projects built by companies with ISO 9000 certification was significantly less than the number of defects in housing projects built by companies without ISO 9000 certification. Corbett et al. (2005) studied the impact of ISO 9000 certification on the financial performance of listed companies in three American economic sectors, over a period of 10 years (1988-1997). The authors stated that certification leads to an improvement of financial performance for firms that had a comparable level of economic performance before starting ISO programs.

Din et al. (2011: 1046) and Coffey et al. (2011:403) report that new regulations in Malaysia required Grade G7 contractors, the highest grade, to be certified with the ISO 9000 QMS as a compulsory condition of registration by January 1st, 2009. Failure resulted in being downgraded, which adversely impacts on the ability to do business. Such initiatives by government to improve quality in the industry will compel companies to adopt quality management systems. Malaysia is not alone in this process Australia, Hong Kong and Singapore have imposed regulations for construction firms to be ISO 9000 certified in order to qualify to bid for public sector projects. There is a global move towards certification and companies that operate globally that neglect to get a certified quality management system may soon find that they do not meet the required standards in some of the markets they previously operated in without difficulty.

3 Research Methodology

This study was conducted in two parts an observation / participation case study and a survey within the case. The survey was conducted amongst participants of the case in order for the phenomena observed to also be described from the participant’s view. The study was conducted over a period of 12 months. The research design employed was mostly qualitative although some aspects of quantitative were borrowed during the interpretation of the data.

The sample population was chosen using the *maximum variation* sampling strategy described by Merriam (2009: 82) and consisted of 54 persons in management positions and of these 21 responded. Respondents ranged from the Project Manager, Designers (Architects and

Engineers), and Contracts Managers to Site Foremen. Palys (2008: 2) wrote that searching for cases or individuals who cover the full spectrum of positions and perspectives in relation to the phenomenon one is studying, allows the researcher to capture both extremes (negative/positive, high/low,) and typical cases plus any other positions that can be identified.

Primary data were obtained through participant responses to the research questionnaire/survey, participatory observations made by the researcher and physical sources, while the secondary data came from the researched literature and these were used for (1) the description of contemporary and historical attributes (2) comparative research (3) reanalysis (asking new questions of the data that were originally not asked and (4) research design and methodological advancement.

Raw data were extracted from the questionnaire coded and plotted on an excel spreadsheet, errors and omissions were corrected and missing variables allocated a code such that no data was incorrectly entered as that may produce false results.

The responses on each questionnaire were recorded horizontally, under a separate heading as suggested by Struwig and Stead (2009: 151).

The bivariate tabulation method as discussed by Struwig and Stead (2009: 152) was used to tabulate the data. All questions in the questionnaire required categorical data, two types of measurement scales were used namely; nominal and ordinal.

The interpretation is coherent and accounts for all the data, although it must be noted it is seldom possible to account for every utterance by the research participants or every paragraph in a large document such as this (Struwig and Stead, 2009: 154).

4 Findings and Discussion

4.1 Case observations

This case examines the implementation of a quality management system (QMS) on large construction project by a South African construction company. At the start of the project the contractor had been operating for 112 years albeit since inception the organisation has become a large construction group operating on six continents. The organisation employs around 4000 employees.

The Bay West City Mall is a Regional Shopping Centre of approximately 90 000 m2 situated in the Hunters Retreat area, west of Port Elizabeth in the Eastern Cape. The project population consisted of a Client, Development Manager, Investors, Project Manager, a design team of Architects and Engineers, Tenant coordinators, Leasing agents, Branding agents, Main Contractor, Nominated / Selected Subcontractors and Domestic Subcontractors.

The quality management system was based on the contractors SHEQ Policy (Safety Health Environmental and Quality) which encapsulates the company’s mission, visions and goals. These form the basis of the project specific project quality plan, which was drafted and presented to the client for approval.

The project had a construction value of R900mil of that approximately R1, 2 mil was lost through rework, defective workmanship, waste, material failures and other quality issues. However, the existence of quality management system was what allowed the contractor to quantify the value of money lost through quality issues. The contractor was able to recover as much as R 121 444, 73 from selected subcontractors and R38 334, 14 from labour only sub-contractors through the non-conformance system. Considering the overall construction value R1, 2 mil makes 0.13% of R900mil, which is less than 1%.

These issues were not only quantified, but the system also calls for an accurate description and investigation into the root cause of quality issues, preventative measures and proposed action, which minimises the possibility of the same errors reoccurring. On a monthly basis a report is compiled highlighting the most prevalent quality problems experienced onsite, this information is presented to the contractor's project manager, contracts managers and site agents who manage the foremen. Foremen are advised on what to look out for and resources are invested towards reducing the likely hood of these issues reoccurring.

Where necessary the system records which subcontractors are responsible for the most costly non-conformances, what is the most prevalent root cause and which trade has the highest number of defects, all this historic data is important for the contractor to understand where his shortcomings are and plan on how to reduce them on the project going forward, but also eliminate them on future project this facilitates continuous improvement on the contractors part.

The client was updated regularly on the performance of the project, through his agents and project reports this allowed the client to form a perception of the contractor and how well or poorly he was performing on the project. The presence of a structured system for recording and rectifying non-conformances boosted the client's confidence in the contractor's ability to manage the risk of poor quality.

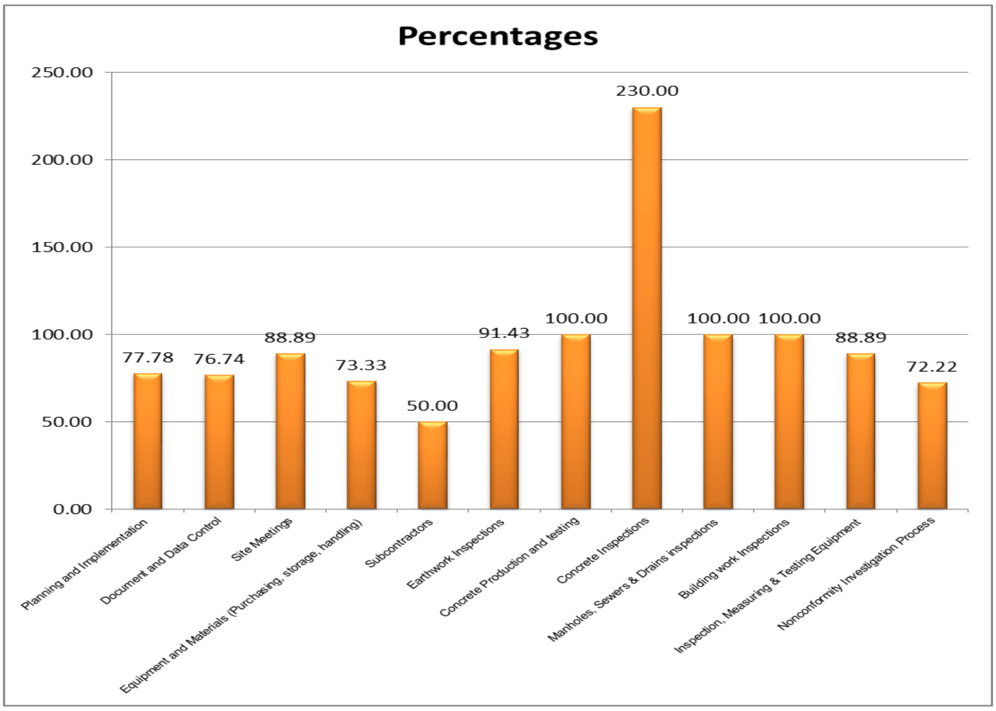

Figure 1. Audit results

Non-compliance to system and processes	70
Partial compliance to system and processes	100
Compliance - room to improve	150

Figure 2. Audit results

Figure 1 seen above shows a graphical representation of an audit conducted by the main contractor and shows that the highest score was achieved in concrete inspections and the lowest score was from sub-contractor performance. This showed the contractor that when it comes to quality his staff had a high focus on inspections and sub-contractors were provided very little guidance and management, which is not the correct view of quality this provided the contractor with an opportunity to change his focus and attempt to achieve a more level graph.

The contractor was able to get more business from the client, in the form of two additional but separate contracts these were negotiated with the main contractor before the client approached other bidders. The cost of rework on the project amounted to less than 2% of the contract value. Employee morale was raised as milestones were met and employees wanted to improve their statistics, wastage was reduced drastically because the main contractor kept a record of material orders versus requirements and was able to track where wastage was highest and resolve, newer employees were inducted on safety as well quality on their arrival and because all their peers were actively managing quality they easily adapted. Employees were sent on training courses to improve their knowledge and management skills, contracts managers took an active position in ensuring quality on the project, with time allocated to discussing quality at all formal site meetings.

The contractor was able to continually improve his processes as the staff got familiar with the quality system, however, it did not stop there a needs analysis project was initiated by the quality management department to assess the shortfalls of the quality system and suggest solutions. One of the shortfalls identified was that the staff did not fully comprehend the impact the quality management system was having on the project and therefore did not see the 'real' value of the system. This was overcome by showing the employees a record of their non-conformances and how much they had cost the company and it was presented to them how a collaborative effort between themselves and the quality department would not only reduce non-conformances but would lead to improved performance in terms of quality of work and delivery time.

4.2 Survey Findings

A survey was conducted amongst the participants of the case, the survey had questions/statements relating to five hypotheses. The sample population consisted of 54 persons in management positions and of the 54 only 21 responded giving a 39% response rate. Respondents ranged from the Project Manager, Designers (Architects and Engineers), Contracts Managers, Site Foremen and sub-contractor staff.

The questions and responses from the questionnaire could not all be tabled in this paper, however, Table 1 shows a summary of the hypotheses generated from this study through literature review and observation, these were then confirmed/supported by the data collected from the survey questionnaires.

Table 1. Hypotheses summary

Hypothesis Number	Description	Hypothesis Supported	Inconclusive	Hypothesis Rejected
1	Implementation of a certified Quality Management System leads to improved contractor performance on projects.	x		
2	Quality Management Systems are a fundamental business imperative.	x		
3	A construction company with a certified Quality Management System has a competitive advantage over one that does not have a quality management system	x		
4	The implementation of certified quality system allows a company to continually improve its processes and outputs.	x		
5	Quality management systems allow companies to meet client quality requirements		x	

Overall responses from the survey showed that respondents agreed that the existence of a certified quality management system does lead to improved contractor performance, a wide range of researchers agree that QMS leads to improved project performance as well as financial and organisational performance (Cagnazzo 2010, Taticchi and Fuiano 2010, Chachadinha, 2009, Coffey 2011, Willar and Trigunarsyah 2011, Seneratne and Jayarathna, 2012).

Respondents viewed the existence of certified quality management systems as a fundamental business function. In his study *A study of challenges small black eletrical contractors in Durban and Pietermaritzburg areas are faced with that could lead to their failure* Myeza (2006) found that successful growing firms use low-cost strategies to compete. They compete with high-quality products and superior service and adopt continuous improvement strategies. They also take advantage of new opportunities and adopt formal and professional approachs to people management. Customer care is crucial customers are not interested in the problems that the firm has but are concerned with what can be obtained from the interaction of the two parties. Losing valuable customers could be detrimental to the business survival (Myeza 2006: 20). QMS is a suited to acieving the success factors listed by Myeza (2006: 20).

Responses support the hypotheis "*A construction company with a certified Quality Management System has a competitive advantage over one that does not have a quality management system*". Cagnazzo, Taticchi, and Fuiano (2010); and Magaud (2006) suggest that companies with certified quality management systems have a competitive advantage over those that do not.

The majority of respondents strongly agreed that quality management systems allowed companies to continually improve their processes. When QMS is applied as an ongoing process it results in continuous improvement (Elghamrawy and Shibayama 2008: 156). Magaud (2006); and Chachadinha (2010) discovered that the main purpose of the ISO 9000 standards is to achieve an effective management system that focuses on continuous improvement, communications, and meeting customer requirements.

Findings were inconclusive for the hypothesis "*qms allows a company to meet client requirements*".

5 Conclusion and Further Research

The aim of this study was to highlight how important certified quality management systems have become in today's construction environment and how contractors should really begin to see the use/implementation of quality management systems as the next step in improving their business performance. Through the use of a quality management system the main contractor at Bay West City Mall was able to keep his rework related costs low, react to risks better, build his clients confidence, continuously improve his overall performance on the project through acting on lessons learnt from previous projects and even achieve some lesser known benefits of QMS's such as increased employee involvement, open communication and behavioural changes in employees.

The use of a certified QMS leads to long-term return on investment that is not only higher but also more sustainable. The study revealed that companies that use QMS are able to improve their performance, being renowned for quality makes it easier to get repeat business. Literature revealed that at present the concept of QMS was receiving utmost attention from larger construction companies while small and medium sized enterprises tended to postpone this step. On the same token QMS are a highly credible solution to challenges faced by small and medium sized enterprises such as poor customer retention, lack of continual improvement and the failure to adopt formal and professional approaches to business. There are difficulties and problems to overcome, however, the implementation of a thorough Quality Management System will permanently change the company's modus operandi in ways that could be uncomfortable for employees and / or management, nevertheless the advantages of QMS are undeniable.

It is the recommendation of this study that the South African government and industry regulation bodies (CIDB, NHBRC, BIFSA etc.) look at ways of increasing quality whether it be with push factors such as; making it compulsory for contractors wanting to undertake work for government to have a certified QMS in place or pull factors such as preference being given to contractors that can show their commitment to quality and end the practice of awarding business on price alone. Industry professionals/ client's agents should advice clients' not to appoint based on price alone but on quality criteria. Lastly studies should be conducted, as variable outcomes amongst companies using QMS lead to the hypothesis that there must exist critical elements in implementation. Identifying these elements could be the push required for companies not yet sold on quality management.

6 References

Cagnazzo, L., Taticchi, P. & Fuiano, F., 2010. Benefits, barriers and pitfalls coming from the ISO 9000: implementation: the impact on business performance. WSEAS TRANSACTIONS on BUSINESS and ECONOMICS, 7(4), pp. 311-321.

Chachadinha, N. M., 2009. Implementing Quality Management Systems in Small and Meduim Construction Companies: A contribution to a road map success. *Leadership and Management in Engineering*, pp. 32-39.

Coffey, V., Willar, D. & Trigunarsyah, B., 2011. *Quality Mnagament System and Construction Performance*. Brisbane, IEEE Xplore Digital Library.

Construction Industry Development Board, 2010. *Results of 2010 CIDB Construction Industry Indicators*, Pretoria: CIDB.

Construction Industry Development Board, 2011. *Construction Quality in South Africa: A Client Perspective*, Pretoria: cidb.

Delagado-Hernandez, D. J. & Aspin, E., 2008. Quality Management case studies in UK construction industry. *Total Quality Management*, 19(9), pp. 919-938.

Din, S., Abd-Hamid, Z. & Bryde, D. J., 2011. ISO 9000 certification and construction project

performance: The Malaysian Experience. *International Journal of Project Management*, Issue 29, pp. 1044-1056.
Elghamrawy, T. & Shibayama, T., 2008. Total Quality Management Implementation in the Egyptian. *Journal of management in Engineering*, 3 July, 24(3), pp. 156-161.
Gharakhani, D., Rhamati, H., Farrokhi, M. R. & Farahmandian, A., 2013. Total Quality Management and Organisational Performance. *American Journal of Industrial Organisation*, 1(3), pp. 46-50.
Ghodbane, B. S., 2014. The Effect of Quality Management on Business Performance: Case of Tunisian Firms. *International Journal of Information, Business and Management*, 6(4), pp. 67-72.
Hoonakker, P., Carayon, P. & Loushine, T., 2010. Barriers and Benefits of quality managemnt in the construction industry: An empirical study. *Total Quality Management*, 21(9), pp. 953-969.
Jafari, A. & Love, P. E., 2013. Quality Costs in Construction: Case of Qom Monorail Project in Iran. *Journal of Construction Engineering and Management*, 139(9), pp. 1244-1249.
Magaud, B. A., 2006. The Modern Quality Movement: Origins, Development and Trends. *Total Quality Management & Business Excellence*, 17(2), pp. 179-203.
Merriam, S. B., 2009. *Qualitative Research: A Guide to Design and Implementation*. San Francisco: Jossey Bass.
Myeza, M. P., 2006. *A study of challenges small black eletrical contractors in Durban and Pietermaritzburg areas are faced with that could lead to their failure*. Pietermaritzburg: University of Kwa-Zulu Natal.
Palys, T., 2008. *Purposive Sampling*. Burnaby: Simon Fraser University.
Prince, S. N., 2008. *Assessing quality management systems of SMME's in the manufacturing sector*. Port Elizabeth: Nelson Mandela Metropolitan University.
Seneratne, S. & Jayarathna, T., 2012. Quality Planning Process of Construction COntractors: Case studies in Sri Lanka. *Journal of Construction in Developing Countries*, 17(1), pp. 101-114.
Sidumedi, K. S., 2006. *An investigation into the relationship between the corporate culture of South African construction firms and performance*. Johannesburg: University of Witwatersrand.
Smallwood, J. J., 2012. *Quality Management in Construction*. Cape Town: Nelson Mandela Metropolitan University.
Struwig, F. W. & Stead, G. B., 2009. *Planning, designing and reporting research, 5th ed*. Cape Town: Pearson Education South Africa.
Sullivan, K. T., 2011. Quality Management Programs in the Construction Industry: Best Value Compared with other Methodologies. *Journal of Management in Engineering*, 27(4), pp. 210-219.

STRATEGIES FOR EFFECTIVE MATERIALS MANAGEMENT TOWARDS SUSTAINABLE CONSTRUCTION ENHANCEMENT

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Abstract
Despite the significance of the construction industry in developed and developing nations, construction activities tend to have adverse impacts on environmental and socio-economic aspects of society. This paper aims to evaluate the impact of construction materials management on materials usage efficiency towards the enhancement of sustainable building construction in the Western Cape Province of South Africa. The study adopts a quantitative research approach. Closed-ended questionnaires were administered to seventy (70) construction professionals in different construction companies in the Western Cape. The data obtained were analysed using the Statistical Package for Social Sciences (SPSS). Strategic planning before procurement at design stage, procurement strategy considered for materials purchase, enforcing the adoption of Green Building Councils of South Africa (GBCSA) policy in every construction projects in the country and evaluating the life-cycle analysis (LCA) of materials proposed for use were acknowledged as the predominant factors of materials management that enhance the construction of sustainable buildings. This study was delimited to construction professionals (project managers, procurement officers, engineers, and architects), contractors and company suppliers in the construction industry in the Western Cape Province of South Africa. The adoption of sustainable materials management principles during construction will have the following implications: increased competition amongst material manufacturers, leading to a reduction in material cost which will facilitate economic advancement; and a reduction of material wastage during construction by ensuring availability of material when required on site. Effective materials management during sustainable construction remains a significant attribute of a successful project which ensures waste reduction, cost profitability optimization and government participation in sustainable development through policy implementation related to construction.

Keywords: Construction materials management, Materials selection, Materials usage, Sustainable building construction, Sustainable development

1 Introduction

The construction industry is a significant contributor to the social, economic and environmental development of a country. Sustainability is *'the ability to meet the present needs of humans without compromising the ability of the future generations meeting their own needs*' (Du Plessis, 2007). Social, economic and environmental aspects of the human existence is also known as the 'Triple Bottom Line' (TBL). According to Asif, Brujin, Fissher and Steenhuis, (2008) TBL is a framework used in measuring the impact of human activities on the environment, the economic and social well-being of humans in a territory. Sustainable building construction is a process aimed at restoring or maintaining a balance between built environment and the eco-system to create a settlement that promotes economic and social equity (Osec, 2010). Achieving sustainability in construction through the adoption of the principles of sustainability is therefore expedient towards human development and environmental protection.

Environmental issues in the last century have lightly been considered as a major problem in construction (Nagapan, Rahman, Asmi, Memon and Latif, 2012). However, recent studies have shown that these challenges are complex in nature as it affects the well-being of the society. The process of materials usage during the cycle of construction has imposed increasing damages to the environment over the years through illicit consumption of materials and illegal wastes disposal (Ljungberg, 2007). As a result of this increasing negative impacts of construction, mitigating measures such as legal frameworks, technical, strategic and managerial processes should be adopted at the pre and post phases of construction (Du Plessis, 2007). Gaustad, Olivetti and Kirchain (2011) added that the key strategy towards materials usage efficiency is the adoption of the four Rs of sustainability (Reduction, Reuse, Recycle and Renew).

This paper sets to evaluate the impact of construction materials management on materials usage efficiency towards the enhancement of sustainable building construction. Firstly, a literature review was conducted to establish a background for the study. Based on literature the factors that enhance efficient materials management were identified to form the basis for data collection and data analyses were carried out to determine and rank the factors considered during materials selection to facilitate optimum materials usage.

2 Construction Materials Management

Construction materials are a collection of materials utilized at any stage or phase of construction (Samarasinghe, Tookey, Rotimi and Thiruchelvam, 2012). Hillebrandt (1988) cited in (Samarasinghe *et al.,* 2012) noted the existence of a strong relationship between various construction projects and the materials used in the construction. Samarasinghe *et al.,* (2012) added that the success of a project towards stakeholders' satisfaction at minimum cost and time is dependent on the management process of materials used for construction. The value of construction materials used in a project has been confirmed to claim 40-70% of the total cost of construction which contributes to a significant measure of construction wastes (Kasim, 2011; Nagapan *et al.,* 2012). In affirmation, Donyavi and Flanagan (2011) highlighted that the total cost of construction is relatively high as a result of the material cost, procurement cost and the site-handling costs which includes the cost of transportation, cost of receiving, storage, issuing, and disposal. Thus, for reduced construction cost, increased productivity, quality and timely project delivery, effective materials management must be of top priority to the project manager (Donyavi and Flanagan, 2009).

Materials management is thus defined as a plan or control adopted during construction to improve the flow of materials and to ensure that the appropriate quality and quantity of materials required for particular activities are acquired at a reasonable cost and when needed. To Patel and Vyas (2011), sustainable materials management is an integrated approach towards the reduction of materials wastages during construction in order to increase cost profitability, materials optimization and environmental protection. From the planning phase of the building to the selection of materials and disposal or recycling of materials waste during building production, the adoption of life-cycle analysis improves the chances of achieving the goals of sustainability. Thus, the aim of materials management is to reduce the adverse impact of materials usage during construction on the environmental and social well-being for a sustained economic prosperity.

With regards to achieving sustainability, it should be noted that materials used in construction determines the functionality, quality and other properties of the building regardless of the expertise involved during construction (Karana, Hekkert and Kandachar, 2010). However, it is vital for the project manager to understand the process of materials flow analysis (MFA) to determine the mass or quantity of materials used during production. The MFA is also known as Domestic Materials Consumption (DMC), used for the purpose of quality control and construction waste reduction (Fiksel, 2006). The process of materials flow analysis (MFA) involves several strategic methodologies, techniques and tools such as Life Cost Assessment, (LCA), Life Cycle Costing (LCC), Building for Environmental and economic sustainability (BEES), dematerialization, detoxification and other government established policies (Khalfan, Maqsood and Noor, 2011).

Materials selection in sustainable construction is being conducted in various ways which are guided by the same principles. These principles according to Ljungberg (2007) include the following:

- Function and structural demands of the building
- Environmental impacts
- Design
- Technological demands
- Cost of materials
- Construction method adopted

Remarkably to this effect, several sustainable materials management (SMM) policies have been launched by the South African government with regards to waste generation, quality control, environmental protection and sustainability realization. Policy bodies such as the Green Council of South Africa (GBCSA) and the South African Bureau of Standards (SABS) were established to raise awareness on the benefits of sustainable building and to facilitate and encourage the adoption of sustainable practices in the industry. The governments in some other developing countries such as Japan, China and Korea have adopted comprehensive policies and regulatory approaches relating to the reduction of material consumption, resource recycling, waste production and disposal, to ensure socio-economic equity and environmental justice during and after the building production process. Examples of these government policies as identified by Fiksel, (2006) include product life-cycle policies, waste management policies and natural resources policies. In addition, the integration of government policy should focus on the issues of materials management in an approach that transcends all boundaries of management (Fiksel, 2006).

Materials management towards sustainable construction simply poses an indispensable aspect of project management which aids in dissociating excessive material consumption from the increasing growth recorded in the construction industry. Hence, materials management during sustainable construction remains a significant attribute for successful project delivery.

3 Methodology and Methods

The study adopted a closed-ended questionnaire survey designed to examine the impact of construction materials management on materials usage efficiency towards the enhancement of sustainable building construction. This study identified fifteen materials management strategies considered during materials selection, thirteen factors that facilitate materials usage and eight approaches to materials usage towards enhancement of sustainable construction. Due to the vast size of the South African construction industry, the survey was delimited to the Western Cape Province. Data collection was conducted using the cluster sampling technique from construction industries situated in the Central Business District (CBD) of Cape Town. This technique was adopted in order to obtain precise data with generalizable conclusions from companies in the district.

The questionnaire design adopted the five point Likert scale and was administered by hand to two principle target groups. These groups are government establishments and private companies. These groups were selected because of their significant function in the construction supply chain and because their perceptions would be highly valuable to this research. In order to explicitly gain their perceptions, the target groups were sub-divided into site managers, project managers, architects, quantity surveyors, contractors, procurement officers and company suppliers. The Cronbach's alpha reliability test was conducted on the research questions to ensure the reliability of the questionnaire. A total of seventy (70) questionnaires were administered to aforementioned groups to ascertain the perspectives of the respondents on construction materials management and usage efficiency towards the enhancement of sustainable building construction. Forty-three copies (61%) of the questionnaires were retrieved after numerous phone calls, and visitation to the construction sites and consulting offices. This was observed to be as a result of the respondents' busy schedules on site, considering the positions they occupy in their organisations. Data analyses were conducted using the descriptive statically analysis in the Statistical Package for the Social Science (SPSS) version 23.

4 Data Analysis and Discussion of Findings

4.1 Data Analysis

Biographical information of respondents

Table 1 provides an overview of the respondents' background information in terms of profession and company information, working experience and highest qualification.

From the table, a high percentage of the survey respondents are working with contracting firms (30%), 33% work with government establishments, 14% work with quantity surveying companies and 21% work with engineering firms. The results reflect that 14% of the respondents have between 1-5 years' experience, 32.6% have between 6-10 years' experience, 27.9% of the respondents have between 11-15 years' experience, 18.6% of the respondents have between 16-20 years' experience and 6.9% of the respondents have had over 25 years' experience. Figure 4.1 illustrates the highest qualification obtained by the respondents, the result show that 29% of the respondents obtained National diplomas and 9% obtained Master's Degree while the majority obtained Bachelor's degrees (62%). The results of the analysis on respondents demographic and background information have shown that the respondents sampled were qualified and experienced practitioners in the construction industry whose judgments on issues of construction materials procurements can be reliable.

Table 1. Biographical information of respondents

QUESTIONS		VALID %	FREQUENCY
Participating company	Contractors	30.2	13.0
	Engineering	20.9	9.0
	Quantity Surveying	14..0	6.0
	Suppliers	2.3	1.0
	Government Establishment s	32.6	14.0
Company Specialization	Residential buildings	32.6	14.0
	Public buildings	16.3	7.0
	Both	51.1	22.0
Working experience	1-5years	14.0	6.0
	6-10years	32.6	14.0
	11-15years	27.9	12.0
	16-20years	18.6	8.0
	Above 20years	6.9	3.0
Profession	*Procurement officers*	32.6	14.0
	Quantity surveyors	18.6	8.0
	Site engineers	23.3	10.0
	Project managers	25.5	11.0

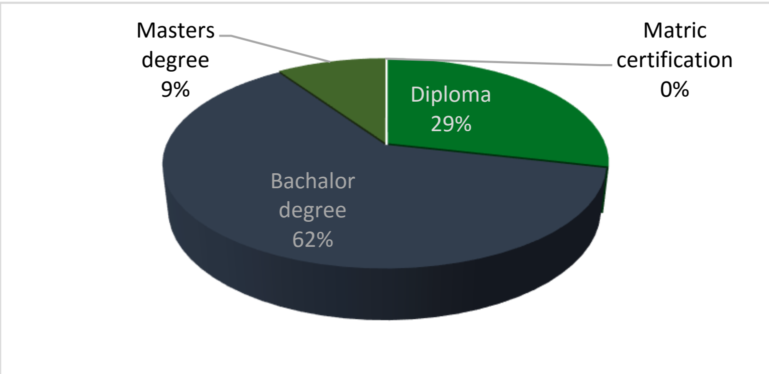

Figure 1. Highest educational qualification obtained

Table 2 shows the results obtained from the Cronbach's alpha test conducted on the questions to ensure the reliability of the research questions. Cronbach's alpha reliability test is an estimate of the internal consistency associated with the scores that can be derived from a scale or composite score (Allen, 2004). From the table, it is observed that the Cronbach's alpha coefficient values are greater than 0.70 (>0.70). To supports this, Tavakol and Dennick (2011) stated that the score values between 0.70- 0.90 are the standard acceptable values for the reliability of a test to be proven.

Table 2. Reliability of the survey tool/instrument

Headings	No. of items	Cronbach's alpha values
Materials management strategies considered during materials selection	15	0.88
Materials usage facilitators	13	0.85
Approaches to materials usage backed by government policies	8	0.75

4.2 Data analysis and Discussion of findings

4.2.1 Strategies for Construction Materials Selections during sustainable construction

Table 3 presents the results of data analysed on management strategies considered during materials selection for optimum materials usage. The respondents were required to rank the importance of these strategies towards enhancing sustainable construction. Strategic planning before procurement at design stage (mv=3.84), procurement strategy considered for materials purchase (mv=3.79), competence Level of the workforce required for construction (mv=3.79) and the environmental impact of the materials emerged as the most important factors to consider during materials selection (mv=3.72). Isa *et al.* (2014) supported the adoption of the findings in their study, stating that the planning process at the early stage is the most important process conducted in managing the life-cycle of the building project. Isa *et al* (2014) argued that the planning phase of a building project is the most strategic phase to integrate the principles of sustainability, determine the procurement strategy to be implemented and evaluate the possible environmental impact of the materials proposed for construction.

Table 3. Construction materials strategies considered during materials selection

Strategies	Mean value (mv)	Rank
Strategic planning before procurement at design stage.	3.84	1
Procurement strategy considered for materials purchase.	3.79	2
Competence level of the workforce required for construction.	3.79	2
The environmental impact of the materials	3.74	3
Selection of SABS approved materials	3.72	4
Total involvement of clients at the design stage	3.72	4
Effects of materials cost fluctuations on cost of construction	3.72	4
General site organization which may affect the flow of materials on site	3.70	5
The level of communication between the workforce during construction	3.70	5
Availability of required materials in the market.	3.65	6
Availability of adequate materials storage facility	3.16	7
The sustainable nature of materials (recyclable or renewable materials)	3.12	8
Materials specifications take-off from building designs	3.07	9
Choice of building design by stakeholders	2.98	10
Properties of the materials required for construction	2.79	11

4.2.2 Materials usage facilitators

Table 4 presents factors considered in facilitating materials usage efficiency towards sustainable building construction. The respondents were required to rate the factors based on a five point agreement scale. 1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4=agree and 5=strongly agree. Proper project planning from the inception using sustainable building design was ranked as the top facilitator of effective materials usage by the respondents and 88.4% of the respondents agree that proper project planning from the inception using a sustainable building design (mv=4.21) improve the flow of construction resources on site and workforce productivity. Implementing government policies and laws regarding usage or disposal of materials (mv=4.16), environmental impact of the materials proposed for use (mv=4.09) and proper understanding of clients ideas at the conceptual phase of design (mv=4.07) were also identified to significantly facilitate the effective usage of materials to enhance the building sustainability.

Table 4. Facilitators of materials usage efficiency

Facilitators	Strongly disagree (%)	Disagree (%)	Neither agree nor Disagree (%)	Agree (%)	Strongly agree (%)	Mean	Rank
Proper project planning from the inception using sustainable building design	0.0	0.0	11.6	55.8	32.6	4.21	1
Government policies and laws regarding usage or disposal of materials	0.0	0.0	14.0	55.8	30.2	4.16	2
Environmental impact of the materials proposed for use	0.0	2.3	11.6	60.5	25.6	4.09	3
Proper understanding of clients ideas at the conceptual phase of design	0.0	7.0	9.3	53.5	30.2	4.07	4
Efficiency of the materials procurement strategy in place during construction	0.0	4.7	18.6	46.5	30.2	4.02	5
Timely delivery of construction materials to site	0.0	9.3	16.3	46.5	27.9	3.93	6
Implementing waste reduction techniques during construction	0.0	7.0	20.9	46.5	25.6	3.91	7
Effective communication amongst workers during construction	0.0	11.9	20.9	37.2	30.2	3.86	8
Early learning on sustainable building practices should be encouraged in institutes and universities	0.0	14.0	18.6	39.5	27.9	3.81	9
Staff innovations on materials usage for effective materials utilization	0.0	7.0	23.3	53.5	16.3	3.79	10
Using self-efficient material (durable, renewable and recyclable materials) to reduce construction waste	0.0	4.7	37.2	37.2	20.9	3.74	11

4.2.3 Approaches to materials usage backed by government policies

Table 5 presents approaches to effective materials usage during construction aimed at enhancing the adoption of sustainability in the industry. The respondents were required to rate the agreement of the items using a five (5) point Likert scale: strongly disagree =1, disagree =2, neither agree nor disagree = 3, agree =4 strongly agree = 5. Majority of the respondents 86.1% agreed that the Green Building Council of South Africa (GBCSA) policy on selection and usage of building materials be enforced in every construction projects towards the enhancement of sustainable building production. Ninety-point-eight per cent (90.8 %) of the respondents indicated that evaluating the life-cycle analysis (LCA) of materials proposed for use as important and 86.1% agreed that adopting the principles of recycling material wastes to reduce environmental pollution are top policies that must be considered in enhancing sustainability during construction materials procurement.

Table 5. Approaches to materials usage backed by government policies

Strategies	Strongly disagree (%) (%)	Disagree (%)	Neither agree nor disagree (%)	Very effective (%)	Extremely effective (%)	Mean value
Enforcing the adoption of Green Building Councils of South Africa (GBCSA) policy in every construction projects in the country	0.0	14.0	25.6	37.2	23.3	3.70
Evaluating the life-cycle analysis (LCA) rating process of materials proposed for use	0.0	14.0	32.6	41.9	16.3	3.65
Adopting the principles of recycling materials wastes to reduce environmental pollution	0.0	14.0	25.6	41.9	18.6	3.65
Using renewable and reusable materials for construction	0.0	16.3	37.2	34.9	11.6	3.42
Adapting the principles of dematerialisation at every phase of construction	0.0	18.6	39.5	25.6	16.3	3.40
Adapting the use of alternative building materials(rammed earth, adobe etc) to reduce excessive consumption of manufactured materials	0.0	27.9	32.6	25.6	14.0	3.35
The use of Eco-friendly technologies during construction	4.7	20.9	32.6	27.9	14.0	3.26

5 Conclusions and Recommendations

Materials management “involves an integrated coordination of materials related functions such as taking-off, materials selection, vendor evaluation, purchasing, shipping, warehousing and distribution” (Linden and Josehson 2013). Effective selection and management of construction materials is identified as the easiest approach for project managers to incorporate sustainable principles in building construction project (Akadiri and Olomolaiye, 2012). This study evaluated the impact of construction materials management on materials usage efficiency and the identification of strategies for effective materials management towards the enhancement of sustainable building production in the Western Cape construction industry. The quantitative research approach was adopted in collecting empirical data. Data analysis indicated that strategic planning before procurement at the design stage is a significant approach to consider for effective materials management towards sustainable construction. Strategic planning before procurement at design stage gives engineers/contractors time to develop a feasible plan in meeting the building specifications with the available materials in the market. The building planning at the design phase involves the process of materials selection, ordering and scheduling. Based on the findings in this study, it can be concluded that a lapse in the planning process will negatively affect materials usage, workforce productivity, production cost (cost overrun) and construction resource wastages due to construction time delays. The findings suggested that to effectively manage construction materials’ towards the enhancement of sustainable construction, the adoption of the Green Building Councils of South Africa (GBCSA) policy in every construction projects is a strategy that must be considered for implementation by the construction profession. The findings also indicated that in enhancing the sustainability of buildings during production, the LCA is one of the most effective tools available to the contractors to holistically evaluate the environmental and economic impacts of using certain materials in the construction phases. Based on the finding, it can be concluded that the evaluation of the life-cycle analysis (LCA) ratings of materials proposed for construction is an essential strategy in ensuring sustainability in a building. There, considerations of these strategies in materials management for efficient materials usage will ensure and enhance sustainable development in building design and construction.

This paper recommends that the planning phase of any construction project should be given enough time for extensive planning as this is the best stage of construction to integrate sustainability into the processes of production. This paper also recommends that strict implementation of government legislation on sustainable building production should be enforced to ensure compliance by construction stakeholders'. It further recommended that the South African government enacts the GBCSA policies into law to ensure compliance in the industry towards the enhancement of sustainable buildings production in the country.

6 References

Akadiri, P. O., & Olomolaiye, P. O. (2012). Development of sustainable assessment criteria for building materials selection. *Engineering, Construction and Architectural Management*, *19*(6), 666-687.

Allen, K., "Explaining Cronbach's Alpha", available at http://coecs.ou.edu/sci under Publications. A paper is also being prepared with the findings

Arain, M., Campbell, M.J., Cooper, C.L., and Lancaster, G.A. 2010. What is a pilot or feasibility study? A review of current practice and editorial policy. BMC Medical Research Methodology. http://www.biomedcentral.com/content/pdf/1471-2288-10-67.pdf

Asif, M., Bruijn,E.J., Fisscher, O.A.M and Steenhuis, H.J. 2008. *Achieving Sustainability Three Dimensionally.* Proceedings of the 2008 IEEE, ICMT; pp. 423-28.

Babbie E. 2007. *The Practice of Social Research,* Eleventh Edition. USA: Thomson Wadsworth

Donyavi, S. and Flanagan, R. 2009. The impact of effective material management on construction site performance for small and medium sized construction enterprises. In: Dainty, A.R.J. (Ed) Proceedings 25th Annual ARCOM Conference, 7-9 September 2009, Nottingham, UK, Association of Researchers in Construction Management, 11-20

Du Plessis, C. 2007. *A Strategic Framework for Sustainable Construction in Developing Countries. Construction Management and Economics*. Vol. 25: pp.67-76.

Edwin, R. Teijlingen, V. and Hundley, V. 2001. Social research Update (ISSN: 1360-7898). Department of Sociology, University of Surrey, Guildford GU2 5XH, United Kingdom.

Fiksel, J. 2006. A framework for sustainable materials management. *JOM*,*58*(8), 15-22.

Gaustad, G., Olivetti, E., & Kirchain, R. 2011. Toward sustainable material usage: evaluating the importance of market motivated agency in modeling material flows. *Environmental science & technology*, *45*(9), 4110-4117.

Gillham, B. 2000. *Developing a Questionnaire*. London: Continuum.

Isa, N. K. M., Alias, A., & Abdul Samad, Z. 2014. Sustainability integration into building projects: Malaysian construction stakeholders' perspectives. *The Macrotheme Review*, *3*(3), 14-34.

Karana, E., Hekkert, P., & Kandachar, P. 2010. A tool for meaning driven materials selection. *Materials & Design*, *31*(6), 2932-2941.

Kasim, N. 2011. *ICT implementation for materials management in construction projects: Case Study.* KICEM Journal of Construction Engineering and Project Management.

Khalfan, M. A., Maqsood, T. and Noor, M.A. 2011**.** Attitudes towards sustainable construction amongst construction contractors. *Built Environmental Journal. Vol. 8, No. 2, 9-21*

Ljungberg, L. Y. (2007). Materials selection and design for development of sustainable products. *Materials & Design*, *28*(2), 466-479.

Nagapan, S., Rahman, I. A., Asmi, A., Memon, A. H., & Latif, I. 2012, December). Issues on construction waste: The need for sustainable waste management. In *Humanities, Science and Engineering (CHUSER), 2012 IEEE Colloquium on* (pp. 325-330). IEEE.

OSEC 2010 Sustainable Construction in Southern Africa. Available online: http://www.sge.com/en/filefieldprivate/files/6551/field_blog_public_files/796 [Assessed 9th June, 2014]

Tavakol, M and Dennick R. 2011. Making sense of Cronbach's alpha. *International Journal of Medical Education*. http://staff.neu.edu.tr/~cise.cavusoglu/Documents/ELT%20516/cronbachs-alpha2011.pdf

THE IMPACT OF IMPLEMENTING BIM ON AEC ORGANISATIONAL WORKFLOWS

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Abstract

The seemingly elusive pursuit of completing projects predictably, within the constraints of cost, time and quality requires the aggregation of information and integration of various project team member work processes. BIM has been put forward as a possible approach for achieving this aim, albeit with attendant challenges, prominent among these is the need for streamlining intra-organisational workflows. This study therefore sought to develop and understanding of how implementing BIM impacts organisational workflows with a view to enabling professionals make more informed decisions about adoption and implementation of BIM. Semi-structured qualitative interviews were conducted with three consultancy companies in Johannesburg, South Africa. Data in form of transcriptions and notes were descriptively coded in two cycles, and analysed thematically. This study found that resistance to change and high set-up and training costs are key impediments to the successful implementation of BIM. Furthermore, there were experiences of a loss of productivity during training and the development of standards, disconnects between project team members collaborating at lower of higher maturity compared to others, change in the sequence of project team activities, and the creation of new roles, such as a BIM coordinator/manager to facilitate the adoption and development of organisation specific standards and documents. These challenges can lead to varying patterns of adoption and implementation and consequently, a lack of interoperability of inter-organisational business processes. The findings are instructive on the need for unified industry strategy to facilitate the diffusion of BIM in the South African construction industry as in countries like the UK.

Keywords: BIM, Collaboration, Delivery, Maturity, Workflows

1 Introduction

The nature of the Architecture Engineering and Construction (AEC) industry is such that constant interaction through communication and sharing of information between various professionals is essential for successful delivery of projects (Crotty, 2012). Project delivery involves complex processes that require extensive collaboration for efficient management, amid global industry challenges to completing projects predictably, within the constraints of cost, time, and quality (Crotty, 2012; Fang and Marle, 2013). Further, as a result of the separation of design and construction functions, and the continued specialisation of construction industry practices into more specific fields of operation, the industry has grappled with its fragmented nature and project delivery processes (Nawi *et al.*, 2013). This is coupled with severe difficulties in aggregating construction information dispersed among project stakeholders (Latham, 1994; Egan, 1998; Nawi *et al.*, 2013). Consequences of these are sub-optimal levels of project performance. In the United States, evidence show that these challenges contribute to about 15.8 billion dollars yearly losses through inefficiencies (Gallaher *et al.*, 2004).

As solutions to these challenges, the integration of multiple stakeholder work processes, and a shift from traditional competitive delivery methods towards integrated design and construction methodologies have long been advocated (Latham, 1994; Egan, 1998). Importantly, the use of integrative and collaborative technologies have been argued, and shown to be capable of providing the impetus for the required change (Howard *et al.* 1989). Building Information Modelling (BIM) is one such 'technology'. A process of developing digital representations of construction components elements to simulate planning, design, construction, operation and maintenance of structures, BIM when implemented enables the rendering of several views of data about a structure in 2D (Simple CAD), 3D (Visualisation), 4D (Schedule), 5D (Cost), and 6D (Operations and Maintenance) in an aggregated model, and collaborative environment (Deutsch, 2011). Notwithstanding that Building Information Modelling authoring tools have been in existence since the late 20th century, clients and project teams have only recently become conscious of its benefits in delivering projects (Linderoth, 2010). Implementing BIM has been shown in practice to facilitate increased efficiency (Deutsch, 2011) increased productivity of professional organisations (Crotty, 2012) while also improving communication and collaboration (Wong et al, 2011). Without doubt, the associated benefits are the main drivers of its adoption and implementation within the construction industry (Cao, 2015).

However, there are several barriers to successful implementation of BIM in the construction industry (Migilinskas, 2013; Arayici *et al.*, 2011). These include *inter alia*, the need for changing procurement culture (Rowlinson *et al.*, 2010), need for changing or adapting intra- and inter-organisational work practices and workflows (Porwal and Hewage, 2013; Bryde *et al.*, 2013), lack of clarity of stakeholder roles and responsibilities on BIM projects and varying degrees of experiential knowledge of BIM among project teams (Porwal and Hewage, 2013). This implies that organisation and project team work practices need to be aligned to BIM requirements to achieve success. Nonetheless, evidence from literature shows reluctance towards shifting from traditional work methods to adopting innovative approaches to project delivery among industry professionals (Arayici *et al.*, 2012). This may be attributable to deficient understanding of BIM adoption and implementation implications. A lack of knowledge about how implementation enables, and on the other hand, constrains organisational work practices may hinder wider adoption, and its successful implementation on projects. This study therefore seeks to develop an understanding of how professional service providers in the South African construction industry have implemented BIM within their organisations, and of how the implementation enables or constrains organisational workflows. This will enable implementers to make more informed decisions about how to implement BIM to realise the benefits accruable from its implementation.

2 Literature Review

Succar (2009) however, describes BIM as a set of processes, technologies and policies that work together to produce a methodology for digitally managing project information through the whole life cycle. Furthermore, Sebastian (2011) argues that collaboration between project stakeholders is the main premise on which BIM relies. Therefore, the key ideas that cut across these definitions are information aggregation, integration and collaboration among project stakeholders through the use of appropriate technology. This is at the core of the appeal of BIM to the construction industry. Nevertheless, it is important to note that BIM's potential for enabling more efficient project delivery processes is a major driving force behind the growth in implementation, and indeed government demand, as in the United Kingdom (Cao, 2015). As Barlish and Sullivan (2012) put it, clients are willing to utilise BIM once they understand its capabilities and benefits. The benefits include improved efficiency, communication and collaboration, increase in productivity, reduced project cost, time and rework (Migilinskas, 2013; Wong *et al.*, 2011; Cao, 2015). It is therefore evident that BIM implementation can positively contribute to project success and overall industry performance.

However, implementing BIM does not lead to guaranteed project success. Its implementation comes with attendant risks and challenges as is common with similar innovations. In fact, at the initial stages of adoption and implementation within organisations, it is likely to cause conflicts in the status quo, and temporarily reducing performance. The resolution of these challenges brings about transformation into a new status quo. This is depicted in Satir's model of change in Figure 1 below (Cameron and Green, 2012).

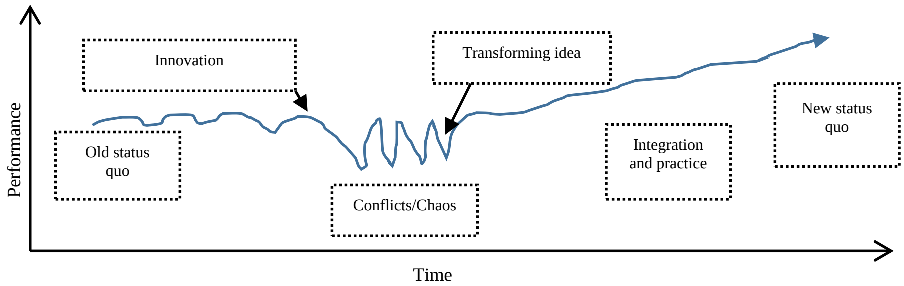

Figure 1. Satir's model of change (adapted from Cameron and Green, 2012)

To elucidate on this, the following section highlights evidence in literature, of challenges to successfully implementing BIM.

2.1 Challenges to successful implementation

Khosrowshahi *et al*. (2012) in consonance with the views of Linderoth (2010), posit that the slow adoption of BIM by organisations can be attributed to a lack of preparedness to make the required changes necessary for implementing BIM, combined with the misunderstanding of their roles and responsibilities on such projects. In a case study of a Swedish company, Linderoth (2010) found that the diffusion of BIM would depend on how well it fits in with user roles, responsibilities and competencies. Yet, the levels of BIM use across organisations and professionals vary greatly (Eadie *et al.*, 2015: Khosrowshahi *et al.*, 2014). Other challenges are fear of changing roles, responsibilities and work practices (Elmualim and Gilder, 2014). Kiprotich *et al.* (2014) in a South African study found that the BIM use in South Africa is largely isolated, and only to the extent of simple 3D modelling (visualisation) applications. A summary of BIM implementation challenges is show in Table 1 below.

2.2 Benchmarking BIM implementation capability and maturity

There have been a few attempts at benchmarking levels of collaborative working with BIM. Taylor and Bernstein (2009) employed a 4-level categorisation of BIM use into visualisation, coordination, analysis, and supply chain integration while Succar *et al.* (2012) developed five stages of BIM implementation maturity (initial, defined, managed, integrated and optimised).

Table 1. Challenges militating against successful implementation of BIM

Challenges militating against successful implementation of BIM	**Singh, *et al.*, (2011)**	**Lawrence *et al.*, (2012)**	**Porwal and Hewage (2013)**	**Dossick and Neff (2010)**	**Elmualim and Gilder (2014)**	**Rowlinson *et al.*, (2010)**	**Khosrowshahi and Arayici (2012)**	**Owen *et al.* (2010)**	**Rekola *et al.* (2010)**	**Gu and London (2010)**	**Becerik-Gerber and Kensek (2010)**
Industry's reluctance to change existing work practices/workflows	x		x		x		x			x	
Need for changing or adapting intra and inter organisational workflows/work practices			x	x	x			x	x	x	
Lack of clarity of stakeholder roles and responsibilities on BIM projects	x	x			x				x	x	
Need to train staff on new technology					x		x		x		x
Need to establish new process or workflows for delivery of projects					x			x	x	x	
Varied readiness to implement BIM across stakeholders	x		x							x	
Varying degrees of experiential knowledge and understanding within project teams							x		x	x	
Difficulty in maintaining completeness, quality and consistency of shared models					x				x		
Cultural barriers towards adopting new technology/cultural division within teams				x							x
Undefined fee structures						x					x
Difficulty in measuring costs/benefits of BIM implementation		x	x								
Software interoperability and data exchange issues									x		x
Lack of understanding of BIM capabilities, challenges		x									
Need for change in procurement culture						x					
Reluctance towards adoption due to time required to produce and maintain complete models							x				
Lack of understanding of other team members' workflows on BIM projects									x		
Ineffective collaboration among team members (modelling and model utilisation)											x
Need for investment in new IT infrastructure											x
Insufficient legal framework											x
Competition and lack of common interests among BIM authoring tool vendors											x

Nonetheless, in order to facilitate the achievement of the UK government's mandate that BIM be used at maturity level 2 for all public projects by 2016, the British Standards Institute (BSI) has developed the PAS 1192:2013 specification. It describes the levels of collaborating with BIM (BML) in generic terms as:

- BML-0: Unmanaged CAD with the use of 2 dimensional (2D)
- BML-1: Requires collaboration tool to provide a common data environment and established standard data formats. Cost data to be managed by standalone packages with no integration.
- BML-2: Collaborative environment to be of 3D form, held in separate discipline BIM authoring tools with attached data managed by Enterprise Resource Planning (ERP) Approach may also utilise 4D and 5D capabilities.

- BML-3: Fully open processes and data integration enabled by web-services. Compliance with relevant data exchange standards, managed by a collaborative model server.

2.3 Review synthesis
Building Information Modelling (BIM) is potentially useful for improving AEC industry performance. However, several associated risks and challenges need to be identified and mitigated. Consequently, successful implementation is not guaranteed. Therefore, it can be surmised from literature reviewed, that informed adoption and implementation decisions for AEC organisations in South Africa requires an understanding of its implications on their organisations workflow. This is the central focus of this study. The theoretical underpinnings of this study are in activity theory (understanding changing patterns of human activity on impact by technology) and role theory.

3 Research Methodology

3.1 Philosophical assumptions
This research is informed by subjectivist philosophical assumptions, where social phenomena are seen as being created from the perceptions of social actors and with a focus on individual meanings (Saunders, 2012; Creswell, 2013). The focus of this study is on developing an understanding of the experiences of professional service providers in implementing BIM within their organisations. A subjectivist ontological position is well suited to achieving this in that it emphasises conduction of research among people rather than about objects (Saunders, 2012). In consonance with this philosophical leaning, and with literature on studies with similar foci with this study, an interpretivist epistemology, albeit with a largely deductive approach to reasoning, is appropriate as is supports methods of knowledge gathering in participants' natural settings (Saunders *et al.*, 2012; Creswell, 2013). This is to facilitate an understanding of their experiences from their own point of view.

3.2 Research methods
Following from the philosophical choices made, this study is designed after the qualitative research tradition. This is suitable for exploring a problem in-depth (Creswell, 2013). Further, current research in the domain is mainly qualitative in nature. Gu and London (2010) employed focus group interviews (grounded theory strategy); Balish and Sulivan (2012) used cases studies, while Linderoth (2010) used semi-structured interviews with participant observational methods.

3.2.1 Data collection method and participant selection
Conversations are one of the best ways of obtaining systematic and in-depth knowledge (Kvale, 2008). Therefore, one-on-one semi-structured interviews, with professionals representing selected organisations, were considered the best way to collect data. In order to focus on unique case contexts, a heterogeneous purposive sampling technique was employed with snowballing (field referrals) to select participants for the study. Further, participants for this research were selected from consulting professional service providers in South Africa. This comprises Architectural, Quantity Surveying, and Engineering organisations. The selection criterion was mainly evidence of adoption and implementation BIM within the organisation. 3 interviews (2 Architectural and 1 Quantity Surveying organisation) were conducted, analysed and presented in the following sections. Notes and audio recordings were taken during the interview sessions to ensure all information is captured. The audio recordings were also transcribed (verbatim),

while handwritten notes and researchers preliminary reflections from the interview were summarised into analytic memos, one per interview (Miles *et al.*, 2014).

3.2.2 Method of data analysis

Data in form of notes and transcripts from the interviews were analysed thematically. Thematic analysis followed a two-step procedure. Texts were coded using broad descriptive codes (Miles *et al.*, 2014). First, notes and transcripts were read while also highlighting relevant portions of the material, and assigning descriptive words of phrases (pre-defined or developed as analysis progresses) to the highlighted chunks of textual data and refining same as analysis progresses. Second, codes were developed into key themes for each highlighted text (groupings or more finely coded) while considering interpretive themes from theoretical or practical positions of the study (Miles *et al.*, 2014).

4 Preliminary Findings and Discussion

4.1 Data Analysis and Findings

Table 2 describes the contexts of each organisation that participated in this study as the context is important to understand when analysing the data.

Table 2. Participant organisation contexts and implementation strategies

Case 1 (Company A)	Case 2 (Company B)	Case 3 (Company C)
Context		
• Medium sized **Architectural firm** (staff is about 60nr) • Based in, Johannesburg • Established in 1945 • Projects are based in South Africa and internationally	• International **Quantity surveying firm** (head office in the UK). • The Johannesburg office is one of 90 branches. • Established first international branch in 1982 • Projects are based in South Africa and internationally	• Medium sized **Architectural firm** of about 200 employees • Based in Johannesburg with a branch office in Nigeria. • Projects are based in South Africa and internationally
Implementation strategies		
• Motivation for implementing BIM: improvement of job delivery workflows efficiency, competitive advantage, keeping up with evolving industry trends. • Implicit policy to implement BIM on all projects. • Each person in the organisation has access to the BIM authoring software and training • New computers and software licenses were purchased to facilitate adoption of BIM. • Formal implementation plan was drafted for training and implementing standards • BIM manager was hired to facilitate transitioning to BIM.	• Motivation for implementing BIM: improvement of job delivery workflows efficiency • They have not implemented BIM in South Africa as part of a project team, but they have in the UK • Their staff have had training on how to use BIM authoring software • Organisation has achieved a capability for BIM level 1 here in South Africa but operating at a Maturity level between 0 & 1.	• Motivation for implementing BIM: competitive advantage, keeping up with evolving industry trends. • In-house expert to coordinate BIM implementation and use internally (documentation management). • Staff have had access to the BIM authoring software and had training • The firm has achieved implementation Maturity level 1. • Formal implementation plan for achieving BIM maturity level 2 has been drafted). • Willing to start working towards BIM maturity level 3

Case 1 (Company A)	Case 2 (Company B)	Case 3 (Company C)
• Achieved a capability for BIM level 2 but presently operating at maturity level		

Cases *1*, *2* and *3* (shown in Table 2) represent experiences of BIM implementation from three organisations that are some of the most prominent professional practices in South Africa and will therefore be treated as key informants. It should be noted that since *Company B* (Quantity Surveying) have only implemented BIM as part of a project team in the UK. However, the staff have undergone training to acquire the capability to participate in BIM projects in South Africa, at least to BIM level 1. This is not farfetched as the diffusion of BIM naturally starts with lead design firms long before other allied professional organisation. Furthermore, while *Companies A & C* have only been operating at BIM level 1, interestingly, the momentum for level 2 BIM implementation (information sharing & coordination) has begun already (BSI, 2013). This is a significant development from Kiprotich *et al.* (2014)'s report of only isolated use of 3D modelling and visualisation applications of BIM in South Africa. Yet, these efforts are limited to intra-organisational drive for collaborative practices. Expectedly, as in the works of Wong *et al.*, (2011) and Cao (2015), the main motivation for implementing BIM for all the companies are the associated benefits (see Table 3).

Table 3. Experiences of benefits from Implementation BIM

Case 1 (Company A)	Case 2 (Company B)	Case 3 (Company C)
• Problem solving • Improved design workflows • Implementation of BIM being worthwhile • Design clash detection • Time and cost savings • Improved communication, collaboration and integration within the organisation and with allied professionals • Increased productivity and efficiency • Capability for executing larger projects	• Cost savings • Time savings • Design clash detection • Quick resolution of conflicts • Improved accuracy • Competitive advantage • Increased delivery speed • Increased productivity and efficiency	• Increased demand for firm's service • Increased efficiency • Able to execute projects quicker and better • Design and construction risks are detected earlier • More work done at lower cost compared to competitors • More work is done earlier in the delivery process. • Improved collaboration among teams • Design clash detection • Increased Productivity • Increased project turnover

There are several commonalities in the experiences of the three organisations regarding the benefits from BIM implementation. These experiences are similar to the findings in existing literature (Wong *et al.*, 2011; Cao, 2015). BIM is perceived as being able to assist in problem solving, improving efficiency and increasing overall productivity. While all three organisations attest to increase in productivity, Company C further links this to increased turnover.

Table 4. Challenges to Implementing BIM

Case 1 (Company A)	Case 2 (Company B)	Case 3 (Company C)
• Mind-set shift • Resistance to change • Time consuming training • High software and update costs • Disconnect between consultants: where other consultants don't implement BIM, interoperability becomes an issue • More efforts required to develop good quality • Presentations when compared to traditional CAD	• Resistance to change • 'BIM is all about technicalities' • Huge training requirements • High cost of BIM authoring software • 'BIM is mainly economically viable for large scale projects' • No BIM specialist in company's SA office • Technological advancements reduces relevance of experiential knowledge • Implementation is being driven mainly by BIM champions from large practices	• Time consuming training • High software and update costs • Disconnect between consultants (lack of interoperability) Project team members' silo mentality' • Need for allied professionals to start evolving their design skill

Companies A & C report very similar experiences of challenges to implementing BIM (see Table 4). Importantly, resistance to change within their organisations and disconnect with other professionals (lack of interoperability of organisational business practices) are key challenges identified. These are two of the most prominent challenges to implementing BIM and can be deterrents to increased adoption and implementation within the construction industry. Collaboration through BIM is only as effective as the weakest link in the project team makes it. Further, down times experienced when learning to apply new technology impacts negatively on productivity (Cases 1&3). Company B's report is from a different perspective as Quantity surveyors, the participant mentioned that the lack of a BIM expert to facilitate implementation is a challenge. These suggest, however inconclusively, that experiences of challenges vary by organisation type. Nevertheless, for all three cases a common thread of evidence was that of declining productivity as a result of a substantial amount of training that is required to facilitate BIM implementation.

Table 5. Impacts of BIM on organisational workflows

CASE 1	CASE 2	CASE 3
• Downtimes while training and developing new organisational workflows to implement BIM • More efficient design workflows • Better integration of team design processes. • Increased productivity and efficiency • Increased capability for executing larger projects • Creation of new roles (BIM coordinator or BIM manager)	• Improved efficiency and performance • Increased productivity and efficiency	• Downtimes while training and developing new organisational workflows to implement BIM • More is done earlier in the delivery process • More time and resources are spent on the design phase, i.e. model development phase. • Increased productivity and efficiency • Creation of BIM coordinator/manager roles • Design and construction risks are detected earlier

Participants have had both positive and negative experiences of BIM impacts on organisational workflows (see Table 5). One impact of BIM that is rarely reported in literature is experiences of downtimes while training or developing new organisational workflows to implement BIM. Misunderstanding this may mean that organisations that are unable to overcome these challenge have to roll back on the implementation. Perhaps more importantly, Company C emphasised the temporal shift in effort for design and construction activities. This implies that more work is done earlier in the delivery process when the cost impacts of change in employer requirements are minimal effects on dependent activities. Furthermore, the findings suggest that creation of a new role for BIM facilitation and coordination within firms is critical to the success of the implementation as in Porwal and Hewage (2013) and Sebastian (2011).

5 Conclusion and Further Research

This study sought to develop an understanding of how implementing BIM impacts the workflows of construction professional service providers in South Africa. This is on-going research. Nonetheless, thus far, the findings have far reaching implications. These impacts are structural and social in nature. Expectedly, the three cases presented associate several benefits with implementing BIM. Likewise there are experiences of many challenges that impinge on professional practice. The reports varied slightly due to the differences in level of capability and BIM maturity level within the organisations. Further, the requirement for in-house BIM facilitators or managers, expansion of professional responsibility, temporal shift in design and construction activities, and the need for new or restructured project documentation are enlightening. The results also reveal that BIM is being led mainly by design firms who employ in-house BIM experts to develop and maintain organisation specific standards and guidelines. This can lead to varying patterns of adoption and implementation and consequently, lack of interoperability of inter-organisational business processes. These findings suggest a need for unified industry strategy to facilitate the diffusion of BIM in the South African construction industry as in countries like the UK. This strategy may be driven by government or the private sector since it is clear that clients are the main drivers for BIM implementation, while also being the biggest beneficiaries of BIM benefits (e.g. aggregating and managing asset information). However, while there are competing arguments for or against either, the private sector, through entities like the South African Property Owners Association (SAPOA), which claims control of about 90 per cent of all commercial and industrial property in South Africa, are perhaps better positioned to drive a unified industry strategy for implementing BIM due to the sector's dynamic nature. This is an on-going debate. Future work will seek to expand on these ideas and document more experiences of BIM implementation in South Africa so as to increase the credibility of the research findings.

6 References

Arayici, Y., Coates, P., Koskela, L., Kagioglou, M., Usher, C., and O'Reilly, K. (2011). Technology adoption in the BIM implementation for lean architectural practice. *Automation in Construction*, *20*(2), pp. 189–195.

Barlish, K., and Sullivan, K. (2012). How to measure the benefits of BIM — A case study approach. *Automation in Construction*, *24*(0), pp. 149–159.

Becerik-Gerber, B., and Kensek, K. (2010). Building Information Modeling in Architecture, Engineering, and Construction: Emerging Research Directions and Trends. *Journal of Professional Issues in Engineering Education and Practice*, *136*(3), pp. 139–147.

BSI (2013). *PAS 1192-2:2013 - Specification for information management for the capital/delivery phase of construction projects using building information modelling*. The British Standards Institution.

Cameron, E., and Green, M. (2012). *Making sense of change management: a complete guide to the models tools and techniques of organizational change*. Kogan Page Publishers.

Cao, D., Wang, G., Li, H., Skitmore, M., Huang, T., and Zhang, W. (2015). Practices and effectiveness of building information modelling in construction projects in China. *Automation in Construction*, *49,* pp. 113–122.

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

Crotty, R. (2012). *The impact of building information modelling: transforming construction*. Routledge.

Deutsch, R. (2011). *BIM and Integrated Design: Strategies for Achitectural Practice*. New Jersey: John Wiley & Sons, Inc.
Dossick, C., and Neff, G. (2010). Organizational Divisions in BIM-Enabled Commercial Construction. *Journal of Construction Engineering and Management*, *136*(4), pp. 459–467.
Eadie, R., Browne, M., Odeyinka, H., McKeown, C., and McNiff, S. (2015). A survey of current status of and perceived changes required for BIM adoption in the UK. *Built Environment Project and Asset Management*.
Egan, J. (1998). *Rethinking Construction*. London: The Construction Task Force.
Elmualim, A., and Gilder, J. (2014). BIM: innovation in design management, influence and challenges of implementation. *Architectural Engineering & Design Management*, *10*(3/4), pp. 183–199.
Fang, C., and Marle, F. (2013). Dealing with project complexity by matrix-based propagation modelling for project risk analysis. *Journal of Engineering Design*, *24*(4), pp. 239–256.
Gallaher, M. P., O'Connor, A. C., Dettbarn, J. L., and Gilday, L. T. (2004). *Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry*. Maryland: National Institute of Standards and Technology.
Gu, N., and London, K. (2010). Understanding and facilitating BIM adoption in the AEC industry. *Automation in Construction*, *19*(8), pp. 988–999.
Howard, H., Levitt, R., Paulson, B., Pohl, J., and Tatum, C. (1989). Computer Integration: Reducing Fragmentation in AEC Industry. *Journal of Computing in Civil Engineering*, *3*(1), pp. 18–32.
Khosrowshahi, F., and Arayici, Y. (2012). Roadmap for implementation of BIM in the UK construction industry. *Engineering, Construction and Architectural Management*, *19*(6), pp. 610–635.
Kiprotich. C. *et al* (2014). An investigation on Building Information Modelling in Project Management: challenges, strategies and projects in the Gauteng Construction Industry, South Africa. WIReDSpace: Wits Institutional Repository environment on Dspace. Available at: http://wiredspace.wits.ac.za/handle/10539/15492
Latham, M. (1994). *Constructing the Team* (Joint Review of Procurement and Contractual Arrangements in the United Kingdom Construction Industry).
Lawrence, T. M., Watson, R. T., Boudreau, M.-C., Johnsen, K., Perry, J., and Ding, L. (2012). A new paradigm for the design and management of building systems. *Energy and Buildings*, *51*(0), pp. 56–63.
Linderoth, H. C. J. (2010). Understanding adoption and use of BIM as the creation of actor networks. *Automation in Construction*, *19*(1), pp. 66–72.
Migilinskas, D., Popov, V., Juocevicius, V., and Ustinovichius, L. (2013). The Benefits, Obstacles and Problems of Practical BIM Implementation. *Procedia Engineering*, *57*, pp. 767–774.
Miles, M. B., Huberman, A. M., and Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook*. SAGE Publications, Incorporated.
Nawi, M. N. M., Lee, A., Azman, M. N. A., and Kamar, K. A. M. (2013). Fragmentation Issue in Malaysian Industrialised Building System (IBS) Projects. *Journal of Engineering Science and Technology*, *8*(3), pp. 278–292.
Porwal, A., and Hewage, K. N. (2013). Building Information Modeling (BIM) partnering framework for public construction projects. *Automation in Construction*, *31*, 204–214.
Rekola, M., Kojima, J., and Mäkeläinen, T. (2010). Towards Integrated Design and Delivery Solutions: Pinpointed Challenges of Process Change. *Architectural Engineering & Design Management*, *6*(S1), pp. 264–278.

Rowlinson, S., Collins, R., Tuuli, M., and Jia, Y. (2010). Implementation of Building Information Modeling (BIM) in Construction: A Comparative Case Study (pp. 572–577). Presented at the 2nd International ISCM Symposium and the 12th International EPMESC Conference, American Institute of Physics.

Saunders, M., Lewis, P., and Thornhill, A. (2012). *Research Methods for Business Students*. Essex: Pearson.

Sebastian, R. (2011). Changing Roles of the Clients, Architects and Contractors through BIM. *Engineering, Construction and Architectural Management*, *28*(2), 176–187.

Singh, V., Gu, N., and Wang, X. (2011). A theoretical framework of a BIM-based multi-disciplinary collaboration platform. *Automation in Construction*, *20*(2), 134–144.

Succar, B., Sher, W., and Williams, A. (2012). Measuring BIM performance: Five metrics. *Architectural Engineering & Design Management*, *8*(2), pp. 120–142.

Succar, B. (2009). Building information modelling framework: A research and delivery foundation for industry stakeholders. *Automation in Construction*, *18*(3), pp. 357–375.

Won, J., Lee, G., Dossick, C., and Messner, J. (2013). Where to focus for successful adoption of building information modeling within organization. *Journal of Construction Engineering and Management*, pp. *139*(11), 04013014.

Wong, A. K. D., Wong, F. K. W., and Nadeem, A. (2011). Government roles in implementing building information modelling systems. *Construction Innovation*, *11*(1), pp. 61–76.

AN INVESTIGATION INTO SUPPLY CHAIN MANAGEMENT PROCESSES EFFICACY AND SERVICE DELIVERY ENHANCEMENT IN THE CITY OF JOHANNESBURG METROPOLITAN MUNICIPALITY

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Abstract
There is a general lack of advance planning for Supply chain management (SCM) processes and the lengthy processes involved impact negatively on municipal construction projects. The study investigated stakeholder's perceptions of the improvement attempts being made in SCM processes for construction projects and service delivery in the City of Johannesburg (CoJ), South Africa. An empirical study using one municipality was undertaken through the administration of questionnaires. Key findings showed that respondents were of the view that SCM processes related functions are well defined, service delivery is not improving while the organisation encourages implementation of project management processes that are harmonised with its SCM processes. The study concludes that the SCM processes of the municipality under study are somewhat improving and current legislation has a positive effect. However, there is room for improvement to streamline the processes in order to reduce the bureaucracy which impacts negatively on the commencement and performance of construction projects. The study only involved one municipality therefore the sample size and geographical limitations may reduce the generalisablity of the results. The study is relevant to various stakeholders as it enhances the understanding of how improved SCM processes can contribute to the overall performance of construction projects.

Keywords: Suppy Chain Management, Service Delivery, Construction Project Management

1 Introduction

1.1 Problem identification

McCarthy (2006) claims that there is lack of capacity and limited knowledge about supply chain management processes in the public sector which affects the effectiveness and efficiency of procurement processes, leading to poor governance. Similarly, Luyt (2008) contends that poor planning and poor budgeting amongst government entities result in inadequate implementation of supply chain management processes. Amber & Badenhost-Weiss (2011) reported the following challenges; lack of knowledge, skills and capacity, non-compliance with supply chain policies and regulations, inadequate planning and poor linking of demand to the budget, accountability fraud and corruption, inadequate monitoring and evaluation of supply chain management processes, unethical behaviour, over decentralisation of the procurement system and ineffective Black Economic Empowerment Policy.

There is generally a problem in terms of planning of projects as sometimes it happens that after planning City of Johannesburg (CoJ) officials find themselves having to execute projects that were not budgeted for due to pressure to deliver services to communities that are affected by non-availability of critical basic services (City of Johannesburg 2007). This often makes the planning process for projects redundant. Further, small and medium contractors are increasingly demanding to be appointed as sub-contractors on big projects even when they do not qualify therefore undermining the system and the Supply chain management (SCM) processes (City of Johannesburg 2007). Despite the availability of various legislations such as the Preferential Procurement Policy Framework (PPPF), Municipal Supply Chain Management Regulations and the Municipal Finance Management Act, the CoJ still has ineffective and long supply chain management processes for construction projects, as well as other challenges relating to service delivery enhancement.

1.2 Purpose and importance of the study

The purpose of the study is to investigate the SCM processes for construction projects in the CoJ and service delivery with the view to optimising SCM processes for construction projects and service delivery. The study also seeks to evaluate the quality of training and development provided by the CoJ on related SCM processes and service delivery procedures, policies, strategies and legislations. A further objective is to assess the effectiveness with which top management addresses procurement and service delivery related issues. This study will benefit not only the CoJ as an organisation through improving its SCM processes, but also the residents of Johannesburg through efficient delivery of construction projects and better municipal capital spend. Both the beneficiaries and small and medium enterprises will also benefit, as their construction projects will be finished on time without the fear of having contract price adjustments and penalties for late completion. This research project seeks to investigate the supply chain management process efficiency of construction projects and whether the CoJ is enhancing its service delivery to Johannesburg residents.

The outcome of the study will assist the CoJ to better manage construction projects in terms of time management within scope, quality and the allocated budget. It is hoped that some activities during the supply chain process would be done simultaneously in order to reduce the CoJ SCM bureaucratic processes, therefore ensuring the timely completion of construction projects.

2 Literature Review

2.1 Implementation of Supply Chain Management

European Union (2010) states that challenges in the public sector include the non-existence of follow up routines and effective reporting which impede strategic and methodical developments of a particular organisation in terms of its procurement management system applications. According to van der Waldt (2001), most spheres of government utilise project management to execute facility delivery programmes in the form of construction projects. Van Der Waldt (2001) asserts that while project and programme management is a tool-kit to improve facility delivery, by and large managers in the public sector do not know how to apply project management principles, i.e. they tend not to equip themselves through relevant courses. This is an indication that in order for the CoJ to succeed in improving their procurement systems it will have to harmonise project management and procurement systems. Therefore, the entire organisation and its systems, including procurement, should support projects' management in order for them to work effectively (Van der Waldt, 2007). The Project Management Capability Delivery Framework is one of the tools that is recommended to manage projects successfully and therefore achieve service delivery in marginalised areas. It should also be noted that vision and strategy are part of what this framework can deliver (Marnewick, 2010). Lessons, failures and successes should be learned from previous projects in order to improve service delivery (Brown, 2005).

The CoJ currently uses the project life cycle model when implementing construction projects as illustrated in Figure 2.1, which assists in the planning process aimed at demonstrating how the projects' outcomes will be achieved successfully within the required timescale, scope, quality and the agreed budget. The project life cycle model is a useful way of understanding the different phases of a project as it progresses (Martin, 2008). The challenge is that this life cycle model is not harmonized with the procurement process in the CoJ which includes compiling of bids, advertising, closing of bids, bid evaluation as per PPPFA and recommendations, adjudication of bids and final award as well as compiling of service level agreements and contract documents. This implies that these two processes are utilized separately, and as a result projects are not finished on time due to delays (City of Johannesburg, 2007).

Figure 1. Project life-cycle model (Martin, 2008)

The above misalignment occurs between the defining and the planning stage when the built environment and engineering consultants are appointed, as well as during the planning and the implementation stage when the main contractor, sub-contractors and nominated contractors are appointed. Lastly supply chain management has become an important matter for some organisations to gain their competitive edge (Shi-Jie, Chen and Huang, 2007).

2.2 Service delivery theme

There are many public sector projects in South Africa which are not executed within the predetermined parameters of cost, time and quality and which also experience delayed payments (Baloyi and Bekker, 2011). An example of such is the construction of 104 housing units in Saulsville in Tswane (City of Tswane Municipality) with a cost of R85 million which were delivered with defective or poor quality (Mogomotsi, 2013). This reflects a waste of resources as well as poor serveice delivery to the intended beneficiaries. Public procurement in South Africa has since 1994, become an important tool to deliver wider social, economical and political iobjectives (Bolton, 2006). This is due to government's procurement capacity and its dual role as a regulator and purcahser. The way decisions are taken regarding with whom and how much to contract with has implications for various industry players and intended beneficiaires. Bolton (2006) argues that the leverage of the South African government to use procurement as a policy tool has encountered various challenges.

Russell and Bvuma (2001) explain that service delivery is a focal point on which the public service is most probably judged, especially in a country where service delivery benefits the poor communities. There are three key service delivery improvement initiatives in the country:

- Batho Pele;
- Public-private partnerships; and
- Alternative service delivery routes (Russell & Bvuma, 2001: 244-245).

In analysing the problem in conjunction with service delivery, officials at the CoJ are not motivated and their individual needs are not catered for, hence they are allegedly not seen to not be taking their work seriously and thus perpetuating poor service delivery. Employees in the CoJ are often on strike and the communities, especially poor people, are frequently protesting. Abraham Maslow established a theory to illustrate the effects (i.e. individual needs) that motivate human behaviours (Robbins and DeCenzo, 2001: 314). Using Maslow's theory, it can be deduced that certain needs of officials of the CoJ need to be met for them to function well and for Johannesburg residents to receive quality services. This becomes evident when the executive management looks to increase salaries every year, as the South African Municipal Union (SAMU) rejects offers for salary increases and also highlights issues such as working conditions, health benefits, lack of tools, housing subsidies, car allowances, performance bonuses, favouritism, temporary/contract employment and unfair treatment by top management. Strikes have become a norm every year in the CoJ for all departments and Municipal Owned Entities (MoEs), while communities also protest about poor service delivery (City of Johannesburg, 2007). All these issues highlighted above affect the SCM processes.

3 Research Methodology

The empirical study used a case study approach using structured questionnaires to solicit respondents' views as indicated in Tables 1 and 2. The objective was to determine perceptions on the duration of the SCM processes, and the way construction projects are affected by the SCM bureaucratic processes including service delivery enhancement. Purposive sampling was used in the study. The sample was selected from the total population of CoJ employees who met the selection criteria, namely those that operated in certain departments and entities such as the Department of Environment, Infrastructure and Services; the Department of Development Planning and Urban Management; the Johannesburg Development Agency; Jo'burg Water; City Power; Pikitup; the Johannesburg Roads Agency, nine regions and the Department of Housing as indicated in Table 1.

Table 1. Size of the sample strata and response rate to the questionnaires

Departments and Entities	Proposed		Actual	
	No.	%	No.	%
Department of Infrastructure and Services	5	12.5	5	**12.5**
Department of Planning and Urban Management	5	12.5	5	**12.5**
Department of Housing	5	12.5	5	**12.5**
Department of Environment Management	5	12.5	5	**12.5**
City Power	5	12.5	5	**12.5**
Jo'burg Water	5	12.5	4	**10**
Johannesburg Development Agency	5	12.5	5	**12.5**
Pikitup	5	12.5	5	**12.5**
Total	**40**	**100**	**39**	**97.5**

The reason for this purposive sampling was that these entities, departments and regions deal with SCM in construction projects as well as service delivery related matters more often. Table 1, indicates that a high response rate of 97.5% was achieved. During the study, each department, entity and regional office was contacted telephonically so as to enquire who the appropriate Executive Director, Managing Director and Regional Directors to approach for permission to conduct a survey in their respective departments, entities and regions would be.

Table 2. Positions held by respondents in their representative organisations

Positions held by respondents in terms of management levels of operation (%)				
Senior management	Middle level management	Officer	Supervisor	Other
34.2	44.7	7.9	7.9	5.3

Table 2 shows that the majority of the respondents (78.9%) who implement construction projects using the SCM process operate at a senior management and middle management level and therefore are knowledgeable enough for the study. An introductory letter which outlined the purpose and objectives the study as well as request consent was sent to the respondents.

4 Findings and Discussion

Respondents were presented with statements related to procurement processes and infrastructure/service delivery by the CoJ, to which they needed to indicate the extent of their disagreement on a 5-point Likert scale where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The findings are ranked in terms of their mean scores (MSs) based on the percentage responses to the 5-point scale with 1.00 as a minimum value and 5.00 as a maximum value based on the percentage indicating the degree of concurrence of the statements (see Table 3 below). The Cronbach's alpha was used to determine the reliability or consistency of the measure. The Alpha coefficient ranges in value from 0 to 1 and was used to describe the reliability of factors extracted from dichotomous (questions with two possible answers) and/or multi-point formatted questionnaires or scales, e.g. rating scale: 1 = poor to 5 = excellent. Only the statements with an acceptable alpha value of more than 0.5 were used in this study. The values ranged from 0.5 to 0.90. The data were analysed using basic statistics as presented and discussed in the next section. The results are presented in Tables 3 and 4 below.

Table 3. SCM processes and service delivery

	Aspect	Response (%)					Mean Score
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
1.1	Your procurement SCM related functions are properly defined at the CoJ as an employee.	7.9	13.2	21.1	28.9	28.9	3.6
1.2	You are properly trained on SCM processes at the CoJ.	10.3	28.2	17.9	25.6	17.9	3.1
1.3	The CoJ is perceived to be delaying construction projects through inefficient SCM processes.	15.8	28.9	15.8	31.6	7.9	2.9
1.4	The CoJ is currently not improving SCM processes.	10.3	30.8	38.5	17.9	2.6	2.7
1.5	Despite the existing policies, programmes and legislation the CoJ is unable to implement its SCM processes.	25.6	30.8	35.9	5.1	2.6	2.3
1.6	Legislation has not negatively impacted on SCM processes.	20.5	25.6	20.5	30.8	2.6	2.7
1.7	You are properly trained on service delivery programmes of the CoJ.	2.6	20.5	15.4	35.9	25.6	3.6
1.8	The CoJ is perceived by Johannesburg residents to not be properly delivering services.	10.3	28.2	20.5	20.5	20.5	3.1
1.9	The CoJ is currently not improving on service delivery.	28.2	23.1	28.2	17.9	2.6	2.4
1.10	Despite the existing policies, programmes and legislation the CoJ is unable to deliver on its services effectively and efficiently.	20.5	28.2	10.3	30.8	10.3	2.8
1.11	Legislation has not positively impacted on service delivery.	5.1	35.9	17.9	38.5	2.6	3.0

Based on the Mean scores (MSs), the key findings are as summarised in Table 4.

Table 4. Training and top management involvement in SCM processes

	Aspect	Response (%)					Mean Score
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
1.1	Top management at CoJ monitors the various stages of currently existing SCM processes.	12.8	10.3	20.5	25.6	30.8	3.5
1.2	Top management at CoJ is involved in the process of evaluation and monitoring of SCM processes.	7.7	12.8	25.6	38.5	15.4	3.4
1.3	Officials are fully involved in the implementation of the SCM processes policies.	7.7	7.7	33.3	41.0	10.3	3.4
1.4	The CoJ offers training and education on SCM processes.	7.7	17.9	33.3	33.3	7.7	3.2
1.5	CoJ encourages the implementation of project management processes that are harmonised with its SCM processes.	5.1	20.5	23.1	38.5	12.5	3.3
1.6	Top management at CoJ monitors and evaluates service delivery.	2.6	17.9	12.8	48.7	17.9	3.6
1.7	The CoJ addresses clients' complaints within reasonable turn-around times on service delivery related issues.	17.9	20.5	28.2	20.5	12.8	2.9

The main findings of the study from the two tables are discussed further below.

4.1 Discussion of key findings

From Table 41, the items "top management in the organisation monitors and evaluates service delivery" scored the highest mean score of 3.6 followed by "top management at CoJ monitors the various stages of currently existing SCM processes" with a mean score of 3.4. These are encouraging results and put the organisation in better light. It was also found that CoJ encourages the implementation of project management processes that are harmonised with its SCM processes (mean score of 3.3). However, it emerged that "CoJ does not address client complaints within reasonable turn-around times on service delivery related issues" as it showed the lowest mean score of 2.9, undermining the image of the organisation. As Russell and Buvma (2001) indicated in the literature, service delivery is one important parameter on which the public sector is judged. From table 4.2, the following findings can be highlighted as: SCM processes related functions are properly defined in the organisation to employees (3.6 mean score highest mean score) and the organisation is currently not improving SCM processes (2.4 mean score second lowest). While the organisation under study is perceived as not properly delivering services or addressing client complaints within reasonable turn-around times on service delivery issues, the respondents were also of the view that "CoJ is improving its SCM processes and service delivery". The results suggest that there is an effort to improve both SCM and service delivery.

The study also investigated respondents' perceptions on the training of employees in the organisation on SCM processes. A key finding was that; CoJ offers training and education on SCM processes (mean score of 3.4). They are also properly trained on the service delivery programmes of the CoJ (3.1). However, the results show that most of the respondents were not formally trained in the Preferential Procurement Policy Framework Act as well as the Public Finance Management Act (PFMA), but were mostly trained in the Constitution of the Republic of South Africa, the Municipal Finance Management Act and the Local Government: Municipal Systems Act.

On the aspect of strategic leadership, respondents believe that SCM process-related functions are properly defined for them to perform their duties as this scored the highest mean score of 3.6. Results also show that top management monitors the various stages of currently existing SCM processes and is involved in the process of evaluation and monitoring of SCM processes. The results also show that top management at the CoJ monitors and evaluates service delivery and that it is relatively easy for top management to monitor and evaluate procurement and service delivery processes because most employees who deal with the SCM process of construction projects and service delivery operate at a middle management level. Top management is addressing the SCM and service delivery related issues. However despite the existing SCM policies, programmes and legislations available, the CoJ is unable to implement its SCM processes adequately as the results indicate the lowest mean score of 2.3.

5 Conclusions and Recommendations

The study sought to investigate the enhancement of SCM processes and service delivery by the CoJ by investigating top management involvement and formal training opportunities among others on on SCM and service delivery policies. The study found that while top management seem to be involved in the implementation and monitoring of SCM and service delivery, the SCM processes are not fully optimised and the organisation is not able to handle client complaints within reasonable turn-around times particularly on service delivery related issues. The study concludes that the SCM processes of the municipality under study are somewhat improving and current legislation has a positive effect. However, there is potential for improvement to streamline the processes in order to reduce the bureaucracy which impacts negatively on the commencement and performance of construction projects. There is room for harmonisation of project management processes with SCM processes to enhance performance. Further studies on technical skills and relevant education should be conducted and there is also a need to explore reasons for the many service delivery protests and the failure to attend to complaints within the stipulated time lines. Studies in other municipalities should also be undertaken to determine if similar results will obtain.

6 References

Abdullah, N.R.., Aziz, A., Memon, A.H. & Rahman, I.A. 2013. Modelling Causes of Cost Overrun in Large Construction Projects with Partial Least Square-SEM Approach: Contractor's Perspective. *Research Journal of Applied Sciences, Engineering and Technology*. 5(6), pp.1963-1972.

Amber, I.M. & Badenhost-Weiss, J. 2011. An Examination of Supply Chain Management in the South African Public Sector. *20th Annual IPSERA 2011 Conference*, 10-14 April Maastritch, the Netherlands

Baloyi, L & Bekker, M.2 011. Causes of construction cost and time overruns: The 2010 FIFA World Cup stadia in South Africa. *Acta Structilia*, 18(1), pp. 52-67.

Bolton, P. 2006. Government Procurement as a policy tool in South. *Journal of Procurement* 6(3), 193-217.

Brown, C.J.B. & Botha, M.C. 2005. Lessons learnt on implementing project management in a functionally-only structured South African municipality. *South African Journal of Business Management*, 36(4), pp. 1-7.

City of Johannesburg 2007. *City of Johannesburg Supply Chain Management Procedure Manual* Supply Chain Management Procedures eds, City of Johannesburg, Johannesburg,

Braamfontein.
European Union. 2010. Risk Management in the Procurement of Innovation-Concepts and Empirical Evidence in the European Union. Research Policy. European Commission. pp. 124
Luyt, D. 2008. Media and Advocacy Head of the Public Service Accountability Monitor (PSAM), at the Monitor (PSAM). Paper Presented at the United Nations Social Forum on 2 September 2008 in Geneva, Switzerland
McCarthy, N.G. 2006. Report of the Auditor-General, Free State, Bloemfontein. 30 June 1-7
Marnewick, C. L.L. 2010. A conceptual framework to improve the delivery capability of an organisation. *Acta Commercii*, 10, pp. 249-263.
Martin, V. (ed) 2008, *Session 1-3, Block 4 Managing Projects and Change*, The Open University, Milton Keynes.
Mogomotsi, M. 2013. *R85m wasted on building*. [Online]. South Africa: IOL. Available on: http://www.iol.co.za/news/south-africa/gauteng/r85m-wasted-on-building-1.1507627#.VO8X9PmUd1Y [Accessed 22 December 2015].
Robbins, S. & DeCenzo, D. (eds) 2001, *Fundamentals of Management: Essential Concepts and Application (3rd ed.)*. Prentice-Hall, Upper Saddle River, New Jersey.
Russel, E.,W. & Bvuma, D.,G. 2001. Alternative service delivery and public service transformation in South Africa. *International Journal of Public Sector Management*, 14(3), pp. 241-265.
Shi-Jie, G., Chen, S. & Huang, E. 2007. A systematic approach for supply chain improvement using design structure matrix. *J Intell Manuf*, 18, pp. 285-299.
Van der Waldt, G. 2007. Project management: a new service delivery paradigm: research article. Koers: *Bulletin for Christian Scholarship = Koers : Bulletin vir Christelike Wetenskap*, 72(2), pp. 239-260.
Van der Waldt, G. 2001. Establishing a management by projects approach for service delivery. *Journal of Public Administration*, 36(4), pp. 296-311.

EVALUATING THE IMPACT OF PUBLIC SECTOR TARGETED PROCUREMENT STRATEGIES ON THE DEVELOPMENT OF SMEs IN THE CONSTRUCTION INDUSTRY

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Abstract
This paper examines the targeted procurement (TP) strategies of public sector clients such as state-owned enterprises (SOEs) in South Africa and whether these strategies impact on the development of SMEs in the construction industry. The rationale for this study stems from reports that while TP has been widely used as an instrument to improve the position of SMEs in the South African construction industry, three out of five SMEs do not become established firms. In addition, the nature of the impact of TP strategies on the growth performance of SMEs in the construction industry is not known. This stage of the study adopts a literature survey, mainly employing theoretical perspectives to establish the TP strategies used by public sector clients and the nature of its impact on SME development in the construction industry. Preliminary findings reveal that the TP strategies frequently used in the construction industry include unbundling, mandatory subcontracting, preferencing, third party management and incentives for KPIs and that TP strategies directly influence SME growth performance, however this relationship is mediated by the level of supply chain integration. It can be inferred from these findings that SOEs would need to carefully choose and implement the most appropriate TP strategy that enhances the integration between targeted SMEs and other entities in the supply chain.

Keywords: construction industry, procurement, SMEs, supply chain integration, targeted procurement

1 Introduction

Interacting with almost all spheres of human endeavour and having strong links with other sectors of the economy, the construction sector and its activities occupy a critical position that influences national strategic socio-economic development and improvement in the quality of life (Rwelamila, 2012; UNCHS, 1996). Government's understanding of the construction industry's significant role in the economy is well-documented in literature (London, 2008; Rwelamila, 2012; Shakantu, 2012). Implicitly, there has also been an increasing understanding of the need for the government to intervene in the construction industry that is largely dominated by albeit specialized, underperforming small and medium-sized enterprises (SMEs) (Egan, 1998; Latham, 1994; UK BIS, 2013; Wolstenholme, 2009).

SMEs have long been recognised to play an important role as key drivers of economic growth (Abor and Quartey, 2010; Shakantu, 2012; Vosloo, 1994). The South African architectural, engineering and construction (AEC) subsector, accounts for about 34.2% of total small business employment (Schüssler, 2012), making it the second largest employer among SMEs. Construction SMEs are very diverse and highly specialized; and they constitute a significant part of the construction industry supply chain (Dainty et al., 2001). The sustained significance of construction small businesses has led to the focus of government's policies on promoting the advent of capable small contractors and supporting their continuous development and sustainability (Egan, 1998).

Consequently, some governments have implemented prescriptive measures to promote small contractor development (Gounden, 2000; Hawkins, 2012; Ofori, 1996; Watermeyer, 2003). Others have gone ahead to set-up and implement supportive procurement programmes (demand side interventions) and well-structured contractor development models (supply side interventions) (Dlungwana and Rwelamila, 2004). These interventions are usually implemented through public procurement where the government becomes an active participant in the market economy as a major client contributing significantly to GDP – up to 50% of entire domestic construction expenditure in South Africa (Ncwadi and Dangalazana, 2006). Therefore governments progressively use their purchasing power to intervene in the construction industry towards achieving a broad range of national socio-economic goals including the development and sustainability of the de facto drivers of economic growth, i.e. local SMEs.

Targeted procurement (TP) is an innovative government procurement intervention strategy designed to promote the participation of targeted enterprises and targeted labour in contracts (cidb, 2008a; Ofori, 2009; Watermeyer et al., 2001); in a bid to achieve the state entities' contractor development goals which are included as a relevant criterion for contract award, along with other functional criteria e.g. price and quality. While fewer studies have been undertaken to assess the impact of TP in South Africa, there have been more studies (e.g. Gounden, 2000; Kajimo-Shakantu, 2007; Letchmiah, 2012; Manchidi and Harmond, 2002) relating to preferential procurement policy generally. Previous reports (Letchmiah, 2012; Manchidi and Harmond, 2002) indicate that TP have successfully opened up the construction industry to SMEs with their contract-winning rate and market share increasing significantly; however, SMEs remain deprived in a competitive industry where three out of five SMEs do not become established firms (Greyling, 2012; Mofokeng and Thwala, 2012).

The TP process in the construction industry is made-up of a network of supply chain relationships between targeted SMEs and other entities in the project supply chain. Manchidi and Harmond (2002) highlight the difficulty of targeted enterprises to form genuine quality contracting relationships (or integration) with other entities in the supply chain, which limit their ability to develop organizational and operational capacities (Kajimo-Shakantu, 2007). This paper therefore examines the TP process of public sector clients, specifically state-owned enterprises (SOEs) in South Africa using a literature survey, to identify the prevalent TP strategies used when targeting SMEs in the construction industry, and whether the quality of relationships formed with other entities in the TP process interacts with the TP strategies implemented to influence the growth performance (or development) of SMEs.

2 Overview of targeted procurement strategies, supply chain relationships and measures of SME growth performance

The phenomenon being investigated by this study (i.e. the relationship between TP and SME development), has its theoretical underpinnings in the field of industrial organisation economics. Industrial organisation economics builds on the theory of the firm, which is a group of economic theories that explains and predict the nature of the firms – existence, behaviour, structural organisation, and their relationship to the market or industry as a whole. However industrial organisation economics focuses on two main areas, i.e. the structural and behavioural characteristics of the industry, and how these influences the performance of firms in the industry (Bain, 1959; Martin, 1993). Two schools of thought exist in the field of industrial organisation economics, namely: the Chicago School and the Structure-Conduct-Performance (SCP).

The Chicago School argues for economic rationalism, i.e. market forces rather than government intervention should dictate the allocation of economic resources and determine the performance of firms within the industry (Stilwell, 1993). This approach is usually applied to markets in perfect competition, which is not always the case, as some experience market failure or severe socio-economic challenges e.g. income inequality in South Africa (Palma, 2005; Rwelamila, 2012; UNDP, 2013). While the SCP school of thought argues for government intervention. The rationale is that because market structure has a direct influence on, and is central to the firm's economic conduct/behaviour, which in turn affects the firm's performance in the market, it is necessary for governments in their role as the regulator of the economy, to intervene in altering the market structure towards influencing the growth performance firms and the market as a whole (Bain, 1959). Targeted procurement – a form of government intervention, adheres to the SCP paradigm, and evidence (Kajimo-Shakantu, 2007; Letchmiah, 2012) shows that TP has changed the structural characteristics of the construction industry with the market share of SMEs increasing significantly.

2.1 Targeted procurement strategies

The ADB (2012) reveals that SME development procurement initiatives are most often applied by governments in two broad ways: bid price preferences that load the lowest non-SME bid or provide a discount to the lowest SME bid, and set-asides which provide quotas for targeted SMEs to bid competitively against each other. For example, in Singapore, bidding preferences were offered to local construction firms and joint ventures (Ofori, 1996).While, Botswana implemented bid preferencing schemes to promote engagement of citizen contractors (Watermeyer, 2003). On the other hand, set-asides or reserved procurement strategies have been used to encourage participation of small businesses and minority business enterprises in government contracts in the US, South Africa, Indonesia and Malaysia (Arrowsmith, 1995; Hawkins, 2012) and to develop minority enterprise and counter the effects of past discrimination (Bolton, 2006; Chatterji et al., 2014).

Preferential procurement practices in public procurement are an important government intervention strategy for stimulating the growth and development of SMEs in the construction industry of many countries including South Africa (Hawkins, 2012; Watermeyer et al., 2001). The adoption of preferential procurement policies in South Africa as a vehicle for contractor development, in a practice called targeted procurement is well documented in literature (London, 2008; Shakantu, 2012; Watermeyer, 2003). As part of national procurement reforms to address past imbalances and stimulate SME growth and development, the Department of Public Works, in 1996, introduced innovative TP strategies to promote the participation of targeted SMEs in public sector contracts (Shakantu, 2012).

The various public sector TP strategies used in public procurement include (cidb, 2008b; Letchmiah, 2012; Watermeyer, 2005):

- Unbundling of Contracts – where contracts are broken down into smaller contracts or packages to facilitate the participation of SMEs and/or emerging contractors in procurement as main or prime contractors;
- Mandatory Subcontracting – where larger main contractors are required to subcontract a portion of the works to SME contractors using client-prescribed procurement procedures;
- Preferencing – where tender evaluation points are granted to those contractors who satisfy prescribed preferencing criteria (such as joint ventures between large and SME contractors);

- Third Party Management – where larger established contractors and/or consultants are required to provide construction management support, and mentor SMEs and/or emerging contractors in the execution of contracts as prime contractors and monitor satisfactory progress of their work; and
- Incentives for KPIs – where a specified target (key performance indicator) has been set, contractors who achieve the KPIs are awarded incentive payments. Public sector clients tend to combine some of the identified TP strategies in an effort to maximize outcomes.

2.2 Supply chain relationships and review of existing models

Construction industry projects are often characterized by a highly fragmented supply chain and a less fragmented demand side that is organized and linked via supply chain relationships (Oyegoke et al., 2009). The supply chain management concept aims to integrate the interests of all stakeholders (suppliers and customers) towards the common goal of efficiently delivering best value to the client (Brown et al., 2001; Cox and Townsend, 1998; Oyegoke et al., 2009). According to Pryke (2006), the construction project can be viewed as a network of relationships between firms that make up the project supply chain.

Emerging in the purchasing and supply sector in the mid-1990s, supply chain relationship models has subsequently been introduced in the construction industry to describe, measure and improve the relationships between the key partners of a construction supply chain. Seven existing models that describes the change in supply chain relationships from the traditional to the collaborative have been identified in this paper. They include: the client-contractor working relationship model (Larson, 1995), the model of partnering (Ellison and Miller, 1995), the Construction Industry Institute's (CII) partnering continuum (Thompson and Sanders, 1998), the Best Practice in Partnering Group's (BPiPG) partnering positioning matrix (Jones and O'Brien, 2003), the Strategic Forum for Construction's (SFfC) supply chain maturity assessment grid (SFfC, 2003), the supply chain position matrix (Hines, 1994), and the supply chain relationship maturity model by Meng et al. (2011).

Six of the models are all related to the construction industry, while Hine's supply chain position matrix is a comprehensive model developed in the purchasing and supply sector that provides a good comparison with construction specific models. Three of the construction-oriented models focus on the relationships between clients and main contractors, and have not paid attention to downstream relationships where majority of SMEs in the construction industry are clustered. With the exception of Meng et al.'s supply chain relationship maturity model, the other three models that try to examine the supply chain as a whole have limited use in practice as they are only applicable to integrated supply chains, which makes them difficult to use when different types of relationships exist in different parts/tiers of the supply chain such as the construction industry. Most of the existing models are further characterised by either inappropriate definition of relationship levels, or biased towards the collaborative end of the supply chain relationship spectrum by establishing one level for a traditional relationship and three levels for different partnering (Meng, 2010). However evidence shows that most supply chains in the construction industry are still very traditional, as partnering is yet to be fully entrenched in construction practice (Briscoe and Dainty, 2005; Meng et al., 2011).

In comparison, Meng et al.'s supply chain relationship maturity model builds on the inherent weaknesses of the other models such as incomplete coverage of key criteria, and develops a robust systematic model that explores the special characteristics of the construction industry supply chain. Developed in the UK construction industry, the model adopts the capability maturity approach (Paulk et al., 1993), and establishes four construction supply chain relationship maturity levels in matrix format with 24 assessment criteria in eight categories at each of the four maturity levels. This model will be adapted to reflect supply chain relationships in the context of the South African construction industry. The adopted supply chain relationship maturity model focuses on specific relationships between customer and supplier rather than the whole supply chain. This will allow for a robust understanding of the quality of relationship between targeted SMEs and other key partners of the construction supply chain.

The key component of the model that sum up the quality of supply chain relationships are the four maturity levels which describes the progression of relationship improvement from adversarial, through limited cooperation and short-term collaboration, to close and long-term collaboration. They are: Price competition (Level 1), Quality competition (Level 2), Project partnering (Level 3), and Strategic partnering (Level 4). The supply chain relationship at Level 1 is characterized by self-interest, mistrust, lack of mutual objectives, and win-lose business philosophy that results in adversarial or arms-length relationships. Level 2 is characterized by partial win-win benefits, and trust is mainly built on the capability of each party to execute quality work; this is regarded as a transition from traditional to collaborative relationship. At Level 3, mutual objectives are achieved on a single project, partners work together collaboratively as an integrated project team, goodwill trust and win-win attitude fosters the project partnering relationship. At Level 4, objectives are aligned over a series of projects, close collaboration is achieved across the whole supply chain, high degree of trust exist between partners, and an attitude of performance measurement and continuous improvement is adopted.

2.3 Measures of SME growth performance

Small firm growth theorists (Davidsson et al., 2005; Penrose, 1959; Starbuck, 1971) refer to growth as the change in an organization’s size – a multidimensional phenomenon that necessarily happens over time. Unlike large firms that tend to grow through acquisitions, small firms usually grow organically (Penrose, 1959). In the analysis of firm growth from the change-in-size perspective, growth has been measured with a range of different indicators in the literature; the most frequently suggested being sales, revenue, employment, assets, physical output, market share and profits (Ardishvili et al., 1998; Delmar, 1997; Weinzimmer et al., 1998; Wiklund, 1998). In specific industry studies, more specialized measures are conceivable (Davidsson et al., 2005). For example, in construction, increase in turnover and employment are the most frequently used by scholars in construction management research (Abu Bakar et al., 2011, 2012; Ofori and Chan, 2000; Tucker et al., 2015). However, in the context of this study, multiple indicators of increase in turnover, assets (plants and equipment), and number of permanent and skilled employees will be used to measure SME growth performance (development) in relation to targeted procurement objectives. These indicators are selected because the South African Construction Industry Development Board (cidb) uses increase in financial and works capability plus number of registered skilled professionals in a firm’s employment as the main requirements for progressing through the cidb contractor grading system – a holistic measure of company growth and development in the South African construction industry.

3 The impact of Targeted Procurement strategies on SME development

According to Chatterji et al. (2014) and Letchmiah (2012), little is known about the actual effectiveness of preferential procurement in promoting the growth and development of SMEs, and only a handful of studies have attempted to analyse whether these programmes have met their goals in the construction industry. Reports from previous studies on the impact of set-asides in the US construction industry indicate that set-asides: significantly increased contract awards to SMEs (Marion, 2007); have a positive and significant empirical impact on SME growth regardless of how growth is measured (House-soremekun, 2006); and plays a significant role in the net survival rates of these SMEs (Marion, 2007). However, Blanchflower and Wainwright (2005) argue that these programmes have not achieved their objective of improving the position of SMEs in the construction industry.

In South Africa, four major previous studies (Gounden, 2000; Kajimo-Shakantu, 2007; Letchmiah, 2012; Manchidi and Harmond, 2002) have been identified in literature. Three key similarities can be drawn from the results of these independent studies – the application of TP strategies significantly contributed to increased participation of SMEs in government tendering process, led to greater success in winning government contracts, and promoted the development of business linkages between historically empowered firms and historically disadvantaged SMEs. However, attempts to measure the impact of TP on individual SME growth performance in the construction industry has been evasive so far. Furthermore, it is unknown, how and whether, the quality of relationship interacts with the implemented TP strategies to influence the growth performance of SMEs.

4 Conceptual framework

This study draws on the theories of industrial organization economics, strategic management and supply chain management (Davidsson et al., 2005; London, 2008; Martin, 1993). Based on literature review, a conceptual model is developed showing that there is a relationship between targeted procurement strategies, supply chain integration and the development of SMEs through the procurement process (see Figure 1) (Quality of relationships and supply chain integration are used interchangeably in this paper). The constructs for SME development are turnover, assets (plants and equipment) and number of skilled employees (Abu Bakar et al., 2011, 2012; Ofori and Chan, 2000; Teruel-Carrizosa, 2006; Tucker et al., 2015). Quality of supply chain relationships/integration are price competition (Level 1), quality competition (Level 2), project partnering (Level 3), and strategic partnering (Level 4) (Meng et al., 2011). While TP strategies identified are unbundling, mandatory subcontracting, preferencing, third-party management, and incentives for KPIs (cidb, 2008b; Letchmiah, 2012; Watermeyer, 2005).

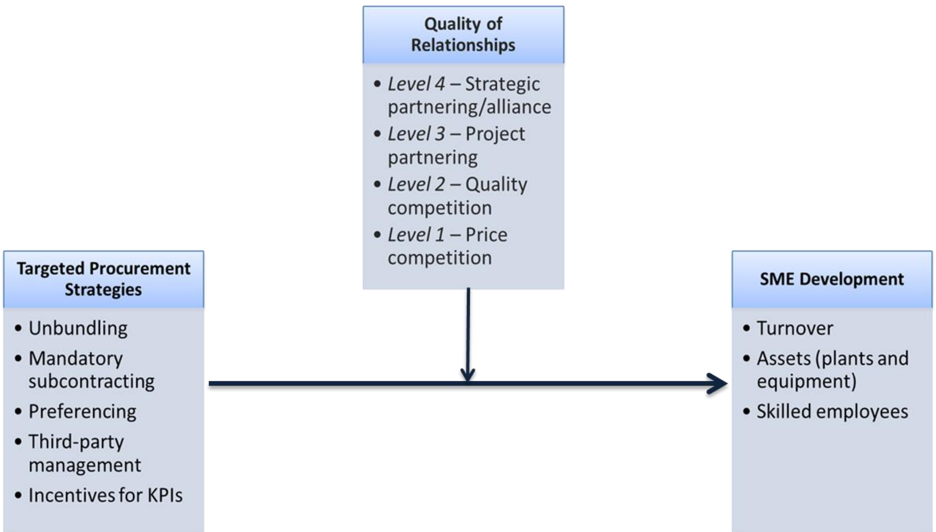

Figure 1. Conceptual framework

The conceptual model proposes that there is a direct linear relationship between TP strategies (independent variable) and SME development (the primary variable, which is also the dependent variable); while quality of supply chain relationships (moderating variable) mediates the relationship between TP strategies and SME development. However it is not known, how and whether, the quality of supply chain relationships/integration interacts with the implemented TP strategies to influence the growth performance of SMEs. Thus further empirical research is required to determine how TP strategies and corresponding relationships impact on the development of SMEs in the construction industry. The relationships among targeted procurement strategies, quality of relationship, and SME development are also modelled using linear (Equations 1, 2, and 3) and multiple regressions (Equation 4).

Y (SME Development) = X (Targeted Procurement Strategies) ………… 1

Y (SME Development) = X (Quality of Relationships) ………… 2

Y (Quality of Relationships) = X (Targeted Procurement Strategies) ………… 3

Y (SME Development) = X1 (Targeted Procurement Strategies) + X2 (Quality of Relationships) 4

In both equation 1 and 2, SME development is the dependent variable while TP strategies and quality of relationships is the independent variable respectively. This implies that SME growth performance changes depending on the TP strategy used, and the level of supply chain integration. In equation 3, quality of relationships is the dependent variable while TP strategies is the independent variable meaning the level of supply chain integration changes depending on the TP strategy used. Because SME development is a dependent variable to both TP strategies and quality of relationships in equations 1 and 2 respectively, it suggests that TP strategies interact with quality of relationships within the supply chain entities to influence SME growth performance. Hence, SME development becomes a function of this interaction as shown in equation 4, where SME development is the dependent variable and TP strategies and quality of relationships/integration between the supply chain entities are independent variables.

5 Conclusion and further research

The study examines the TP strategies of public sector clients such as state-owned enterprises (SOEs) in South Africa and whether these strategies impact on the development of SMEs in the construction industry using theoretical perspectives. The literature survey conducted established that the targeted procurement strategies used in the construction industry include unbundling, mandatory subcontracting, preferencing, third party management and incentives for KPIs and that TP strategies directly influence SME growth performance, however this relationship is mediated by the level of supply chain integration. Further empirical research is required to measure the impact of TP on individual SME growth performance in the construction industry and to determine the type of contracting relationships formed by SMEs with other entities in the supply chain and whether this impacts on their growth and performance.

The proposed further research is to be conducted in South Africa, because the South African construction industry possesses all the legal and structural underpinnings for the proposed investigation. The study will follow a three-stage sequential triangulated mixed-method approach – emphasizing qualitative techniques, but also combining quantitative methods to enrich answers to the research questions. Through deep and robust narratives, qualitative data will provide analytical insights that will help in understanding the quality of relationships that develop in the project delivery process, while quantitative data will provide measurable indicators of outcomes to improve generalizability and transferability of research findings.

The unit of analysis for this study will be the TP projects of identified SOEs such as South African National Roads Agency Limited (SANRAL), Airports Company South Africa (ACSA), Passenger Rail Agency of South Africa (PRASA), Petroleum Oil and Gas Corporation of South Africa (PetroSA). Respondents will be selected from supply chains of SOEs that have developed in response to a TP project. Primary focus will be on the construction cluster in the supply chain, thus excluding the design cluster. Selected respondents will be limited to cidb Grade 3 – 6 contractors that have executed TP projects within the last 5 years. Grade 1 to 2 contractors are excluded because they are unlikely to reflect the growth performance been sought, while Grade 7 to 9 contractors are excluded because these are considered established contractors. Finally, collected research data will be analysed via statistical categorical data analysis, and interpreted in both qualitative and quantitative manner.

Outcomes of this study will include an empirically tested and validated model that proposes a strategy for selecting and implementing the most appropriate TP strategy that enhances the quality of relationship formed between targeted SMEs and other entities in the supply chain. The study will also contribute to the body of knowledge in strategic construction management research that helps decision-makers, researchers and policy makers in better understanding the role of procurement regimes in stimulating the growth and development of SMEs in the construction industry, and will also enable organs of state to better measure their procurement policy objectives against intended outcomes.

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7 References

Abor, J., & Quartey, P. (2010). Issues in SME Development in Ghana and South Africa. *International Research Journal of Finance and Economics*, *39*(39), 218–228.

Abu Bakar, A. H., Abdul Razak, A., Yusof, M. N., & Abdul Karim, N. (2011). Factors determining growth of companies: A study on construction companies in Malaysia. *African Journal of Business Management*, (5), 8753–8762.

Abu Bakar, A. H., Tabassi, A. A., Abd. Razak, A., & Yusof, M. N. (2012). Key factors contributing to growth of construction companies: A Malaysian experience. *World Applied Sciences Journal*, *19*(9), 1295–1304.

ADB. (2012). *SME Development: Government Procurement and Inclusive Growth*.

Ardishvili, A., Cardozo, S., Harmon, S., & Vadakath, S. (1998). Towards a theory of new venture growth. In *Babson Entrepreneurship Research Conference*. Ghent, Belgium.

Arrowsmith, S. (1995). Public procurement as an instrument of policy and the impact of market liberalisation. *Law Quarterly Review*, (111), 235–284.

Bain, J. S. (1959). *Industrial Organization*. New York: John Wiley & Sons, Inc.

Bolton, P. (2006). Government procurement as a policy tool in South Africa. *Journal of Public Procurement*, *6*(3), 193–217.

Briscoe, G. H., & Dainty, A. R. J. (2005). Construction supply chain integration: an elusive goal? *Supply Chain Management: An International Journal*, *10*(4), 319–326.

Brown, D., Ashleigh, M., Riley, M., & Shaw, R. (2001). New project procurement process. *Journal of Management in Engineering*, *7*(4), 192–201.

Chatterji, A. K., Chay, K. Y., & Fairlie, R. W. (2014). The Impact of City Contracting Set-Asides on Black Self-Employment and Employment. *Journal of Labor Economics*, *32*(33), 507–561.

cidb. (2008a). *Inform practice Note #10: Attaining social and economic deliverable*. Construction Industry Development Board.

cidb. (2008b). *Inform Practice Note # 4: Procuring Best Value in Construction Works* (2nd ed.). Construction Industry Development Board.

Cox, A., & Townsend, M. (1998). *Strategic procurement in construction: Towards better practice in the management of construction supply chains*. Lincolnshire: Thomas Telford Publishing.

Dainty, A. R. J., Millett, S. J., & Briscoe, G. H. (2001). New perspectives on construction supply chain integration. *Supply Chain Management: An International Journal*, *6*(4), 163–173.

Davidsson, P., Achtenhagen, L., & Naldi, L. (2005). Research on small firm growth: A review. *European Institute of Small Business*, 1–27.
Delmar, F. (1997). Measuring growth: Methodological considerations and empirical results. In R. Donckels & A. Miettinen (Eds.), *Entrepreneurship and SME Research: On its Way to the Next Millennium* (pp. 190–216). Aldershot, UK and Brookfield, VA: Ashgate.
Dlungwana, W. S., & Rwelamila, P. D. (2004). Contractor Development Models That Meet the Challenges of Globalisation - A Case for Developing Management Capability of Local Contractors. In *CIB 2004 International Symposium on Globalisation and Construction* (pp. 1–12). Bangkok, Thailand.
Egan, J. (1998). *Rethinking Construction: The Report of the Construction Task Force*. London: Department of the Environment, Transport and the Regions.
Ellison, S. D., & Miller, D. W. (1995). Beyond ADR: Working Toward Synergistic Strategic Partnership. *Journal of Management in Engineering*, *11*(6), 44–54.
Gounden, S. (2000). *The impact of the national department of public works' affirmative procurement policy on the participation and growth of affirmable business enterprises in the South African construction sector*. Unpublished PhD Thesis, University of Natal.
Greyling, E. (2012). *South Africa SME Observatory: Opportunities for Employment Creation through SME Development in the construction sector, Free State*. South Africa: International Labour Organization.
Hawkins, J. (2012). Promoting social opportunities in the procurement of construction projects. In G. Ofori (Ed.), *Contemporary Issues in Construction in Developing Countries* (pp. 61–82). Oxon: Spon Press.
Hines, P. (1994). *Creating World Class Suppliers: Unlocking Mutual Competitive Advantage*. London: Pitman Publishing.
Holland, J., & Ruedin, L. (2012). Monitoring and evaluating empowerment processes. In *Poverty Reduction and Pro-Poor Growth: The Role of Empowerment*. OECD.
House-soremekun, B. (2006). The impact of minority set-aside programs on black business success in Cleveland, Ohio: Implications for public policy. *Western New England Law Review*, *30*(19), 19–38.
Jones, M., & O'Brien, V. (2003). *Best Practice Partnering in Social Housing Development*. Thomas Telford Limited.
Kajimo-Shakantu, K. (2007). *An Investigation into the Responses of the Construction Industry to Preferential Procurement in South Africa*. Unpublished PhD Thesis, University of Cape Town.
Larson, E. (1995). Project Partnering: Results of Study of 280 Construction Projects. *Journal of Management in Engineering*, *11*(2), 30–35.
Latham, M. (1994). *Constructing the Team*. London: HMSO.
Letchmiah, D. R. (2012). *An Examination of the effectiveness of Preferential Procurement in the South African Construction Industry*. Unpublished PhD Thesis, University of the Witwatersrand.
London, K. (2008). *Construction Supply Chain Economics (Spon Research)*. Oxon: Taylor & Francis.
Manchidi, T. E., & Harmond, I. (2002). *Targeted Procurement in the Republic of South Africa: An Independent Assessment*. Department of Public Works Republic of South Africa.
Marion, J. (2007). The Effectiveness of Affirmative Action in Highway Procurement. In *Impact 209 Conference UCLA*. Los Angeles.
Martin, S. (1993). *Industrial Economics: Economic Analysis and Public Policy*. NJ: Prentice Hall.
Meng, X. (2010). Assessment framework for construction supply chain relationships:

Development and evaluation. *International Journal of Project Management*, *28*(7), 695–707.
Meng, X., Sun, M., & Jones, M. (2011). Maturity Model for Supply Chain Relationships in Construction. *Journal of Management in Engineering*, *27*(2), 97–105.
Mofokeng, G., & Thwala, W. D. (2012). Mentorship Programmes within the Small and Medium Sized Contractor Development Programme : A Case Study of the Free State Province , South Africa. *Journal of Economics and Behavioral Studies*, *4*(12), 712–722.
Ncwadi, M. R., & Dangalazana, T. (2006). An Analysis of the Challenges Facing Emerging Contractors in the Nelson Mandela Metropole, South Africa. *Africa Insight*, *36*(3), 186–198.
Ofori, G. (1996). International contractors and structural changes in host country construction industries: case of Singapore. *Engineering, Construction and Architectural Management*, *3*(4), 271–288.
Ofori, G. (2009). Construction SMME development. *Isiza*, *6*.
Ofori, G., & Chan, S. L. (2000). Growth Paths of Construction Enterprises in Singapore. *Engineering, Construction and Architectural Management*, *7*(3), 307–321.
Oyegoke, A. S., Dickinson, M., Khalfan, M., McDermott, P., & Rowlinson, S. (2009). Construction project procurement routes: an in-depth critique. *International Journal of Managing Projects in Business*, *2*(3), 338–354.
Palma, G. (2005). Four sources of “de-industrialization” and a new concept of the “Dutch disease.” In J. A. Ocampo (Ed.), *Beyond Reform: Structural Dynamics and Macroeconomic Vulnerability*. Stanford: Stanford University Press.
Paulk, M. C., Curtis, B., Chrissis, M. B., & Weber, C. V. (1993). *Capability maturity model for software, Version 1.1*. Pittsburgh: Software Engineering Institute, Carnegie Mellon University.
Penrose, E. (1959). *The Theory of the Growth of the Firm*. Oxford: Oxford University Press.
Pryke, S. (2006). Projects as networks of relationships. In S. Pryke & H. Smyth (Eds.), *Mangement of Complex Projects: A Relationship Approach*. Oxford: Blackwell Publishing.
Rwelamila, P. D. (2012). Construction project performance in developing countries. In G. Ofori (Ed.), *Contemporary Issues in Construction in Developing Countries* (pp. 318–346). Oxon: Spon Press.
Schüssler, M. (2012). *The 11th UASA employment report. South Africa cannot afford South Africans*. Gauteng, South Africa.
SFfC. (2003). Supply chain maturity assessment grid. Strategic Forum for Construction.
Shakantu, W. M. (2012). Contractor development. In G. Ofori (Ed.), *New Perspectives on Construction in Developing Countries* (pp. 253–281). Oxon: Spon Press.
Starbuck, W. H. (1971). Organizational growth and development. In W. H. Starbuck (Ed.), *Organizational growth and development: Selected readings*. Victoria, Australia: Penguin Books.
Stilwell, F. (1993). Economic rationalism: sound foundations for policy? In S. Rees, G. Rodley, & F. Stilwell (Eds.), *Beyond the Market: Alternatives to Economic Rationalism* (pp. 27–37). Leichardt: Pluto Press.
Teruel-Carrizosa, M. (2006). *Firm growth, persistence and multiplicity of equilibria: An analysis of spanish manufacturing and service industries*. PhD thesis, Universitat Rovira i Virgili.
Thompson, P. J., & Sanders, S. R. (1998). Partnering Continuum. *Journal of Management in Engineering*, *14*(5), 73–78.
Tucker, G. C., Windapo, A. O., & Cattell, K. S. (2015). Exploring the use of financial capacity as a predictor of construction company corporate performance: evidence from

South Africa, Journal of Engineering, Design and Technology, 13(4) 596-611.
UK BIS. (2013). *Construction 2025 Industry Strategy: Government and industry in partnership*. London, UK: Department for Business, Innovation & Skills.
UNCHS. (1996). *Policies and Measures for Small-Contractor Development in the Construction Industry*. Nairobi: HABITAT.
UNDP. (2013). *Humanity Divided: Confronting Inequality in Developing Countries*. NY: UNDP.
Vosloo, W. B. (1994). The small firm as a vehicle for entrepreneurship. In W. B. Vosloo (Ed.), *Entrepreneurship and Economic Growth*. Pretoria: HSRC.
Watermeyer, R. B. (2003). Implementing preferential procurement policies in the public sector in South Africa. *Journal of the South African Institution of Civil Engineering, 45*(3), 11–22.
Watermeyer, R. B. (2005). A generic and systemic approach to procurement : the case for an international standard. *Public Procurement Law Review*, (1), 39–61.
Watermeyer, R. B., Jacquet, A., & Noyana, C. (2001). Developing the Capacity of Targeted Enterprises in Contractor Development Programmes. In *Regional conference on Developing the Construction Industries of Southern Africa*. Pretoria.
Weinzimmer, L. G., Nystrom, P. C., & Freeman, S. J. (1998). Measuring organizational growth: Issues, consequences and guidelines. *Journal of Management*, *24*(2), 235–262.
Wiklund, J. (1998). *Small Firm Growth and Performance: Entrepreneurship and Beyond*. PhD Thesis, Jönköping International Business School.
Wolstenholme, A. (2009). *Never waste a good crisis: A review of Progress since Rethinking Construction and Thoughts for Our Future*. London: Constructing Excellence in the Built Environment.