Emerging Trends in Construction Projects Delivery

THE TRENDS IN CONSTRUCTION OUTPUT FORECASTING STUDIES OVER THE LAST 25 YEARS

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Abstract
Construction output forecasting plays a crucial role in developing strategic plans for the construction industry. Various techniques have been used for construction output forecast research which includes: regression, artificial neural network and structural models, just to mention a few. An up-to-date systematic review of previous studies focused on construction output forecasting will provide insights into the current state of knowledge and gaps in the field. A three-step method was used to obtain relevant publication (15 papers met the inclusion criteria) and to compile a database of techniques and findings. It was found that statistical model is the most dominant method used to forecast construction output data. Four research gaps were identified in the review process. Continued efforts are needed to explore the application of artificial intelligence (AI) models in construction output forecast research. This can be attributed to the accuracy and reliability associated with the AI models in previous studies. Accurate construction output forecast is vital to the sustained growth of the construction industry.

Keywords: Construction industry, Construction output, Forecasting techniques, Systematic review

1 Introduction

The construction industry plays a pivotal role in the economic development process of any nation. Commentators have argued that the construction industry has strong links with the economy. Empirical evidence has shown that the construction industry output (hereafter termed construction output) tends to fluctuate with economic cycles (Chan, 2002, Goh, 2005, Lewis, 2004). Fluctuations in construction output create inefficiencies in the production process (Ofori, 1993; Ofori et al., 1996), bankruptcy and retrenchment within the construction industry during periods of low production (Jiang et al., 2013, Ng et al., 2008a). These fluctuations have detrimental effects on the construction industry and the economy in general. In addition, macro-level studies aimed at improving the construction industry have suggested the need for predictive models to aid long-term forward planning (Egan, 1998, Ng et al., 2008b). The accuracy and reliability of these predictive models are of strategic importance to the construction industry for sustained growth and planning purposes.

Forecasting construction output will aid and improve managerial decision making, policy formulation and sustained economic growth. Various time horizons and levels of aggregation are useful for strategic planning. For example, at construction company level, short-term

forecast is required for project scheduling and staffing; medium-term forecast for product development, pricing of tenders and marketing; and long-term forecast will be useful for decisions associated with capital investments (e.g. acquisition of new equipment) and exploration of new overseas market. Moreso, governments are interested in construction output due to its linkage with other sectors of the economy. Government intervention programmes during periods of economic recession is crucial to recovery (Goh, 2005, Jiang et al., 2013). Jiang et al. (2013) points out that the anticipated impact of such intervention policies was not achieved in Australia because it was halted too early. The ability to anticipate future trends would ensure the development and implementation of adequate response strategies aimed at reducing the impact of changes in construction output.

The purpose of this paper is to systematically review the current state of empirical literature on construction output forecasting. Although, several studies have tried to differentiate between construction output and construction demand (Goh, 1998). Gruneberg and Folwell (2013) assert that construction component of gross fixed capital formation can be used as a measure of construction output. In contrast, gross value of construction work was used as a measure of construction work (see Goh and Pin, 2000; Fan et al., 2010). Akintoye and Sommerville (1995) show that a lagged relationship exist between construction output and construction demand. It is evident that a thin line of difference exists between construction demand and construction output. Thus, construction demand will eventually filter into construction output. To date, there has been little or no studies focused on a systematic review of construction output forecasting research. Although, an earlier review was done by Fan et al. (2007), the main focus of that review was to identify factors affecting construction demand and the use of exponential smoothing technique to predict construction demand. Hence, this paper presents an up-to-date and more comprehensive review of the construction output literature, briefly discusses advantages and disadvantages of forecasting techniques and evaluates the accuracy of construction output forecast generated by various techniques.

2 Overview of Construction Output Forecasting Techniques

Numerous techniques have been developed for construction output forecasting. In construction-related literature, the earliest work was published by Tang et al. (1990). In this study, regression technique was used to forecast construction (aggregated into residential, non-residential and other) activities in Thailand. Construction output forecast research has been evolving leading to the use of new techniques. Empirical evidence also confirms that macro-economic variables are adequate and reliable for developing construction output forecast models (see Goh and Teo, 2000; Jiang and Liu, 2011). The techniques which have been used can be classified into four broad categories (methods) namely: statistical models (SM), structural time-series model (S), artificial neural network (ANN) and hybrid models (H). A detailed discussion on forecasting techniques can be found in the literature (Weron, 2014).

2.1 Statistical Models

Statistical models are based on the mathematical relationship between the dependent variable (current construction output) and a number of independent variables (i.e. determinants), this relationship is either known or estimated (Weron, 2014). Statistical models used in past studies (see Table 1) range from autoregressive integrated moving-average (ARIMA), multiple regression (MR), multiple loglinear regression (MLGR), autoregressive nonlinear regression (ARNLR), vector error correction (VEC), vector error correction model with dummy variables (VEC-D), panel ordinary least squares regression (P-OLS), and panel-vector error correction (P-VEC).

Statistical models can be divided into two subsets namely: stationary process and non-stationary process. Stationary time series possess statistical properties (such as mean, variance,

etc.) which are constant over time. In ARIMA class of models, stationary time series is an important process for fitting an ARIMA model and regression models (Goh, 1998). However, the use of co-integration and VEC forecast models ensure that valuable long-term relationship information is not lost during the transformation of non-stationary variables (Anderson and Vahid, 2011). Common to these models, construction output is expressed in terms of its past values and a white noise process. In addition, the parameters for other significant variables can be estimated in multivariate models such as multiple regression.

2.2 Structural Time-series Model

Structural time-series model are quite similar to statistical models. The main difference is that structural time-series model is based on estimating the relationship between trend, seasonal component and noise. Detailed discussions on structural time-series model can be found in Koopman and Ooms (2011).

2.3 Artificial Neural Network

Most of statistical models are linear predictors; however, construction output forecast is known to be a non-linear function of its input features. Thus, statistical models may not adequately predict construction output. In order to solve this problem, researchers have used artificial intelligence techniques such as Artificial Neural Network (ANN), which have the capacity to capture non-linear and complex data structures. Quantitative forecasting is based on the capacity to adequately map between input and output data. ANN possesses the capability to learn past patterns in data and extrapolate underlying patterns, which aids prediction of future outcomes (Shukla et al., 2010). Thus, ANNmay be adequate for forecasting task.

2.4 Hybrid Models

Hybrid methods combine linear and non-linear modelling capabilities, thus, hybrid models complements on the strength and weakness of both approaches. Shukla et al. (2010) acknowledges that hybrid models possess the additional capabilities, which can improve forecast accuracy. An example of hybrid model used in Goh (2000) is an evolutionary ANN, which used genetic algorithm (GA) to evolve ANNs (GA-ANN).

3 Research Method

It is acknowledged that systematic reviews of previous studies extend the general understanding about a research problem. However, the findings of review studies are often questionable due to inexplicit methods (i.e. sampling approach, inclusion criteria, etc.). Although, a generally accepted standard for reporting systematic reviews do not exist; Booth (2006) suggests that the explicit use of STARLITE (STARLITE represents sampling strategy, type of study, approaches, range of years, limits, inclusion and exclusions, terms used and electronic source) will improve on the quality of systematic reviews. Thus, this review adopts a modified version of a method used in similar earlier reviews (Ke et al., 2009; Tang et al., 2010). These earlier reviews were limited to papers published in top-tier construction management journals as classified by (Chau, 1997). The inclusion criterion was modified so as to cover papers published in construction-related journals. As a result, three relevant papers published in Australian Journal of Construction Economics and Building, Building and Environment and Habitat International were obtained from the publisher's database. The process of acquiring papers related to the focus of this review was carried out in 3 stages.

Firstly, a systematic and comprehensive search was conducted under the "title/abstract/keyword" field of SCOPUS database search engine. The full search code is as follows:

TITLE-ABS-KEY ("Construction sector*" OR "construction output" OR "construction industry" OR "construction industry development" OR "construction demand" OR "model" OR "forecasting") AND KEY ("construction" OR "Forecasting")) AND DOCTYPE (ar OR re) AND SUBJAREA (mult OR arts OR busi OR deci OR econ OR psyc OR soci).

Despite these search criteria, the results of the initial search on SCOPUS included some publications that did not meet the study's inclusion criteria. Thus, the search results were scaled down by focusing on papers published in construction-related journals between 1990 and 2014 (years inclusive). In the second stage, a brief review of the abstracts of the papers was conducted; this was done so as to exclude less-related or unrelated papers. In addition, publications classified as "book reviews", "editorial", "editor's notes", "letter to the editor", and "articles in press" were excluded.

Finally, after initial filtering, a search in the database of publishers of target journals (this was done because SCOPUS database might not cover some periods in the selected journals) was also done. A total of fifteen articles with relevant content were selected for further analysis.

4 Findings and Discussion

4.1 Number of Selected Papers Annually

The place of construction output forecast in strategic planning has led to studies aimed at developing reliable and accurate predictive models. The earliest published paper amongst those selected for review was published in 1990. As presented in Figure 1, the number of relevant papers published annually was no more than five for the period under consideration. This reveals that construction output forecasting has not received adequate attention. A plausible reason for this might be non-availability of reliable and adequate data, which is essential for model building.

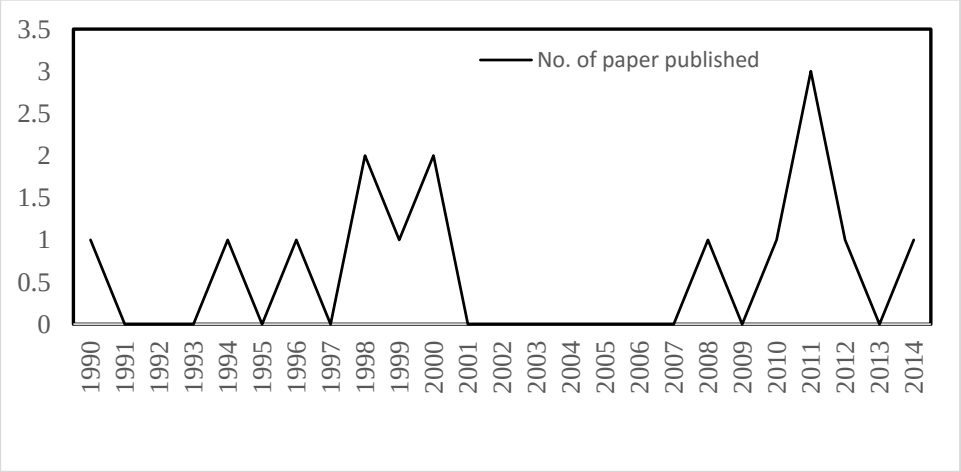

Figure 1. The number of papers distributed annually (from 1990 to 2014)

4.2 Publication Type and Publication Name

In the methods section, the selection criterion was explicitly stated. The search in SCOPUS database and publisher's database was limited to construction-related journal papers. Table 1 presents the publication names and the corresponding number of published papers. As stated earlier, some of the journals are top-tier construction journals as ranked by Chau (1997), including *Construction Management and Economics and Engineering Construction and Architectural Management*. In addition, some leading construction-related journals are also included, such as *Building and Environment, Habitat International and Australian Journal of Construction Economics and Building*. There were 11 papers from Construction Management

and Economics, which comprises 73% of all the selected papers. This demonstrates the significance of Construction Management and Economics in the field of construction output forecasting.

Table 1. Publication names and the number of corresponding papers (1990-2014)

Journal Title	Number
Construction Management and Economics	11
Engineering Construction and Architectural Management	1
Building and Environment	1
Habitat International	1
Australian Journal of Construction Economics and Building	1

4.3 Country/region Distribution

It should be noted that in some previous reviews (Al-Sharif and Kaka, 2004; Ke et al., 2009), country distribution was related to the location of authors affiliated institution. In this review, this has a different meaning; it focuses on where each study was conducted. Five countries/regions from three continents (except Africa, North and South America) were covered as shown in Table 2. This indicates the global focus of construction output forecast studies. With the exception of Thailand, all these studies were focused on developed countries or regions. This clearly highlights the importance attached to the construction industry and the availability of rich database of construction-related statistics, which aids modelling.

Table 2. The number of relevant papers by country/region

Country	Number
Singapore	5
Hong Kong	4
Australia	3
United Kingdom	2
Thailand	1

4.4 Determinants of Construction Output

The determinants (i.e. independent variables) play an important role in the quality of construction output forecast. Determinants of construction output have been classified based on market segment namely: residential, industrial, commercial, public and overall. The significant determinants used along with the class they belong to are presented in Table 3. There are as many as 34 variables used in different studies. Most of the researchers have utilized theory and stepwise regression in selecting variables used in constructing the respective models. Table 3 shows that a diverse range of independent variables have been used in construction output forecast models. A critical look at the variable used as inputs in the studies selected for this review shows that determinants of construction output are unique, i.e. country and context-specific.

Table 3. Significant determinants of construction output

	Dependent Variable (Output)				
Explanatory variables	**Residential**	**Industrial**	**Commercial**	**Public**	**Overall**
Population	TA, G^2, G^3, G^4	G^3			J^1, J^2
GDP/GNP/National Income	A,G^1, N^{sw}	A, G^3	A		N^{fw}, J^1, J^2, F^{NW}
GDP/GNP/National Income per capita	TA, G^1				
Consumer Price	TA, A, G^1, N^{sw}				
Expansion of industrial capacity		TA, G^3			
Expected profits in manufacturing		TA, A	A		
Government revenue/expenditure/ Public construction output				TA	N^{fw}
Value added by public utility				TA,	
Interest rate	A, G^1	G^3	A		J^1, J^2, F^{NW}
Unemployment	G^1, G^2, G^3, G^4, N^{sw}	G^3	A		N^{fw}, J^1, J^2
Gross Fixed Capital Formation	G^1, G^2, G^3				N
Construction material price/Construction tender price index	G^1, G^2, G^3, G^4, F				J^2
Home ownership	G^1				
Saving (personal/national)/ Purchasing Power	G^1, G^2, G^3, G^4	G^3	G^3		J^1
Property Prices	G^1, N^{sw}, F				J^1
Labour force	G^1				
Labour cost		G^3			
Money supply	G^1	G^3			
Housing stock	G^2, G^3				
Housing loan	G^2, G^3				
Planning approval issued/ Additions to housing stock/	G^4, N^{sw}, K		G^3		
Land Price			G^3		
Productivity		G^3	G^3		
Sales (retail,)			G^3		
Investment in manufacturing		G^3			
Export price		G^3			
Volume of exports		G^3			J^1
Exchange rate		G^3			
Leading indicators		G^3			
Availability of Housing loan	G^4				
GFCF (residential)	G^4				
Gross floor area of development commenced	G^T				
Hang Seng Index (stock market index)	N^{sw},				
Value of construction work	F	F	F		F

Note: TA= Tang et al. (1990), A=Akintoye and Skitmore (1994); G1 = Goh (1996); N = Notman et al (1998); G2 = Goh (1998); G3 = Goh (1999); G4 = Goh (2000); GT= Goh and Teo (2000); NSW = Ng et al (2008a); F =

Fan et al. (2010); NFW = Ng et al. (2011); FNW = Fan et al. (2011); J1 = Jiang and Liu (2011); K = Karamujic (2012); J2 = Jiang and Liu (2014)

4.5 Construction Output Forecasting Techniques

The complexity, need for accurate forecast and importance of construction output forecast has resulted in the use of several techniques. Based on the classification of forecasting techniques presented earlier, statistical model were the most used techniques in the selected papers, accounting for 79%. The present usage of other techniques: Structural time-series model, Artificial Neural Network and Hybrid models were 4%, 11% and 7% respectively (See Table 4). It is interesting to find that a large majority of the papers used statistical model. This is largely due to its simplicity in use and its ability to estimate the relationship amongst input variables used in the models.

Table 4. Forecasting techniques used in reviewed papers

Author(s) and year of publication	Forecasting techniques	Class of technique	Forecast horizon (in quarters)	Type of forecast
Tang et al. (1990)	MR	SM	40	Ex-ante
Akintoye and Skitmore (1994)	MR	SM	12	Ex-post
Goh (1996)	ANN	ANN	3	Ex-post
	MR	SM		
Notman et al. (1998)	ARIMA	SM	3 and 4	Ex-ante and Ex-post respectively
Goh (1998)	ANN	ANN	5	Ex-post
	ARIMA	SM		
	MLGR	SM		
Goh (1999)	MR	SM	5	Ex-post
	MLGR	SM		
	ARNLR	SM		
Goh (2000)	ANN	ANN	5	Ex-post
	GA-ANN	H		
Goh and Teo (2000)	ARIMA	SM	5	Ex-post
Ng et al. (2008a)	LRA	SM	12	Ex-post
	GA-LRA	H		
Fan et al. (2010)	ARIMA	SM	10	Ex-post
	MR	SM		
Ng et al. (2011)	VEC	SM	10	Ex-post
	MR	SM		
Fan et al. (2011);	VEC	SM	10	Ex-post
	MR	SM		
Jiang and Liu (2011)	VEC	SM	4	Ex-post
	VEC-D	SM		
Karamujic (2012)	Univariate structural time-series model	S	16	Ex-post
Jiang and Liu (2014)	P-VEC	SM	12	Ex-post
	P-OLS	SM		
	MR	SM		

Note: LRA = Linear Regression Analysis, GA-LRA = Hybrid Genetic Algorithms-Linear Regression Analysis

4.6 Accuracy Comparisons

Studies which compare the accuracy of forecasts of construction output generated by various techniques are presented in Table 5. The selected studies were those focused on out-of-sample forecast. The 10 studies presented in Table 6 presented 12 cases of forecast performance comparison. Statistical forecasting models proves to be the most accurate method in 66.7% of the 12 cases. It was observed that non-linear forecasting techniques tend to generate better out-of-sample forecast. Also, back propagation (BP) as the learning algorithm is the most popular choice amongst researchers using ANN for construction output- forecasting problem.

Table 5. Comparison of forecast accuracy

Paper code	Forecasting techniques	Training data (in quarters)	Dependent Variable	Training data (quarters)	Prediction period (quarters)	Level of accuracy (%)	Most accurate technique
G1	ANN	BP	Residential construction	71	3	MPE -0.56 - -1.41 MAPE 1.21 – 1.41	ANN
	ARIMA	-				MPE -6.99; MAPE 6.99	
G2	ANN	BP	Residential construction	72	5	MPE 0.38; MAPE 0.93	ANN
	ARIMA	-				MPE 0.62; MAPE 1.07	
	MLGR	-				MPE 0.58; MAPE 6.34	
G3	MLR	-	Residential construction	72	5	MPE -5.79; MAPE 9.48	MLGR
	MLGR	-				MPE 0.58; MAPE 6.34	
	ARNLR	-				MPE 7.43; MAPE 7.43	
	MLR	-	Industrial construction			MPE 20.67; MAPE 22.42	MLGR
	MLGR	-				MPE -13.32; MAPE 20.82	
	ARNLR	-				MPE 15.64; MAPE 29.66	
	MLR	-	Commercial construction			MPE -58.97; MAPE 58.97	ARNLR
	MLGR	-				MPE -18.79; MAPE -18.79	
	ARNLR	-				MPE 15.24; MAPE 17.33	
G4	ANN	BP	Residential construction	72	5	MPE 0.15 - 0.36; MAPE 0.87 - 0.93	GA-ANN
	GA-ANN	BP				MPE 6.42- 6.92; MAPE 6.42- 6.92	
N^{SW}	LRA	-	Private housing	48	12	IS 62.68; 127.56	GA-LRA
	GA-LRA	-		20		IS 34.69	
	GA-LRA	-		40		IS 31.90	
F	ARIMA	-	Residential construction	87	10	MAPE 4.3	ARIMA
	MR	-		85	12	MAPE 37.6	
F^{NW}	VEC	-	Overall construction	90	10	MAPE 2.33	VEC
	MR	-				MAPE 3.38	
N^{FW}	VEC	-	Private construction	90	10	MAPE 7.5	VEC
	MR	-				MAPE 8.1	
J^1	VEC	-	Overall construction	51	4	U 0.0262; MAPE 3.58	VEC-D
	VEC-D	-				U 0.0318; MAPE 6.00	
J^2	P-VEC	-	Regional construction	46	12	U 0.0177 - 0.0450; MAPE 2.89 - 5.43	P-VEC
	P-OLS	-				U 0.0304 - 0.1861; MAPE 7.31-11.43	
	MR	-				U 0.0533 - 0.3675; MAPE 9.95 – 20.05	

Note: mean percentage error (MPE); mean absolute percentage error (MAPE); Theil's inequality coefficient (U); Index Sum (IS)

4.7 Discussion and a look into the future of 'construction output forecasting'

Designing of construction output forecast model is a complex task. Variations in significant determinants, forecast horizon, forecasting techniques used, countries/region of study and accuracy assessment have been reported. Although, it was found that statistical models produce most accurate results; this might have occurred due to the over-reliance on such models. It was found that non-linear models (such as ANN, MLGR, etc.) tend to generate more accurate forecast. This was corroborated by the findings of Goh (1999). Marwala (2013) identified the limitation of statistical models to include: linear assumptions, static models, and problems in distinguishing between causality versus correlation. Thus, in order to develop models that can accurately predict construction output, due to its non-linear and complex characteristics. There is a need to further explore the use of non-linear techniques (such as statistical, artificial intelligence and hybrid models) in construction output forecasting research.

The selection of significant determinants (i.e. input variables) is a key issue that affects the success of any forecasting technique. The reliability and adequacy of construction statistics also affects construction output forecast studies. Most studies have used step-wise regression techniques in selecting significant variables for model development. Future studies should consider the use of correlation analysis, principal component analysis (PCA), and similar methods which could further improve performance of out-of-sample forecast.

5 Conclusion and Further Research

It is realized that the reliability and accuracy of construction output forecast can be an effective way to improving planning in the construction industry. The results present a general overview of the trends in construction output forecasting and key issues have been analysed.

In theory several techniques can be used for construction output forecasting; however, in practice just a few of these techniques have been used in empirical literature. The techniques used in construction output have evolved over the last 26 years; it is evident that there have been improvements in model building. One of the interesting findings with respect to statistical models shows that a single model cannot adequately generate forecast for all countries/region/market segment. Hence, it is evident that the construction industry is unique.

Four gaps were identified, namely lack of studies focusing on construction industry in Africa, North and South America; relatively low usage of artificial intelligence techniques despite its ability to adequately capture and forecast non-linearity and complexity associated with construction output data; overlooking of the repair and maintenance sub-sector of the construction industry; and over-reliance on the use of stepwise regression techniques in selecting variables used in model building. Future studies should be targeted at these identified gaps, which will further extend construction output forecasting practice and research.

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FORECASTING CONSTRUCTION DEMAND: A COMPARISON OF BOX-JENKINS AND SUPPORT VECTOR MACHINE MODEL

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Abstract
The construction industry provides infrastructure which are needed to drive the process of economic development. Despite its importance, the demand for construction industry's product tends to fluctuate with changes in the economic climate. These unforeseen events have negative impact on the productive capabilities of the construction sector. In order to formulate strategizes and policies to minimize the impact of such fluctuations, there is a need to developed predictive models that can reliably and accurately predict such unforeseen events. In the study reported here, two univariate modelling (support vector machine and Box Jenkins) techniques were used to predict demand in the Hong Kong Construction market. The results of predictive accuracy test suggest that the support vector machine (SVM) and the Box Jenkins are both satisfactory for forecasting construction demand. However, the SVM model achieves higher prediction accuracy than the Box Jenkins model. The findings validate the reliability of using artificial intelligence models in predicting construction demand. The findings and robust modelling techniques are valuable to both developed and developing countries when estimating future demand patterns of construction demand.

Keywords: Accuracy, Box–Jenkins model, Construction demand, Forecasting, Support vector machine

1 Introduction

Almost every publication in the field of construction economics have shown that the construction sector plays an important role in the economic development process of any country (see Low and Leong, 1992; Han and Ofori, 2001). The construction sector provides constructed space for economic activities, employment and utilizes goods and services of other sector of the economy during the production process. However, empirical evidence has shown that changes in the macro-economic environment causes fluctuations in the output of the construction industry (Goh 2005; Jiang et al. 2013). In addition, findings from Wong and Ng (2010) shows that Gross Domestic Product, Construction output and tender price are closely correlated. Therefore, the cyclic behaviour of tender price index linked to changes in the economy of Hong Kong (due to Asian Financial Crisis of 1997, Severe Acute Respiratory Syndrome of 2003, etc.) would result in the fluctuations in construction industry's output (hereafter referred to as construction output). Thus, in order to sustain the growth of the economy, constant monitoring of the construction industry is vital.

Cyclic construction output is a problem in both developed and developing countries. This cyclic behaviour creates fluctuations in construction output which has an adverse effect on the construction industry. Fluctuations in construction output leads to employee turnover, loss of

knowledge and experience gained in projects, bankruptcy of construction organisations and increased competition among contractors (Ofori et al. 1996; Lam and Oshodi 2015; Ren and Lin 1996; Soo ad Oo 2014). Also, unplanned expansion of the construction sector due to increase in government investments often fail to achieve intended outcomes. This is evident in the studies reported on Nigerian (Awotona, 1990) and Trinidad and Tobago (Lewis, 1984). Therefore, it has become increasing important to implement forward planning policies for the construction sector so as to sustain economic growth and avoid economic waste.

Accurate and reliable forecasting of future construction output is crucial to developing strategic long term plans for the construction sector. Goh (1998) asserts that insight into future volumes of construction output will assist stakeholders (such as property developers) to optimize profits. Similarly, governments can use forecast information to develop intervention policies meant to minimize the impact of changes in construction output. Australian government's stimulus plan after the global financial crisis is a good illustration of such government interventions (Jiang et al. 2013). It is evident that reliable forecast of future levels of construction output is crucial for all stakeholders. The aim of the study reported in this paper is to apply two univariate modelling (i.e. Box Jenkins and Support Vector Machine) techniques to forecast future volumes of construction output using Hong Kong as a representative case.

2 Literature Review

The importance of an accurate and reliable construction output forecast has been established in the preceding section. Despite its importance, construction output forecasting research has been limited when compared to studies such as construction cost forecasting. Limited number of studies can be linked to lack of statistical data on construction output, problems in the data collection process and lack of statistical data on other variables that influence construction output (K'Akumu, 2007; Wong and Ng, 2010). To address this problem, studies (such as Gruneberg and Folwell, 2013) have explored the possibility of using construction component of gross fixed capital formation (GFCF) as a proxy of construction output. It was found that construction output, GFCF and the construction component of GFCF are closely related. Though, there might still be a need for further research to validate this finding. The results of Gruneberg and Folwell's study is important to researchers in most developing countries, where data on construction output is largely unavailable. This is because statistical data on GDP and GFCF are reported in most cases to meet the requirements of donor and global funding agencies.

In construction output forecasting literature, there is an evident preference for quantitative modelling techniques. This can be attributed to accuracy and the ability to reproduce forecast generated from this technique when compared with qualitative approaches. Also, construction output forecasting is largely a time series problem (i.e. the relationship between variables in the past are used for future prediction of the dependent variable). Although multivariate models have shown good predictive capability when compared with univariate models (Goh 1996), this finding does not always hold. For instance, Fan et al. (2010) demonstrated that Box-Jenkins (univariate) model outperforms multiple regression (multivariate) model in predicting construction output of Hong Kong. Poor choice of selection of independent variables and the presence of auto-correlated errors have been attributed to inaccurate forecast from multivariate methods (Akintoye and Skitmore, 1994; Killingsworth, 1990). In addition, the application of multivariate modelling techniques is subject to availability of data on explanatory variables. Thus, it is imperative to identify univariate techniques that produce reliable and accurate forecast.

A wide variety of time series modelling techniques have been applied to construction output forecasting problems. Univariate modelling techniques can be grouped into two broad

categories: econometrics (statistical) and artificial modelling techniques. Econometric techniques such as Box-Jenkins was applied to construction demand forecasting for Singapore (Goh and Teo, 2000), Hong Kong (Fan et al., 2010) and the United Kingdom (Notman et al., 1998). Similarly, artificial intelligence modelling techniques have also been applied to construction demand forecasting problems in Singapore (Goh, 2000). Evidences shows that artificial intelligence models tend to produce more reliable and accurate forecast when compared with econometric models (Goh, 1996; Goh, 1998). This can be attributed to the capability of artificial intelligence models (e.g. artificial neural network) to capture nonlinear characteristics of construction demand data. There is little published data on application of support vector machine to construction output forecasting (see Fan et al., 2007). Therefore, this study sets out to apply SVM to predict construction output in the short and medium term. The result of this forecast is compared with those of Box-Jenkins approach which is considered a benchmark as suggested in Goh and Teo (2000).

3 Model Development

3.1 Construction Output

Construction output which measures the volume of construction works by executed main contractors within a defined time frame is collected from the Census and Statistics department of Hong Kong (CSD-HK). In Hong Kong, the construction output time series data is available from CSD-HK between 1983 and 2014 is presented in Figure 1. The cyclic behaviour (i.e. fluctuations) of construction output series appears to be related with changes in the economy and market conditions which shows the effect of the Asian financial crisis of 1997, SARS outbreak of 2003 and global financial crisis experience towards the end of 2008.

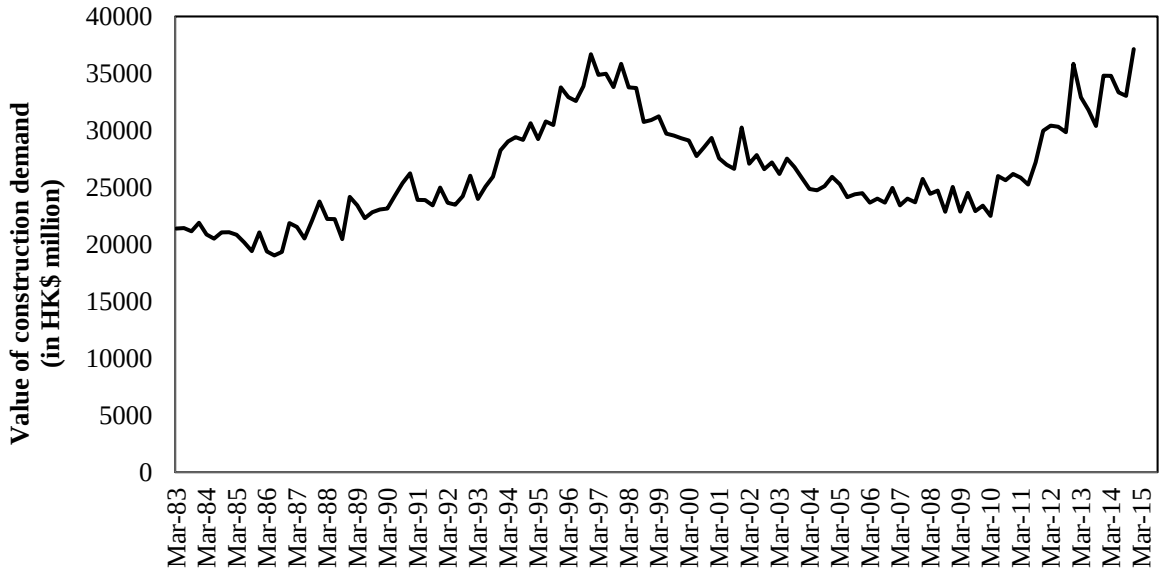

Figure 1. Value of construction demand (data from various years by Census and Statistics Department of Hong Kong)

3.2 Box Jenkins Modelling

Box Jenkins modelling technique is a combination of autoregressive (AR) and moving average (MA) model with differencing which was suggested by Box and Jenkins in 1976. This method is also often referred to as Autoregressive Integrated Moving Average (ARIMA) modelling approach. The process of applying Box Jenkins approach to time series forecasting is an iterative process which involves three major steps: identification, estimation and diagnostic checking, and application. The process is depicted in Appendix 1. The Box Jenkins model is

implemented using the 'Arima' code which is part of the forecast package in R programming (Hyndman et al., 2015). Also, the augmented Dickey-Fuller (ADF) and Box-Ljung (referred to as portmanteau) test used in this study are found in 'urca' and 'stats' package in R, respectively (Pfaff, 2013; R Core Team, 2015). For a detailed explanation on the procedure of fitting time series data to a Box Jenkins model (see Hyndman and Athanasopoulos, 2013).

3.3 Support Vector Machine (SVM)

SVM is an artificial intelligence modelling techniques that has a capability to capture nonlinear behaviour. The SVM algorithm was built based on theoretical foundations found in statistical learning (Vapnik, 1995). Subsequently, this method was later adopted in machine learning and statistics. In addition, SVM has been extensively applied to solving classification and regression problems (see Bin et al. 2006; Lam et al. 2009). This clearly shows that SVM model could be used as a tool for predicting construction output. This is based on the results that emanates from Goh's (1998) study. The detailed explanation and proofs of SVM can be found in Vapnik (1995) and Vapnik (1998).

The SVM creates a binary classifier, called hyperplane, which maps the input vectors into a high-dimension feature space. Subsequently, the regression problem is solved in the new space. The regression SVM can be represented in the following mathematical form:

$$y = f(x) + b \tag{1}$$

The main task is to identify a functional form (*f*) which can correctly predict new cases that has not been used to train the model (i.e. test set). The function is estimated by using the Sequential Minimum Optimization (SMO) of an error function (Vapnik, 1995). With the introduction of slack variables (equation 2), the coefficients can be estimated by minimizing the error function of the SVM:

$$\frac{1}{2} w^T w + C\sum_{i=1}^{N}(\xi_i) + C\sum_{i=1}^{N}(\xi_i^*) \tag{2}$$

Subject to:

$$w^T \phi(x_i) + b - y_i \le \varepsilon + \xi_i^*$$

$$y_i - w^T \phi(x_i) - b_i \le \varepsilon + \xi_i$$

$$\xi_i, \xi_i^* \ge 0, \mathrm{i} = 1,..., \mathrm{N}$$

By introducing Lagrangian multipliers which are solvable under Karush-Kuhn-Tucker conditions, the solution of constrained optimization problem is determined. Once the Lagrange multipliers are found, the functional form of the regression SVM model can be expressed as:

$$f(x) = \sum_{i=1}^{n}(\alpha_i - \alpha_i^*)K(x_i, x_j) + b \tag{3}$$

where, K (.) is the kernel function.

Although other types of kernel functions (e.g. polynomial) exist, the Radial Basis Function (RBF) is used in this study. This can be attributed to its performance and frequency of use in similar previous studies (Bin et al., 2006). In this study, the SVM model was implemented using the SVM with SMO algorithm (named "SMOreg") provided in WEKA (Waikato Environment for Knowledge Analysis) software (Hall et al., 2009). For a detailed explanation on implementing SVM in WEKA, we refer readers to Witten et al. (2011). The process of fitting a SVM model to time series data in this study entailed: dividing collected data into two sets (training and test), import data into the WEKA software, initialize the parameters of the

SVM model, and adjusting of the individual parameters of the SVM algorithm until the adequate parameters are identified.

4 Model Implementation

4.1 Box Jenkins model

Stationarity is critical to applying the Box Jenkins model to time series data, ACF and PACF plots presented in Figure 2 is used to check if the data is stationary. Figure 2 shows that the data in not stationary. The ACF plots gradually die down. Therefore, the first difference is computed and the ACF of the first differenced series is presented in Figure 3. Non-presence of the dying down pattern in the ACF plot suggests that the first differenced series is stationary. ADF test is applied to validate this hypothesis. The ADF shows that the first difference series can be fitted to Box Jenkins model. The parameters of the best fit Box Jenkins model is presented in Table 3-6, the best fit model is selected based on the lowest AICc values as suggested in Hyndman and Athanasopoulos (2013). Subsequently, the residuals of the tentative model are checked for serial correlation. The ACF (Figure 4) and portmanteau test confirms that the residuals are white noise. Absence of serial correlation in the residuals of the final Box Jenkins model indicates the model passed validation test. Thus, the fitted Box Jenkins model is considered adequate. The results of the fitted Box Jenkins model is presented in Table 1.The final form of models for construction outputs is:

Construction output:

$$y_t^{'} = \phi_1 y_{t-1}^{'} + \phi_2 y_{t-2}^{'} + \phi_3 y_{t-3}^{'} + \phi_4 y_{t-4}^{'} + \phi_5 y_{t-5}^{'} \quad (4)$$

where $y_t^{'}$ is $y_t - y_{t-1}$ (construction output variable first-difference); ϕ is the AR coefficient; and ℓ is the random error term (lagged errors).

The out-of-sample forecast generated with the final Box Jenkins model (2013 Q1 -2014Q4) are given in Table 2.

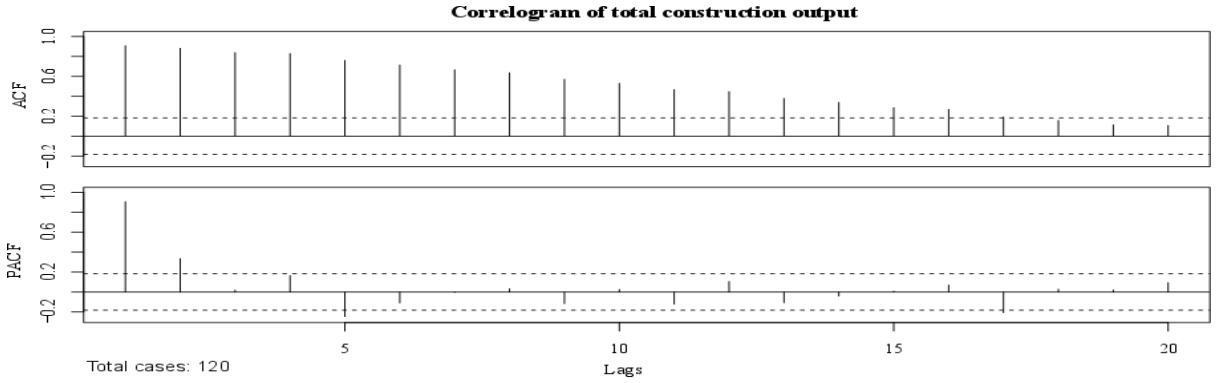

Figure 2. ACF and PACF of 'construction output'

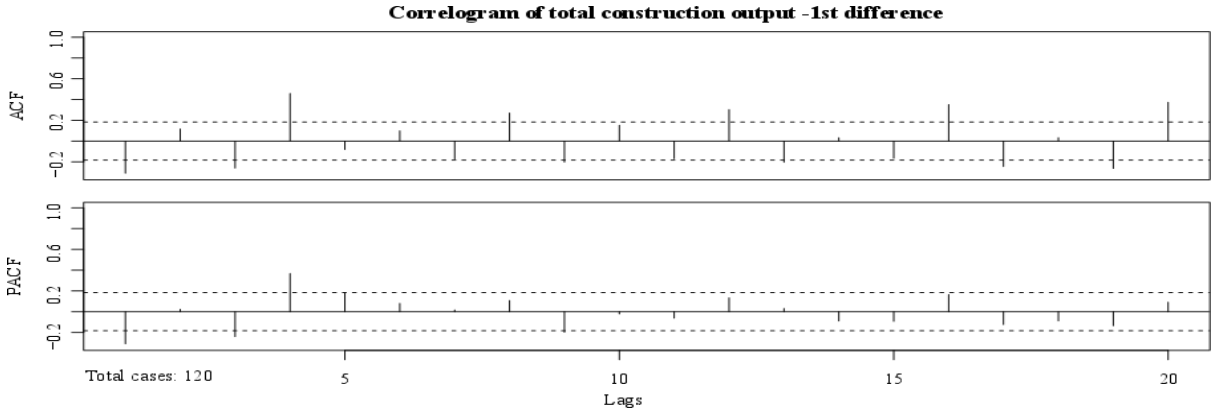

Figure 3. ACF and PACF of first differences of 'construction output'

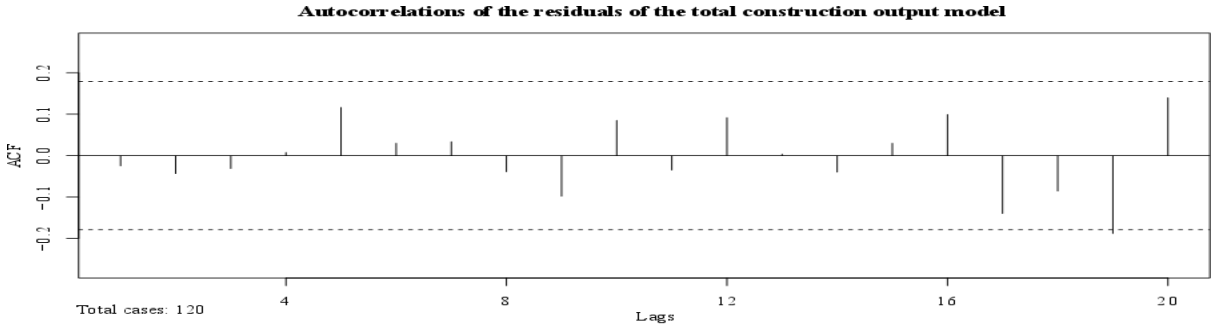

Figure 4. Autocorrelation of residuals of the fitted Box Jenkins (5,1,0) model

Table 1. Estimates of the parameter of the ARIMA (5,1,0) model for total constrution output

	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)
Coefficient	-0.2953	0.0003	-0.1205	0.4712	0.2324
Std. error	0.0953	0.0899	0.0889	0.0900	0.0957

4.2 SVM

The parameters of the SVM algorithm used in training the model affects it performance. Although, grid search of the parameter space could give better results, the parameters were manually tuned. This is similar to the approach used in Bell et al. (2012). The optimal parameters used in the SVM model are (C,γ, learning algorithm) = (32, 0.01, RegSMOImproved). The final SVM model is fitted to the data series to produce out of sample forecast (2013 Q1 -2014Q4) which served as a basis for evaluating the accuracy of forecast (Table 3).

4.3 Predictive Accuracy of Forecasting Models

Out-of-sample test is performed to evaluate the predictive reliability of the developed models SVM and conventional forecasting model (i.e. Box Jenkins), low variance between actual and predicted construction output (in the test data set) signifies better forecasting performance is achieved. In construction output forecasting studies, results of MAPE test that are lower than 10% are considered acceptable. In addition, Theil's inequality U coefficient value closeness to zero signifies better prediction results is achieved (see Goh and Teo, 2000; Jiang and Liu, 2011 for more detailed explanation and equations).

The actual values and out-of-sample forecast value generated from the Box Jenkins and the SVM model are presented in Table 2 and 3, respectively. Three relative measures of accuracy (PE, MAPE and U coefficient) were used to evaluate the predictive accuracy of the developed

construction output models (Table 4). For both models, the values of MAPE test are less than 10% absolute error and the coefficients U are all close to 0. This indicates that the forecast generated by the models can be considered as satisfactory. In addition, the forecast generated by the SVM model achieved lower MAPE and U values show that the SVM model outperforms the conventional Box-Jenkins approach. Furthermore, the results of the evaluation of predictive accuracy test suggest that the SVM gives a more reliable and accurate forecast of construction demand.

Table 2. Out-of-sample forecast generated by the Box Jenkins model

Period	Actual	Forecast	Error
2013, Q1	32900	34935.04	-2035.04
2013, Q2	31788	35318.22	-3530.22
2013, Q3	30384	34230.43	-3846.43
2013, Q4	34796	37378.05	-2582.05
2014, Q1	34785	37371.05	-2586.05
2014, Q2	33337	37475.28	-4138.28
2014, Q3	33031	36641.74	-3610.74
2014, Q4	37132	38119.21	-987.21

Table 3. Out-of-sample forecast generated by the SVM model

Period	Actual	Forecast	Error
2013, Q1	32900	33910.8	-1010.8041
2013, Q2	31788	34178.24	-2390.2443
2013, Q3	30384	33895.57	-3511.5739
2013, Q4	34796	34831.98	-35.9831
2014, Q1	34785	33835.98	949.0157
2014, Q2	33337	33700.58	-363.5812
2014, Q3	33031	33245.3	-214.3005
2014, Q4	37132	32884.02	4247.9842

Table 4. Summarized results of evaluating predictive accuracy

Period	Box Jenkins Model	SVM model
PE for 2013, Q1	-6.19	-3.07
PE for 2013, Q2	-11.11	-7.52
PE for 2013, Q3	-12.66	-11.56
PE for 2013, Q4	-7.42	-0.10
PE for 2014, Q1	-7.43	2.73
PE for 2014, Q2	-12.41	-1.09
PE for 2014, Q3	-10.93	-0.65
PE for 2014, Q4	-2.66	11.44
MAPE	8.85	4.77
U	0.0440	0.0324

5 Discussion, Conclusion and Further Research

Construction demand forecasting is vital to the development of strategic future plans for the construction sector. Previous studies have demonstrated that the Box Jenkins model can be used to predict demand, productivity and prices in the construction market (Goh and Teo, 2000; Fan et al., 2010). However, it has been found that construction demand exhibit nonlinear characteristics. This suggests nonlinear models (such as SVM) possess the capacity to generate reliable and accurate predictions of construction demand. The main purpose of the current study is to compare two univariate modelling techniques (Box Jenkins and SVM), in order to identify and assess the predictive capability of both approaches. The out-of-sample forecast

generated between first quarter of 2013 and fourth quarter of 2014 served as a basis for evaluating the predictive performance of these two models.

The high predictive accuracy achieved by the SVM model when compared with Box Jenkins model (Box Jenkins model is considered as a benchmark for univariate model as suggested in Goh and Teo, 2000). This indicates that the SVM model can reliably and accurately forecast construction demand in Hong Kong. In addition, the finding indicates that artificial intelligence models (SVM) tend to outperform linear models. These results are in agreement with those obtained by Goh in 1998. Though previous studies (such as Goh and Teo, 2000) suggest that Box Jenkins model might not be suitable for medium and long-term forecast, one unanticipated finding was that the Box Jenkins model could generate satisfactory forecast for 8-quarters ahead. A possible explanation for this might be the relative stability of the construction demand data series in the forecast period. In general, therefore, it seems that artificial intelligence models (such as SVM) can be applied to construction demand forecasting problems under different circumstances.

The major limitation to this study is the absence of other explanatory variables in the developed models. Despite this limitation, the intended objective of the study was achieved. It is worth nothing that the univariate modelling techniques applied in the current study could be useful in cases of limited data which affects the possibility of developing large multivariate models. The findings from this study enhance the knowledge on the applicability of univariate modelling techniques to construction demand forecasting problems. Overall, the SVM model developed in this study can be used as a tool for predicting future volume of construction demand. Reliable forecast of construction demand is vital for developing and implementing strategies to minimize the adverse impact of fluctuating demand.

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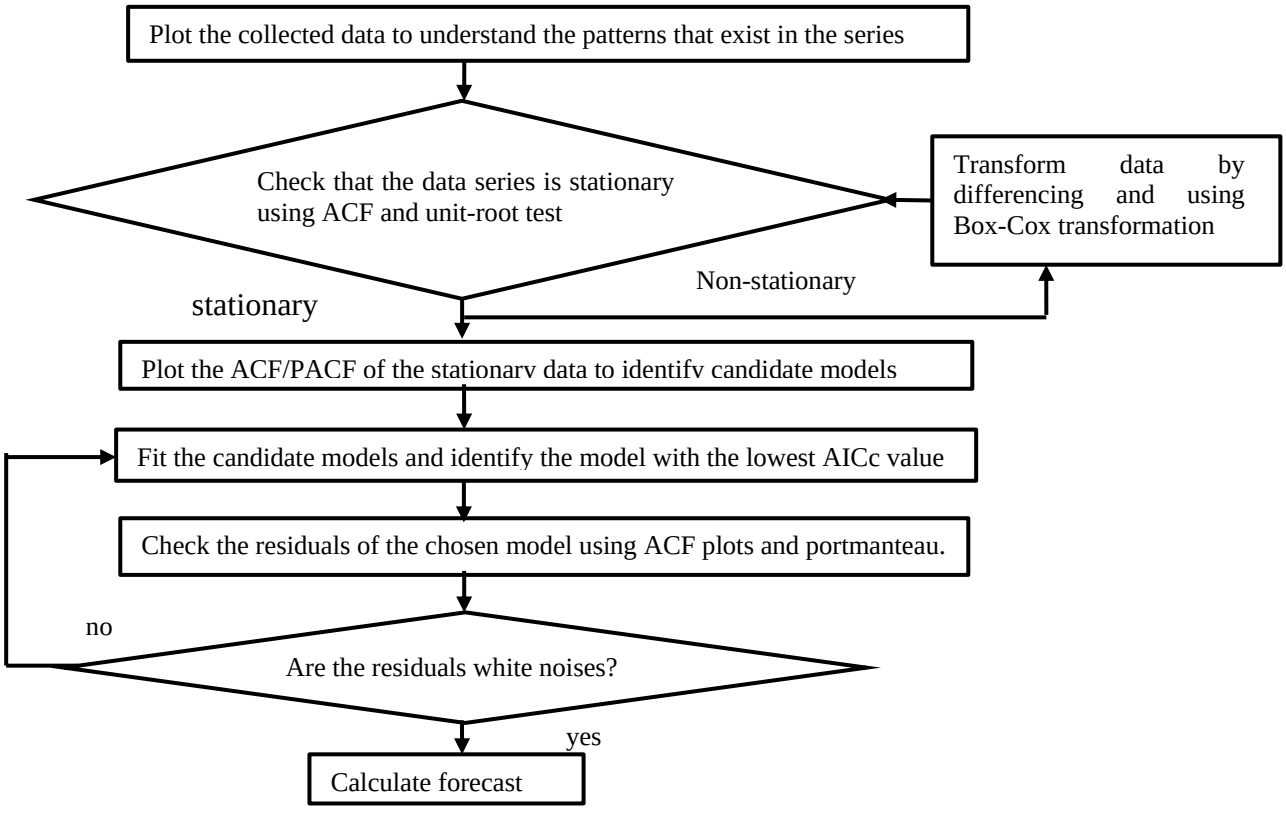
Appendix 1 Process of fitting a Box-Jenkins model (Adapted from Hyndman and Athanasopoulos, 2013)



MODELING THE RELATIONSHIP BETWEEN THE INITIAL TENDER SUM, DURATION AND FINAL CONSTRUCTION COST OF BUILDING PROJECTS IN NIGERIA: A PROPOSED STUDY

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Abstract
Cost and time overruns have instituted a high level of discredit and stigmatization on the construction industry professionals. This is an issue that should task built environment practitioners. While accepting the challenges of project overruns as emerging negative trend in construction industries, the aim here is to propose solutions to the problems by investigating the variability, with a view of relating all the variables together in a single equation. The derived relationship is intended for use in constructing final cost predictive models or charts for building constructions. The objectives include; studying 420 completed buildings and extracting the variables, plotting graphs of costs against times, to establish a relationship. In addition, 1050 project officers shall be interviewed across Nigeria's six geo-political zones and Abuja the federal capital territory to source for other data to complement those from files. Artificial Neural Network system shall be used for analysis leading to the models/charts design. The derived models/charts would serve as formulae/graphs for predicting future cost of building projects. The research outcome shall be a solution to the growing negative trend of wide variability between the targeted and those achieved. The models/charts shall be tools for construction planning and cash flow projections. This invariably shall be instruments for reducing building project abandonments which major reason has been sudden upsurge in construction funds requirement.

Keywords: Cost, Modeling, Predictive, Relationship, Variability

1 Introduction

Tender sum is the estimated cost of building project at the conclusion of tender meetings and award. In all systems of contract, the as-built cost (final cost) is always determined at completion stage (Hammad *et al.*, 2008). The only exception is fixed or firm price contract for which the initial tender sums cannot be altered; i.e., the final construction cost remain same althrough the project stages. Construction cost overrun is a major problem faced by the industry globally and it needs serious attention to alleviate (Rahman *et al.*, 2013). Otunola (2008) and Rowland (1981) in Vidalis and Najafi (2002) explain cost and time overruns as the excess amount of money/time over the original contract sum/time. They negate the projected budgets, and account for numerous abandoned projects that litter parts of the world (Hachney, 1997 in Otunola, 2008: and Amusan *et al.*, 2013b). Variables like material price inflation, work additions and subtractions, changes in policy and fiscal measures, corruption (kickbacks), etc. usually come to play during project execution. Otunola (2008) grouped these variables into ten

and ranked them in order of severity in Nigeria construction industry, inflation ranked highest while underpricing the bills of quantities is least. Rahman *et al.,* (2013) ranked contractor's poor site management highest among the factors in Malaysia. Ugulu & Ikwuogu (2011) affirmed that as the project takes longer to complete, effects of fluctuation are more pronounced especially in an unpredictable and inflationary economy like Nigeria's. They also affirmed that bigger and more complex building projects attract more variations. Managing these variables so as not to have wide deviations from the planned, becomes a major activity of the contractual parties. Inability to manage the project to equate tender sum with final cost voids a major objective of cost control. Since changes in the initial and final figures are not limited to one project, or to one nation, relationship seems to exist between the variables which are: final cost of construction, extensions, resources' price galloping, work changes, daywork, provisional and prime cost sums inadequacies, corruption; etc.

1.1 The Research Gap

Gonzalex (2007) investigated the possibility of using fuzzy mathematical models for construction project scheduling; the results are relevant practically to the construction industry. Analysis of Amusan *et al.,* (2013b) presents preliminary validation of prospect of obtaining a model that would predict building construction cost with minimum error, this also demonstrates the applicability of neural network in forecasting the cost of building work. The NIOB (2002) attributed among others the causes of time and cost overruns in Nigeria to the consequence of not engaging the services of professional builders at the design stages or not early enough even when engaged. The professional institution advocates the engagement of Builders who use Building Production Management Document (Construction Methodology Statement/Construction Plan) to nip in the bud the current trend of time and cost variability. NIOB (2002) document went further to stress that construction programmes hitherto used on Nigerian sites are either too long or short for the projects. This is also the view of Aiyetan *et al* (2012) in South African construction industry, the authors described the targeted completion times as always inaccurate. The conclusion of the NIOB is that they are inaccurate because they are not always prepared by professional builders. Could it be said, all over the world, that construction programmes are prepared by quacks, since the Institute says non-professional builders who prepare programmes are into quackery? Solutions hitherto proffered for solving the variability issue and cost control had not provided cost predictive formulae or charts for construction project as envisaged in this work. The gap of unavailable mathematical formulae or charts for cost prediction at commencement stage is yet to be filled in the building construction industry i.e., cost variability seems **not** to have been reasonably dealt with from several research findings across the globe such as (Azis, *et al.* 2013; Bamile, 2004; Edwards, 2009; Gandu, 2014; Idoro, 2012 and Odeyinka, *et al.* 2012). A number of scholars had worked on issues of time and cost overruns including Odediran and Windapo (2014), the focuses were on the causes. Moreover, time and cost variability are studied separately. This work intends to fill this gap in the construction industries particularly in Nigeria.

1.2 Aim and Objectives

The research seeks to assess the relationship between the tender sum, initial contract duration, extensions and final construction duration/cost of building projects in Nigeria with a specific objective of generating final cost predictive models or charts. The objectives therefore shall be to;

- **(i)** Investigate the average percentage time and cost variability for building projects.
- **(ii)** Survey a sample of completed building projects and extract the contract durations, tender, additional costs/times in course of construction and final construction time and

cost, plot graphs of the cost against duration and hence, the angles of inclination to the horizontals.

(iii) Establish the mean of all the angles of inclination to the horizontals (α), test for any relationship between the variables by the use of regression analysis.

(iv) Build final cost predictive model(s) or chart(s) from the relationship.

(v) Test the models for reliability.

1.3 The Research Questions

Questions to be answered in this work are:

(i) What is currently the average percentage time and cost variability for building projects in Nigeria? Analysis of variance (ANOVA) is most suitable among the available statistical tools for answering this question.

(ii) What is the relationship between the tender sum, the intervening variables of time and cost; with respect to final construction duration and cost of building projects i.e. is there a trend? This can be answered with the use of Regression Analysis.

(iii) What mathematical formulae (models)could be developed from the trend for use in predicting final construction cost of projects with respect to the initial tender sum, the intervening costs and time extensions, project initial completion target date and final durations? Artificial Neural Network (ANN) is a most suitable tool for exploring the possibility.

(iv) What charts could be developed from the trend that would serve as tools for predicting final cost of building projects from the tender sums and other variables? Artificial Neural Network (ANN) is also most suitable tool for exploring the possibility.

According to Morenikeji (2006) model specification as a process of identifying and operationalising suspected variables that best explain the phenomenon being modeled. Keeling and Rohani (2008) numerous scientific computer packages permit quite sophisticated modeling, such as Mathematica, Maple R, MathCAD, and Matlab. Given (t tan α) as the *mean* from a number (n) of past projects a relationship is therefore established (see equation 5), cost predictive model which this research is proposing could be derived by operating on equation 6.

$$FCC_{tn} = ICS_{t0} + \sum(ADC_{t1} + ADC_{t2} + ADC_{t3}) \quad \text{e q (1)}$$

Where; FCC_{tn} = final construction cost at time t_n.

ICS_{t0} = initial tender sum.

$\sum(ADC_{t1} + ADC_{t2} + ADC_{t3})$ = additional costs arising at project execution stage at differing points of time……e q (2)

Similarly;

$$FCD_{tn} = ICD_{t0} + \sum(ADT_{t1} + ADT_{t2} + ADT_{t3}) \quad \text{.....e q (3)}$$

Where; FCD_{tn} = final construction duration at time t_n

ICD_{t0} = initial construction duration set at award stage

$\sum(ADT_{t1} + ADT_{t2} + ADT_{t3})$ = secured construction time extensions on work items…e q (4)

Combined variables (additional works and time extensions) that influence the initial tender sum.

$$\left.\sum (ADC_{t1} + ADC_{t2} + ADC_{t3})\right\} = t \tan \alpha \quad \text{.....e q (5)}$$

$\sum (ADT_{t1} + ADT_{t2} + ADT_{t3})$

Equation (5) establishes the value of all variables that shoot tender sums to a certain final cost.

The **desired model** tentatively put **as equation 6** can be operated upon mathematically for standardizations; $FCC_{tn} = ICS_{t0} + ICD_{t0} + t \tan \alpha$ …….....e q (6)

Analysis of field data hopefully shall focus on the predictive model.

1.4 The Research Hypotheses

Null $\mathbf{H_o}$ – There is no relationship between the initial tender sum, targeted duration, extensions and final construction cost of building projects.

Alternate $\mathbf{H_1}$ – There is a relationship between the initial tender sum, targeted duration, extensions and final construction cost of building projects.

1.5 Need for the Research

Actual or final project costs need not be too wide in deviations from the planned and uncertain to clients and project consultants, otherwise projects get revised when resources needed to complete them overshoot the budget. Moreover the result could be abandonment, where were no provisions for supplementary. In the case of capital projects, which costs at inception, are most likely to change with work progress, and because forces beyond the control of the contractual parties definitely come to play, formulae/models are needed as a guide (indicator) to what the initial cost will change to, with respect to time. This is vital for healthy, effective and efficient budgeting for an agency like the Nigeria Budget Monitoring and Price Intelligence Unit (BMPIU) now Bureau of Public Procurement (BPP). One of the policy objectives of BPP is funding the projects that were duly certified in annual appropriations by the National Assembly (State House, 2005). This implies that estimates for goods and services are pegged at periods prior to tendering and contract award stages. If the policy must be sustained, and if projects are to be completed within budgets (a major project success criteria), the use of a predictive tool like that envisaged from this study shall be relevant to BPP, other corporate clients and even private individuals in capital project financial planning.

2 Project Success Criteria

The achievement of the targeted cost, time and quality in a construction project has remained the success rating tools among construction professionals and clients, Atkinson (1999) label these criteria as the “iron triangle”. Baccarini and Collins (1999) notes that the traditional project management success criteria still hold strong within the project management community in Australia. According to Duggal (2015) project managers are expected to manage the triple constraints and often compelled to live in this triangle of time, cost and quality. Although it is a way to track and monitor projects, many scholars like Atkinson (1999) now view the triple criteria as not sufficient, insisting that there is more to project success than meeting time, cost and quality. According to Atkinson (1999) other success criteria include; the information system, organizational benefits and stakeholder community benefits. Together with the iron triangle they are tagged the “square route”. Notwithstanding, the iron triangle seems to continue to be the preferred success criteria.

2.1 Construction Project Cost Analysis and Control Procedure

Seeley (1976) define cost analysis (cost to the client), as the systematic breakdown of the cost according to the sources from which they arise. This means the tender sum of a project can be broken into elemental costs. Cost control, embarked upon at execution stage aims at ensuring that resources are used to the best advantage. Cost analysis is the basis of cost control.

Cost control process ideally is continued from tender stage through to the construction period by the Quantity Surveyor to ensure that the cost of the building is kept within the agreed cost limit. When work on site commenced, cost analysis is used for controlling variation. Priced bills of quantities, schedules of basic, insurances and other relevant documents are scrutinized, suitable arrangements for dealing with daywork vouchers and claims for increased costs are agreed with the contractor. Accurate record of drawings is maintained with revisions noted and costed, variation orders costed and filed. On site visits for measurements and interim valuations, matters such as labour strength, plant in use, weather conditions and causes of delay, which may subsequently have a bearing on claims, are noted. Throughout the contract period the Quantity Surveyor maintains effective cost control arrangements to keep a constant check on the costs and supplies advice to the project Architect for action to be taken without adverse effects on the project cost.

The foregoing professional duty of the Quantity Surveyor at controlling building construction cost notwithstanding, construction project still terminate at figures above the target. In most cases, plans are hardly made for such uncertain extra fund to complete the project. What industrial damages this inflicts, together with the solution is the concern of this study. Hitherto, researchers are yet to proffer quantitative mechanism(s) for relating the terminal cost to that in the bills of quantities at pre-contract stage. The results of this study hopefully shall be relevant to Quantity Surveyors and Clients for predicting the final construction cost at for use in cash flow planning.

2.2 Combine Effects of Time and Cost Overruns on Final Construction Cost

Hasan *et al.* (2014) submit that cost and time overruns are two most frequent effects of project delay. Completion time the authors posit is very essential in construction; because "time is money". To the contractor, delay causes higher overhead costs because of longer construction period, material costs may increase due to inflation. To the client especially the investor, delay means losing profits. Delays translate always into expenses for the period lost, while materials may not be lost in the period of work hold-ups except when stolen. Delays are funded and this adds to the initially set contract sum. Where additional jobs were duly approved for executions, automatically extra times are required for the extra works. Effects of cost of variated works and delays are interwoven, they both cause increase to the construction cost, or a decrease which in most cases is rear. Studies on time and cost overruns conducted separately would not have much practical relevance to the industry, as it is currently.

2.3 Cost of Delivery Public Infrastructures in Nigeria

Nnorom (1998) discovered cost differences in completed building projects in the study of the effects of variations on project final costs. One of the most highlighted of the findings is that, in the Nigerian Construction Industry, almost all projects are being completed at sums much higher than their initial contract sums. For instance, the Amenity Hospital Kaduna originally awarded at ₦1.25 Million had a projected final account of ₦2.00 Million, an increase of about 63%. Also, the Specialist hospital in Minna, Niger State originally awarded at initial contract sum of ₦17 Million was rewarded to the same contractor at ₦40.50 Million, an increase of 138%. Furthermore, the Presidential Lodge Abuja originally awarded at about ₦20 Million was revised to ₦35 Million, an increase of 75%. More so in Zaria, the contract for the new office complex for the Nigeria Institute of Transport and Technology (NITT) was awarded at a cost of ₦14.50 Million in 1983. However it was reviewed to a cost of ₦31 Million in 1986 and again to ₦100 Million in 1989. Giwa (1988) in Nnorom (1998) noted an overall increase on initial contract sum of 36.02% on ninety (90) completed projects. Analysis of the various final account statements of some of these projects attributed the increases to: fluctuation

10.20%, variation 8.43%, PC sums 5.98%, re-measurement 0.50%, provisional sums 1.37% and others 2.28 % (Nnorom, 1998, p. 2).

3 Research Methodology

Primary data shall be collected through the examination of files of completed projects in the offices of registered Quantity Surveyors across Nigeria's six geo-political zones together with the federal capital territory, Abuja. Corporate and organized private sector clients shall also be visited for collection of data pertaining to the variables. Cluster sampling is a technique suitable for surveys involving natural groupings in a statistical population. The advantage of cluster sampling method is economizing on traveling expense for data sourcing for researches involving geographical area. Six (6) state capitals shall be visited in each of the six (6) geo-political zones and Abuja to study ten (10) projects files in each state. This means sixty (60) completed projects per zone making a total number of 420 completed projects. Also 1050 respondents across the zones i.e. 150 in each geo-political zone including Abuja shall be interviewed to source data that will not be possible to extract from project files. Designed templates for recording data shall be used for the files studies. Interview guide designed with considerations for confidentiality of data involved shall be used, so as not to scare respondents from giving full supports in the provision of relevant data. Space for sourcing the biographical data of respondents shall be created on the guide to enhance the assessment of respondents' professional background, experience and reliability of the data sourced. The interviews with project officers shall focus on sourcing data on type and number of professionals that were involved in the design as well as the contract documents (production information) used in executing the projects. Collected data shall be presented in Tables, Figures and Charts with respect to the research aim and objectives.

3.1 Analysis of Variance (ANOVA) and Artificial Neural Network (Expert System)

According to Agbola *et al.* (2013) and Kirk (2008) the method for testing the difference among k *means (n)* where k>2, is Analysis of Variance (ANOVA). This technique shall be used for testing the hypothesis that the *means (n)* for time and cost overruns of the seven zones are equal at 5% confidence level. If differences exist among the *means (n)*, ANOVA also shows the zone and the zonal difference.

Series of modeling framework had been adopted in the past which are regression based (Amusan, *et al.* 2013a). Efforts in research Amusan *et al. (*2013a) maintained are now directed towards validating the applicability of the developed models. Mawdesley *et al.* (1999) and Asworth (1994) in Amusan *et al.* (2013a) present approaches in modeling; elemental, regression, heuristics and expert system (artificial neural network). Molenaar *et al.* (2000) in Rahman *et al.* (2013) regard Structural Equation Modeling (SEM) as an extension of standardized regression modeling used in dealing with poorly measured independent variables and is ideally suited for many research issues in the field of construction engineering and management. Yang and Ou (2008) and Ng *et al.* (2010) in Rahman *et al.* (2013) state that the SEM method is suitable for exploring relationships among key variables and is highly applicable for resolving the complicated problems in the construction domain as the functionality of SEM is better than other multivariate techniques including multiple regression path and factor analysis. In the context of engineering and management SEM is still new (Henseler *et al.* in Rahman *et al.,* 2013). Therefore this study will not explore further the use of PLS-SEM in data analysis because of its relative newness to construction and engineering fields, the advantages notwithstanding. Regression based models are also found to be limited in application as a result of non-flexibility and margin of error between input and output. The system also relies on historic cost and has its short comings which include; inability to capture

intervening variables that impact project, such as price change, inflation change among others (Moore *et al.,* 1999 in Amusan, *et al.,* 2013a).

Paradigm need to be shifted in the direction of conventional method that complements the regression method's shortcomings as cased base reasoning and expert system. Expert system are patterned after the neural biological neurons with the ability to map input to output and deduct a meaningful inference, it possess capability of studying data trend even if the series is inconsistent. Once the pattern is mastered, the network can generalize the trend to predict a consistent series having mastered the previous trend. Expert system's attributes include; capacity to accommodate large data input, consistent output, output and input mapping, low variation error between input and output. Expert-based system generates less error between input and expected output, it tends to have variation error within the range of 2% to 4% while regression model often have variation error greater than 7%, (David and Seer 2004; Dissanayaka and Kumaraswamy 2007 and Moore *et al.,* 1999 in Amusan *et al.,* 2013a). A robust expert-based model (ANN) incorporates economic and environmental parameters capable of generating accurate project cost. According to Aigbomian and Momoh (1996); Egbule and Okobia (1998) in Idogho (2001) research is act of consciously organizing oneself to solve a given problem with the specific aim of improving on the existing standard, for greater comfort and convenience resulting in contribution to knowledge. Halmatadlefs (1970) in Iredia (2003) defined research as an activity of solving problems which leads to new knowledge using methods of inquiry which are currently accepted as adequate by scholars in the field. The weakness of correlation/regression analysis to capture intervening variables such as, works delay due to inclement weather, daywork, material and labour price rise which are peculiar to construction activities coupled with these definitions of research, shift the anticipated analytical technique to ANN. The relationship between the variables shall therefore be investigated with regression analysis and expert-based system (Artificial Neural Network ANN) explored for predictive cost model construction.

4 Expected Research Findings and Usefulness

The study results are expected to address the following issues:

- **(i)** Establish the percentage deviations between targeted project construction duration and actual contract duration.
- **(ii)** Establish the percentage deviations between targeted project construction cost and final completion cost.
- **(iii)** Establish the relationship between the project variables; initial contract sum, duration, extended times, additional costs, final construction completion time and cost.
- **(iv)** Build final cost predictive models/charts upon the relationship in (iii).

The anticipated results are going to be disseminated widely through seminars, conferences, workshops, technical journals, internet etc.

4.1 Discussion of Related and Earlier Studies

Azis *et al.* (2013) investigated the contributors to cost overrun and proposed fifteen (15) mitigating measures classified into pro-active strategy, organizational and fluid. Idoro (2012) concludes that the level of use of project plans can be a strategy for reducing the high time and cost overruns recorded in design-build projects given room for stakeholders to increase the level of use of project plans in design-build projects. The study suggested that stakeholders should ensure that the required project plans are prepared when projects are procured through design-build system. Bamisile (2004) argued that it is the construction methodology that determines the programme of works, and hence the duration. The construction methodology dictates the details of project quality management plan, which is used to achieve the specified

quality standards from effective site management. Odeyinka *et al.* (2012) presents a different perspective for investigating the solutions to cost overrun. The study modeled the impacts of risks on the variability between contract sum and final account. The focus was on creating awareness on issues capable of raising the signed contract price in the construction stage. An artificial neural network (ANN) for predicting project final cost was recommended. Edwards (2009) in proffering solutions to the negative impacts of cost overrun in United States of America recommended a fundamental reform which is, to terminate and privatize as many federal activities as possible, and move funding for state activities, such as highways, back to the states. That way, federal policymakers could focus on ensuring that the few needed areas of federal spending, such as defense, are carried out as efficiently as possible". This seems a management and executive strategy for dealing with the issue of cost overrun. Gandu (2014) proposed a mathematical proactive cost management model for building projects in Nigeria. The model seems **not** to have considered all the variables that influence cost growth. While project durations seem to address material and labour price galloping others, like contractor's managerial powers, gratifications etc. are part of the variables upon which the mathematical model should have been built. Aiyetan *et al.* (2012) investigated the relationship between initial and final contract time with the aim of developing an equation for reasonably estimating project completion period and derived the following: $Y = 13.1159 + 1.1341X$, where Y is final construction time and X targeted contract duration set at tender stage. That study only focused on contract duration.

5 Conclusion

This paper addresses the conference sub-theme "Emerging trends in construction project delivery" and specifically, trends in international construction issue of cost variability. It is a preliminary part of an ongoing Ph.D. thesis in the department of Construction Economics & Management, Faculty of Engineering and Built Environment, University of Cape Town. Models/Charts derived from this study shall serve as solutions to the current trend of cost variability particularly in the Nigeria construction industry. The findings shall also serve as tools for future project planning to enhance smooth cash flow projections. Project abandonments, which major cause is sudden upsurge in fund requirements, leading to loss of investment interest, shall be reduced when the expected models/charts become operational.

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THEORIZING SPECULATIVE LOW-INCOME HOUSING DEVELOPMENT IN DEVELOPING COUNTRIES

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Abstract
The housing of low-income groups is a global challenge that many developing countries' governments are grappling with. Most empirical studies aimed at addressing this challenge however appear to lack an explicit theoretical grounding, making their generalizability to different contexts to be problematic. This paper reviews the theoretical frameworks that can be applied in housing research and assesses how these theories may be applied in the study of speculative low–income housing development in the context of developing countries. Property development theories can be categorized into three broad categories: neo-classical, neo-Marxist and structuralist theories. Findings from a critique of each of these broad categories of theories show that structuralist theories are more appropriate in the study of speculative low-income housing development. The study concludes that appropriate policy recommendations that can be of use in stimulating private sector engagement in low income housing have to be tailor-made to suit different types of developers and have to be anchored on an understanding of developer strategies in response to risks posed by the target groups, the macroeconomic environment, and institutional constraints and enablers. The State, through policy, can stimulate more speculative developers to produce tailor-made products suited to the target group, which will contribute towards reducing the housing challenge.

Keywords: Developing countries, Low-income housing, Policy, Private sector, Theory

1 Introduction: Problem of Low Income Housing Development

The low-income target group is typically characterised by low, unstable and/or undocumented incomes, no credit history and lack of collateral (Lea, 2005; Loxley, 2013; Moss, 2001; Stein and Castillo, 2005). These characteristics imply that mortgage funding for housing is ordinarily not an option, and there is need for government assistance in housing the low-income target group. These characteristics coupled with housing being a basic need result in housing provision for this group ordinarily falling under the ambit of the state (Mosha, 2013; Moss, 2003; Özdemir, 2011; Wang, Shao, Murie, and Cheng, 2012).

However, in most developing countries, scholarly evidence points to public sector efforts in the provision of housing falling short compared to the overall demand for housing that is exerted on the market by the low income group (Moss, 2003; Özdemir, 2011; Sivam and Karuppannan, 2002). The major reason accounting for state failure in the provision of low-income housing in most developing countries is huge fiscal constraints and large budgets that are not sustainable (Babatunde, Opawole and Akinsiku, 2012; Lea, 2005; Loxley, 2013). Other reasons include but are not limited to: rapid population growth, increased urbanization, displacement of people by natural disasters and conflict and limited technical resources (Abdul-

Aziz and Kassim, 2011; Babatunde et al., 2012; Loxley, 2013). As a consequence of these state challenges, the housing backlog in most developing countries has been ballooning every year, prompting researchers to look for alternative solutions to the housing challenge for the low income group.

One way to ameliorate the state challenges is to tap into private sources of capital through engaging the private sector in the provision of low income housing. The private sector is also deemed to possess a better skill-set, which enables it to complete housing development projects ahead of schedule due to different work values, tenacity in resolving challenges and advanced project risk management structures, which is good for low-income housing delivery (Loxley, 2013). But, if private capital is to be mobilized for low-income housing development it is imperative that the investor considers sources of revenue inflow, an exit strategy for capital recovery and profitability to make the investment justifiable (Demirag, Khadaroo, Stapleton, and Stevenson, 2011; Rust, 2007; Stein and Castillo, 2005). This exit strategy is hampered by a number of challenges that are present mainly due to the characteristics of the target market and by the fact that low-income housing is a politically sensitive issue that the state and other players feel they can easily manipulate for their gain (Cowan and McDermont, 2008; Lea, 2005; Özdemir, 2011; Samaratunga and O'Hare, 2014). As a consequence of this political risk, most low-income housing projects suffer from policy unpredictability (Altmann, 2011) and are also inflexible in terms of housing design as state stakeholders sometimes unnecessarily insist on unreasonably high standards that are not backed by the payment capabilities of the low income sector (Abdul-Aziz and Kassim, 2011; Mosha, 2013; Moyo, 2014; Rakodi, 1990). Dependence on private capital for low-income housing development which is provided by risk averse shareholders would thus entail finding means and ways of pricing and packaging all the risks inherent in the low income housing sector in such a manner that the private sector can then determine if this group can be profitably served, whilst maintaining affordability by the target group (Demirag et al., 2011; Gallimore, Williams, and Woodward, 1997; Lea, 2005; Moss, 2003)

In developing countries, in addition to the above cocktail of challenges, the private sector would have to operate within an economically challenging atmosphere, which is not conducive for large scale projects (Centre for Affordable Housing Finance in Africa, 2012; Lea, 2005; Moss, 2003; Özdemir, 2011). At the same time, it is in those countries where there is the greatest housing backlogs and thus the greatest need to look for ways to engage the private sector. The challenge of how to incorporate the private sector in low income housing production has attracted many researchers in a bid to find solutions to the world wide challenge of housing the low income groups (Abdul-Aziz and Kassim, 2011; Babatunde et al., 2012; Loxley, 2013). Numerous empirical studies have been done on the topic, but their generalizability has been hampered by the problem that many of them have not been guided by explicit theoretical frameworks, a concern which has also been noted even amongst property development researchers in general (Drane, 2013). Without a theory to bind together all the empirical evidence that may be gathered on speculative low income housing, research in this area can end up being too descriptive, with limited ability to be applied in other contexts (Carmen, Steggell Susan, Binder Lori, Davidson Pat, and Vega Eric, 2001; Coase, 1998; Ganderton, 1994; Jacobs and Atkinson, 2008; Mbiba and Huchzermeyer, 2002).

Given this context, the purpose of this paper is to review the theoretical frameworks that have been applied in housing research and to assess how these theories may be applied to the understanding of speculative low–income housing development in developing country contexts. The rest of the paper is arranged in four sections as follows. The following section briefly identifies and critically reviews the main theories that have been applied in housing research in general. Based on this review, the third section considers the most appropriate

approach to the theorizing of housing research in the context of developing countries. The penultimate section draws out the policy implications arising from this approach. The paper ends with conclusions and suggestions for research.

2 Theory in Housing Research

Theories that have been applied in housing research can be categorized into three broad categories, viz. neoclassical theory, neo-Marxist theory and structuralist theory.

2.1 Neoclassical Theories

Neoclassical economics refers to a set of approaches to economics focusing on the determination of prices, outputs, and income distributions in markets through supply and demand. At the core of neo-classical economics is consumer or rational choice theory. Neoclassical consumer theory begins its analysis by considering individuals, who are rational, and have full information but are income constrained as consumers only i.e. as purchasers of consumer goods. Neoclassical consumer theory is therefore essentially a demand-side theory. Thus though individuals may also act as producers in the market, this function is ignored in consumer theory. Megbolugbe, Marks, and dan Schwartz (1991) make the rather ambitious argument that this is the only fully developed economic theory of the housing market for analyzing housing decisions. This theory posits that consumption decisions are the product of preferences for houses with certain attributes, given constraints on supply and the resources available to make purchases. In the case of housing tenure decisions, for example, this theory suggests that decisions about owning versus renting housing are determined by the combination of individual demands for attributes associated with either type of tenure, and constraints on an individual's ability to access the desired kind of tenure.

Applied to speculative development of low-income housing in developing countries, the neoclassic consumer theory of housing demand has significant shortcomings. Perhaps the most fundamental of these is that it has nothing to say about the supply side of the housing market. This is of course where the developers come in. It is therefore inappropriate for the theorizing the question of speculative development of low-income housing. More broadly, the neoclassical consumer theory of housing demand suffers from the same problems associated with neoclassical economic theory. Neoclassic economic theory is based on the idea that the market can always correct itself and is frictionless (Buitelaar, 2004; Van der Krabben and Lambooy, 1993). A form of agent rationality is assumed which allows for unproblematic negotiation given certain structuring parameters which is ideal for perfect supply (Healey and Barrett, 1990).

Demand for low income housing is undisputedly there as is evidenced by housing backlog figures, but empirical evidence which points to market failure in the provision of low income housing to the low income segment is abundant (Craig and Porter, 2006; Özdemir, 2011; Rolnik, 2013; Sivam and Karuppannan, 2002). There is thus need for research on supply side variables (Follain and Jimenez, 1985), an area that is typically ignored by the neoclassical approach, which highlights that the metaphor of the invisible hand that ensures harmony of individual actions in a zero-transaction-cost world does not hold in the low income housing sector (Furubotn and Richter, 2005; Van der Krabben and Lambooy, 1993). Simulations of developer decision making from a neoclassical perspective have also been criticized as being isolated from real life human manoeuvring and also do not explain why developers behave in certain ways (Coiacetto, 2001). Yet, understanding why developers make the decisions that they make is the key that is needed to comprehend low income housing production by speculative developers. Property developers also have to depend on imperfect information (Ganderton, 1994) in the low income housing segment, which rules out the application of any theoretical models that are derived from a neo-classical perspective. The existence of imperfect

information in the low income housing market thus points to incomplete contracts (Furubotn and Richter, 2005) which further implies higher transaction costs. The importance of minimizing transaction costs cannot be overemphasized in low-income housing (Arnott, 1987), as cost minimization might make the final product more suitable to the target group.

2.2 Neo-Marxist Theories

Marxism is, in simple terms, a theory that sees society in terms of a class struggle between capitalists and the 'working class'. This in practical terms is conceptualized as conflict between those who own the means of production, who are rich, and workers, who are poor. The relations have traditionally been seen as exploitative, with the capitalists accumulating wealth at the expense of the poor workers. Neo-Marxism for its part is a loose term that encompasses strands of Marxist philosophy which seeks to answer questions traditional or orthodox Marxism cannot. The neo-Marxist theory of housing conceptualizes developers and landlords as the exploitative capitalist class, whose interests is at variance with the occupiers of low-income housing. Indeed there are a number of researchers in the low income housing space who assert that involvement of the private sector in low income housing provision is likely to result in the marginalization of the poor and more landlessness (Bredenoord and Verkoren, 2010; Campbell, 2011; Craig and Porter, 2006; Mosha, 2013; Rolnik, 2013; Seisdedos, 2009). These theories and researchers working from this theoretical perspective would thus advocate for social justice and call for more government involvement in ensuring equitable wealth redistribution.

It's quite obvious that a neo-Marxist theory of housing is unlikely to lead to fruitful results in research whose objective is to understand the conditions under which speculative low-income housing development may be successfully undertaken. Neo-Marxist theory essentially vilifies landlords and developers as they are assumed to impose and manipulate rents so as to ensure the most profitable arrangement of land uses (Mbiba and Huchzermeyer, 2002). This assumption is however problematic because it wouldn't make economic sense for private developers to actively want to serve this low income housing market to the exclusion of other higher income groups who can afford higher rents. Adopting this theoretical stance would thus entail giving up the fight before even attempting to understand the ideologies and strategies of those private sector players who serve this market against calls by other researchers for research which targets how the private sector can be mobilized and encouraged in serving the lower end of the market (Abdul-Aziz and Kassim, 2011; Altmann, 2011; Bredenoord and Verkoren, 2010; Lea, 2005; Miller, 2010).

Since the subject of study is the low income groups, those without the adequate means of out-rightly affording housing on the open market, the neo-Marxist perspective would advocate for more subsidy as a form of wealth redistribution. But, governments in developing countries are already operating on bloated budgets and not much fiscal resources can be spared that can adequately help meet housing demand that is exerted by this group (Chipungu and Adebayo, 2013; Lea, 2005; Loxley, 2013). The social implications will be reluctance to adopt alternative housing solutions such as self-help schemes even by those groups in the society who have the means to get access to housing (Landman and Napier, 2010). Failure also by the government to provide housing under the neo- Marxist perspectives can lead to civil unrest within the society, especially if the low income groups take it as an infringement of their rights.

2.3 Structuralist Theories

Structuralist theories seek to relate and understand the behaviour and actions of individuals (or agents) as arising from, and shaped by, underlying structure. The balancing of agency (action) and structure is referred to as the duality of structure, and looks at how structure affects the actions of agents and how it is also affected by agency. Structural theories hence have the power to explain why low income housing provision by speculative developers is the way it is

today through applying theory to empirical evidence to get a sense of how structure affects and is affected by agents. The roots of structural concepts in housing are class, production, capital accumulation, power, and conflict (Lawson, 2009).

Class: Theories which utilize these structural concepts do recognize housing delivery systems differ depending on the targeted market (Gumbo, 2010). This implies that structural theories would not view housing as a homogenous product and would not expect demand patterns and supply patterns to be exactly the same for different classes. As such, the out-come would be different structures of housing provision (Ball, 1998). Similarly, developer expectations of profit margins, house design patterns, marketing efforts, risk management strategies should be differentiated per class, a notion which can be tested through using structural theories. Unlike the neoclassical approach which focuses on demand side economics, structural theories can enable both demand and supply side economics to be interrogated after stratifying the market into different classes.

Production and capital accumulation: Production of low income housing depends on the rate of capital formation i.e. increase in the volume of real savings, mobilization of savings through financial and credit institutions, and investment of savings (Lawson, 2009). This implies that low income housing production is affected by the macro economic environment (Leung, 2004) and producers have to act in this environment which can also be a constraint towards capital accumulation. Indeed, there are researchers who attest that it is impossible for the private sector to profitably go into low-income housing development and bring authentic social and economic development for the target market (Campbell, 2011; Craig and Porter, 2006; Rolnik, 2013; Seisdedos, 2009). But, instead of taking a neo-Marxist perspective and assuming that speculative developers involved in low income housing can only make a profit through charging excessive prices, adopting a structural perspective can enable researchers to explore institutional concepts such as transaction cost minimization, methodological individualism, social capital and so on (Furubotn and Richter, 2005). These concepts can make it possible for speculative developers to leverage on their strategies and come up with profitable delivery systems that are suitable for the low income earners.

Power: In any housing market, different participants can be said to have different competences or powers. This difference can arise from unequal opportunities in access to resources, differing ideologies and for some, political affiliations can give an advantage over other market participants. Structure addresses resources available to developers, rules governing economic activities within the market and motivation or objectives of the market players (Healey and Barrett, 1990), and interrogating these concepts can yield insight into what can be done to stimulate low income housing production. In low income housing studies, this power becomes evident when some developers are able to successfully serve the low income earners whilst some can't. Adoption of structural theories in low income housing research will thus reveal some of these variables that can yield insight into what determines low income housing production success.

Conflict: the potential for conflict amongst market participants serves to highlight the importance of structure, that is, the rules that shape human interaction (Buitelaar, 2004) and promote cooperation among human agents so that the costs of coordinating economic and other activities can be lowered (Furubotn and Richter, 2005). In low income housing research, information asymmetry abounds (Arnott, 1987; Ball, 1998; Lawson, 2009), which emphasizes the concept of bounded rationality amongst market participant. Without structure to serve as a fall-back position in case contracts fail, in a bid to reduce risks, there would be a rise in transaction costs (Buitelaar, 2004).

3 Theorizing Speculative Low Income Housing Development

Having noted that structural theories are more appropriate in the study of low income housing by speculative developers, the two widely recognized property development theories stemming from the structural theory are Healy's Structure-Agency theory and Balls' Structures of Housing Provision (SoHP) model. Each model applies institutional concepts differently which will affect the suitability of each of the models in the study of low income housing. Institutional analysis is important for this research because institutions provide structure- that is limits or constraints to business and human practice which can influence how low-income housing development takes place (Callinicos, 2004). On the other hand, structures reduce uncertainty in human relations (Furubotn and Richter, 2005), and thus can contribute significantly towards reducing transaction cost in low income housing provision.

SoHP does not differentiate between structure and agency (Ball, 1998). Instead, the model concentrates on mapping out the structures of housing provision which are defined as the network of relationships of all players involved in housing provision. It thus concentrates on the ontology of housing provision, i.e. what are the networks, but ignores the epistemological side, which is what we need to understand in order to promote private sector involvement in low income housing. Structure-Agency on the other hand recognizes that different property developers are unique and provides a structured way to understand individual actors involved in the production process (Healey and Barrett, 1990). This might be time consuming compared to just lumping up all the low income housing developers under one stereotypical banner, but it is a necessary step that has to be taken in order to understand the speculative low income housing production process determinants.

Given that under institutional economics, individuals are assumed to maximize utility under constraints (Furubotn and Richter, 2005), the SoHP falls short in exploring this concept as it just provides a way of visually mapping how organizations are linked. Although the SoHP acknowledges that these networks are influenced and/or constrained by rules, it lacks the explanatory power to explain how agents then react to these constraints. Instead the researcher would have to deduce from a longitudinal study how the constraints have resulted in a change in networks, making the model less useful in cross sectional studies which are more frequently carried out. This in a way, assumes that all the reactions to constraints are translated into changes in networks, but, this is not always the case as cultural norms can make a structure of provision rigid such that it might not fully reflect the agents' reaction to certain institutional constraints. The Structure-Agency theory on the other, by separating between structure and agency, enables the researcher to fully explore how agents maximize utility under given constraints. This is of ultimate importance in the study of low income housing by the private sector as the sector is fraught with challenges as was shown above.

Bounded rationality (Eggertsson, 1990; Furubotn and Richter, 2005) is a concept that has to be fully explored in the provision of low income housing by the private sector. Information asymmetry abounds in this sector which exacerbates risks, and this implies that private developers have to make do with incomplete information and incomplete contracts (Buitelaar, 2004). The Structure-Agency theory enables the interrogation of the ideologies of the private sector players and the strategies that they employ to cope with the unique risks imposed by this information asymmetry. By separating structure and agency, it is possible to explore how agents are affected by structure and how their actions also influence structure which tests the duality of structure and agency and this model gives the researcher a chance to check influential variables which can then be used to explain a particular structure of provision. Ball's structures of housing provision on the other hand does not separate between structure and agency and the author states that there may be no contemporary rationale for the existence of a particular structure. Although this might be true, this perspective does not equip researchers with much

to go on in low income housing research that is targeted on finding ways of attracting private sector developers into the sector, which will result in researchers having to resort to other theories in order to answer some research questions that they may have.

4 Implications for Policy

Once frictions are noted in a market as is evident in the low income housing sector, economic behaviour will be assumed to include the development of enforcement rules and the necessary collective action to support the rules (Furubotn and Richter, 2005), which is where policy comes in. Therefore, appropriate policy recommendation that can be of use in stimulating private sector engagement cannot be gleaned from any studies that adopt a neoclassical theoretical perspective. If policy makers were to understand why developers behave in a certain way and how they are likely to react to certain policy changes, then they could actively start pursuing the implementation of policies that are likely to encourage more private players in the low income housing space. Policy should thus be crafted, not with a blanket view of the property development sector, but should be tailor made to suit different types of developers. If policy makers are made aware of the significance of structure in shaping developer outlooks, then more care and attention will be given in policy crafting to influence more involvement of the private sector. Researchers however agree that neoliberal policies are path dependent and contingent processes that materialize differently according to contextual realities (Altmann, 2011; Fawaz, 2009; Rolnik, 2013; Wang et al., 2012) and as such, empirical research on low income housing production should be used to inform policy.

This emphasizes the role of government policy in low income housing production. The state enters into these processes in diverse ways, through sectoral policies, as a development intermediary itself, and in order to safeguard particular interests and values (Healey and Barrett, 1990). However, the financial and economic interest of the private sector need to be harmonized with the political and social needs of the government and that can only happen through policy intervention. Through using the Structure-Agency theory, the effect of current government policy on the operations of practicing speculative low income housing producers will be uncovered. From the challenges faced and strategies that are being implemented, government, can, through policy, help the speculative developers produce a tailor made product suitable to the target group in all aspects. Issues that have been consistently raised by other researchers such as bureaucratic land acquisition and planning procedure, tenure, housing standards, costs of exchange and so on are likely to be exposed, but in greater detail which show the relative importance of policy reform on speculative low income housing production

5 Conclusion and Further Research

Low income housing shortages are real, the world over, more so in developing countries. The solution to the housing challenge will take a concerted effort from researchers, practitioners and policy makers. Policy, however, has to be adequately informed for it to have the desired effect. This can be achieved by research that draws on an appropriate theoretical framework and is also backed by empirical evidence that fits the context in question. The Structure-Agency theory that flows from structural theory is a promising theoretical entry point that can be used to research ongoing speculative low income housing development in a bid to unravel effects of current policies on speculative low income housing. Results from such researches are also going to highlight challenges being faced by the developers, giving the state a chance to use policy as a tool to reduce barriers to entry for the private sector developers, and to create a structural environment that is conducive to the creation of a product that is affordable to low income earners.

Although Healy's Structure-Agency theory appears to be more suitable in the study of low income housing provision by speculative producers, there is still a need to interrogate the model

and come up with a robust conceptual framework that will capture all the variables that can affect private sector involvement in the housing sector in developing countries.

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AN INVESTIGATION INTO STUDIO-BASED PEDAGOGY FOR BUILT ENVIRONMENT GRADUATES: A NEW MODEL FOR A NEW CONTEXT

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Abstract
The democratization of South Africa has necessitated a transformation of the education system, it requires basic curricululm concepts and teaching practices to be rediscovered and, rethought. The process of democratisation of South Africa looks easy and many institutions have addressed the issue with regard to alignment, in terms of the curriculum outer structure or exoskeleton which only refers to modules, credits, levels, and outcomes. It is the classroom practices that remain unchanged in many respects. The purpose of this paper is to investigate the studio pedagogy as a possible new method in the education of Built Environment graduates, to meet the concepts as set out for South African higher education. A mixed method of research was followed, firstly qualitative by means of a literature study and secondly quantitative by means of two structured questionnaires. The findings indicate which current educational methods are used and where these methods are lacking. Studio-based pedagogy is a promising educational method to help students acquire the skills and knowledge to be more effective practioners as set out for South African higher education. This paper presents an investigation into the application of this method as a way to address the gap between education and practice, and help improve the current traditional methods of academic instruction.

Keywords: Studio-based pedagogy, Construction education, Curriculum development, Higher education, South Africa

1 Introduction

The South African education policy has contributed to a new context of learning. This has been influenced by many factors, especially globalization of the economy since 1994. Ramdass (2012) identifies skills development as a national concern, South African higher education institutions need to meet the expectations and be responsive to many role players including industry, state and society. These changes have led to the requirement of flexibility, adaptability and innovation not only in curriculum alignment, but importantly to new education and training demands in order to remain competitive (Ramdass, 2012). In essence, education institutions are called to be firstly attentive and secondly responsive to the need of the knowledge economy. Graduates need to become well-developed problem-solving individuals who can adjust their body of knowledge and skills to changing environments. The empirical study tests the perception of the students regarding the current curriculum and identifies gaps within current teaching and learning practices. Relating to the above teachers need to understand teaching methods, how students learn and industry requirements in order to bridge the gap as outlined by the study. The paper proposes the theoretical perspective of the proposed

pedagogy of problem based learning in a studio context that Biggs (1999) refers to as 'alignment itself!' as a possible solution. For the purpose of this paper, curriculum does not only refer to content but also to the teaching and learning of the programme of study: outcomes, methods, and assessment form integral parts of the curriculum (McDonald and Van der Horst, 2007).

2 Literature Review

2.1 New Context: Economic and Policy Responsiveness

The National Plan on Higher Education in South Africa provides the framework, and mechanisms for restructuring the system to achieve the vision and goals for higher education system outlined in the White Paper, A Programme for the Transformation of Higher Education (Department of Education 1997). The goals are summarised as three core concepts namely: curriculum alignment, globalization or internationalization, and quality assurance.

…high-level skills training: the training and provision of person power to strengthen this country's enterprises, services and infrastructure. This requires the development of professionals and knowledge workers with globally equivalent skills, but who are socially responsible and conscious of their role in contributing to the national development effort and social transformation…Production, acquisition and application of new knowledge: national growth and competitiveness is dependent on continuous technological improvement and innovation, driven by well-organised, vibrant research and development system which integrates the research and training capacity of higher education with the needs of industry and of social reconstruction (White Paper, 1997).

In terms of the exoskeleton defined by Jansen in Lange (2011) as the outer structure: modules, credits, levels, and outcomes the process of democratisation of South Africa looks easy as far as the curriculum is concerned. It is the endoskeleton that remains unchanged in many respects. What has been neglected is Section 2 of the National Plan is the production of graduates for both social and economic development within South Africa. The objective can be outlined as 'to produce graduates with the skills, and competencies to meet the human resources needs of the country' (Ministry of Education, 2001).

What does 'globalizing' the curriculum mean? According to McDonald and Van der Horst (2007) it is a curriculum that is different in three ways namely: content (i.e. what is taught), form (i.e. delivery methods), and structure (i.e. the organization of the learning experiences and content of programmes). Teaching always involves firstly teaching something (content and skills) to someone somewhere (context). According to Jansen in Lange (2011) curriculum should be viewed as an institution, which reiterates the concept that knowledge is not only transmitted through syllabus content, but also in a tangible manner through classroom practices. It can be argued that too many policymakers and educational leaders are focused on traditional assessment approaches rather than answering the question of whether our students are learning what they need to know. If we are to align teaching to higher-level outcomes it is important to start asking the following questions of how it is carried out as well as how understanding develops within the curriculum. The need for globally competitive skills require these students to have firstly well-developed problem-solving skills and to be able to adjust their body of knowledge and skills to changing environments. Higher education focus should shift to providing students with broad, generic and transferable skills in contrast to the current context of specialised knowledge. Furthermore according to Griesel (2002) attributes considered to be most important by employers can be summarised as follows:

- Critical and analytical ability;

- Flexibility and ability to apply knowledge to new situations; and
- Ability to plan and execute tasks independently.

A University education is not just transmission of knowledge to perform a given profession, but should also include attributes such as rational debate and conceptual thinking. Schon rejects the 'established procedure in professional education of building application upon basic science and theory; he dismissed the notion that professional practice was based on the rigorous application of theoretical knowledge' (Green and Bonollo, 2003). This paper will argue that the studio-based pedagogy can provide construction professionals with an education in a real life context (Nompunga, 2013).

2.2 Studio-based Pedagogy: History

Educational theory offers five broad models as indicated by Long (2012) namely (1) behaviourist, (2) humanist, (3) cognitivist, (4) activist, and (5) situated learning. Understanding these is essential in assessing the value and potential of studio pedagogy for Quantity Surveyors and Construction Managers. As seen in the data collected our program approaches educating Quantity Surveyors and Construction Managers predominantly from a lecture point of view (behaviourist). Not to mention assessment, also approached by traditional practices of essays and problem-type examinations. The pedagogy of this model can be seen as 'learning that exists in a traditional didactic format, where the lecturer is seen as the expert in disseminating knowledge' (Long, 2012), also translating in the lecturer controlling the environment and offering rewards for students predetermined responses. According to the literature reviewed studio pedagogy can be placed in the 'situated learning theory' model because learning is centred on a problem or activity and the context becomes key, where learning is different for each student based on their abilities, knowledge and competency (Long, 2012).

It is important to examine the history behind the studio, since this will lead to an understanding of the educational approach that ultimately shapes its delivery and provides a guideline for its implementation. The model discussed in this paper can be seen as based on Plato's model of teaching, the free exchange of knowledge later known as Platonism. Academia Platonism is a humanistic discourse; a free, sociable and informal means of discussion (Green and Bonollo, 2003). The architecture studio is an adaptation of this and the atelier-based training at the Ecole des Beaux-Arts in 19th Century Paris (Kuhn, 2001), it offers a teaching model which blends the social and technical aspects associated with design and provides interesting possibilities for other technical fields of education.

Architectural education is based primarily around the design studio as a pivot and gathering point of all knowledge and skill accreted throughout the curriculum (Mostafa and Mostafa, 2010).

The 'studio' is used to describe two concepts, firstly the physical space (the place where learning and teaching takes place) and secondly the mode of engagement (pedagogical strategy). It is based on the historic model as explained of apprenticeship, where the master educates the student (Crowther, 2013). Crowther (2013) refers to the 'studio' as a place of learning where the two concepts of physical space and pedagogical activities merge to form one. Ochsner (2000) states that there is potential for the pedagogy of the design studio to have wider application in other disciplines and professions. Architects have been educated through a process that revolves around the 'studio course' and this paper explores to apply the studio method of teaching to the education of other allied construction professions such as Quantity Surveying and Project Management.

2.3 New Model: Pedagogical Responsiveness

In a study conducted by Nompunga (2013) , third year level Construction Management students at the Cape Peninsula University of Technology were asked to complete an online survey. The data revealed that a professional discipline requires theory to be applied to practice in the classroom setup. Students preferred direct face-to-face teaching which centres around the student rather than a conventional teacher-centred approach which typically focusses on what teachers teach rather than what students learn. Nompunga (2013) confirms this by stating that students do not want to learn basic concepts first and then apply them later on, but rather prefer to be involved in immediate, direct and first hand experiences. Research has also shown that students feel unprepared for their jobs because the integrating of theory learnt at institutions into their professional practice leaves a gap. A study conducted by Dlamini and Fester (2012) argues that students currently being trained are not acceptable for the construction industry which already is challenged by a skills shortage.

Lange (2011) refers to the development of a student into a critical being, persons that can exercise critical reason, critical self-reflection and critical action. In order to educate a critical being we need to provide a space for education where students can become themselves and bring their knowledge to situations (Lange, 2011). Nompunga (2013) encourages a deep approach to learning, this can be summarised as the following: Firstly the teacher should guide the learning process within his or her field of knowledge and secondly select the correct approaches that communicates this knowledge. This can further be summarised as teaching being the process of sharing knowledge to create better understanding (Nompunga, 2013). Assessment plays an important role to simulate the real world of construction. Assessment should encourage students to engage in problems that use and apply knowledge facilitating as discussed above in terms of deep learning approaches.

Chan (2012) advocates the use and growing teaching approach of construction undergraduates as Outcomes Based Teaching and Learning (OBTL). Academics can no longer teach in ways that were appropriate in the past, a paradigm shift has placed the focus on the learner and how to facilitate the best learning outcomes for them (Nompunga, 2013). Teachers should continually learn and adapt their practice to be seen as Dewey (1993) refers to them as ‘teachers as learners’, ‘teachers as researchers’ and ‘teachers as practitioners’. Design studios typically employ the semi-structured learning strategy of experimental learning; particularly, the project (Crowther, 2013) which as discussed above includes aspects of problem-based learning. This form of learning centres on dialogue, beginning with students given a project while tutors/ mentors offer feedback weekly. What is the unique value of studio pedagogy in the education of Quantity Surveyors and Project Managers? Firstly its value lies in teaching ‘synthesis,’ ‘learning-by-doing,’ and ‘reflection-in-action’ while also incorporating or exposing the students to ‘real-world problems’ (Long, 2012), further he identifies the following as key learning objectives and contributors to learning of studio courses.

- Teamwork
- Professional socialization
- In-depth problem
- Adapting procedures to real cases
- Field experience

Furthermore, the complex and flexible nature of the architecture studio can be seen to accommodate three types of learning as indicated by Crowther (2013):

- Learning about design (knowledge development);

- Learning to design (development and application of skills); and,
- Learning to become (where learning transforms a student).

3 Research Methodology

A mixed method was used, firstly a literature review was done prior to data collection in terms of structured questionnaires. Two structured questionnaires was sent out to groups of students at the University of the Free State. The questionnaire was developed and constructed based on the literature review. It was aimed at assessing the student's opinion of their learning experience, in terms of preparedness for work, current teaching practices and lecturers. For the purpose of the research conclusions will be made from the data collection in order to establish the gaps in the teaching practices as well as provide possible solutions for implementation.

3.1 Questionnaire construction

Both questionnaires were structured the same, the first part consisting of personal questions and the second of employment details. The third part of the questionnaires required the students to answer questions relating to their education. They had to rate the importance of education practices on a five point Likert scale, graded from one which is least- and five which is most appropriate. There were also open-ended questions where they were required to give their own opinion and respond with views or comments. Table 1 below shows the two sample populations, the response rate was 100%.

Table 1. Sample population 1 and 2

Sample 1			**Sample 2**		
Under Graduate	55	88.7%	Under Graduate	10	19.2%
Degree	7	11.3%	Degree	34	65.4%
Honours	0	0%	Honours	7	13.5%
Other	0	0%	Other	1	1.9%
Total	**62**	**100%**	**Total**	**52**	**100%**

4 Findings and Discussion

4.1 Important attributes to be prepared for a long term career

When asked to what extent the students practise self-study, the results revealed only 3.8% of students regarded it as important. Vorster (2011) states that the goal of education ought to be to create independent, autonomous learners who take responsibility for their own learning. Improvements as seen in the literature can be achieved by moving toward learner-centred teaching (Vorster, 2011). Firstly the attitudes as well as abilities for this need to be cultivated in our classrooms. Lecturers need to shift the focus more on our students and how we can encourage them to become more independent learners, and this paper aims to show that the possible solution lies in studio-based pedagogy through the literature review and further research of implementation. Students will not be developed if lecturers still, as the data shows take responsibility for their learning. When asked to evaluate the important attributes for a long term career, Table 2 shows the mean score on a scale of 1 to 5, where 1 is the least important and 5 is the most important, 51.6% of the students rated analysis of problems as well as 45.2% creativity as most important.

Table 2. Important attributes to be prepared for a long term career

	1	2	3	4	5
Analysis of problems	0	0	9.7	38.7	51.6
Creativity	0	6.5	25.8	24.2	43.5
Application of knowledge	0	1.6	4.8	48.4	45.2
Evaluation of ability	0	0	25.8	40.3	33.9

4.2 Importance of elements in professional development

When asked to rate the importance of certain elements in terms of professional development, communication (50%) and people skills (46.1%) were rated as most important as indicated in Table 3 below. Toor (2008) supports this when he states that industry requires academia to produce professionals with not only technical but also soft skills as indicated by the data. Toor (2008) states that 'technical coursework should be complemented with elements of flexible education, and emphasis on soft-skills development.' The data shows a lack in the education of these soft skills in our current programme. Chan (2012) states that assessment efforts should also be made to involve 'soft skills', students should not only be evaluated on content-based knowledge but also on transferable skills which include as shown communication, problem solving, interpersonal relationships and teamwork.

Table 3. Importance of elements in professional development

	1	2	3	4	5
Communication	0	0	11.5	38.4	50
People Skills	0	0	15.3	38.4	46.1
Leadership	0	0	30.7	36.5	32.6
Motivation	0	1.9	21.1	51.9	25
Ethics	0	0	5.7	55.7	38.4
Creativity	0	7.69	30.7	48	13.4
Research methods	0	3.8	21.1	67.3	7.6

4.3 The impact of educational elements in terms of knowledge gained

The techniques used by construction education programs can have an important factor contributing to the type and quality of graduates and the success of these graduates in industry. When asked to indicate the impact of each of the following educational techniques in terms of knowledge gained while enrolled as indicated in Table 4, practical classes (9.6%), site visits (11.5%), group work (1.9%), research projects (0%) and computerised classes (5.7%) were rated as having the least impact. Students were then asked to name which of these elements were inadequately addressed and results reiterate the findings above listing practical classes, computerised classes and site visits. Study material was also found to be 0% but not listed as an inadequacy in the follow up question. The data indicates that the curriculum exoskeleton was not rated as an inadequacy but most of the educational elements that were lacking refers to the endoskeleton as indicated in the literature review. This proves predominant use of traditional assessment practices that cannot adequately test for creativity, reflection and critical thinking as stated by McDonald and Van der Horst (2007). Practices namely practical classes, site visits, group work etc. can have an impact on the qualities mentioned above but are not being implemented as indicated by the data. As indicated above the students have limited learning activities that encourages them to be able to think critically, reflect on problems and apply knowledge or concepts to new problems.

Table 4. The impact of educational elements in terms of knowledge gained

	1	2	3	4	5
Practical classes	9.6	11.5	34.6	28.8	15.3
Site Visits	11.5	11.5	21.15	34.6	21.1
Computerised assignments and classes	5.7	9.61	30.7	42.3	11.5
Group Work	1.9	34.6	46.1	15.3	1.9
Research projects	0	7.6	34.6	53.8	3.8
Attending seminars and Conferences	11.5	9.6	30.7	40.3	5.7
Study material	0	13.4	38.4	36.5	11.5

4.4 Studio-based pedagogy solutions addressing gaps in current educating practices of Built Environment graduates

The studio-based pedagogy addresses these issues above as seen in Table 5 below, in the following ways. Generally studios and students who participate in them, possess a set of common characteristics as summarised by Jones et al (1994):

Engaged learners are responsible for their own learning. These students are self-regulated and able to define their own learning goals and evaluate their own achievement. They are also energized by their learning; their joy of learning leads to a lifelong passion for solving problems, understanding, and taking the next step in their thinking. These learners are strategic in that they know how to learn and are able to transfer knowledge to solve problems creatively. Engaged learning also involves being collaborative – that is, valuing and having the skills to work with others.

Studios traditionally begin with an open-ended problem that gives students some choice in the direction but leaves a certain area for creativity. The problem takes account current issues and deals with 'real world and client' scenarios. The studio is a place where the project is executed and it should reflect professional practice (Green and Bonollo, 2008), he continues to state that this should not be isolated but rather complementary to other modules. This can and should include structured conversations with outside experts with knowledge of the problem, which comes back to the importance of industry development. Assessment usually takes place in the form of a critique, derived from architecture and fine art teaching. This is central to the studio and can also be termed review, assessment or evaluation. The studio also encourages a high degree of contact between the instructor and the student which again contribute to the development of soft skills such as communication and people skills. According to Long (2012) the students work is regarded as iterative, where the problem and the solution of the problem is revisited repeatedly. Knowledge is socially constructed and thus group work is crucial to developing a student's knowledge base and people skills. Studios always include a degree of group assignments, as well as attempts to work across disciplines and promote collaboration. Studio courses teaches 'practice' for which there is no substitute pedagogy (Long, 2012). The next stage of the evolution, as stated by Long (2012) include questions such as how to engage technology and social media in new ways to teach within the studio setting. Studios as indicated by Long (2012) should be places where,

…creativity can be taught, where theory can be tested, where research can be conducted, where outreach and service activities can be deployed, and where different modes of practice can be explored.

Table 5. Studio-based pedagogy solutions addressing gaps in current educating practices of Built Environment graduates

Identified gap	Studio-based pedagogy solutions
Self-study	Student-centered learning
Analysis of problems	Critical reflection
Creativity	Open-ended problem
	Iterative work pattern
Communication	Critique – Formal and Informal
	Contact between instructor and student
People skills	Social environment
	Professional socialization
	Present work to peers and instructor for review and discussion
Group work	Multi-disciplinary and collaborative team assignments
Practical classes	Learning by doing
Site visits	Industry involvement- engaging experts
Research projects	Precedent
	Case studies
Computerised classes	Further research into applicable uses of technology (E-learning)

5 Conclusion and Further Research

It is time that academics not only address the curriculum as content but also in terms of how we teach to address what the students need to learn. The data suggest that a conventional teaching approach is still followed which typically only focus on what teachers teach and not how students learn, thus the teaching and learning environment need to change. There is definite potential as seen in the literature review for the pedagogy of the design studio to have a wider application on unrelated or related disciplines. Long (2012) states that: "Experience-based learning – including studios and internships – Is the most appropriate approach of teaching practice." As shown teaching should be student-centred rather than teacher-centred to minimise and overcome the gaps in construction graduates education. This research should now be implemented in the department as a pilot or case study and aid the development of a studio-based module to assist current modules offered.

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CHALLENGES IN THE DELIVERY OF ENVIRONMENTAL SUSTAINABILITY IN HOUSING DEVELOPMENT IN ABUJA, NIGERIA

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Abstract
The environment has a major impact on our lives; construction can affect communities and business and can make heavy demands on limited natural resources, however, when planned successfully it can also lead to positive outcomes. Sustainable development is the achievement of a better quality of life through the efficient use of resources, which realize continued social progress while maintaining stable economic growth and caring for the environment. The aim of this paper is to explore the challenges in the delivery of environmentally sustainable housing schemes in Abuja. The research uses desk study, which involves the review of related literature, and Delphi method, which is used in developing variables for the interview and survey questions. Abuja was selected, because of the level of housing development that is taking place there providing the ideal environment to undertake the study. Preliminary results show that there are challenges in achieving environmental sustainability in housing delivery in Abuja.

Keywords: Challenges, Delivery, Environmental sustainability, Housing development

1 Introduction

Housing provision is a major challenge facing not only developing countries but also the developed ones, for example, in the UK there exists a housing demand of over three million houses in England (Long et al., 1990). This challenge is more pronounced in developing Countries and will remain a major socio-economic and financial problem for these economies (Akintola et al., 2013). This problem led 131 Nations, including Nigeria, to endorse 64 recommendations of the 'National Action Plan' at the United Nations conference on Human settlement, on the 11th of June 1976 in Vancouver Canada. Meeting this challenge globally has led to plundering the natural environment without regards to its preservation or protection, and thus extends to a more complex problem. About 170 Nations met at Rio de Janeiro, Brazil, on June 3rd 1992 for another United Nation Conference tagged "Earth Summit," or "Rio Declaration on Environment and Development.'' The debate centred on sustainability, with particular emphasis on resolving the conflict between development and the environment,

however current debate is critical about the lack of post-Rio momentum at both political and practical level (Lozano, 2008).

Nigeria is a signatory to the 'Rio declaration' and is laden with a huge housing deficit. It struggles towards achieving sustainable environment are noticeable through the various policy formulations and advocacy (Odebiyi, 2010). The 1999 constitution, the pinnacle of all laws in Nigeria, has a provision for the protection of the environment, for example section 20 of the law states that: 'The State shall protect and improve the environment and safeguard the water, air, land, forest and wildlife of Nigeria' (FGN 1994). One of the local environmental laws, which have been enacted is: the Land Use Decree of 1978. There is also the National Policy on Environment (1989) concerned with securing the quality of the environment, conserving and using the environment for the benefit of present and future generations; restoring, maintaining and enhancing the ecosystem and ecological processes essential for the functioning of the biosphere and the principle of optimum sustainable yield in the use of natural resources. Another major provision of this policy is promoting public awareness on the link between development and the environment; international co-operation with countries and international organizations in the protection of the environment.

The aim of this paper is to explore the challenges in the delivery of environmental sustainable housing schemes in Abuja with particular emphasis on ways to address these challenges

2 Housing and Environmental Sustainability

As momentum continues to increase on concerns over the depletion of our natural environment, principle of sustainable practice has continued to raise more attention globally. The number of various concerned advocacy, conferences and seminars being held on the issue, evidences this. The activities within the built environment is said to contribute between 30-40 percent of greenhouse gases globally. (Abolore, 2012). As identified in literature, housing provision takes centre stage in depletion and pollution of the environment. Fiorino (1990) opines that the built environment provides a synthesis of environmental economic and social issues he asserts that it provides us with houses, infrastructures and also plays a vital role in our economy. Agbola (1998) concludes that its design is significant in determining the pattern for the resource consumption over its relative life cycle. Initiations have prompted philosophies and strategies in pursuing affirmative actions and policies in numerous countries to engage and implement sustainability issues in property valuation. Architects are also required to provide sustainable construction (Lorenz, 2006; Majdalam et al., 2006)

Arayela (2002) concludes that the transition to sustainability is urgent because global life-support systems and the environment have a time limit. Arayela posits that there is no time to dream of creating more living spaces or more environments, the remnants of the environment must be saved, time must be allowed for regeneration of what humans have already damaged.

Environmental sustainability is a globally – espoused objective, mainly credited to Brundtland commission (WCED, 1987), UNCED earth submit in 1992 and the position of Canada (1992). Environmental sustainability means maintaining global life support systems, or more specifically, maintaining environmental sound capacities to assimilate wastes and maintaining environmental sound capacities to regenerate raw materials, such as healthy air, water and so forth (Arayela, 2002). Therefore environmental sustainability means maintaining both the sources of raw materials and energy within its regenerative and assimilative capacities.

3 Conceptual Framework

Housing policies that focus on quantity, instead of quality, and that ignore the most basic sustainability guidelines, as well as the fact that many developing countries lack housing policy to speak of are issues that need to be addressed. While where such policies exist,

implementation become an outcry. Criteria is synonymous to indicators of environmental sustainability. Odebiyi (2010) stated that it is not clear what the phrases mean for analytical practice. The implication of that statement is that, there are varied criteria or indicators, which suggest the term to be genuine. Odebiyi (2010) studied the environmental equity and sustainability from the art benefit side, and concluded that Environmental Equity and sustainability are of major interest to those outside economics. The European Association for Bio-industries (2008) sets out Environmental sustainability creative for biofuels, the document finds that Environmental and Social criteria are equally important. The building and construction authority (2008) code for Environment sustainability of buildings version 1.0 allocate points for each of the category of the building criteria, which includes: energy efficiency, water efficiency, environmental protection, in door environmental quality, other Green features. Addae et al. (2009) did a stakeholder analysis and local identification of indicators of the success and sustainability of farming based livelihood systems, which sets out sustainability indicators for natural resources management and policy. The document meet further to develop a set of indicator of the sustainability of farming based livelihood systems that can be used to assess or monitor the impact of policy and intellectual change, which will produce two set of indicators, external set of sustainability and the second set comprising local indicators of success. The studies identified internal indicators for sustainability in Uganda under the following themes Natural Physical, Financial, Human and Social.

Alabi (2012) analyzed Environmental Equity and sustainability rejecting the Kaldor-Hicks Criteria finding by Katie and Carol (2006) and Dietz and Neumayer (2007) and advocates a multi-criteria decision analysis (MCDA) framework, that the construction industry can use in ensuring that decision about built assets are balanced, feasible, desirable and as sustainable as possible. Studies by Metal et al. (2008) employed a numerical approach to measure performance, in terms of the following parameters, energy, land, water, materials, greenhouse gases, ozone, site ecology, solid waste, liquid effluents, noise, and quality aesthetics, durability, indoor environmental quality, adaptability, traffic, socio-economic and creative.

Studies by Dietz and Neumeyer (2007) agree that major difficulties with the assessment of sustainability, and the plethora of conceptualization and terminology has led to an equally diverse range of techniques and methods used to assess or appraise sustainability development. Lozano (2008) observes that Sustainability is a difficult concept for people to understand. Studies by Alabi (2012) found that there is a need to refine the decision making process for assessing sustainability applicable to the built environment the author also stresses that this should involve integrating various aspects of sustainability rather than dealing with discrete element of the problem.

Herath and Prato (2006) made use of various methods for assessment of environmental sustainability, which included multi-criteria analysis. Guy and Kibert (1998) discuss the local development of sustainability indicators, the authors concluded that sustainability indicators are principally about raising awareness and making environmental, economic and social sub-systems transparent to citizens and decision makers: whilst Bond and Saunders (2011) brought up a range of assessment issues, including the difference between “green” and “Sustainable” references and benchmarks, target performance levels, potential version actual performance version actual performance qualitative and quantitative criteria. Bond and Saunders (2011) identified three dimensions of assessment criteria (human, site, ecological); Time (past, present, future) and scale (materials, components, site, community, regional, global) and stated that the notion of a universally applicable tool that would be widely adopted in different countries was questionable. Lenz (2006) found that the existing design and assessment tools used do not address the many economic, social and performance facets over the life span of a building; and do not provide building assessment results for all dimensions of sustainable

development. Lenz highlighted that the maturity of sustainability evaluation begins with the assessment of the technical building design and construction costs, followed by the introduction of life cycle costs (LCC) and life cycle assessment (LCA) to the further introduction of social aspects and utility, resulting in an Integrated model that evaluates technical building design in the context of economic, social and environmental criteria.

4 Environmental Sustainability in Nigeria

With an area of 923,770sqkm, Nigeria is the largest country in tropical West Africa. It extends between latitude 4° 16' N and 13° 52' N and between longitude 2° 49' E and 14° 37' E and bounded by Cameroun and Chad Republic to the East, Niger Republic to the North and Benin Republic of to the West. The southern coastline is dominated by the Delta of the River Niger. Although Nigeria is the twelfth largest country in Africa, it contains a quarter of the continents people and a greater population than any other country in Africa. The country has a great diversity of ecosystems that range from the rainforest through dry savannah to dry lands and flat coastal zones to plateaus and highlands. The current environmental issues in Nigeria like most developing countries cover soil degradation, rapid deforestation, urban air and water pollution, desertification, oil pollution - water, air and soil have suffered serious damage from oil spills: loss of arable land and rapid urbanization (Alabi 2012). Erosion is one of the identified ecological problem that have affected many cities. Solid waste characteristics in Nigeria are similar to those of other developing countries and can be classified into residential, municipal and industrial waste (Iyagba, 2012). In many cities, waste is disposed of informally at open dumps.

5 Challenges to Environmental Sustainability

Past studies on sustainability has been focused on areas as wide as tourism (Kruja and Hasaj, 2010). Studies by Lenz (2006) look at barriers that affect the implementation of environmental management initiatives in an organization. The study further notes that the implementation of an environmental management strategy involves several dynamic stages that may be affected by various barriers. The barriers that may affect an organization depend on: its size; incompatibility with corporate culture; lack of information and knowledge; lack of resources; formal and informal management styles; presence of multiple stakeholders with conflicting interest; and the stage of development of the organization of environmental programmers.

Most of these barriers may be related to one another and often the presence of one barrier may increase the likelihood of or lead to, the presence of another barrier. The following strategies that can be utilized to overcome potential barrier and improve implementation of environmental programmers' strategies identified by Djokoto and Dadzie (2013) are: identifying the driving factors that affect an organization; education; training and communication; aligning the organizations environmental management strategies; identifying and sharing resources.

6 Methodology

The research uses desk study, which involves the review of related literature, and Delphi method, which is used in developing variables for the interview and survey questions. A semi-structured interview protocol was used in eliciting information on the challenges of environmental sustainability. The first round of interview involved nine professionals who were selected on a set of criteria (see Fellows and Liu, 2008). The second round of interviews involved three key professionals who were selected based on their knowledge in the field of environmental sustainability and housing to validate or disprove the themes generated by the first round of interviews (Garson, 2007). The first set of answers provided was compared to the extant literature, in other to develop the key variable using the open-ended technique. For

detail on the Delphi and survey methods see (Fellows and Liu, 2008; Fink, 2003). The rationale for adapting this approach hinges on a number of cogent considerations as outlined by Gill and Johnson (2012). Hakim (1997) observed that the method offers a logical template to study selected issues exhaustively, they further assert that approaching research work without being constrained by predetermined categories of analysis contribute to the depth, openness and details of qualitative enquiry. The researcher will be able to have a first-hand experience or in depth knowledge of challenges of housing development on environmental sustainability. Abuja was selected, because of the level of housing development taking place, which will provide the ideal environment to undertake the study. The research used data obtained from interviews for analysis. The questions were first developed using Delphi method to carry out a first round of interviews of nine respondents, who were experts in their field. They included Architects, builders, town planners, estate surveyors, environmental managers and quantity surveyors; however contractors and the end users were not included in the Delphi techniques which culminated in the development of the interview questions.

7 Findings and Discussions

7.1 Challenges of delivering environmental sustainability in housing schemes in Abuja

For the challenges in the delivery of sustainability in housing development the key informants all agree that stakeholders' perception of environmental sustainability and the challenges to the delivery of environmental sustainability is directly correlated and that the relationship is also significant. Some of the challenges to the delivery of sustainability in housing development are the mentality of people who believe that concrete is better than green lawns, the cutting of trees to be used for construction (as wood) and the cutting of the trees to make way for construction work which is in line with earlier findings by Abolore (2012), Agbola (1998), and Watuka and Fiorino (1990). Also a challenge to environmental sustainability is that construction managers and construction supervisors don't know environmental sustainability very well, this may be as result of low level of awareness or lack of awareness as observed by Lenz (2006), and Djokoto and Dadzie (2013). Another notable factor is in the design not being inclusive and integrating nature, the emphasis is on artificial buildings, which agrees with findings by Herath and Prato (2006), Peloza et al. (2012) and Long et al. (1990). Also of note is the finding that there is no articulate policy and legislation that spells out the indices and process to achieving environmental sustainability, which conforms to findings by Lozano (2008), Megbhenu, (2003) and Freeman (1984); non-inclusion of the community in the policy framework to enhance the environment, which agrees with findings by Fiorino (1990), Long et al. (1990), and John et al. (2012). Akintola et al. (2013) notes that there is an implementation gap in adaptive strategy for environmental sustainability as a result of barriers within the residential community.

8 Conclusion and Further Research

The findings from the extant literature and semi-structured interview indicates that land uses, design of houses, affordability and availability of materials for housing, community involvement in activities that would influence or affect the environment and the process in which environmental sustainability would be carried out, policy framework are key factors that need to be considered in overcoming the challenges in environmental sustainability in the Nigerian Federal Capital Territory of Abuja. The non-inclusion of communities and other stakeholders may affect the results obtained, as it is not a true reflection of the generality of the stakeholders. Further research can be carried out to include the exempted stakeholders. A large number of stakeholders may be used, which would allow the use of factor analysis to factor in

the variables as it affects embedding environmental sustainability into the housing delivery process in Abuja.

9 Limitation

The purpose of this research was mainly focused on Architects, Town Planners, Estate Surveyors, Quantity Surveyors, Builders, and Environmental Managers, which is not a true reflection of the totality of the stakeholders in environmental sustainability in the Nigerian Federal Capital Territory of Abuja. Hence the findings cannot be generalized to the totality of the stakeholders group. The number of the Delphi interviews and subsequent personal interviews were limited due to obvious reasons as outlined by the criteria for Delphi techniques.

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EVALUATING THE BUDGETARY RELIABILITY OF DESIGN STAGE ELEMENTAL COST PLAN IN BUILDING PROCUREMENT: A NEW ZEALAND STUDY

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Abstract
Accurate prediction of final tender sums (contract sums) of building projects depends on reliable projections of baseline cost plans developed at the design development stage. However, no matter how much care and effort is put into the preparation of design stage elemental cost plans, deviations are usually observed between these cost plans and the final tender sum. This makes accurate predictions challenging for construction practitioners in New Zealand. The major attributable factors for the observed variability are inherent risks in the design stage elemental cost plan development. Whilst this is recognised, this study evaluates the reliability of elemental cost plans in traditional building procurement. The study seeks to answer the question: is elemental cost plan a reliable budgetary tool for construction projects? The study was undertaken based on 20 completed building projects from which secondary data were collected within the New Zealand construction industry. Data analysis was carried out using document analysis and percentage deviation of final tender sums from the cost plans. Further analyses were carried out using root mean square and relative mean absolute deviation methods of analyses. The results showed that the budgetary reliability of elemental cost plans varied depending on project types. Whilst a deviation of -3.67% and +3.95% was obtained on the residential projects analysed, the deviation on educational projects was between -3.98% and +12.15%. Commercial projects attracted -14.22% and +16.33% while in the case of refurbishment projects, a deviation of -10.07% and +30.14% was obtained. These findings suggest that the larger or more complex a project is, the less reliable it is to use elemental cost plans to guarantee cost certainty.

Keywords: Elemental cost plan, Final tender sum, New Zealand, Reliability, Traditional building procurement

1 Introduction

The main concerns of construction clients in New Zealand are projects delivered within budget, on time, to the expected quality and with no surprises (Alan et al., 2008). Potts (2008) suggested that most clients work within tight pre-defined budgets or cost plans prepared by the consultant Quantity Surveyor at the design development stage. This is normally not expected to be exceeded; otherwise the whole scheme may fail. According to Odeyinka (2010) risks in traditional procurement are covered through the allocation of contingencies to cover both foreseen and unforeseen circumstances in design stage elemental cost plans. This is expected to ensure the completion of a project within the budget or cost plan. However, there are evidences in construction management literature indicating that it is difficult to find a project in which the final tender sum is the same as the design cost estimate/cost plan estimate (Akintoye, 2000; Aibinu and Pasco, 2008; Odusami and Onukwube, 2008; Enshassi et al., 2013).

Further, related studies conducted by researchers in the UK, Middle East, Asia and Africa concluded that in procurement methods where cost plans are used, deviations between the cost plan sums and final tender sums are common. Such deviations in the region of +1% to +12% are mentioned in (Morrison, 1984; Cheong, 1991; Oladokun et al., 2011; Enshassi et al., 2013). According to Zou et al. (2007) the major attributable factors for these deviations are risk elements that are inherent in construction project developments.

Whilst these risk factors are recognised, the study determines the reliability of design stage elemental cost plan in building project procurement. This study provides information on cost plan and final tender sums of selected case study projects in New Zealand. This represents a benchmark for measuring cost planning accuracy or reliability. Although the usefulness of design stage elemental cost plan and final tender sum as pre- and post-contract cost control tools in traditional procurement has been documented, to the best of the knowledge of the researchers, there is no recent documentary evidence of an investigation into the budgetary reliability of design stage elemental cost plan in traditional building procurement in New Zealand construction. As such, the study finds its significance.

2 Literature Review

2.1 An Overview of Elemental Cost Planning

Early study by Dent (1978) defined cost planning as a system for monitoring cost at building design stage such that: (a) tenders do not exceed preliminary estimates; and (b) costs are developed in a way that gives project owners the best value for money. According to Seeley (1996) cost planning is a systematic application of cost criteria to a building design process to maintain in the first place, a sensible and economic relation between project parameters (cost, time, quality and functionality) and in the second place, provide overall control of proposed expenditure as circumstances might dictate. Several contemporary authors including (Ashworth, 2004; Ashworth and Hogg, 2007; Kirkham, 2007; Smith and Jaggar, 2007; Ashworth, 2008) have expressed that cost planning is not only a pre-tender estimating method but also seeks to offer a control mechanism during the design stage.

Building cost planning was originally developed within the framework of the traditional procurement arrangement using conventional documentation, tendering and administration processes. With the advent of alternative forms of procurement and with more fluid approaches to design stage processes and documentation, the need for sound cost planning has not diminished (Smith et al., 2004). Thus, as a process established on solid theoretical foundations, Smith et al. suggested that cost planning should be robust enough to adapt and flourish in a variety of procurement environments.

In view of the above expressions and within the context of the current study, cost planning is simply a term that describes any system of bringing cost advice to bear upon a design process. In the same vein, design stage elemental cost plan is a pre-contract or specifically, a design stage cost control strategy based on elemental cost analysis which is prepared during the design development to give construction clients value for money. This bears in mind the need to meet specific requirements and ensure that available funds for a project are rationally distributed among the elements of the building. In this context, measuring the reliability of an elemental cost plan (a budget) means assessing the quality of the cost plan in term of the expected accuracy range. Consequently, the reliability of a cost plan is determined by whether the expected accuracy range matches the required accuracy range. Meanwhile, the accuracy of a cost plan can be defined as the difference between final tender sum (contract sum) and elemental cost plan sum; this can be measured by the error rate calculated from Equation (1) (An et al., 2011):

[1] *Error rate (%) = (| Final Tender Sum – Elemental Cost Plan Sum|/ Final Tender Sum)* × *100*.

Similar view was illustrated in (Ashworth, 2004) whereby a range of -4% to +15% was recommended as an acceptable parameter for measuring estimating accuracy.

2.2 Previous Studies

Substantive research has been carried out in the field of pre-tender estimating for construction projects, a significant outcome of which is the identification of numerous risks that influence budgetary performance. Also some studies have investigated the accuracy of design stage elemental cost plans and their respective measure of influences, which is similar to the focus of the current study. Several researches (Akintoye, 2000; Enshassi et al., 2005; Aibinu and Pasco, 2008; Odusami and Onukwube, 2008; Onukwube et al., 2009; Oladokun et al., 2011; Jafarzadeh, 2012) have indicated that pre-tender estimating accuracies are significantly affected by the level of risk information available to estimators. These are recognised by this study as fundamental evidence of risk factors causing variability between elemental cost plans and final tender sums (Choy and Sidwell, 1991; Ling and Boo, 2001; Baloi and Price, 2003; Hlaing et al., 2008; Tsai and Yang, 2010).

The disparity between design stage elemental cost plan and final tender sums received in competition for a project would provide further evidence to the issues relating to the accuracy of pre-tender cost estimates in this study. Morrison (1984) had investigated this disparity in the United Kingdom by collecting and analysing data from seven separate quantity surveying firms. Morrison found that a mean deviation of 12% was obtained by the quantity surveyors. Also Ogunlana (1991) reported significant deviations of design cost estimates from accepted tenders using information held by seven design offices in the United Kingdom.

Cheong (1991) found that the disparity between cost plan estimates and contract sums is generally between 5% and 10%. Cheong's study had collected opinions across a wide range of Quantity Surveyors in Singapore. Significantly, Cheong's analysis of 88 projects from one quantity surveying consultancy in Singapore found that variability values between cost plan estimates and contract sums ranged from 33.79% (over-estimates) to 31.30% (under-estimates).

Similarly in Nigeria, Odeyinka and Yusif (2003) using cost data on preliminary cost estimates and lowest tenders that were supplied by 24 quantity surveying firms, found the following: 17 of 40 building projects (42.5%) had their lowest tender sums lower than the Quantity Surveyors' estimates and this ranged between 1% and 47%. 23 of the projects (57.5%) had their lowest tender sums higher than the Quantity Surveyors' estimates and this ranged between 1% and 174%. An analysis of pre-tender cost estimating performance of a Nigerian consulting

quantity surveying firm by Oladokun et al. (2011) found that on 81 building projects there was an estimate bias reflecting underestimates of about 34%.

In a related study, Odeyinka (2010) asserted that no matter how much care and effort is put into the preparation of design stage elemental cost plans, deviations observed between them and the final tender sums are usually significant. According to Zou et al. (2007) the major reason for this is inherent risks in both design and construction. The traditional way of dealing with these risks is merely to allow a percentage as contingency allowance. Thus, the essence of having an elemental cost plan as a budgetary tool for building projects is defeated if these risk elements are not captured or properly evaluated. Overall project objectives regarding cost, time and quality targets become threatened.

2.3 Risk and Cost Predictability

Risk could have different meanings to different people (Baloi and Price, 2003). The concept of risk can vary according to individual's perceptions, attitudes and experiences. For instance; architects, engineers and contractors are more likely to view risk from a technological perspective while lenders and developers tend to view it from an economic and / or financial point of view. Baloi and Price therefore concluded that risk is generally seen as an abstract concept that is difficult to measure. Rezakhani (2012) defined risk as a potential for complications around project completion, achievement of project objectives and an uncertain future event or condition whereby the occurrence rate is greater than 0% but lesser than 100%. Risk generates an effect on at least one of the main project objectives in terms of cost, time and quality targets. Early study by Akintoye and MacLeod (1997) explained that risk has been significant owing to the occurrence of budget/cost and schedule/time overruns associated with construction project developments. Joshua and Jagboro (2007) submitted that risk is inevitable and exposes project activities to adverse consequences of future events. The effect of risk on a project can be positive or negative. To align with the common usage of the word risk, this research embraces the view that benefits or positive impacts of risks on project objectives could be achieved by minimising risk occurrence and its detrimental impacts.

Potts (2008) explained that the budgeted cost established by the consultant Quantity Surveyor at the pre-contract stage forms the basis for the assessment of the tender sums submitted by bidding contractors. The successful tender therefore becomes the final tender sum (contract sum) for the project. Potts suggested that most clients work within tight pre-defined budgets/ cost plans which are usually part of a larger overall scheme. If a budget or cost plan is exceeded, the whole scheme may fail. Pre-contract estimating produces the original budget or cost plan and this forecasts the likely expenditure for the client. The budget or cost plan should be used positively to make sure that the design stays within the scope of the original scheme. Thus, many budget overruns are due to circumstances observed as risk factors and an important issue is the ability to predict such factors and the impact they have on the project. The smaller the level of information available at the early stages of a construction project, the higher is the level of uncertainties and hence risks. This view was shared by Zou et al. (2007) and Taroun et al. (2011). Therefore, as project information increases, risk is expected to decrease.

There has been lesser attention paid to the disparity between design stage elemental cost plan and final tender sums in New Zealand. Recently, Adafin et al. (2014) undertook a preliminary exploration of the theoretical concepts and methods for assessing risk impacts on the variability between design stage elemental cost plan and tender sums in New Zealand. It is apparent that there is a dearth of literature on this subject, which is being addressed by this study.

3 Research Methodology

This study was carried out primarily through the use of secondary data. The research approach collated data on elemental cost plan and final tender sums from twenty completed building

projects located in Auckland (AKL), Christchurch (ChC) and Wellington (WLT), New Zealand. Access was obtained to project records held by three quantity surveying firms based in Auckland. Project records and documents produced by professionals and organizations were explored as the main data analysis for the study (Gibson and Brown, 2009). A thorough examination of their project files within the limitations of the Privacy Act was undertaken. Apart from this project information, five senior partners within the three firms who had worked closely with the projects were interviewed. Project data were collected from four different types of building projects.

Tables 1-5 present the project information obtained for residential, educational, commercial, and maintenance projects. These project details were analysed to achieve the research objective, which was to evaluate the budgetary reliability of design stage elemental cost plans in each of the four project types. For the purpose of anonymity, the projects are coded P01 - P20. In this study, the use of document analysis helped to justify the theoretical conclusions generated from the review, regarding cost predictability. Simple descriptive analysis was used to express the percentage difference between cost plan and final tender sums (Nworgu, 2006). Two further analyses were carried out using root mean square (RMS) deviation, and relative mean absolute (Rel. MAD) deviation methods of analyses as adopted by (Odeyinka et al., 2009). The *RMS* is expressed mathematically as follows:

$$[2]\ RMS = \sqrt{\left\{\frac{1}{n}\sum_{i=1}^{n}(c_i - o_i)^2\right\}}$$

Where *RMS* is the root mean square deviation measure; n is the number of projects investigated, c_i is the cost plan sum for individual project and o_i is the final tender sum for the individual project.

The *Rel. MAD* is expressed mathematically as follows:

$$[3]\ \text{Re}l.MAD = \frac{1}{n}\sum_{i=1}^{n}\frac{|(c_i - o_i)|}{c_i}$$

Where *Rel. MAD* is the relative mean absolute deviation measure; n is the number of projects investigated, c_i is the cost plan sum for the individual project and o_i is the final tender sum for the individual project.

4 Findings and Discussion

Demographic information obtained from participants included their designation, academic and professional qualifications and work experience. Generally, all of the respondents hold tertiary education at HNC/HND/Bachelor's degree levels in quantity surveying, while one of them holds an MBA. They are senior partners in their individual firms and are professionally qualified (three full members and two fellows) with the New Zealand Institute of Quantity Surveyors (NZIQS). The participants have an average of 28 years of work experience in their consultancies. This demographic information indicates that the participants have been involved with running of projects and therefore have some knowledge of issues relating to project cost planning. This also enhances validity of survey data. Therefore, the secondary data provided by them could be relied upon for this study.

Table 1 presents elemental cost plan sums and final tender sums for five residential building projects studied. An analysis of the percentage difference between the cost plan sum and final tender sum gives an indication of the budgetary reliability of the elemental cost plan. It is evident from the Table that the percentage difference between the cost plan and final tender sums ranges between -3.67% and +3.95%. This falls within the ±5% range adopted by

Morrison (1984) as the acceptable accuracy range between the Quantity Surveyor's estimate and the accepted or final tender sum. Similarly, a range of -4% to +15% was recommended by Ashworth (2004) as an acceptable standard for measuring estimating accuracy.

Table 1. Budgetary reliability measures for residential building projects

Project Code	Elemental Cost Plan Sum (NZ$)	Final Tender Sum (NZ$)	Cost Difference (NZ$)	Percentage Difference (%)	Year	Project Location	Procurement System Adopted
P01	7,210,250.80	6,859,266.32	-260,984.48	-3.67	2013	AKL	Traditional
P02	794,456.98	815,257.68	20,800.70	2.62	'12-13	ChC	Traditional
P03	905,500.00	924,680.00	19,180.00	2.12	'12-13	ChC	Traditional
P04	1,914,848.40	1,878,417.15	-36,431.25	-1.90	2013	AKL	Traditional
P05	1,034,360.00	1,075,210.00	40,850.00	3.95	'12-13	ChC	Traditional

Though, traditional contracting systems in New Zealand require contractors to prepare their own quantities in a lump sum competitive contract. The schedules of quantities prepared by contractors are usually in a trade format while cost plans are produced in an elemental format by the consultant Quantity Surveyors during design development stage. Hence, this does not allow a compatible platform for comparison. It is noteworthy that the budget or cost plan established by the consultant Quantity Surveyor during the design development stage forms the basis for the assessment of tender sums submitted by bidding contractors. The successful tender therefore becomes the final tender sum (contract sum) for the project. A thorough examination of the cost plan and final tender summary for each of the five projects studied showed a minimal difference between the cost plan sums and final tender sums. This then suggests that in traditional procurement where elemental cost plan based on New Zealand Institute of Quantity Surveyors (NZIQS) Elemental Analysis of Costs of Building Projects is used, the cost plan tends to be a reliable budgetary tool. This is not unsurprising because residential building projects are usually well defined in terms of design and specification at their pre-construction phases. This view was shared by Ling and Boo (2001) explaining that the risk of variation and change in scope is usually very low during the construction phase for this category of projects.

Table 2 presents the cost plan data and final tender sums for five educational building projects. An analysis of the percentage difference between the cost plan and final tender sums gives an indication of the budgetary reliability of the cost plan. Data on the Table show that the percentage difference between the cost plan and final tender sums range between -3.98% and +12.15%. This range is significant. The high disparity observed, may suggest that the cost plan is not a very reliable budgetary tool in educational building projects. As evident from the cost plan and final tender summary, high variability was observed in some cases which suggested the occurrences of risk factors such as client's change, incomplete design information and site investigation information among others. This finding justifies Potts' (2008) suggestion that failure to keep within the provisions of pre-defined budgets or cost plan is one risk that impacts on a project's budgetary performance and consequently the client's cash flow position.

Table 2. Budgetary reliability measures for educational building projects

Project Code	Elemental Cost Plan Sum (NZ$)	Final Tender Sum (NZ$)	Cost Difference (NZ$)	Percentage Difference (%)	Year	Project Location	Procurement System Adopted
P06	994,678.00	1,084,000.00	89,322.00	8.98	2013	AKL	Traditional
P07	2,403,619.00	2,477,000.00	73,381.00	3.05	2013	AKL	Traditional
P08	944,000.00	906,409.00	-37,591.00	-3.98	2013	AKL	Traditional
P09	34,922,850.00	38,628,000.00	3,705,150.00	10.61	2012	ChC	Traditional
P10	48,833,750.00	54,768,250.65	5,934,500.65	12.15	2012	ChC	Traditional

Table 3 presents the cost plan data and final tender figures for five simple and complex commercial building projects. An analysis of the percentage difference between the cost plan and final tender sums shows a range between -14.22% and +16.33%. This is a very significant deviation. Further scrutiny of the percentage difference for each of the five projects indicates that the larger the scope of the commercial building, the higher the level of disparity between the cost plan sum and final tender sum. A thorough examination of the cost plan and final tender summary for each of the five projects showed a high disparity between the cost plan sums and final tender sums. The observed high variability therefore suggests that the elemental cost plan is not so much a reliable budgetary tool for commercial projects, especially where the project is large in scope and of a complex nature. This further suggests that there is uncertainty in a lot of project information available where large and complex projects are involved. Hence, it is noteworthy that the more uncertain the project information is at the pre-construction stage when elemental cost plan is prepared, the more risky it is for cost certainty to be guaranteed to the client at the end of the tendering process.

Table 3. Budgetary reliability measures for commercial building projects

Project Code	Elemental Cost Plan Sum (NZ$)	Final Tender Sum (NZ$)	Cost Difference (NZ$)	Percentage Difference (%)	Year	Project Location	Procurement System Adopted
P11	1,985,000.00	2,085,369.83	100,369.83	5.06	'12-13	AKL	Traditional
P12	31,000,000.00	26,593,185.00	-4,406,815.00	-14.22	2012	ChC	Traditional
P13	33,225,000.00	38,650,125.00	5,425,125.00	16.33	'11-12	ChC	Traditional
P14	2,850,000.00	3,058,252.85	208,252.85	7.31	'12-13	AKL	Traditional
P15	28,245,000.00	31,285,225.00	3,040,225.00	10.76	2010	AKL	Traditional

Table 4 presents the cost plan data and final tender figures for five refurbishment projects. An analysis of the percentage difference between the cost plan and final tender sums shows a range between -10.07% and +30.14%. This presents a highly significant deviation. It is important to note that the highest positive variability emanated from a small maintenance project and the Table does not reflect a clear-cut pattern of percentage variability. A thorough examination of the cost plan and final tender summary for each of the five projects showed a high disparity between the cost plan sums and final tender sums. The observed significant variability suggests that the elemental cost plan is less reliable as a budgetary tool in refurbishment projects. This is not a surprise as refurbishment projects harbour loaded estimates and assumptions that cater for higher risks due to unknown items involved in terms of scope and complexity at project inception, hence unpredictability regarding cost certainty.

Table 4. Budgetary reliability measures for refurbishment projects

Project Code	Elemental Cost Plan Sum (NZ$)	Final Tender Sum (NZ$)	Cost Difference (NZ$)	Percentage Difference (%)	Year	Project Location	Procurement System Adopted
P16	**2,266,000.00**	**2,522,725.36**	**256,725.36**	**11.33**	**2011**	**WLT**	**Traditional**
P17	**380,341.12**	**342,045.24**	**-38,295.88**	**-10.07**	**2010**	**AKL**	**Traditional**
P18	**666,000.00**	**866,725.36**	**200,725.36**	**30.14**	**2011**	**WLT**	**Traditional**
P19	**805,134.60**	**736,687.56**	**-68,447.04**	**-8.50**	**2010**	**AKL**	**Traditional**
P20	**2,023,490.94**	**2,233,773.04**	**210,282.10**	**10.39**	**2011**	**WLT**	**Traditional**

Further analyses were carried out to determine the budgetary reliability of the elemental cost plan for procuring the different types of buildings previously analysed. *RMS* deviation measure was expressed mathematically in Equation 2. This was converted to a percentage measure through normalization adjustment in order to make it comparable to other measures. In Table 5, this is regarded as the adjusted RMS measure. Odeyinka et al. (2009) justified the relevance of the normalization process as the RMS values obtained in their study are more of the function of tender and final account figures. This is applicable to the current study regarding the comparison between elemental cost plan and final tender sum. Moreover, the adjusted values are relative values that are more comparable.

The fourth analysis is the *Rel. MAD* measure that was expressed mathematically in Equation 3. The results of these analyses are presented in Table 5. As shown in the Table, the normalized / adjusted *RMS* measure and *Rel. MAD* measure are moderately close. This indicates that the two measures are reliable for measuring the budgetary performance of the design stage elemental cost plan under study. From the Table, the reliability ranking based on the normalized *RMS* and *Rel. MAD* measures shows that the elemental cost plan is most reliable as a budgetary tool for procuring residential building projects (Ranked1). This is followed by educational, commercial and refurbishment projects respectively (Ranked 2, 3 and 4). The reliability ranking showed that the elemental cost plan is least reliable as a budgetary tool for procuring maintenance or refurbishment projects. Meanwhile, it is important to note that this result reveals the level of threats involved in relying considerably on elemental cost plan as a budgetary tool. Besides the residential building projects with a budgetary reliability of ± 2.85% that is quite reliable and acceptable, the deviation margins for other project types are quite significant. Hence, Quantity Surveyors need to attach some level of confidence limits to the estimate they give to project owners if interested in cost certainty. This is very important because the deviations observed are as a result of inherent risks in the design stage elemental cost plan development.

Table 5. Elemental Cost Plan (ECP) budgetary reliability measures of different building types

Building Type	RMS Measure (NZ $)	Adjusted RMS Measure (%)	Rel. MAD Measure (%)	Reliability Ranking
Residential	**119,924.48**	**3.00**	**2.85**	**1**
Educational	**3,129,255.85**	**9.15**	**7.75**	**2**
Commercial	**3,410,231.99**	**12.96**	**10.74**	**3**
Refurbishment	**176,956.90**	**17.16**	**14.09**	**4**

Results and findings could be presented either in tables or figures for illustration purposes. These presentation modes could be adopted in the earlier and latter sections (2, 3, 4 and/or 5) when deemed necessary. The table caption should be numbered and positioned before the table as shown in Table 1.

5 Conclusion and Further Research

The aim of the study was to investigate the budgetary reliability of design stage elemental cost plan in procuring building projects using secondary data from completed building projects. This study therefore concludes within the limitations of the data set confined to New Zealand, that in traditional procurement where elemental cost plans are used, there are deviations between elemental cost plan sums and final tender sums. The percentage deviation ranges between -3.67% and +3.95% for residential building projects. It ranges between -3.98% and +12.15% in the case of educational buildings. Commercial buildings attract a range of -14.22% and +16.33%, while it ranges between -10.07% and +30.14% for refurbishment projects. This suggests that besides the residential projects with little and acceptable deviation, the deviations observed in other projects are very significant.

The study concludes further that the elemental cost plan was most reliable (*Rel. MAD* of 2.85%) as a budgetary tool in procuring residential projects. This was followed by educational projects (*Rel. MAD* of 7.75%) and commercial projects (*Rel. MAD* of 10.74%) respectively. The design stage elemental cost plan was found to be least reliable as a budgetary tool in procuring refurbishment projects (*Rel. MAD* of 14.09%). An awareness of the possibility of deviations in different project types in quantitative terms offered by this study makes the design stage elemental cost plan a relevant tool for risk management to avoid budget overrun. Further, given construction projects procured using the elemental cost plan in traditional procurement, inherent risks could be subjected to quantitative assessment and management. Hence, the observed deviation measures could offer a relevant background towards the application of risk management techniques in budgetary and cost control in order to avoid budget/cost overrun in construction projects.

Further development of the work reported here, when further data are collected and analysed, will provide information for the development of a predictive model for application in New Zealand. Future study could also explore a factor approach to the analysis of risks impacting variability between design stage elemental cost plan and final tender sum.

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TENDER PRICE INDEX DEVELOPMENT: A CRITICAL LITERATURE REVIEW OF MODELS FOR PREDICTION

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Abstract
Tender price determination for every construction project remains a critical variables for a successful project delivery. For project participants it is the fundamental concept for which prices for project are appraised. Proper analysis of how much clients investment can afford within appreciable cost is hinged on the Tender Price Index (TPI), which gives and forecasts the average movement in building prices within a certain time frame and much treasured at design stage for effective cost planning The need for cognizant effort by quantity surveyors in giving a realistic price for project remains crucial due to the extent that clients are willing to spend within their budget peripheral. In the domain of accurate tender price index prediction researchers over the years have conjectured divergent views due to variances of statistical method adopted and their interpretations. This paper reviews various models adopted for prediction of TPI as a way of establishing need for further studies that will ensure more accurate prediction. The findings indicate that a combination of two statistical tools give more accurate prediction. In addition, variables used varies from one model to another which was compounded with a common statistical problem of non-stationary. This suggest that variables for tender price index prediction continues to vary from one geographical location to another, this is due to dynamism in economic indicators. Consequently, the need for development of a robust model cannot be shelved in any developing countries due to the fact that these countries have unstable market conditions.

Keywords: Tender Price Index (TPI), Model, Prediction, Review

1 Introduction

Pioneers modeling discussion describe a model as a technique developed to reflect, by means of derived processes, adequately acceptable output and establish series input data (Seeley, 1996). Shafique and Mahmood (2004) posit that a model is an abstraction or a framework for analysis of a system. It assists researchers in unfolding more accurately to reality; it also aids them to describe, predict, test or understand complex systems or events. Thus, models often provide a framework for the conduct of research and might consist of actual objects or abstract forms, such as sketches, mathematical formulas, or diagrams. It involves simplified representations of real-world phenomena (Powell and Connaway, 2004). Consequently, in Tender Price Index (TPI) development, there have been a number of models that have been developed by previous studies. The need for more unbiased methods, and the benefits of quantitative predictive price models in general has been recognised in the construction industry (Li and Love, 1999; Ng *et al.,* 2000:2004) however, the search for more concretive model remains debatable among researchers as new statistical and econometric methods keep on

revolving. As a result, diversity of cost models of varying complexities have been devised by researchers. Statistical methods have been widely applied in TPI prediction, with Regression Analysis (RA) and Time Series (TS) being the most popular approaches. Vector Error Correction (VEC), Fuzzy Sets (Chang et al., 1997), Structural Equation (Akintoye and Skitmore, 1999) and Artificial Neural Network approaches (Williams, 1994). It must be noted that all these methods were adopted as a medium of exploring statistical or econometric methods that will give the best prediction accuracy. In addition, the adoption of any method for the development of any model is founded on availability of the said variables and the conditions existing within geographical context. Hence, the motivation of this study is to critically review the various model for the forecasting TPI.

2 Extant of Tender Price Index Model Development

2.1 Regression Method

Regression are mostly used to examine the relationship between variables. These variables are either dependent or independent and such their measuring effects are hooked on the estimated regression equation. Regression method was the first approach used in predicting of TPI and remains the most popular techniques in modelling of TPI (Bowley and Corlett, 1970; Ng *et al.*, 2004). McCaffer *et al*. (1983) developed a regression model in United Kingdom which was purposefully done to measure the disparity between the input and output price of building contractor. This produced more accurate predictions of tender price movements than the subjective approach (judgmental) current at that time. This model predicted the TPI of buildings during the early design stage. They provided estimates using a library of data containing rate, quantity and date for the constituent elements of previously constructed buildings, inflation indexes and statistical models. However, this model was predicting a set of data covering a period of 9 years, although the statistical result applies that their data straddling 6-6.5 years. On the other hand, Chau (1988) found out that, there was downward trend of TPI to Building Cost Index (BCI) ratio over a period of 16 years in Hong Kong. This shows that a downturn is expected in the output growth of the industry. In using the data from Florida Department of Transportation, Herbsman (1983), developed composite cost index, which was similar to McCffer's (1983) prediction in terms of the exploratory variables used in the measuring of the industry's output. Runeson (1988) proposed a multiple regression model for forecasting building price movements. The dependent variables were market condition index, whereas the predictor variables included the level of building approvals (a measure of demand), the fixed capital formation of building (a measure of current capacity or output of the industry) and the level of unemployment (a measure of capital utilization). It was found that, the R2 was very satisfactory (0.8556) and the average absolute error stood at 3.67%. However, a multiple regression model was not stable over time and its forecasting accuracy diminished. The Building Cost Information Service (BCIS) produced a 2-year forecast of TPI also based on a linear regression model. The input variables consisted of the building cost index, the amount of construction output as well as the amount of construction new orders. The resulting forecasts were then adjusted by using experts' judgment. A major problem in forecasting TPIs is the contractors' unpredictable reactions to changes in construction demand (Akintoye and Skitmore, 1994). Fitzgerald and Akintoye (1995) found that the TPI forecasts produced by BCIS have been generally over-optimistic, leading to systematic forecast error. The mean absolute percentage error (MAPE) of the forecast indices varied from 3.60% at the first quarter forecast horizon to 12.23% at the eight-quarter forecast horizon. By using an optimal linear correction to remove biases and regression proportions of forecast errors, the MAPE of the forecast value was reduced to 2.20% at the first-quarter forecast horizon and 10.52% at the eight quarter forecast horizon. Regression models provide accurate prediction of TPI

movement when price levels are steady that is, moving constantly upward or downward. However, construction prices are mostly affected by market conditions and can fluctuate radically. This is evident in recent world economic crisis, for instance in Ghana, it is very vivid as the cedi remains unstable. Several studies have also shown that the weakness of current models are due to changing economic situations, thus always lead to substantial errors (Taylor and Bowen 1987; Akintoye and Skitmore, 1994; Wong and Ng, 2010), and so have not produced satisfactory results in terms of predicting (Ng *et al.*, 2000). Consequently, Wisnowski *et al.* (2001) argued that, the candid causal relationships between the TPI and the associated variables cannot be revealed in the regression analysis (Yu, 2014).

2.2 Time Series

Time series analysis involves the identification of the nature of phenomenon represented by sequence of observation and forecasting. Box-Jenkins approach (Box and Jenkins, 1970) is the most common used because it offers a more structured way of choosing the specification of the model and estimating the parameters. This technique determines future trends based on past values and corresponding errors. Since a time series method only requires the historical data of forecast variable itself, it is widely used to develop predictive models. The time series method has been used to forecast Taiwan's construction cost indices (Wang and Mei 1998), building costs (Taylor and Bowen 1987), price index (Fellows, 1991; Goh and Teo, 1993; Goh and Teo, 2000; Goh 2005), cost index (Hwang, 2011) and tender price index (Fellows 1991; Ng *et al.*, 2000). In the study of Engineering News Record (ENR) of Construction Cost Index (CCI) by Williams (1994), time series method was compared with linear regression and neural network models with respect to predictability. Taylor and Bowen (1987), however, modelled the tender price index in South Africa which reflected movements in price that contractors charged their clients. Current statistical methods, such as univariate time series models, do not have expounding capability and suitability for short-term predicting (Goh and Teo 2000; Wong and Ng 2010). However, the univariate time series modelling assumes that recent trends to remain relatively steady, it might produce high forecasting errors when the trend discontinues within the projected timeframe (Tong and Lim, 1980). Besides, the limited structure in the time series approach makes them only suitable for short-term forecasting (Wong et al., 2010). This further suggest time series models are not robust enough to endure economic pressure and such it predictive ability is questionable, thus unsuitable when explanation or reasoning is critical (Goh and Teo, 2000; Wong *et al.*, 2010).

2.3 Multivariate Discriminant Analysis

Multivariate Discriminant Analysis is similar to regression analysis, however, the dependent variables consist of classifications that are related to the linear combination of independent variables. Thus, in an attempt to advance the accuracy of TPI forecasts, Ng et al. (2000) in Hong Kong adopted the multivariate discriminant analysis for forecasting directional changes of the TPI by utilizing eight leading economic indicators. These indicators comprised the best lending rate, building cost index, composite consumer price index, gross domestic product (construction), implicit gross domestic product deflator, and money supply and unemployment rate. Two discriminant functions were derived in order to distinguish between 'upward', 'constant' and 'downward' index trends. However, under closer examination the study was uncertain on many fronts. Firstly, the definition of the "constant movement" category of tender price movement change over time. Thus there was constant movement as when the value of the tender price index is the same as the previous quarter (Yu, 2014). In addition, rationalization of the discriminant model by the holdout sample is contentious. The holdout sample selected the best lag periods for the economic indicators in the model. Therefore, the 'holdout sample' is not really held out from the model construction Yu (2014) further argued that the prediction

power of the model can be regarded as poor. Given the clear long term upward trend of the tender price index, the fair benchmark predictions of the direction change would be always upward, which would be correct in 65% of the cases, better than the 59.7% by the model.

2.4 Vector Correction Error

Econometric models were developed for predicting various economic and financial variables, little has been done in the construction industry especially in forecasting the tender price using the VEC modeling approach. Vector Error Correction (VEC) models are readily comprehensible and commonly used to empirically analyse the dynamic behaviour of macroeconomic variables (Price, 1998). This method is also preferred because of its dynamic nature and sensitivity to a variety of factors affecting the measured variable, while it takes into account the long-run equilibrium relationships among the variables in the system (Lutkepohl, 2004) and allows short-term forecasting errors to be eliminated efficiently (Allen and Morzuch, 2006). The forecasting accuracy of the VEC model was also compared with the Box–Jenkins and regression models using the same data set. The MAPEs of the forecast TPI for one quarter ahead generated by the VEC, Box–Jenkins and regression models were 2.9, 11.4 and 4.2%, respectively. It is thus found that the VEC model outperforms the Box– Jenkins and regression models and proved to be efficient and reliable in forecasting the short-to medium-term tender price movements. Wong and Ng (2010) in a similarly studies use vector error corrections by integrating the correlation of co-integration non-stationary variables, which gave better results.

2.5 Neural Network

Williams (1994) developed back-propagation neural network models to forecast the changes in the construction cost index for time spans of 1 month and 6 months ahead. Variables selected as inputs to neural network models include the percentage change in the construction cost index, the prime lending rate, the percentage change in the prime lending rate, the number of housing starts, the percentage change in housing starts and the month of the year related to. The output from the neural network models is compared with prediction made by exponential smoothing and simple linear regression. It was found that the exponential smoothing and regression models produced a sum of the squares of errors (SSE) equal to 2.45 and 2.65, respectively, whereas the SSE for the neural network was 5.31. The forecasts produced by the neural network model gave a greater error than either exponential smoothing or linear regression. It was concluded that construction cost indices could not be forecasted accurately by using the back-propagation neural network model. Similarly, Yu (2014) also argued that neutral networks require massive amounts of data, although the difficulty in the explanation of the theory behind makes its disadvantage. However, there is an increasing trend toward the use of neutral networks, this due to the extent that neutral networks allows for more complex variables to be recognized and make it more flexible to use.

2.6 Structural Equation Model

Akintoye and Skitmore (1994) derived a structural equation model for forecasting TPI. The demand equation comprises the number claiming unemployment-related benefit, the manufacturing output price/input cost ratio, the real rate of interest and the quarterly gross national product. The supply equation comprises the quarterly TPI, the output per person employed in the construction industry, the quarterly building cost index, the working days lost by workers involved in operation of construction industry due to industrial disputes, the number of registered private contractors and the dummy variable to reflect the general increase in prices(see Table 1 at appendix). This model produces inaccurate results as changes in the coefficients of the structural demand and supply equations will change the coefficients of the equation. On the other hand a study done by Asano et al. (2008) using the equation data based

on Akintoye and Skimore (1994) model showed that some values of some coefficients differ and some variables are less significant statistically.

2.7 Integrated Approach

Ng et al. (2004) in further attempt to improve the accuracy, developed a building tender price index (TPI) forecasting model by combining the multivariate regression model with univariate ARIMA mode. This postulation agrees with Granger's (2001) study which suggested that the integration of techniques might further enhance the predictive ability. It was found that the forecasting accuracy between the regression model and time-series model appeared similar when used in a one-quarter TPI forecast. However, the forecasts were improved when the integrated model was adopted. For a two-quarter TPI forecast, the regression model was found to be the most accurate, whereas the time-series model was the worst. The integrated model improved the forecasting accuracy. However, the multivariate regression model still remains doubtful. The model was built on the levels rather than the growth rates of the TPI and other economic indicators, and many of them, including TPI, display strong upward trend, it is very feasible that the correlation is inaccurate (Yu, 2014). This due to the fact that no unit roots test or co-integration test was carried out.

2.8 Further Studies on TPI Modelling Forecasting

Li et al. (2006) observed that the main problem associated with existing methods being used for forecasting the TPI is the limited consideration of market conditions, particularly when the market is unstable. They proposed that the TPI was the power function of the ratio of demand over capacity of the industry, which represented the industry's economic condition. The model is represented by TPI= α (Demand/Capacity) $^{\beta:}$ *β = should be greater than 1 in order to give a slower reaction TPI to a lower ratio and a faster reaction to a higher ratio of demand over capacity; and α = acts as a multiplier to generate the TPI as the desired index value*. Actual quarterly demand in 2002 and 2003 and estimated capacities were used to forecast quarterly TPIs for those two years that were then compared to TPIs generated using completed project expenditures and expert opinions. It was found that the differences between actual and forecast TPIs ranged from 0.9 to 5%. However, Li et al. (2006) does not explain how the experts' views are formed or obtained. The description of the demand measures in their model is also brief, stating only that the "s-curve method was applied" to "workload data". Therefore, it is not possible to either replicate the demand measures or apply it to other countries. Furthermore, Ho (2013) in an attempt to forecast TPI for under incomplete information of the building project proposed the grey system theory. The grey system forecasting is based on a statistical method, which is similar to time-series method. However, in the construction industry, incomplete works do not give actual cost implication hence, using such data cannot be assumed to give accurate results. The forecasting power of this model depends on the identification of appropriate leading variables. However, the proven leading variables of tender price indices are not known. Moreover, the temporal relations of variables are ignored in this models.

3 Conclusion and Further Research

Tender Price index prediction is still evolving, however, as current economy condition remain very vague with anticipated difficulties, clients are searching for professionals who can give them value for their intend investment. For researchers, the search for appropriate tool for the improvement of the predictive power remains the ultimate agenda. From the review the following conclusion were drawn, that included:

- It is difficult to generalize the use of any of the models that were reviewed due to the fact that there are different economic factors or indicators that were used and data span adopted for the various studies were not the same;

- Although, in some cases similar data were used, the results differ from one model to another due to the statistical tools used;
- In addition, a lot of models were hinged on time series and other techniques, have major a problem of stationary. This further indicates an inadequate level of knowledge in statistics on the part of some of the researchers; and
- Furthermore, the use of integrated approach have so far been used by Ng et al. (2004).It thus, shows the robustness of combining two methods, however, there were some weakness (Yu, 2014).

Hence, this suggest that further studies should be carried out on using the integration approach by dwelling on Granger (2001) study which suggested that the integration of techniques enhances the predictive ability of a TPI model. This can be done by improving Ng et al, (2004) work or building a new statistical model based on the combination of two different tools.

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Appendix 1

Table 11. Summary of Review Models

Author	Method	Purpose	Weakness	Conclusion
McCffar et al., (1983)	**Regression**			Can be used when price level are steady constantly upwards or downward. Not suitable for unstable market conditions. Relationship of between TPI and the associate variables cannot be reveal. Non-stationary of variables.
	$\underline{TPI_t} = a + b + o_{t-4}$ BCI_t a and b are estimated of the regression coefficients, O = building Cost Index	Measuring disparity between the input and output price of building contractors	Short run supply was basis for curve in terms forecasting, indicating upward trend only. Prediction covered 9 years instead of 6 to 6.5 (Yu,2014)	
Chau(1998)	$\underline{LMI_t} = 0.8553+0.00912t$ TPI_t where t is the time in quarters	Relation of Labour and Material and Index (LMI) to TPI	Long run supply was basis for curve in term forecasting thus, long run indicates downwards trend only	
Ng et al (2000)	**Multivariate Discriminant Analysis**			It can be use where there are more than one variables from different units or sources
	$Z = -1.079 + 0.264BCI_{t-2} - 0.007BLR_{t-2} + 0.028CPI_{t-2} – 0.012GDP_{t-2} - 0.024GDPC_{t-3} + 0.0251GDPD_{t-2} - 0.080M3_{t-2} – 0.034UR_{t-2}$ **BCI**= Building Cost Index, **BLR**= Best Lending Rate, **CPI** = Composite Consumer Price Index, **GDP** = Gross Domestic Product, **GDPC** = Gross Value of Investment in Building, Construction, Plant, Developers, Margin and Transfer Costs of Land and Buildings, **IGDPD** = Implicit Gross Domestic Product Deflator, **M3**= Money Supply Definition 3, **UR**= Rate of Unemployment.	Predicting changes of a TPI of new buildings in Hong Kong	Handout sample was not held out from the model. Prediction power of the model show only upward trend. Under constant movement there was change over time, that was change in TPI	
Ng et al, 2004	**Integrated Approach**			

(Time series and Regression)	F= 0.512Ra + 0.488ARIMA= period one forecast F= 0.647RA + 0.353ARIMA = period two forecast Régression Analysis $TPI = 66.6274 + 1.6115BLRT_{t-3} + 0.4746BCI_{t-1} -- 0.3117CPI_t – 2.7375UR_t + 0.0932M3_t – 0.00215HSIVA_{t-1}$ ARIMA $TPI_t-TPI_{t-1} = e_t +0.7312e_{t-1} + 0.47_{t-2}$ **BCI** = Building Cost Index, **BLR** = Best Lending Rate, **CPI** = Composite Consumer Index, **M3** = Money Supply Definition 3, **UR** = Rate of Unemployment, and **HSIAV** = Hang Seng Index 100 days Moving Average	Forecasting TPI	No root or co-integrated test was carried out. Model was built on level rather than the growth rate of TPI and other economic indicators. Handout sample was not held out from the model. Prediction power of the model show only upward trend.	The need to introduce a variable for validation was not done. Differencing test was also not done to bring variables to stationary (Box-Jenkin, 1970).
Taylor and Bowen (1987)	**TIME SERIES,** P_t =Price index at time t, *d*= is difference operation, *In*= natural logarithm operator $dlnP_t$= is an approximation of the grow rate of the price P over the time t			
	ARIMA (0, 1,2) $P_t = 1.2864P_{t-1} – 0.3115P_{t-2} + 0.76506e_{t-1} + e_t$	Tender Price Index based on information return from QS firms		Suitable for short term forecasting.
Fellow 1999:1988	ARIMA (0, 1,2)-BCIS $dP_t = 1.161+ 1.33dP_{t-1}—0.473dP_{t-2} + e_t$ ARIMA (0, 1,1) : PSA $dP_t = 0.673 + 0.8891dP_{t-1} + e_t$ ARIMA (0, 1,3) $dP_t = 1.254 + 1.4425dP_{t-1} – 0.7963dP_{t-2} + 0.2063dP_{t-3} + e_t$	BCIS : All-in tender price index PSA : tender price index Davis, Belfield and Everest Tender Price Index	The variables were non-stationary meaning that either mean or variance of the variables are not constant over time.	Errors are forecast when the estimated trend discontinues within the projected timeframe.

Goh and Teo 1993	ARIMA (0, 1,1) $dP_t = -0.38399dP_{t-1} + e_t$	Public industrial buildings tender price index	The indices over time display upward trends indicating that at least means of these indices are not constant	
Goh and Teo,2000	ARIMA (0, 1,1) $dP_t = -0.3864dP_{t-1} + e_t$	Public industrial buildings tender price index		
Goh,2005	ARIMA (0, 1,1) $dP_t = -0.08251dP_{t-1} + e_t$	Building and Construction Authority (BCA)		
Wong and Ng, 2010	**Vector Error Correction**			
	$\Delta tpi_t = 0.0034 - 0.0737\ (longrunrelationship) +0.39\Delta tpi_{t-1} + 0.05\Delta tpi_{t-2} + 0.04\Delta tpi_{t-3} -0.06\Delta tpi_{t-4} + 0.32\Delta bci_{t-1} - 0.11\Delta bci_{t-2} + 0.21\Delta bci_{t-3} + 0.12\Delta bci_{t-4} -0.10\Delta gdp_{t-1} -0.08\Delta gdp_{t-2} -0.12\Delta gdp_{t-3} -0.14\Delta gdp_{t-4} -0.04\Delta gdpc_{t-1} + 0.04\Delta gdpc_{t-2} + 0.17\Delta gdpc_{t-3} + 0.03\Delta gdpc_{t-4}$ where *tpit* is log of quarterly tender price index of building industry in Hong Kong at time t; *bcit* is log of quarterly building cost index at time t; *gdpt* is log of quarterly gross domestic product at time t; *gdpct* is log of the quarterly construction component in gross domestic product at time t; Δ is the first difference operator such that $\Delta tpit = tpi_t - tpi_{t-1}$ for *long run relationship* in their preferred model is as follows: $= tpi_{t-1} + 1.81bci_{t-1} + 1.88gdp_{t-1} - 0.03gdpc_{t-1}$ That is for long run co-integrating equation as follows $tpi_{t-1} = -1.81bci_{t-1} - 1.88gdp_{t-1} + 0.03gdpc_{t-1} + e_{t-1}$ Where e_{t-1} is a white noise random variable with a constant variance and zero mean.	For predicting TPI in Hong Kong first quarter of 1983 and first quarter of 2006	The used of negative coefficient of bid was not explained. From the equation the higher the building cost index the lower the TPI. Which is not normal, but the author did not explain what might have cause for such occurrence.	It is use to correct the ARIMA error of stationary

Akintoye and Skitmore,1994	**Structural Equation**			
	TPI_t= -3.615 + 0.807InBCI_t + 0.009 In STR_{t-4}-0.296InPRO_{t-2}-0.258In FRM_{t-5} +0.003RIR_{t-3} + 0.542In MAN_{t-7}-0.136InEMP_{t-2} + 0.606In GNP_t + 0.061OIL_{t-1} **SUPPLY** ln QS $_t$ = 1.049 + 0.970 ln TPI $_t$ +0.628 ln PRO $_{t-4}$ – 0.695 ln BCI $_{t-2}$ – 0.019 ln STR $_{t-3}$ + 0.239 ln FRM $_{t-8}$ – 0.093 OIL $_{t-1}$ **DEMAND** ln QD $_t$ = -14.051 – 0.766 ln TPI $_{t-3}$ + 1.632 ln GNP $_t$ – 0.011 RIR $_{t-1}$ – 0.249 ln EMP $_{t-4}$ + 1.764 ln MAN $_{t-4}$ **EQUILIBRIUM** ln QS t = 3.281 + 0.197 ln QD t + 0.158 ln QD $_{t-1}$ + 0.106 ln QD $_{t-2}$ + 0.055 ln QD $_{t-3}$ + 0.02 ln QD $_{t-4}$ + 0.016 ln QD $_{t-5}$ + 0.058 ln QD $_{t-6}$ **TPI:**BCIS quarterly tender price index deflated by retail price index, **BCI:** BCIS building cost index deflated by retail price index, **STR:** number of strikes or stoppages, **PRO**: labour productivity, **FRM**: number of construction firms, **RIR:** real interest rate, **MAN:** profit margin in manufacturing sector ,**EMP**: level of unemployment, **GNP**: Gross National Product deflated by retail price index ,**Oil:** Oil crisis dummy	Forecasting price index based on demand and supply curves	Changes in the coefficients of the structural demand and supply equations will change the coefficients of that equation making it inaccurate for forecasting. Variables were not tested for stationarity, e.g. The TPI and GNP for the supply equation	

TOWARDS AN INTEGRATED SUSTAINABLE PROCUREMENT MODEL FOR THE NIGERIAN CONSTRUCTION INDUSTRY: A REVIEW OF STAKEHOLDERS' SATISTISFACTION WITH CURRENT REGIMES

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Abstract
Procurement of public works in Nigeria has been plagued by several ills. Principal amongst these are; inadequate management of the highly competitive contractual relationships, prolonged project time, failing of infrastructure in serviceability requirements, extreme cases of frequent buildings collapse long before the design life has expired and controversial claims. The incidences or accusation of collusion among parties which are detrimental to the projects are burning issues among the Nigerian construction professionals and academics. The aim of this study is to explore stakeholders' satisfaction with the current procurement methods in construction project delivery in the country. The objectives of the research are; to identify stakeholders' expectations for procurement performance in the Nigerian Construction Industry and to explore the level of stakeholders' satisfaction with the procurement methods used. The research employs an exploratory qualitative research approach. 45 respondents who are stakeholders in the construction industry identified through purposive sampling were interviewed. The findings showed that the current methods have not delivered intended benefits to the spectrum of stakeholders. The study concluded that there exists a gap in stakeholders' expectation of performance regarding total project costs, time of delivery, value derivable from projects in their service life and the actual project delivery in the Nigerian Construction Industry. Thus, in developing a sustainable procurement model, stakeholders' perspective is important. Stakeholder's support and buy – in are important being potential users of the new model. Their input, critic and aspirations are necessary ingredients.

Keywords: Construction Industry, Satisfaction, Stakeholders, Procurement, Project

1 Introduction

Construction procurement has become of concern and attracted industry-wide attention considering its critical role in the delivery of intended benefits to project stakeholders (Association for Project Management, 2006). The Construction Industry has struggled to deliver real value to its clients when compared to other industries. This phenomenon scholars argue is largely due to the poor performance of the procurement strategy (Dada, 2012; Dim and Ezeabasili, 2015). According to Love, Skidmore and Earl (1998), procurement performance is a direct measure of the construction industry performance. It is believed that a good procurement is synonymous with successful project performance (Rwelamila, 2010). Hence, Watermeyer (2011) found it appalling, the unwillingness of developing countries and the

paucity of efforts at developing procurement strategy that will deliver better results than currently experienced. Ofori (2000) posits that part of the challenges of procurement in developing countries is that most of the methods used are imported from the developed nations that have different history, culture, technological development and size of industry. Thus, in developing an integrated procurement model for the construction industry in Nigeria, there is need to evaluate stakeholder satisfaction with current methods. This study builds on the works of Dada (2013); Adeojo and Babalola (2013); Ekung, Okonkwo and Odesola (2014) and Omonori and Lawal (2014). The existing studies focused on stakeholder's view of success factors and their engagement on construction projects in the industry. Hence, there exists a gap of an industry-wide inquiry of stakeholders' satisfaction with current methods. The aim of the study is to evaluate stakeholders' satisfaction with the current procurement processes in construction project delivery. The objectives of the research are; to identify stakeholders' expectations for procurement performance in the Nigerian Construction Industry and explore how satisfied the stakeholders are with the procurement methods used in the country. This new study contributes to existing knowledge by providing useful insight into different stakeholders experience as regards construction procurements in Nigeria.

2 Construction Procurement and Stakeholders' Satisfaction

2.1 Construction Procurement

Love *et al*. (1998) argue that procurement is a key factor in attaining client satisfaction and project success. Love, Irani, Cheng, and Li (2002) and Rwelamila (2010) define procurement as "an organisational system that assigns specific responsibilities and authorities to people and organisations, and set out how different elements of a construction project would relate". Also, Greenwood and Walker (2002) describe procurement systems as an arrangement comprising of at least four distinguishable elements:

1. Organization of inputs for the project (how the project will be executed);
2. Relationships of the participants;
3. Reimbursement regimes for participants; and
4. Contractual arrangements.

The definitions above show that procurement entails complex interaction of several components that ultimately determine how construction projects are delivered. The variants of procurement systems used today stem from the need to improve on construction project delivery gains (Babatunde, Opawole, and Ujaddugbe, 2010). Consequently, the selection of the most suitable procurement system is critical for clients and project participants. Thus, an important and contemporary issue for industry practitioners and academics. Construction Procurement methods are broadly classified into Traditional and Non-Traditional types.

2.2 Procurement methods

Literature has identified more than 12 procurement routes through which construction projects can be delivered. These are; Traditional, Design-Build, Construction Management, Management Contracting, Labour Only, Direct Labour, Public Private Partnerships, Partnering, and Strategic Alliance etc. These procurement methods have been classed as traditional and non-traditional types. Traditional procurement method handles the design and construction of a project in two separate phases and by two separate teams (Masterman, 2002; Mbamali and Okotie, 2012). Using this approach, the Client enters into separate contracts with the design team as consultants to produce necessary designs and contract documents. Afterwards, the client signs a separate agreement with the contractor to deliver the project based on agreed criteria. The Client selects a contractor through a tendering process that may

be open, selective or negotiated (Odusami and Bamisile, 1997; Mathonsi and Thwala 2012). The non–traditional types are: Integrated, Management Oriented, and Collaborative/discretionary procurement systems. These are exemplified as Packaged Deals, Turnkeys, Design and Build, Build Operate Transfer (BOT), Design Build Operate Transfer (DBOT); Management Contracting, Construction Management; Public Private Partnerships, Private Finance Initiatives, Partnering, Strategic Alliancing, Concessions, Framework Agreements (Latham, 1994; Rwelamila, 2010).

2.3 Procurements in Nigeria Construction Industry

For over 45years after Nigeria's independence, there was no proper legal framework that regulated procurement in the public sector. Procurements were done based on individual policies of each agency of government fraught with irregularities and corruption. Contracts were awarded based on personal recognition and political office holders used contract awards to settle cronies and families. Succinctly, the World Bank Country Procurement Assessment found:

"*fraudulent practices in the award and execution of public contracts through inflation of contract cost, lack of procurement plans, poor project prioritization, poor budgeting processes, lack of competition and value for money and other kinds of manipulations of the procurement and contract award processes*" (Bureau of Public Procurement, 2015).

In order to mitigate these challenges, the Public Procurement Act of 2007 was promulgated. Thus, Bureau of Public Procurement (BPP) was established in Nigeria to provide a legal/ institutional framework and develop professional capacity for public procurement in Nigeria. The framework covered procurement of goods, works and services. The PPA entrenches the two stage traditional procurement method. This entails the pre-qualification of contractors (technical qualification, financial capability, experience in the industry, adequate personnel, equipment etc.) and financial bidding to select the lowest and most responsive bidder (Adeojo and Babalola, 2013).

Consequently, the main legal frameworks guiding public procurement in Nigeria are Public Procurement Act (PPA), 2007 and Infrastructure Concession Regulatory Commission Act (ICRCA), 2005. The PPA has been criticized for failing to deliver on value for money, transparency, as intended by major stakeholders in the industry due to factors such as failure of the Government to constitute the National Council for Public Procurement and incompetency of procurement officers in running the process. Some successes have however been recorded (Jacob, 2010; Williams–Elegbe, 2012; Bureau of Public Procurement, 2015).

Babatunde, *et al.* (2010) acknowledge the use of both traditional and non-conventional procurement methods in the Nigerian Construction Industry. The study reveals 48.08% of respondents use variants of traditional procurement, 32.69% variants of public private partnership and 19.24% Design and Build methods. The factors that ranked highest in the selection of traditional methods are project completion at estimated time and cost. While the factors that ranked highest in the selection of non-traditional methods are quality assurance and project completion at estimated time.

The Construction Industry Stakeholders in Nigeria have been identified as Architects, Engineers, Project Managers, Builders, Quantity Surveyors, Governments, Local communities, Suppliers and Financial Institutions (Adeojo and Babalola, 2013). Depending on where the projects are located, the local communities are usually willing to accept construction projects geared towards infrastructure development due to years of lack and underdevelopment in certain parts of Nigeria. However, matters of land tenure system, acquisition, adequate compensation, environmental degradation and local participation in terms of employment for the host communities are front burners when it comes to new developments. Experience have

shown that certain social projects such as schools, boreholes, municipal treatment plants, roads, markets, mass housing were poorly delivered (Ekung, *et al.* 2014; Omonori and Lawal, 2014).

2.4 Stakeholder Theory and Construction Project Stakeholders

There is a consensus among many researchers that what is known as "Stakeholder Theory" has its roots in the works of Freeman (1984). Freeman argues that at the organizational level, stakeholder management has a tripartite function. These are: identification of stakeholders, the development process that recognises their needs cum interests and cultivating relationships with them in line with the corporate objectives of the company. Clarkson (1995) asserts that stakeholders can be broadly categorized into two groups. The primary and the secondary groups. Stakeholders that have an official or contractual relationship with an organization such clients, employees, suppliers, and shareholders belong to the former while those not holding such contracts such as government, local community are the latter. Hirsh and Morris (2010) agree with this position.

Turner (1999) opines that "stakeholders" are all the people or groups whose lives or environment are affected by the project but who receive no direct benefit from the project. Thus includes; teams family members, people made redundant by the product of the project, and local community where the project is based. Association for Project Management (2006) views stakeholders as all those who have interests or roles in the project or are impacted by the project. Project stakeholders according to Anderseen (2008) are individuals or groups of people affected by a project or in a position to influence it. These individuals may not have official roles to play on the project. Project Management Institute (1996) defines project stakeholders as individuals or organizations who are actively involved in the project or whose interest may be positively or negatively affected as a result of executing the project.

Despite the above views, Mairnades et al. (2011) strongly posit that there is yet a lot of uncertainties as regards the term "stakeholders". The authors concern stems from delimitation for the word "stakeholder". Who and who are stakeholders indeed? The authors argue that there exist several definitions for the term, therefore creating confusion as to what the term means. Supporting this position, Friedman and Miles (2006), asserts that the term "stakeholder" has been inappropriately used in the past 20years. Though, the term is popularly used by governments, businesses, non-governmental bodies and the Media, there exist more than 60 different concepts and meanings associated with the term "stakeholder" (Bryson, 2004; Beach 2008). Thus, there is an ongoing debate as regards the merits and demerits of the stakeholder theory or whether it is a theory at all (Jones and Wicks, 1999 and Donaldson, 1999).

Nonetheless, the common principle that ran through most of the concepts or definitions is that the Company should take into consideration the needs, concerns and influences of persons or groups who either impact or are impacted by its policies (Federick, 1992). At the organisational level, Cleland (1999) argue that one of the key functions of managers is to develop an organizational structure for a project. This function can be achieved by identifying appropriate stakeholders, specifying the nature of their interest, measuring stakeholders' interest, predicting the future behaviour of each stakeholder, and evaluating the impact of the stakeholders' behaviour on the team's ability to manage the project (project politics).

Eskeroid and Hueman (2013) contest that addressing the needs and challenges of the society entails identifying and managing the needs of stakeholders. The authors suggest that for effective stakeholder management to occur which satisfies the requirements of sustainable development, the following questions require answers;

a) Does value determine the basis of decisions e.g. participation, transparency or fairness?
b) How will the needs of the stakeholders be balanced within the economic, environmental and social interests?

c) To what extent will the values and perspectives of the stakeholders be considered in the short, medium and long-term basis? What of future stakeholders?
d) How far-reaching will the inclusion be in terms of spatial consideration (Gareis, Huemann, and Martinuzzi, 2013) i.e. local, regional, and global stakeholders?

Elkington (1998) uses the term "Triple Bottom Line" to convey the financial, social and environmental performance of a project. The author assets that sustainability could be achieved at the intersection of the environmental, social and financial performance of a project. This is a necessary trade-off for a practicable result (Doloi, 2012). Boyd (2011) views project stakeholders as customers who are either users of the product of the project or those who pay for the project. These stakeholders can be internal or external to the project. It is the project stakeholders that determines whether a project is successful or not depending on the agreed parameters at the beginning of the project and the final project results.

2.5 Project Stakeholders satisfaction

A prominent view in marketing literature as regards customer satisfaction is the GAP model. The model explains that a company must understand its customer expectations and measure its performance against those expectations (Parasuraman, Zeithaml, and Berry, 1985). Strong, Ringer and Taylor (2001) applied the model to the wider field of stakeholder management. The study reveals that timeliness of communication, honesty, completeness of information, the empathy shown by management and treatment of all stakeholders with equity are critical to stakeholder satisfaction.

Satisfaction is identified as one of the challenges of the Construction Industry (Dulaimi, 2005; Nzekwe-Excel, 2012). Traditionally, project team satisfaction derives from meeting the needs of the Client. However, with recent developments in the industry, satisfaction has been redefined as meeting the needs of the clients and other project participants. Construction Industry Development Board (2008) included contractor satisfaction as one of the measures of Construction Industry performance in South Africa. Thus, the success of projects regarding stakeholders' satisfaction is expressed as the extent to which requirements, needs, and expectations of the Client and other project participants are met i.e. key stakeholders.

Boyd (2011) believes there are satisfiers and dissatisfiers that impact on the overall satisfaction of the customer. A satisfier is a project deliverable that if achieved will affect the customers satisfaction positively while a dissatisfier is that which will affect the customer satisfaction negatively if it is not achieved. Thus, highlighted the Maxims of project satisfaction as;

i. Implicitly or explicitly delivering the products that the stakeholders needs or desires
ii. Offering products at quality consistent with the prices
iii. Making projects available in the timeframe specified by the customers
iv. Providing appropriate feedback mechanism
v. Instituting a conflict resolution process that is fair to all the stakeholders.

The APM (2006) defines project success as the satisfaction of stakeholders' needs and thus measured by the success criteria identified and agreed upon at the start of the project. Lim and Zain (1999) explain that from project participant's perspective, project success is construed as the attainment of some established project goals while public or end users perceive project success from satisfaction derivable from the project. Thus, Cleland and Ireland (2004), thought it not strange to see different stakeholders express success/satisfaction from their view point.

Hence, Construction Industry Satisfaction Constructs are Cost, Quality, Time and Utility in a healthy and safe environment (Rwelamila, 2010; Nzekwe-Excel, 2012). Rwelamila (2010) posits that different project procurement systems have varying degrees of impact on meeting

certain stakeholder expectation. These expectations could range from contractor collaboration during the design process, client involvement, reduction in variation, constructability, value engineering, risk sharing and allocation, public accountability to a host of others. The author argued that when the desires of key stakeholders cannot be met by the proposed procurement system an alternative or a variant may be appropriate. Thus concluded that there is a lack of adequate knowledge of procurement systems by construction experts which has been a source of numerous project failures.

In a survey study, Dada (2013) identified that there is no significant difference between the expectation of contractors and clients as regards using the following as parameters for measuring satisfaction in the Nigerian Construction Industry: project completion at expected time, project completion meeting and exceeding agreed quality specifications, project completion at expected cost, transparency and accountability, potential for providing technology transfer, completion for prestige and status symbol.

It is easier to evaluate what stakeholders want at the project level because there is an established technique to do so. The stakeholder analysis is a technique that helps to identify project stakeholders, discern their values, beliefs, expectations and group their level of influence on the project. Thus, at the end of the project the level to which the needs or aspirations of the key stakeholders have been met can be established. However, at the industry level there is much complexity. Stakeholders' satisfaction requires making comments through the aggregation of experiences on numerous unrelated projects. This scenario in itself posed challenges for the research. The paper progresses to the methodology for the research.

3 Research Methodology

This research employs an exploratory qualitative approach. The choice of research methodology was determined by the ontological and epistemological basis of the research and position of literature. Thus, it is important to discuss what constitutes a qualitative research. There are many positions in literature as to what qualitative research entails. However, Mason (2002) succinctly describes qualitative research as that with the interpretivist philosophical approach. Its data generation processes are flexible and sensitive to social context in which the data is produced. Methods of data analysis involves case building which consist of understanding of complexities, details and context. This position is supported by Creswell (1994) and Saunders, Thornhill, and Lewis (2003). It suffices to say, that certain quantitative researchers view qualitative research as less systematic and anecdotal or at best illustrative. Sufficient proof exists in literature that shows that this position is far from the truth. The strategic significance of context and in-depth understanding of the social world remains obvious strengths of the qualitative research.

Key stakeholders in the Nigerian Construction Industry were identified through purposive sampling and interviewed. 45 interviews were conducted. The participants were based in two major Nigerian cities of Lagos and Abuja. The choice of location is due to the concentration of construction activities at these locations. The researcher obtained the consent of the participants regarding their willingness to partake in the study and were informed it is part of an ongoing doctoral research. The interviews were conducted via telephone, thus audio recorded and transcribed for analysis. Table 1 contains list of interviewees according to the stakeholder types.

Table 1. Categorization of interviewees according to stakeholder types

Type of stakeholder	No of interviewees
Government Agency/Procuring Authority	6
Private Sector Client Organization	5
Construction Professionals (Architect, Engineers, Builders, Quantity Surveyors)	12
Construction Companies	8
Informed members of the public	7
Financial Institutions	3
Suppliers	4
Total	45

4 Findings and Discussion

The cross section of respondents admitted to using Traditional, Labour only, Direct Labour, Construction Management, Management Contracting at one time or the other but with limited experience with Design and Build and PPP methods. The interviewees said that it is the clients that determine most of the time the choice of procurement option ably assisted by the consultants after consideration of a host of factors. However, public construction projects delivery at Federal and State levels are governed by the Public Procurement Act, 2007.

The perception of informed members of public concerning the performance of the construction industry regarding its delivery on the cost, quality, time of delivery, and utility basis is less than satisfactory. Projects meant to be delivered within a reasonable period of time get unduly delayed. According to this category of respondents, project costs nearly always escalates. It is common for roads newly constructed to start having potholes within few years of their use. Delivery and maintaining good quality projects have been a challenge. The government hardly carry the public along with good information as regards public infrastructure projects. This in line with the position of Strong *et al.* (2001) with claims that timeliness of communication, the correctness of information, honesty, and a sense of being treated equally affect satisfaction significantly.

Private Sector clients use a wider range of procurement options than the public sector though the public sector is the bigger client. Certain principles such as public accountability, competitive bidding make some procurement options less desirable. Example of such are Cost reimbursable variant of traditional method and Partnering. This is because the tax paying public are less comfortable with the idea of no financial ceiling for projects and fear monopoly in the market. This situation necessitates choosing the most appropriate procurement system and thus impact on stakeholder satisfaction (Rwelamila, 2010). The private sector clients have achieved better delivery of projects because funds are more readily available, delivery of projects are fitted to business outcomes, there is more discipline as regards use of funds, and risk management. The private sector clients feel satisfied with the current methods.

The Professionals' perspective is that more needs to be done concerning choosing appropriate procurement methods to suite the project specifics. The current challenge with funding of national budget has made Public Private Partnership (PPP) a desirable model for government at all levels. However, the PPP is still hardly open enough for scrutiny as there are few of such projects in the country. Most of these projects are still at construction stages. The Financial Institution respondents and Suppliers have been at the receiving end of the imperfection in the industry. These two groups facilitate delivery of projects through the provision of funding, warehousing of funds, provision of performance guarantees and supplying materials. Instability

in the industry affect both groups negatively. The perspectives of the two groups is that while the construction industry has potential for employment generation and increased liquidity, it has performed below expectation. The Construction Company senior management respondents identify delays in payment by Clients, non-effective judicial system for pursuing claims when clients defaults, financial strain in the economy as factors influencing effective procurements. The contractors lament the loss of margin due to stoppage of funding to some projects. Thus admitted the industry can perform better than it is currently in meeting stakeholders' expectation.

5 Conclusion

The study explores stakeholder satisfaction with current procurement regimes in the Nigerian Construction Industry through a quota sampling of key industry stakeholders. The study reveals that there exists a gap in stakeholders' expectation of performance of construction projects and the actual project delivery in the Nigerian Construction Industry in terms of cost, schedule, quality and utility. It suffices to say that satisfaction is low when the spectrum of stakeholders is considered. Thus, in developing a sustainable procurement model, stakeholders' perspective is important. The current research is part of an ongoing research, so the findings of the research will help direct future research in developing a procurement model that will be tailored made to the realities of the Nigerian Construction Industry.

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FINANCIAL PERFORMANCE OF MULTINATIONAL CONSTRUCTION COMPANIES IN SOUTH AFRICA

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Abstract
The paper examines the financial performance of multinational construction companies (MNCC) in South Africa and whether the financial resources of these MNCC are sufficient to meet the demands of the domestic market. The rationale for this examination stems principally from the need for large scale contractors to have enormours resources and capabilities for the execution of construction works in international markets. Although, this has made international markets to be oligopolostic. The research makes use of the Engineering News-Record (ENR) data set as a standard through which the level of revenues and assets of MNCC in South Africa were assessed in order to know whether these financial resources are sufficient for international construction operation. Financial and other relevant data were collected through a qualitative research approach from four MNCC listed on the Johannesburg Stock Exchange (JSE). These data were obtained through an evaluation of the archived data (annual and financial reports); and analysed using content and thematic analysis. The paper establishes that the financial capabilities of MNCC in South Africa are adequate for overseas market operations. This is because their revenues and assets compete favourably with their counterparts from other parts of the world who were ranked among the top 100 by the ENR in 2015. The paper concludes that the construction market in South Africa would tend to be oligopolistic if other African-based construction companies do not build up their financial resources so as to be able to compete in the domestic, cross-border African and International construction markets.

Keywords: Construction companies, Financial performance, International markets, Multinational companies, South Africa

1 Introduction

This paper examines the financial status of MNCC in South Africa. Construction market has become a global market due to the impact of globalization which enables transfer of resources, skills and capabilities mostly from developed to under-developed/developing economies (Ofori, 2000; Ngowi et al., 2005) and vice versa in recent times. Globalization also had made irrelevant national and political boundaries; it has increased economic reliance; and exposed national and societal differences relating to cultures and business issues (Ngowi et al., 2005). However, only large-scale construction companies operate in international markets because international construction projects are often of large scale in scope (Jaring, 2009) and due to the nature and magnitude of risks in the markets when compared to a local market (Gunhan and Arditi, 2005; Loo, *et al*., 2013). The larger the scale of a project, the more is the demand in term of resources (material and human) commitment in overseas operations.

For a company to succeed in international markets, certain level of resources and capabilities are required to meet the demands that may arise due to the magnitude of uncertainties associated with overseas construction. Capabilities are configurations of routines and resources that allow an organization to achieve its goals (Nelson and Winter, 1982). However, dynamic capabilities reflect a firm's capacity to reconfigure its capabilities to adapt to its environment (Eisenhardt and Martin, 2000; Sapienza, Autio, George and Zahra, 2006). The demand for enormous amount of resources (materials and labour) for overseas markets operation had made international markets to become oligopolistic i.e. few large firms control the major shares in international markets (Messner, 2006; Kenter, 2014). However, there are limited studies that establish the experiences of MNCC on international construction markets within Africa. This paper examines the financial records of MNCC in South Africa with a view to establish whether their financial strength are sufficient to meet the demands of the local construction market using the Engineering News Record (ENR) annual ranking of international contractors as a basis of assessment. The research investigates the level of revenues and assets of MNCC in South Africa and how sufficient these resources are for operation in an international space when benchmarked against global standard.

2 Literature review

This section presents a review that justifies the significance of financial indicators as a measure for successful operation of construction companies in overseas markets and outlines the financial performance of international contractors as established by ENR.

2.1 Financial requirements for international market operation

Construction works could be situated either locally or internationally depending on where clients who own the projects or construction companies who execute the projects reside. Similarly, a company becomes international if it exports its services and resources (materials and human) to other markets outside its home country. According to Forlani et al. (2007), a capability is the ability of the firm to successfully manage its assets and activities in the international environment while Eisenhardt and Martin (2000) describes dynamic capabilities as an organizational strategic routine whereby managers alter their firms' resource base to generate value-creating strategies. Similarly, dynamic capabilities reflect a firm's capacity to reconfigure its capabilities to adapt to its environment (Sapienza et al., 2006). The level of uncertainties associated with overseas markets pose a demand on firms going international to be well equipped with certain measures of capabilities before entry into unknown market terrains (Jaring, 2009).

The measures of resources and capabilities that are essential have been argued in literature. In a study by Gunhan and Arditi (2005) on factors affecting international construction, measures of resources and capabilities required for overseas operation highlighted include track record/performance, specialist expertise/human resources, technical skills, international network/experiences, financial strength (revenues) and equipment (assets). Li et al. (2013) established that resources like know-how, capital, technology, equipment and personnel are as significant for firms to attain success in foreign markets. Similar studies further argued that firms going international without having sufficient number of employees, technological base/assets and adequate revenue base are on a suicidal mission (Majocchi, Bacchiocchi and Mayrhofer, 2005; Suarez-Ortega and Alamo-Vera, 2005; Filatotchev, Liu, Buck and Wright, 2009; Serra, John and Abdou, 2012).

In another view, level of resources and capabilities within firms are trio in nature and these cover financial (revenues & assets), human (technical & managerial employees) and experiential (years of operation) (Evans and Berman 1994). The major argument in international business environment is how best or to what advantage these resources are used

in meeting the demands posed due to level of constraints in overseas markets (Grant, 2008; Ballegooiljen, 2010). Tucker et al (2015) established that financial capacity is a predictor of construction company performance. It becomes obvious that firms cannot have a successful operation in foreign markets without being adequately equipped with required resources and capabilities such as financial, human and experiential. Hence, financial resources such as revenue and assets of MNCC in South Africa were considered in this paper. The following section presents a review of the revenues of the Top 250 international contractors as annually ranked by ENR.

2.2 Revenue of the Top 255 international contractors

Engineering News Record (ENR) is a monthly global publication with a focus on ranking of top international contractors, shares of regional markets and construction services among the top rated international contractors. The ranking is based on the level of revenue that individual firm generates annually from global construction markets out of its total revenue. A review of the 2015 edition of the ENR publication reveals revenues of the top rated international contractors over a decade (2005-2014) (see Table 1) while their total revenue between 2001 and 2004 were obtained from other sources (Reina and Tulacz, 2014; Statista, 2015).

Table 1. International Contractors Revenues from 2001-2014

S/N	Year	Revenues (US$ Billion)
1	2001	106.5
2	2002	116.5
3	2003	139.8
4	2004	167.5
5	2005	189.4
6	2006	224.4
7	2007	310.3
8	2008	390.0
9	2009	383.8
10	2010	383.7
11	2011	453.0
12	2012	507.5
13	2013	544.0
14	2014	521.5

(Source: Reina and Tulacz, 2014; Statista, 2015)

In addition, the nationalities and revenues of the top 20 international contractors in 2013/2014 was also examined (see Table 2) and the share of the global construction market across the nationalities of the Top 250 international contractors in 2013 according to the ENR records is further presented in Table 3.

Table 2. International Revenues of the Top 20 International Contractors in 2013/2014

S/N	Contractor Name	Nationality	Revenues (US$ Billion)
1	Group ACS	Spain	44.05
2	Hochtief AG	Germany	34.65
3	Bechtel	Unite States	23.64
4	Vinci	France	20.29
5	Fluor Corp	United States	16.78
6	Strabag	Australian	15.39
7	Bouygues	France	14.79
8	Skanska	Sweden	14.14
9	CCC	China	13.16
10	Technip	France	12.24
11	Saipem	Italy	12.14
12	Constutoral Norberto Oderechit	Brazil	9.88
13	Hunndae Engineering and Construction	South Korea	8.71
14	Ferrovial	Spain	7.42
15	Samsung Engineering	South Korea	7.13
16	Bilfinger	Germany	6.85
17	Samsung C & T	South Korea	6.31
18	Royal BAM Group	Netherlands	5.94
19	Abemsa	Spain	5.82
20	China State Construction Engineering	China	5.74

(Source: Statista, 2015)

Table 3. Share of International Construction Market across Nationalities of 250 Top International Contractors in 2013

S/N	Contractor Nationality	Number of firms	Revenue (US$ Million)	Percentage (%)
1	AMERICAN	31	70,955.4	13.0
2	CANADIAN	2	1,112.4	0.2
3	EUROPEAN	58	272,040.6	50.0
	British – 2			
	German – 5			
	French – 5			
	Italian – 16			
	Dutch – 3			
	Spanish – 13			
	Others – 14			
4	AUSTRALIAN	4	10,589.1	1.9
5	JAPANESE	14	22,243.8	4.1
6	CHINESE	62	79,013.0	14.5
7	KOREAN	13	42,415.9	7.8
8	TURKISH	42	20,409.2	3.8
9	BRAZILIAN	4	12,977.4	2.4
10	ALL OTHERS	23	12,084.6	2.2
	ALL FIRMS	**250**	**543,840.4**	

(Source: Reina and Tulacz, 2014)

Further assessment of the ENR Records presented in Table 4 highlights the level of revenue being generated by international contractors by region in 2013. Prior to this period, the revenues generated by international contractors outside their home countries in 2006 was estimated at US$224.43 with a growth rate of 18.5% from US$184.41in 2005. In 2009, their earnings were estimated at US$383.78 billion and the biggest increases in international contracting revenues came from Africa. Notably, their international revenues in central and southern Africa grew by 31.7% to $29.29 billion in 2009 from $21.04 billion in 2008. North Africa grew by 30.8% to

US$27.52 billion in 2009 from US$21.04 billion in 2008 (Reina and Tulacz, 2010). In 2013, the total revenues of international contractors had grown to US$543.97 billion with Central/Southern and North Africa representing US$41.23 billion (7.6%) and US$21.02 billion (7.2%) respectively (see Table 4) (Reina and Tulacz, 2014). Nevertheless, statistics about other regions such as East and West Africa are excluded. Gaps in infrastructural needs within Africa have received global attention in recent times due to the backlog of physical infrastructure such as power/electricity, roads, water etc. in most of the African states (AfDB, 2011).

Table 4. Revenue of International Contractors in 2013

Region	Revenue (US$ billion)	Percentage (%)
Europe	111.86	20.6
Middle East	84.13	15.5
Asia and Australia	146.47	26.9
United States	48.41	8.9
South/Central Africa	41.22	7.6
North Africa	21.02	3.9
Latin America	54.12	9.9
Canada	34.20	6.3
Caribbean Islands	2.41	0.4
Other Arctic/Antarctic	0.13	0.0
Total	**543.97**	

(Source: Reina and Tulacz, 2014)

3 Research Methodology

A review of literature was carried out to establish the financial requirements for international markets operation and the significance of revenue as a major financial requirement for international construction operations. The study from which data discussed in this paper were obtained employed a convergent mixed methods research approach in data collection and analysis. However, the paper presents a part of the qualitative data analysis result. The study was conducted on South African MNCC construction companies, which are registered with the cidb on Grades 8 and 9. The qualitative strand in form of case studies (interview and documents analysis e.g. annual/financial reports) was conducted on MNCC that are listed on the Johannesburg Stock Exchange (JSE). A sample frame of nine MNCC was obtained and all were listed on Grade 9 with some on Grade 8 in the cidb Register of Contractors. These grades of contractors are considered because they are on the uppermost grade of the cidb Contractor Register in South Africa and are capable of operating in the international space. Out of this, a sample size of 4 was selected for investigation, which represents 44.44% of those construction companies listed on JSE. Data reported in this study were obtained through the evaluation of the archived data (annual and financial reports) of MNCC in South Africa, which were mostly obtained from the companies' websites. These data include their grade, region of operation/geographical presence, construction services being exported/areas of specialization, revenue, assets, number of employees, and international experiences/year of establishment/listing. Other data extracted are risks encountered and entry models to African markets. Data obtained were analyzed using NVivo in forms of content and thematic analysis.

4 Findings and Discussion

4.1 Background information of the JSE listed companies in the case study

Table 5 presents the background information about the companies who were selected as the cases in the study. There were 4 cases and each of them registered on grade 9, which means that the cases constituted the large-sized contractors in South Africa. All are registered to

execute large scale infrastructural projects which are mostly general building and civil engineering works. Most of these cases had been established for more than 4 decades and listed on JSE. Similarly, the permanent workforce on the payrolls of most of these cases are more than 10,000 and they operate in African countries, Middle East, Eastern Europe etc. These data show that the cases/JSE listed MNCC investigated are actually large-scale contractors; have adequate experiential and human capitals; are operating in international space and could be described as international contractors.

Table 5. Background information of the cases/JSE listed companies

Type	Grade	Class of work	Year Established	JSE Listed	Current Employees	Regions of operation
A	9	9CE & 9GB	1971(more than 40 years)	2007	>12,000	Africa countries, Middle East, Abu Dhabi & Qatar
B	8, 9	8GB, 9CE & 9GB	1984 (more than 30 years)	nil	>1,000	Southern African Development Community (SADC)
C	9	9CE & 9GB	1974(more than 40 years)	1978	>12,000	Africa countries, Middle East & Eastern Europe
D	8, 9	9CE & 9GB	1970(more than 40 years)	1994	>14,000	SADC, Middle East, Indian Oceans Islands

Key: CE- Civil Engineering; GB- General Building; CEO- Chief Executive Officer
(Source: Authors, 2015)

4.2 Financial resources and capabilities of the cases/JSE listed companies

This paper examines how the cases/JSE listed MNCC in South Africa behaved financially over a period of ten years. The results as presented in Table 6 and Figure 1 show that the revenues of these companies range between 2.57 to 36.039 billion rand. The average revenue for company A over a period of ten (10) years was 7.418 billion rand; and 33.736, 9.630 and 14.165 billion rand for companies B, C and D respectively. These are equivalent to US$539.065million, US$2.544billion, US$726.244million and US$1.068billion for companies A, B, C and D respectively.

Table 6. Revenues of the cases/JSE-listed companies (2005-2014)

	Companies (US$ Billion Rand)			
Year	**A**	**B**	**C**	**D**
2005	-	10694	4939	4765
2006	-	11098	5865	5795
2007	-	17815	7689	8128
2008	2570	27898	8900	10784
2009	6317	32684	12090	14769
2010	7417	31962	11338	15201
2011	8998	30535	9207	14767
2012	8068	35406	9805	17893
2013	9057	34575	11131	23773
2014	9498	36039	15340	25777
Average	**7418**	**33736**	**9630**	**14165**

1 US Dollar = 13.26 (Accessed October 12, 2015)

This is significant when compared with the total revenue of the top 250 international contractors in 2014 as ranked by ENR (Reina and Tulacz, 2015). In addition, these are higher than the total revenues of most of the contractors ranked on the ENR list. The extract of the revenues of the top 100 international contractors in 2014 is shown in Table 7 and the result shows that the revenues of the cases examined can compete favourably within this group as

ranked by ENR. However, most of the contractors with ranking below 100 on a total rank of 250 international contractors had total revenues less than that of MNCC in South Africa in 2014. However, company B has the strongest financial base followed by companies D, C and A.

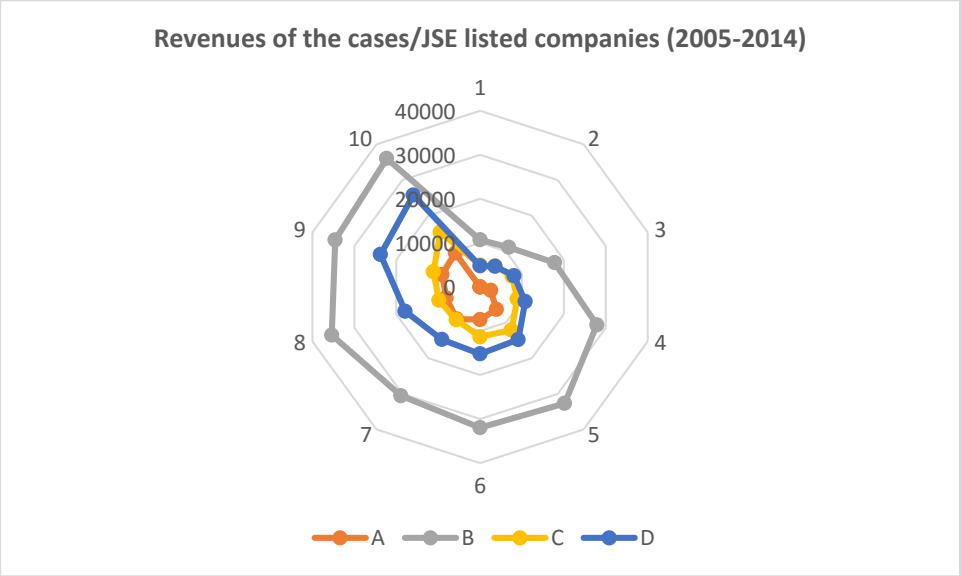

Figure 1. . Revenue of the cases/JSE listed companies (2005-2014)

Table 7. Total revenue of the Top 100 international contractors in 2014

S/N	Ranking		Name	2014 Total revenue (US$ Billion)
	2015	**2014**		
1	62	85	POLIMEKS INSAAT TAAHHUT VE SAN TIC. AS, Istanbul, Turkey	2.2026
2	65	52	ENKA CONSTRUCTION AND INDUSTRY CO. INC, Istanbul, Turkey	2.1389
3	69	66	VAN OORD, Rotterdam, The Netherlands	2.5663
4	74	84	CHINA INT'L WATER & ELCTRIC CORP., Beijing, China	1.5417
5	79	81	JOANNOU & PARASKEVAIDES GROUP OF COS, Guemsey, Channel Island, UK.	1.3801
6	80	78	MAIRE TECHNIMONT, Milan, Italy	1.6137
7	82	83	TAV CONSTRUCTION, Istanbul, Italy	1.4544
8	85	105	THE ARAB CONTRACTORS CO., Cairo, Egypt	2.3670
9	86	93	CGCOC GROUP CO. LTD, Beijing, China	1.1098
10	89	157	CALIK ENERJI SAANAYI VE TICARET AS, Ankara, Turkey	1.0107
11	90	101	TEKFEN CONSTRUCTION & INSTALLATION CO. INC, Istanbul, Turkey	1.3460
12	91	64	SHANGHAI ELECTRIC GROUP CO. LTD, Shanghai, China	1.5360
13	92	107	ANT YAPI CONSTRUCTION, INDUSTRY & TRADE CO. LTD, Istanbul, Turkey	1.0568
14	94	96	CONDOTTE SPA, Rome, Italy	1.5364
15	95	99	ARABIAN CONSTRUCTION CO., Abu Dhabi, U.A.E.	1.0484
16	97	106	BAUER AG, Schrobenhausen, Bavaria, Germany	1.1690
17	99	118	SHANGHAI CONSTRUCTION GROUP, Shanghai, China	0.9095

(Source: Reina and Tulacz, 2015)

The result on the assets of the companies presented in Table 8 and Figure 2 reveal that the assets of the MNCC's studied in South Africa range between 2.291 to 24.532 billion rand. In a period of ten (10) years, the average revenue for company A was 5.555 billion rand, 18.494 for company B and 7.833 and 8.304 billion rand for companies C and D respectively. These are equivalent to US$418.929million, US$1.395billion, US$590.724million and US$626,244billion for companies A, B, C and D respectively. These are significant assets when compared with their revenues. Company B has the highest asset base followed by D, C and A respectively.

Table 8. Total assets of the cases/JSE listed companies (2005-2014)

	Companies (Billion Rands)			
Year	**A**	**B**	**C**	**D**
2005	-	8104	2867	2291
2006	-	10385	4904	3008
2007	-	13011	6888	4248
2008	4371	21650	9250	7958
2009	5024	23493	10373	9608
2010	5027	21952	9950	9358
2011	5604	19560	7771	9492
2012	5991	22442	7589	11342
2013	6571	24532	8804	12337
2014	6298	19811	9933	13398
Average	**5555**	**18494**	**7833**	**8304**

1 US Dollar = 13.26 (Accessed October 12, 2015)

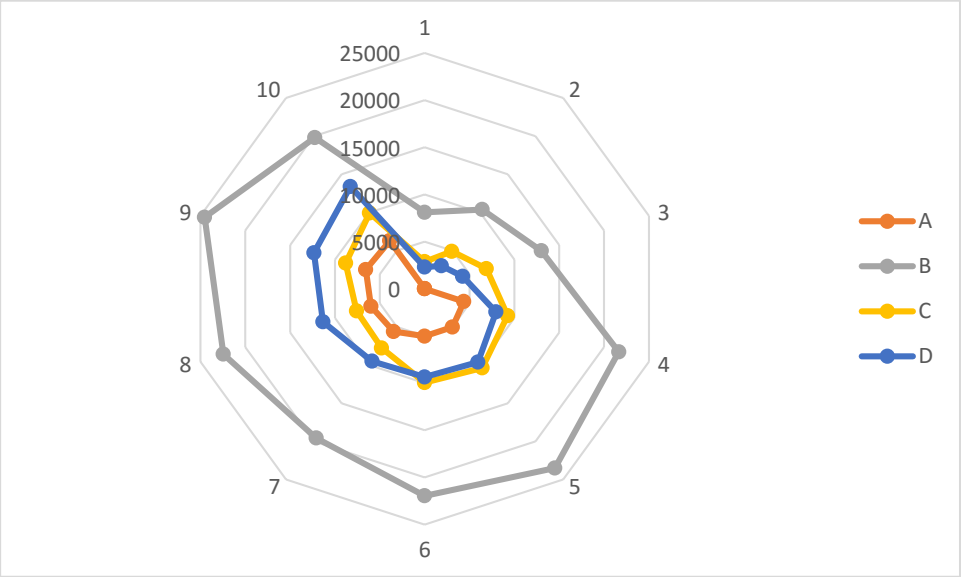

Figure 2. Assets of the cases/JSE listed companies (2005-2014)

From the result of international contractors ranking by ENR in 2015, it was established that there are contractors among the top rated 250 international contractors that has revenue that is as low as US$101. 9 Million (Reina and Tulacz, 2015). However, the average revenue of MNCC examined in South Africa over a period of 10 years range between US$7.418 to 33.736 Billion. Within the same period of years under review, the least total revenue among the cases/JSE companies investigated was US$2.570 Billion with the maximum up to US$33.736

Billion. These figures reveal that the total revenue of the significant number of international contractors as ranked by ENR are below the revenue of MNCC in South Africa. This therefore supports the argument that the financial performance of MNCC in South Africa are adequate and this place them on leverage to compete globally.

5 Conclusion and Further Research

This paper examines the financial performance of MNCC in South Africa and this was achieved through cases investigation (annual and financial reports) of JSE listed construction companies. A review of extant literature reveals that financial resources and capabilities such as revenues and level of assets are significant for any firms intending to internationalize. It was established in the cases conducted that there are construction companies in South Africa that are multinational because they are of large scale and have adequate financial, experiential and human capitals. It was further revealed through data obtained that the revenue of MNCC in South Africa is adequate when compared with the total revenues of the top 100 international contractors in 2014. The paper concludes that the construction market in South Africa would tend to be oligopolistic if other African-based construction companies do not build up their financial resources so as to be able to compete in the domestic, cross-border African and International construction markets. Further research that aims to employ financial ratios in establishing the level of financial performance of the cases/JSE listed construction companies is proposed.

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CONCEPTUAL FRAMEWORK OF INFLUENCING FACTORS FOR DESIGN DOCUMENTATION QUALITY

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Abstract
Globally and in South Africa, inadequacies in construction design documents negatively impact upon the implementation of engineering construction projects. To date, research studies have focused on the ranking of the factors within the design process that influence the quality of design documentation. However, there has been limited attempt to explore the nature of the interrelationships amongst these factors or to quantitatively illustrate their collective impact on design documentation quality. The overall goal of this on-going research is to develop and test a structural equation model empirically illustrating the nature of interrelationships and collective impact of these factors within the context of the South African construction industry. This paper details the initial stage involving the development of the conceptual model. A comprehensive literature review was undertaken to identify indicators of and factors within the design process that influence the quality of the design documentation. Thirty-seven factors were identified. These were categorised into four latent constructs namely; Industry, Client, Design professional and Design firm related factors. Furthermore, six indicators of design documentation quality were identified. These findings provided the basis for the development of a conceptual model illustrating the hypothesized interrelationship amongst the factors and their impact on quality of design documentation. The conceptual model provides preliminary support and a foundation for further empirical investigation aimed at refining and validating the model within the context of the South African construction industry.

Keywords: Design documentation quality, Design process, Influencing factors, South Africa

1 Introduction

The construction industry is widely recognized as a significant contributor to the social economic development of countries. The provision of physical infrastructure through the implementation of construction projects provides employment opportunities, increases economic productivity and improves the quality of life of citizens (Kessides, 1993; World Bank, 1994).

A typical engineering construction project has three principal role players namely; Project owners or clients, who set the operational criteria for the completed project, provide indication of acceptable costs and delivery period for the construction project; designers who are responsible for producing the design documents that meet the needs of the project owner, and the contractors who are responsible for the execution of the work in accordance to the design documents as prepared by the designer (Oberlender, 1993). Thus in traditionally procured engineering construction projects, there is a separation between design and construction.

Engineering design is described as the process of applying various techniques and scientific principles for the purposes of defining a device, process, or a system in sufficient detail to permit its physical realisation (Reymen, 2001). It is a collective effort combining the skills and knowledge of a number of individuals often working within a design organisation (Emmitt, 2007). A key product of this process is the design documents. These include drawings, project specifications, bills of quantities, construction site specific documentation e.g. geotechnical and topographical surveys. The design documents serve as the link between the design and construction phases of a project and by extension provide the means through which the client's needs are realised. Therefore, it is crucial that the contractor is provided with good quality design documentation containing all information necessary to enable the physical construction activity to be carried out as required, efficiently and without hindrance (Tilley *et al.*, 1999).

The International Standards Organisation (ISO) defines quality as "the degree to which a set of inherent characteristics fulfil requirements." Degree in this definition means the level to which a product or service satisfies. Characteristics are features of the product that are meant to satisfy. Requirement refers to the needs of the customer (ISO 9000:2005.,). Adopting this definition for the research, with the customer being the contractor; it is then implied that the design documents need to embed certain characteristics and meet the expectations of the project participants in order to be described as being of either poor or good quality. Subsequently, good quality design documentation is characterised by being complete, internally consistent, unambiguous and providing the relevant information on time (Ballard and Koskela, 1998; Emmitt, 2007; Tilley *et al.*, 1999). Tilley *et al.*, (1999) assert that the desired characteristics or attributes associated with the quality of design documentation are: accuracy, completeness, coordination, conformance, clarity, consistency, relevance, standardisation, certainty and representation.

Despite the recognised importance of the construction industry and the associated significance of good quality design documentation, globally inadequacies in construction design documents have been identified as negatively impacting upon the implementation of construction projects (Assaf and Al-Hejji, 2006; Hwang *et al.*, 2009; Josephson *et al.*, 2002; Love and Li, 2000; Love, 2002; Love *et al.*, 2006). Similarly in South Africa, the poor quality of design documentation is identified as a significant contributing factor to project delays (Baloyi and Bekker, 2011; Ramabodu and Verster, 2013); cost overruns (Baloyi and Bekker, 2011; Ramabodu and Verster, 2013; Ramabodu and Verster, 2005) and poor quality (cidb, 2011; Emuze, 2012; Emuze and Smallwood, 2011; Simpeh *et al.*, 2011).

The studies undertaken in South Africa, although not specifically examining the quality of design documentation, provide anecdotal evidence indicating that the quality of design documentation is problematic within the South African construction industry. Notwithstanding this, no known research has been undertaken to specifically investigate the quality of design documentation and the factors that influence it within the context of the South African construction industry. Although lessons could be drawn from studies undertaken in different countries (Abdalaziz, 2009; Love *et al.*, 2006; Minato, 2003; Mohammed, 2007; Philips-Ryder *et al.*, 2013; Samuel, 2011; Slater and Radford, 2012; Tilley *et al.*, 1997; Tilley *et al.*, 1999) and in South Africa (Windapo and Cloete, 2012), a significant number of these studies were undertaken in the context of developed countries in Europe and Asia and focused on identifying and ranking the factors within the design process that influence the quality of design documentation. There has been limited attempt to explore the nature of the interrelationships amongst these factors or to quantitatively illustrate their collective impact on design documentation quality.

The overall goal of this research is to develop and empirically test a structural equation model illustrating the nature of interrelationships and collective impact of these factors on design documentation quality within the context of the South African construction industry. Specifically, this paper details the initial stage involving the development of the conceptual model based on a comprehensive review of pertinent literature.

2 Literature review

In addition to communicating the design intent, design documents play a significant role on construction projects. They influence the attainment of the construction project performance objectives of quality, cost and time, facilitate the identification and allocation of risk amongst the parties (Yong and Mustaffa, 2011; Chua *et al.*, 1999); and in the case of Bills of quantities, these are used for cost estimation and cost control purposes throughout the lifespan of the construction project. (Davis *et al.*, 2009). Results from studies undertaken in a number of countries: Australia (Mclennan and Parminter, 2001; Slater and Radford, 2012; Tilley *et al.*, 1997; Tilley *et al.*, 1999), Japan (Minato, 2003), Lithuania (Samofalov and Papinigis, 2010), UK (Samuel, 2011) and Saudi Arabia (Darwish, 2007) indicate a general perception of the existence of poor and a continued decline in the quality of design documentation.

The inadequacies identified in the design documentation include missing information, uncoordinated and conflicting information in the various documents provided, incomplete information, non-applicable details, lack of clarity and failure to use standard details where suitable (Darwish, 2007; Minato, 2003; Samuel, 2011; Tilley *et al.*, 1999).

Whilst there is general agreement on the issue of poor quality of the design documentation, the nature of inadequacies varies from country to country. In the Japanese construction industry, contractors identified incomplete design documentation specifically failure to obtain regulatory approvals prior to construction, as the most significant design document related problem (Minato, 2003). Within the UK construction industry, Samuel (2011), established that, lack of clarity and inaccuracy of project specifications, engineering drawings and bill of quantities negatively impacted upon the efficiency and effectiveness of the tender process. Arain *et al.*, (2004) identified insufficient details on the working drawings as a significant cause of discrepancies during the construction phase of a project.

The above variances suggest that issues related to the quality of design documentation are influenced by the local or context-specific characteristics of the construction industry in question. These unique characteristics need to be taken into consideration in efforts aimed at addressing the quality of design documentation.

2.1 Indicators of quality of design documentation

In a significant number of studies, the quality of design documentation was determined based on the perceived level of incorporation of the design documentation quality attributes (Darwish, 2007; Minato, 2003; Slater and Radford, 2012; Tilley *et al.*, 1999). However, some authors suggest alternative and objective indicators that could be used to gauge the quality of design documentation. These indicators consist of revisions to drawings; Request for Information (RFI); issuance of new engineering drawings; the number of variation orders; submission of Early Warning; and Field technical queries (NEC, 2005; Philips-Ryder *et al.*, 2013; Tilley *et al.*, 2002; Tilley *et al.*, 1997) . The notation Q1-Q6 is used to refer to the above indictors in in the conceptual framework.

Philips-Ryder *et al.*, (2013) argue that design documentation issued during the construction phase is often aimed at correcting deficiencies in the original documentation and, therefore, is a good indicator of the quality of the original design document. Similarly, Tilley *et al.*, (1997) reports using information obtained from drawing registers and the RFI process as indicators of

quality of design documentation. The New Engineering Contract suite of documentation specifically refers to the early warning as the means of notification of events that could affect the project costs and timelines. In practise, the Early warning system is often used to provide notification with respect to delay in the provision of information and cost impact of changes to design drawings. This is used in conjunction with the risk register and compensation event clauses (NEC, 2005).

2.2 Review of factors influencing the quality of design documentation

Several studies have reported on the factors that influence the quality of design documentation (Abdalaziz, 2009; Darwish, 2007; Love and Li, 2000; Love *et al.*, 2006; Mclennan and Parminter, 2001; Minato, 2003; Philips-Ryder *et al.*, 2013; Slater and Radford, 2012; Tilley *et al.*, 2002; Tilley *et al.*, 1997). A number of the studies have used different approaches to categorise these factors. Tilley *et al.*, (1999) within the context of project delivery, categorised the factors based on the typical construction project phases (that is project initiation phase, design phase, tendering phase and construction phase) while Abdalaziz (2009) grouped the factors into client related factors, tender procedures and designer related factors.

Hales and Gooch (2004) identify a number of factors that influence the engineering design process and as a consequence, the products of the process. These factors are grouped based on the level of influence namely macro-economic, micro-economic and corporate / organisational level factors. Considering the context of this research, the influencing factors for design documentation quality within the design process were categorised under four main latent constructs (see Table 1). Two of the categories, namely Design professional and Client related factors; were based on the major role players on a construction project. The influence of the economic environment and the design organisation was reflected in the choice of the categories of Industry and Design firm related factors respectively.

Table 1 presents a summary of the four latent factors and their respective indicators as identified from the literature review. The frequently reported Client related factors influencing the quality of design documentation are client expectations with respect to time required for design, quality of project brief; and no focal person on client team responsible for design coordination and providing information. Lack of quality control practices and procedures in the generation of design documentation, failure to adopt quality assurance systems and failure to provide relevant training to staff are highlighted with respect to the Design Firm related factors. While low design fees and the use of inexperienced designers were identified as the Industry and Design Professional related factors respectively.

Table 1. Factors influencing the quality of design documentation

	INDICATORS/ATTRIBUTE	SOURCE										
		Tilley *et al.*, (1999)	Love & Li (2000)	Tilley *et al.*, (2002)	Minato (2003)	Love *et al.*, (2006)	Darwish (2007)	Abdalaziz (2009)	Slater & Radford	Mcleannan & Pariminter (2001)	Phillips-Ryder *et al.*, (2013)	
CLIENT (CR)												
C1	Client expectations with respect to time required for the design.			✓	✓		✓		✓	✓		
C2	The quality of the project brief provided.				✓	✓	✓		✓			
C3	No focal person responsible for design coordination and providing information.				✓		✓	✓		✓		
C4	Clients lack of relevant project experience.				✓		✓			✓		
C5	Changes to client requirements.				✓		✓	✓				
C6	Insufficient and missing information input			✓	✓			✓				
C7	Provision of wrong information by the client.			✓	✓			✓				
C8	Failure to review the design documentation.				✓		✓	✓				
C9	Provision of conflicting information.							✓				
C10	Client expectations with respect to time required for construction.				✓							
C11	Client's insistence to commence construction prior to completion of the detailed design phase.						✓					
DESIGN FIRM (DF)												
D1	Lack of quality control practices and procedures.		✓							✓	✓	
D2	Failure to adopt quality assurance systems e.g. ISO 9001.				✓				✓		✓	
D3	Failure to provide relevant training to staff.				✓		✓	✓				
D4	Inadequate design review processes.			✓				✓				
D5	Work overload on designers due to low staff levels						✓	✓				
D6	Poor allocation of time with consideration to available workload.					✓		✓				
D7	Lack of relevant software.								✓			
D8	High staff turnover.					✓						
D9	Inadequate supervision of junior design staff.						✓					
INDUSTRY (IR)												
E1	Low design fees.	✓		✓	✓		✓	✓	✓			
E2	Selection of design firms on the basis of lowest price offered.				✓		✓	✓	✓	✓		
E3	Shortage of civil engineering skills				✓		✓		✓	✓		
E4	Low emphasis on professional standards.						✓		✓			
DESIGN PROFESSIONAL (DR)												
F1	The designer is inexperienced.			✓	✓		✓	✓	✓	✓		
F2	Lack of coordination between different design disciplines.		✓		✓	✓		✓	✓		✓	
F3	Limited time available for checking and coordinating all design documentation.			✓	✓	✓		✓		✓		
F4	Improper use of design software.				✓	✓	✓		✓			
F5	Reuse of design documents and details from previous projects without effective review.						✓	✓		✓		
F6	Designer's unfamiliarity with construction techniques and materials.				✓			✓	✓			
F7	Heavy work load on the designer.				✓			✓	✓			
F8	Poor communication amongst multi-disciplinary teams.				✓				✓			
F9	Failure to understand the client brief.				✓							
F10	Lack of experience on similar projects.							✓				

3 Research Method

A comprehensive literature review was undertaken to identify factors within the design process that influence the quality of design documentation. In addition indicators of design documentation quality were sought. Google scholar was used as the primary electronic search engine to narrow down the literature consulted to peer-reviewed articles. The keywords used included design documentation, design documentation quality, construction design management, construction design documentation, South Africa construction industry and a combination thereof. After a preliminary perusal of the literature, additional keywords such as contract documentation and Request For Information (RFI) were used to identify other relevant articles for inclusion in the study. The reference lists of these articles were also used to identify additional articles that could contribute to the research. This paper reports specifically on the findings with respect to factors within the design process that influence the quality of design documentation.

4 Proposed Conceptual framework

The findings from the literature review provided the theoretical framework for this study and a basis for the development of a conceptual model. It is hypothesised that factors that are attributed to the industry (IR), the design firm (DF), the client (CR) and design professional (DR) collectively influence the quality of the design documentation. It is further hypothesised industry related factors (IR) may influence the occurrence of client (CR) and design firm (DF) related factors. This influence could, for example, be through legislation regarding selection criteria for engineering design consultants and levels of professional fees paid for their services. Engineering design is often undertaken by designers with complementary skills and experience working within an engineering design firm. It is this set of complimentary skill and experience that the client seeks when appointing a design firm to find a solution to a problem. On this basis, it is assumed that through this interaction, the client related factors influence the occurrence of the design firm related factors. In addition, considering the umbrella role played by the design firm, it is hypothesised that the design firm mediates the influence of industry and client related factors on the design professional.

The proposed model shown in figure 1 explores and it illustrates the hypothesized interrelationship amongst the factors and their impact on quality of design documentation. The latent variables that represent the constructs in the research are shown in the oval symbols while the indicators or measurable attributes of the constructs are shown in the rectangles. The number notation for the indicators is the same as that shown in Table 1. The direction of the arrows represents the hypothesised influence in the model.

The conceptual model provides preliminary support and a foundation for further empirical investigation aimed at quantitatively illustrating the nature of interrelationship and collective impact of these factors on the quality of design documentation within the context of the South African construction industry. In order to examine the nature of the relationship between the design process factors and the quality of design documentation, the research sets out the following hypothesis:

Hypothesis 1: The occurrence of industry related factors (IR) in the design process negatively impacts upon the quality of design documentation.

Hypothesis 2: The occurrence of client related factors (CR) in the design process negatively impacts upon the quality of design documentation.

Hypothesis 3: The occurrence of design firm related factors (DF) in the design process impacts upon the quality of design documentation.

Hypothesis 4: The occurrence of designer related factors (DR) in the design process negatively impacts upon the quality of design documentation.

In order to examine how the design process factors influence one another, the research sets out the following additional hypothesis:

Hypothesis 5: Industry related factors (IR) in the design process interacts with client related factors (CR) to influence the quality of design documentation

Hypothesis 6: Industry related factors (IR) in the design process interacts with design firm related factors (DF) to influence the quality of design documentation.

Hypothesis 7: Client related factors (CR) in the design process interacts with design firm related factors (DF) to influence the quality of design documentation.

Hypothesis 8: Design firm related factors (DF) in the design process interacts with designer related factors (DR) to influence the quality of design documentation.

5 Limitations and Implications for Further Research

The conceptual model presented was developed based on a literature review. It therefore, provides a starting point and a foundation for further empirical investigations and validation within the context of the South African construction industry.

It is recognised that the factors have been identified from studies undertaken in the context of Europe and Asia. As part of the subsequent phases of this research, the relevance and applicability of the identified factors within the context of the South African construction industry will be assessed through an initial round of semi-structured interviews conducted with South African civil engineering consulting professionals. The engineering professionals will be purposefully selected and based in Cape Town. The selection of the professionals for this phase is influenced by the locality of the researcher.

The next stage of the research will involve refining the conceptual model. To achieve this, personal interviews using semi-structured interview protocols will be conducted with twelve experienced engineering consulting personnel identified nationally. Respondents will be requested to verify the existence of the proposed links and influence direction amongst the variables, and include any perceived missing interactions to the conceptual model. The constructs included in the refined model will be tested and validated using information obtained through a nationally administered survey questionnaire to civil engineering consulting professionals. The Structural Equation Modelling technique will be used to establish the statistical significance of the hypothesised relationships between the constructs in the model.

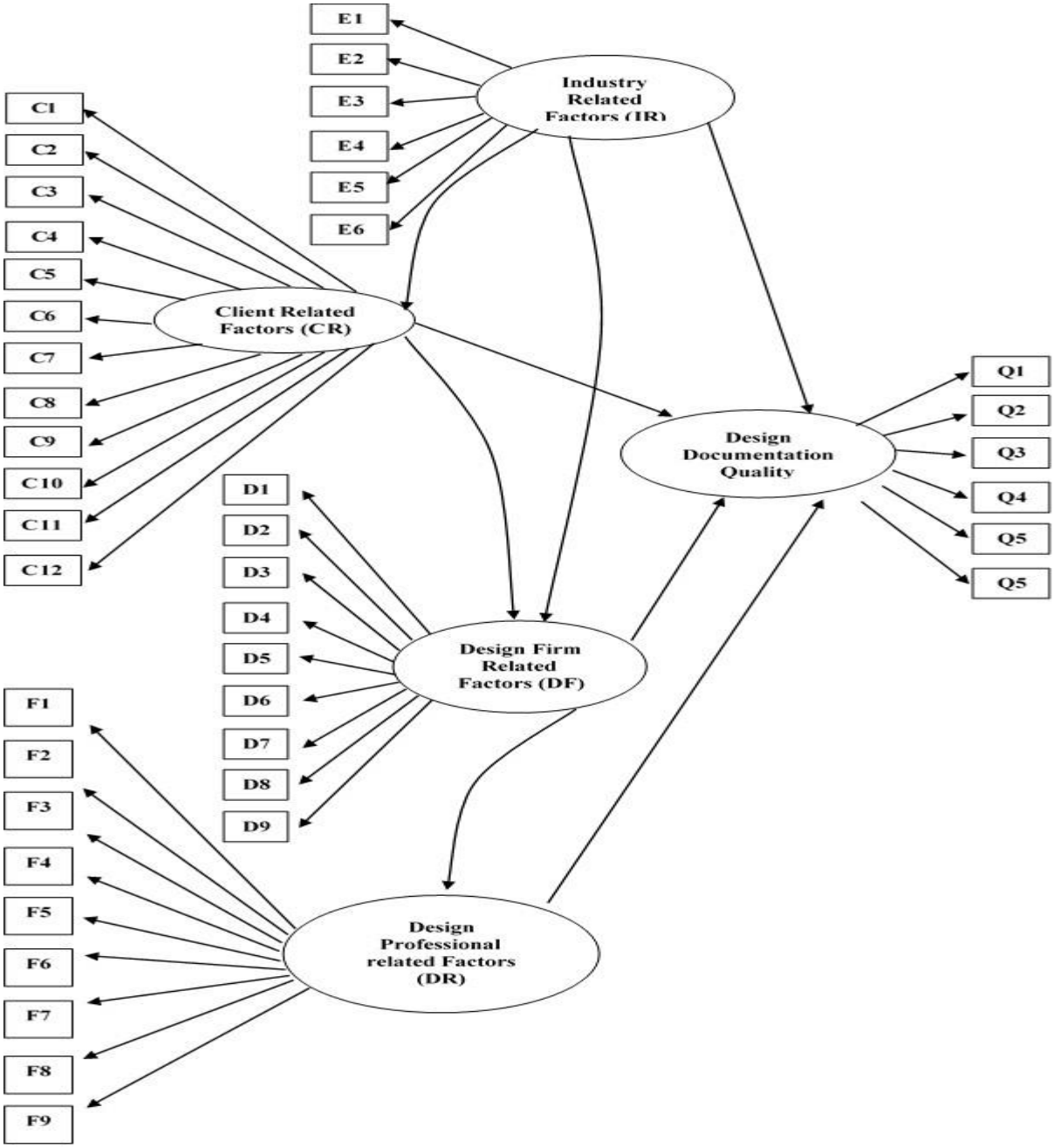

Figure 1. Conceptual model showing hypothesized interrelationship between variables

6 Conclusion

Poor quality of design documentation has been identified as a significant contributor to inefficiencies experienced in the implementation of construction projects, leading to delays, cost overruns and rework. Whilst a number of studies have identified and ranked factors within the design process that influence the quality of design documentation, the nature of interrelationship among the factors, although alluded to remains unexplored.

Following a comprehensive literature review, thirty-seven factors were identified and categorized under four latent constructs namely; Industry, Client, Design professional and Design firm related factors. In addition six objective indicators of design documentation quality were identified. A conceptual model incorporating the categorised factors and illustrating the hypothesized interrelationships among the factors and their impact on design documentation

quality was developed. Using the model as a foundation, a brief discussion is provided on proposed further work aimed at refining and empirically validating the model within the context of the South African construction industry.

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THE ROLE OF PUBLIC PRIVATE PARTNERSHIPS IN THE PROVISION OF INFRASTRUCTURE PROJECTS

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Abstract
It is estimated that Africa needs $93 billion annually until 2020 in order to bridge its infrastructure deficit. It is through significant investment in infrastructure development that economic growth and poverty alleviation can be enhanced. However central to all construction projects is an effective and sustainable procurement system. There is a notable shift by some African governments to turn to the private sector to design, build, finance and operate infrastructure facilities previously provided by the public sector in the form of Public Private Partnerships (PPP's). As an innovative financing model, PPPs present an opportunity to governments to improve service delivery. It is therefore necessary to access private capital for the provision, delivery and procurement of such public infrastructure. Accordingly, this paper focuses on assessing international best practices as to how some developing nations tap into the resources of the private sector in implementing their infrastructure projects. The findings of this paper reveal common challenges associated with PPP notably lack of political acceptability of PPPs, lack of clear government policy statement on PPPs, weak capacity of the public sector, in appropriate enabling legal and institutional environment among others. Key lessons learned are that PPPs should be designed with a long term approach, PPPs are a long term relationship between the public and private sectors and lastly the project development process should not be rushed unnecessarily. The study is a result of critical review, synthesis and contextualization of relevant academic literature, conference and journal publications. A thorough document review method was employed to assess how some developing countries have institutionalized PPP as part of their development strategy. The paper will be of significant value to senior government officials in that understanding the concept and dynamics of PPP will result in accelerated and effective service delivery.

Keywords: Infrastructure development, Innovative financing model, Public Private Partnerships, risk allocation, Value for Money

1 Introduction

The purpose of this paper is to assess international best practices on how some developing nations tap into the resources of the private sector in implementing their infrastructure projects. The paper reviews recent trends on Public Private Partnerships (PPPs) as a financing and procurement vehicle mainly in the construction projects on the African continent. The study employed exploratory study using document review method of the review protocol designed for the author's dissertation study. The organization of the study is compiled into five parts. The first part discusses the link between infrastructure development and economic growth as well as the status of infrastructure development in Africa, the second one focuses on PPPs as an innovative finance model, the third one outlines the research methodology employed by the

study, the fourth part presents the findings of the study. Finally a conclusion summarizes key lessons learned from the experiences of developing countries that have implemented PPP as an attractive alternative for procuring public service infrastructure.

1.1 The link between infrastructure development and economic growth

The basic gap in African infrastructure development is considered a severe handicap to growth and poverty alleviation. At the micro-level, it is recognized that an investment in infrastructure boosts private sector activities by lowering the cost of production and opening new markets, thereby presenting new production prospects and trade. It is therefore critical that Africa should invest in infrastructure development (Bwanali, 2015). The African Union Commission and Nepad Agency (2011) state that the link between the economy and infrastructure is clearly critical to stimulating inclusive growth and sustainable development. In fact, high cost of energy, transport, and internet access is a major economic growth deflator and is partly linked with Africa's sustained economic marginalization. This has forced governments to upscale infrastructure for Africa to become more competitive in the global marketplace. Increased investments in roads reduce transport costs while ports and other logistics infrastructure lessen the cost associated with trade, all of which improve the competitiveness of firms. Infrastructure development can contribute to growth and development through several channels such as decreasing trade transaction costs, increasing the durability of capital goods, fostering higher trade and investment, escalating demand and supply divergence and achieving economies of scale and scope (United Nations Conference on Trade and Development, 2013). According to Ondiege, Moyo & Chouchane (2013), Africa needs huge financial investments and support to narrow the region's infrastructure gap and set itself on par with the rest of the developing world. African countries must therefore undertake infrastructure sector reforms and innovation to generate more resources for the sector, because the traditional sources of finance will not be sufficient.

Bhattacharya, Romani and Stern (2012) concur that many emerging economies and most low income countries require a significant injection in infrastructure investment to ease growth limitations, respond to urbanization pressures and meet their critical goals for development, inclusive growth, and sustainability. Strategic infrastructure, in the form of energy, roads and ports needs to be built to spur economic growth. According to Bhattacharya *et al.* (2012), the magnitude of the required infrastructure increase is much greater now than it has previously been due to two reasons. Firstly, as global trade is playing an increasingly important role in countries' economic development, so too must infrastructure. This includes traditional transport infrastructure such as roads, railways and ports, but also information technology infrastructure such as broadband networks that enable better integration of supply chains and international trade in services (e.g., in outsourcing services). As emerging countries develop their service and manufacturing sectors, the intensity and excellence of infrastructure becomes critical in order to exploit network externalities. Secondly, the fast pace of urbanization has a greater sustainable infrastructure need than before. Between 2010 and 2030 the global population will have increased by almost 2 billion, from 6.1 to 8.1 billion. Most of this growth is expected to be in the developing world, and nearly all of this will be in urban settlements that are under-developed. Responding to these urbanization pressures will require a massive injection in infrastructure investment, conclude Bhattacharya *et al* (2012). This view is shared by Ernst & Young (2011) who state that by 2050, the world's population is expected to have grown by 2.3 billion people, ultimately reaching 9.1 billion. Therefore there is a need for impactful and sustainable investment in infrastructure that will support the growing African population (Bwanali, 2015).

1.2 The status of infrastructure development in Africa

Africa has enormous infrastructure shortage and it lags behind other developing regions, mostly in the area of energy and transportation but also in Information and Communications Technology (ICTs). In fact only 30% of Africa's population is estimated to have access to electricity, compared to almost 70% to 90% in other developed regions (Ondiege *et al* 2013). In addition, access to roads in Africa is limited to just about 34% of the population, compared with 50% in other parts of the developing world. Although there has been significant progress in rolling out ICTs, largely due to the tremendous increase in mobile connections over the last 10 years, Africa started from a very low base and its internet penetration rate is only about 6%, compared with an average of 40% in the developing world (Ondiege *et al* 2013). Thus, Africa needs to invest a lot in its infrastructure capacity in order to be as competitive as other emerging blocs namely Asia and South America. Landlocked countries in Africa face particular challenges due to the lack of multimodal infrastructure. The continent's 15 landlocked countries are constrained in transporting their goods to markets and in bringing in imports because of the lack multimodal infrastructure that can accommodate their particular requirements. The role of a network of infrastructure that links producers to markets through an interlinked platform that includes feeder roads, national roads, airports, and ports in connecting markets, particularly in landlocked countries, cannot be overemphasized (Ondiege *et al* 2013).

It is widely acknowledged that Africa needs huge financial investments to narrow the existing infrastructure gap in order to be on par with the rest of the developing world. The Programme for Infrastructure Development in Africa (PIDA) states that Africa will have to invest up to US$ 93 billion annually until 2020 for both capital investment and maintenance projects. Taking into account the substantial amount involved, this requires innovative sources of funding for sustainable infrastructure development and investment (Ondiege *et al* 2013). Over US$800 billion is invested in infrastructure in developing countries every year. However the needs are estimated to be more than twice that amount, with the infrastructure financing gap estimated to amount to about US$57 trillion until 2030. Funding the infrastructure gap is thus a major challenge (Bilal, 2013).

This is where investment in infrastructure development through Public Private Partnerships (PPP) as an alternative to the conventional procurement of infrastructure comes in. Before discussing the PPP concept, it is important to first analyse the current situation of the traditional infrastructure investment and its associated challenges and then discuss why the PPP has the potential to become the game-changer for Africa's economic growth and development. The next section discusses generic constraints on project finance.

1.3 Key constraints on project finance

Three related sets of factors limit Africa's potential to tap into both foreign and local currency markets for the purposes of raising private finance for infrastructure, especially long term debt (Sheppard, Stephan & Geeta 2006). Firstly most of the African countries have low or non-existent sovereign credit ratings. In all other developing regions the share would be more than two-thirds of regional GNI, and in East Asia and Pacific, close to 100% (Sheppard *et al* 2006). Secondly, most local financial markets on the African continent have limited capacity to finance infrastructure projects. In fact only South Africa has domestic banks and a local capital market with capacity to provide local currency sufficient for financing infrastructure projects on suitable terms and conditions. In almost all other African countries, local long term financing has been limited and infrastructure projects have had to require sizable credit enhancement (for example, through guarantees), provided mostly by official agencies, to attract local currency debt (Sheppard *et al* 2006). Lastly, infrastructure projects naturally raise the exposure of investments. In comparison to projects in other sectors, those in infrastructure

usually have longer payback and built – out periods and have the tendency to be more vulnerable to political and regulatory interference. This obviously increases the inherent regulatory risk such investments may be facing (Sheppard *et al* 2006). Therefore for Africa to be in a position to raise the required finance for its much needed infrastructure there is a need to improve its sovereign credit ratings, the local financial markets must have capacity to finance infrastructure and Africa must manage the specific risks associated with infrastructure investments (Bwanali, 2015). The next section discusses innovative finance solutions.

1.4 Innovative finance: Instruments to finance infrastructure

Infrastructure development in the emerging economies, especially sub - Saharan Africa, where it is needed most has been very limited. Financing has been a major constraint since most of the current investment in infrastructure comes from the public sector. It is estimated that growth in Africa can be enhanced on average by about 2% per annum only if the existing infrastructure deficit is closed (Boston Consulting Group, 2013). The Boston Consulting Group (2013) further states that whereas the demand for infrastructure is growing, public infrastructure finance has become more difficult to source. Public budgets are strained due to the global financial crisis and, more recently, the Eurozone sovereign debt crisis and the budgets of major donors that have customarily supported aid flows to Africa are under extreme pressure, effectively making ODA increasingly uncertain and likely to decline in the long run. Since the crisis of 2008, it has become exceedingly difficult for banks to lend (e.g. as a result of the Third Basel Accord) and the application of risk mitigation tools (e.g. collateralized debt obligations) has been curtailed, concludes (Boston Consulting Group, 2013).

It becomes imperative that African governments must find innovative ways to fund infrastructure development projects. This can be done by improvising relevant innovative financing models which will not only moderate the impact of these diminishing financial flows, but also to find alternative methods to secure new role players who will push up the level of financing of infrastructure projects (Bwanali, 2015). Innovative financing for development is defined by the World Bank as "those that depart from traditional approaches to mobilizing development finance", that is, through budget outlays from conventional sovereign donors or bonds issued by multilateral and national development banks solely to achieve funding objectives (UNDP, 2012). One such innovative financing model for infrastructure development is the concept of Public Private Partnerships (PPPs). The next section discusses PPPs as an innovative finance model.

2 Public Private Partnerships as an Innovative Finance Model

Participation of the private sector in public service delivery is not a new concept. Over the last 15 to 20 years, a growing market for public-private partnerships has developed globally. Particularly in industrialized countries, the private sector had for many decades serviced public needs through a range of construction, maintenance and management contracts (Rwelamila & Snijder, 2008). It appears that there is no universally agreed definition of PPP. This paper will adopt National Treasury of South Africa definition which defines PPP as a commercial transaction between an institution and a private party in terms of which the private party – (a) performs an institutional function on behalf of the institution; and/or (b) acquires the use of state property for its own commercial purposes; and (c) assumes substantial financial, technical and operational risks in connection with the performance of the institutional function and/or use of state property; and (d) receives a benefit for performing the institutional function or from utilizing the state property.

What is unique about PPPs in comparison to other models of private participation in infrastructure is the element of risk sharing. This means that in the event that the contract fails, both government and parties will suffer financially. The US Department of Treasury (2015)

states that PPPs bring private sector capital and management expertise to the challenges of modernizing and more efficiently managing assets. Under a PPP, a government contracts with a private firm to design, finance, construct, operate and maintain (or any subset of those roles) an infrastructure asset on behalf of the public sector. The next section discusses benefits of PPPs.

2.1 Benefits of PPPs

PPP's have become a global phenomenon because of the three main types of benefits they offer namely: the capacity to develop new infrastructure services despite short term fiscal constraints; improved service quality and innovation through use of private sector proficiency and performance incentives and lastly value for money realized through efficiencies in procurement, construction and operation. Each benefit is discussed below.

2.1.1 Accelerated infrastructure development

According to the Commonwealth Secretariat (2010), many governments around the world are constrained in terms of how much they can borrow to invest in infrastructure projects. This is especially true for greenfields developments, such as a new power station or major toll road, which typically involve hundreds of millions of dollars of upfront capital expenditure. The problem is most acute in poorer countries, where infrastructure needs are large relative to the size of economies and where fiscal capacity is often severely limited, with many competing demands for scarce resources. Therefore in order to reverse years of underinvestment in infrastructure development in Africa requires high level political will, broader social consensus and dynamic rethink of how African states can fund and manage infrastructure investments. Some African governments have entered into PPPs to provide and manage infrastructure that has traditionally been provided by the public sector. PPPs bring private sector capital and management expertise which are not available in the public sector.

2.1.2 Improved service quality

PPPs have the potential to bring enhanced innovation and augmented service quality largely due to specialist skills brought in by the private sector. This is possible due to the commercial incentive mechanisms that are put in place to deliver improved performance over the life cycle of the contract (Commonwealth Secretariat, 2010).

2.1.3 Value for Money

The growing element in decisions about PPPs is the cost-benefit factor, referred to as value-for-money (VfM). The underlying argument is that the involvement of the private sector in delivering public services must be a better alternative to the public sector providing the same service through its line departments and bureaucratic administrations. PPPs allow governments to introduce private sector capital into a project and also harness private sector management and technical expertise. When a PPP transfers risks to the private sector that it can manage more cost effectively, it can benefit taxpayers by lowering long term project costs, improving the quality of services or both. According to the Commonwealth Secretariat (2010), PPPs allow governments to transfer certain types of risks of infrastructure projects to the private sector. This can bring VfM because in theory the private sector brings specialist expertise and a commercial approach that brings down project costs over the whole life of the contract. In addition, there is increased certainty to taxpayers about the total cost of infrastructure projects because risks of cost overruns are either reduced or passed on to private investors.

Allocation of risk between private and public sectors is a complex area for PPPs due to the unpredictable nature of project risk (Economist Intelligence Unit Limited, 2015). It follows therefore that if the PPP is properly designed at the outset, these efficiency gains are passed on

to the end user. The next section provides a detailed discussion on the types of risks and their allocation.

2.2 Types of risks associated with PPP

Transfer of risk is an element closely linked to the VfM consideration based on the cost associated with service non-delivery and delays in design, construction, and implementation of projects as well as the private sector imperative of business efficiency. Operational efficiency drives the private sector's involvement, especially where contracts values and service fees have been predetermined in legal contracts. Without adequate transfer of risk, the required level of efficiency will not be achieved by the private sector party, which will in turn obscure the value derived from the partnership.

Risks in PPP arise due to uncertainty regarding the occurrence of certain events and their consequent impact on the project. Given the long nature of the contract, there is a possibility of a number of different events occurring such as changes in government policy and decline in demand for the infrastructure service (Commonwealth Secretariat, 2010). Therefore it is critical that there is an appropriate allocation of risks to the party that is most able to mitigate such risks should they occur. The typical risks associated with PPP framework are market risks, development/planning risks, project risks, political risks, regulatory risks and financial risks. These risks are discussed below:

- **Market risks** – these refer to risks that arise due to uncertainties about the market demand for the infrastructure service. These include, for example, volume risks - which relate to uncertainties arising from the number of users and their frequency and intensity of use of the infrastructure service – and price risks, which arise due to uncertainties in the tariff that can be charged for the use of the infrastructure service (Commonwealth Secretariat, 2010). Thus market risks are closely linked to the users' appetite and ability to pay for the services.
- **Development/planning risks** – these are risks arising from planning or preparing projects for private sector participation. Governments or the private sector may invest substantial amounts to develop a project (through payment for several scoping, feasibility and structuring studies), but bear the risk of the project being infeasible (Commonwealth Secretariat, 2010).
- **Project risks –** project risks relate to uncertainties in relation to project construction, completion and operation (i.e. activities post award of contract and which occur while implementing the PPP project) and financing, can be split into start up risks, such as capital cost overrun, completion delays and ongoing risks such as operating performance, operating costs and lifecycle costs (Commonwealth Secretariat, 2010).
- **Political risks** – these are risks that arise from wars, civil disturbances, terrorism etc., and include currency transfer restrictions, expropriation, war and breach of contract. Political risks are more serious in certain regions of the world than in others (Commonwealth Secretariat, 2010).
- **Regulatory risks** – these risks arise from the lack of a suitably developed regulatory system which, for example, ensures regulatory independence from the government, regulations for the participation of the private sector in infrastructure or appropriate periodic review of tariffs can cause considerable uncertainties for lenders and investors in any infrastructure sector (Commonwealth Secretariat, 2010).
- **Financial risks –** infrastructure projects are impacted by financial risks exchange rate appreciation/depreciation and changes in interest rates, which can have a substantial impact on costs and revenues. The ability to hedge financial risks depends on the level

of development of capital markets and/or access to specialist hedging facilities (Commonwealth Secretariat, 2010).

The Commonwealth Secretariat (2010) further states that key to the design of a PPP is the allocation of these risks between the public and private sectors so as to ensure that the PPP delivers VfM. The essential principle for risk allocation in a PPP is to accord the risk to the party who can best manage it. The next section discusses research methods.

3 Research Method

This paper employed exploratory study using document review method of the review protocol designed for the author's dissertation study. This paper is therefore premised on extensive literature study which is based on several reports carried out by various international organizations and researchers to identify current global trends and practices with respect to PPPs. For lack of space and brevity all the details of research methodology are not provided but could be found elsewhere in Bwanali (2015). Therefore the findings in the following section are deduced from relevant literature, government policy documents and articles published in scientific journals.

4 Findings and Discussions

Based on literature reviewed, this paper has identified common challenges associated with PPPs. These challenges together with possible remedial measures are presented below:

4.1 Challenges with PPPs and possible remedial measures

PPPs have some inherent challenges especially in the developing countries and this could be the major reason why there has been little or no progress in implementing PPP projects in most African countries. The Commonwealth Secretariat (2010) identifies such challenges/constraints as lack of political acceptability of PPPs; lack of clear policy statement; weak capacity of the public sector; an inappropriate enabling environment in terms of legal, regulatory and institutional frameworks; the high costs and risks of project development facing the private sector; absence of long term debt; inability of users to afford service fees and the small size of the economy/sector. These challenges impact both the government and the private sector thereby affecting the development and implementation of effective PPPs. The challenges are discussed below.

- **Lack of political acceptability of PPPs –** as discussed earlier, traditionally the provision of social infrastructure for service delivery has been the responsibility of government. Therefore it becomes politically sensitive to involve the private sector in the provision of core infrastructure. The key reasons for such resistance include the perception that tariff might be higher as the private sector is profit oriented, possibility for mass job losses in order to contain overheads and the fear of privatization. The creation of dedicated PPP units, putting in place a mechanism of strong political support along with high level political champion could manage the political resistance. The Labour Movement in South Africa has been at the forefront of protesting key PPP projects such as e-toll in Gauteng as well as planned projects in Cape Town.
- **Lack of clear policy statement –** the success of a PPP programme requires formal support in terms of clear policy statement on the government's strategy for the development of infrastructure PPPs. The lack of a clear policy statement will imply uncertainty and ambiguity, and projects may therefore not get off the ground. Governments need to develop explicit PPP policies and include the use of PPPs in their planning documents (Commonwealth Secretariat, 2010). In South Africa, National Treasury has developed a framework document on PPP and managed through the

Public Finance Management Act (PFMA). In addition, the National Development Plan 2030 has identified public infrastructure development through PPPs, amongst other finance instruments, as one of its top 10 critical actions.

- **Weak capacity of the public sector –** lack of appropriate skills and experience in infrastructure PPPs can lead to delays, inefficiencies and sometimes the failure of infrastructure projects. Poor project development skills in the public sector can lead to the preparation of 'unbankable' projects, a common issue to many countries, where the project design and structure is unattractive to private investors. Moreover, weak capacity in the public sector reduces government's ability to negotiate and communicate effectively with private companies (Commonwealth Secretariat, 2010). As a way of capacitating the public sector on PPPs, some countries have established PPP units that provide governments with expert advice and support on infrastructure PPPs. According to the Economist Intelligence Unit Limited (2015) only 12 African countries have developed central PPP units and their functionality varies from established bodies (South Africa) through to newer start-ups (Uganda and Tanzania). Central PPP units bring advantages such as better coordination, increased efficiency and a clustering of relevant skills in a single place.
- **An inappropriate enabling environment in terms of legal, regulatory and institutional frameworks –** private sector participation requires an enabling legal, regulatory and institutional framework that will guide and support transactions. Many countries do not have legislation to regulate infrastructure PPPs or a regulator that monitors performance and ensures compliance (Commonwealth Secretariat, 2010). In South Africa, Treasury Regulation 16 on PPPs which is issued in terms of the PFMA 2004 is a vital legislation for PPPs which articulates the procedure, approvals and management of PPP transactions. According to the Economist Intelligence Unit Limited (2015) despite good progress, PPP laws often are stronger on paper than in practice. Nigeria and Zambia for instance, have strong legislation pertaining to issues like bidding transparency and dispute resolution, but these are not always effective in practice.
- **The high costs and risks of project development facing the private sector –** early stage development involves a significant investment of resources that are only recoverable if the project is ultimately successful. In addition, in many developing countries, the private sector is at an early stage of development and lacks the knowledge to develop, prepare and structure projects. As a result, infrastructure projects are not fully defined or, if they are, they may be developed to such low standard that competent private sponsors or investors will not be interested (Commonwealth Secretariat, 2010). One way of addressing this challenge is by establishing a fund for project development. According to the Commonwealth Secretariat (2010), India has set up the India Project Development Fund with the objective of structuring and developing bankable projects that can be offered to the private sector on a PPP basis. The Development Bank of Southern Africa which is based in South Africa plays a similar role.
- **Absence of long term debt –** a 20 year life cycle for an infrastructure project implies a considerable time lag between the raising of finance and the ability to pay back through project generated revenues. In most developing countries, it is not possible to raise finance of sufficiently long tenure for infrastructure development. This not only constrains the development of infrastructure due to increased uncertainty, but also makes the infrastructure service more expensive in the short term because of the front-end loaded prices and other factors (Commonwealth Secretariat, 2010). As a counter measure, some governments such as Bangladesh and India have set up project financing

facilities aimed at crowd-in private sector finance by taking up greater risks in the project. The Government of Bangladesh has set up the Infrastructure Development Company Limited (IDCOL) and the Government of India has set up the India Infrastructure Finance Company Limited (Commonwealth Secretariat, 2010). These are the type of project financing facilities that African governments should establish to help crowd-in private sector finance.

- **Inability of users to afford service fees –** perceived lack of ability and willingness to pay for infrastructure services is a key challenge in most developing countries. According to the Commonwealth Secretariat (2010), it is often believed that large numbers of people on lower incomes will be unable to afford full cost-recovery tariffs for electricity or water, especially if the tariff level reflects the high costs of building greenfield infrastructure. In addition, many people may be perceived as being unwilling to pay for essential infrastructure services for political or social reasons such as the e-toll system in South Africa. In instances where it is impractical to levy user charges to recover costs, governments will have to find alternative sources of funds in the form of subsidies.
- **The small size of the economy/sector** – the size of the economy or infrastructure sector is also an important constraining factor limiting the development of PPPs for the delivery of infrastructure services. Small size implies lack of economies of scale in project development, as well as a project size which is below the minimum that is efficient. While size is a constraint for public provision of infrastructure services as well, this is particularly so for PPPs, as a small scale project may be 'unbankable' (Commonwealth Secretariat, 2010). One way of improving economies of scale is by initiative regional projects which will result in pooling of resources. A good example within the African context is the Inga hydropower plant to be developed in the Democratic Republic Congo, which is said to have the potential of illuminating the entire African continent, would not be economically viable as an investment by a single country when other countries in the region can benefit from such an investment. The next section looks at the emerging best practices on PPPs and key lessons that can be used by other African government when developing PPPs.

4.2 Emerging best practices on PPPs and key lessons learned

Based on various academic literatures, successful PPPs projects have the potential to deliver significant benefits in terms of increased quantity and quality of infrastructure services at lower overall cost for both end users and taxpayers only if appropriate incentives are in place for the private partner to deliver efficiently. However when PPPs fail, costs can be high which would result in long and exorbitant legal disputes. This would also result in wastage of public funds resulting in a drop in spending on other important infrastructure services. Ultimately this results in poor service delivery. In order to avoid PPPs failure, it is advisable to take a long term view in managing PPPs. According to the Commonwealth Secretariat (2010) many of the key lessons on PPPs are therefore related to the need to take a long term view when designing and implementing a PPP programme. This paper has synthesized three main sets of lessons emanating from the literature study undertaken by the authors and these are discussed below.

5 Conclusion and Key Lessons

This paper has highlighted some opportunities, risks, challenges that some countries have encountered in the implementation of PPPs for infrastructure development. In order to ensure that other African governments can learn from these experiences, the following key lessons are presented:

5.1 Lesson 1: Design PPPs with long term approach together with VfM considerations

As stated earlier, PPPs allow governments to introduce private sector capital into a project and also harness private sector management and technical expertise. The ability to raise funds for infrastructure projects is attractive to governments as they can avoid short term budgetary constraints by spreading up-front project costs over the lifespan of the project. However African governments must avoid the pitfall of viewing PPPs only as a mechanism of raising the much needed and scarce capital. The Commonwealth Secretariat (2010) states that the success of a PPP programme should be assessed against quantity, quality and cost of infrastructure services provided to the public over the long term. Key to ensuring long run sustainability and value for money of PPPs are the following: robust feasibility analysis; proper due diligence in selecting a strong private sector sponsor and good project and contract design.

5.1.1 Robust feasibility analysis

In the early years of modern PPP programmes in Europe and America, a common mistake was for government and project sponsors to overestimate future revenues on PPP contracts. Nowadays there is more awareness of the importance of robust feasibility analysis which incorporates various scenarios about key revenue and cost drivers. In emerging markets, there is often the challenge of a lack of data to inform a feasibility analysis (Commonwealth Secretariat, 2010). For example, there is no tangible evidence on the number of potential end users of a required service which impacts the potential tariffs or user charges to be levied. This results in unreliable feasibility analysis to determine whether the project will be economically viable.

5.1.2 Proper due diligence in selecting a strong private sector sponsor

In selecting a private partner for the successful implementation of a PPP contract, it is critical for governments to undertake a wider assessment of the capability of the sponsor to manage unexpected events as they occur. It is advisable that governments undertake thorough due diligence to establish whether or not the contract will deliver VfM. The South African government through National Treasury has factored VfM considerations into its PPP legislative framework which requires the accounting authority to obtain treasury approval that the PPP agreement meets the requirements of affordability, VfM and substantial technical, operational and financial risk transfer as approved in terms of the applicable treasury regulation.

5.1.3 Good project and contract design

Projects need to be bankable in order to attract private sector investment. Key aspects for project bankability are risk allocation, incentives and affordability. These aspects determine whether a project is good or bad. It is not sufficient to have a good project design without an equally good contract design. According to the Commonwealth Secretariat (2010), good contract design warrants that: (i) the processes and procedures for the PPP are clearly spelt out; and (ii) the measures for evaluating the performance of the PPP are clearly laid out. This means that all relevant aspects of the contract are clearly spelt out and that the approach and basis of contract evaluation are clear in order to avoid ambiguities.

5.2 Lesson 2: PPPs are a long term relationship between the public and private sectors

In a PPP framework, the role of government remains relevant over the full lifecycle of the project. This long term nature of PPPs has implications for the PPP framework, ongoing management of the contract and the skills and experience required in the public sector.

5.2.1 Establish a flexible PPP framework

The creation of a PPP framework enhances the long term success of PPPs. A PPP framework establishes rules of the game in that it provides a platform for ongoing dialogue and cooperation

between the public and the private sectors. The framework should not be rigid to an extent that it limits a process of renegotiation in cases where unexpected events occur which are beyond the control of either party.

5.2.2 Ensure effective ongoing management of the PPP contract

As highlighted earlier, the role of government remains relevant over the full lifecycle of the project. As such, efficient contract management and monitoring are key success of the project. Since the project is financed with public funds, government has an obligation to manage the PPP contract so as to ensure that the desired outcomes and expectations of the public are met. Key to this is the performance monitoring mechanism of the PPP which should keep track of possible deviations as well as consequence management whenever required.

5.2.3 The need for skilled personnel with the public sector

PPP are complex transactions which call for highly skilled and competent staff. It is important that both parties have the right skills set in order to implement PPP projects successful. The public sector personnel tasked with the responsibility to negotiate contracts with the private sector must possess specialist legal, financial and technical skills. In addition, there should be a regular and effective communication channel between the two parties.

5.3 Lesson 3: Avoid a rushed project development process

PPPs are by nature complex transactions and normally project development phases last a minimum of three years before finance is secured and any meaningful construction takes place. This has the potential to cause conflict with short term political dynamics. The Commonwealth Secretariat (2010) states that there can be a temptation for governments to short circuit the project development process in order to deliver on public expectations of improved services from a PPP programme. A high level political support as well as suitable management of political and public expectations on PPPs is crucial to their success. In addition given the complexity of PPPs, expert advice is very important.

5.3.1 High level political patronage is vital

Any project requires a champion: someone to articulate and refine the vision, guide process, and advocate for support. For PPPs, political champions are very vital, given the significant public stake in them (World Bank Group, 2014). It is essential that PPPs transactions have political champions within the government machinery who can drive these projects through required legislation and other regulatory processes. An effective PPP unit can play a very critical role in pushing PPP projects up the political agenda for broader public buy in. In addition, strong government commitment to PPPs would boost private sector confidence in investing in these projects.

5.3.2 Management of political expectations

It is advisable to avoid the temptation of ‘overselling’ PPP projects early in the project life cycle for political expediency because of the risk of creating unrealistic public expectations. It may be prudent to target ‘quick wins’ in order to build public support for the project. A good example within the South African context would be the upgrading of highways/freeways leading to the 2010 FIFA World Cup.

5.3.3 Relevant expert advice is expensive but necessary

Investing in expert advice in fields such as financial, legal and technical can be expensive but it is necessary due to the fact professionals with relevant international expertise and experience on PPPs are in scarce supply. This investment, according to the Commonwealth Secretariat (2010), is essential to ensure the project is properly designed and structured. It is equally

important that the public sector has access to high quality advisers to make sure that there is an equitable sharing of costs and risks with the private sector.

This paper confirms that developing a successful PPP programme is a complex undertaking which requires the public sector to have relevant skills levels as well as an appropriate legal and regulatory framework. It is only through the leveraging the strengths of both public and private sectors that PPPs as an alternative to the traditional procurement system, can become a vehicle for delivery public infrastructure which can boost economic growth for the developing economies in Africa.

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A STUDY OF THE RELATIONSHIP BETWEEN MATERIAL WASTE AND COST OVERRUN IN THE CONSTRUCTION INDUSTRY

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Abstract
While wastage of materials has become a serious problem requiring urgent attention in the construction industry, cost overrun is a problem which affects 90% of completed projects in the world. The argument on how to eliminate cost overrun has been on-going for the past 70 years as on-site wastage of materials leads to increase in the final project cost. This paper examines the relationship between the causes of material waste and those of cost overrun at the pre-contract and post-contract stages of a project. The paper adopts the desktop methodological approach. This involves comparing the causes of material waste and those of cost overruns from the literature to determine the possible relationship. The result reveals that all the causes of material waste also cause cost overrun at the pre-contract and the post-contract stages of a project. However, 96.88% and 81.81% of the causes of cost overrun also cause material waste at the pre-contract and post-contract stages respectively. There is an 86.74% overlap between the causes of material waste and those of cost overruns at all stages of a project. Other causes which are not related are mostly, the micro-economic and macro-economic factors. Based on these findings, it can be concluded that effective management of material waste would translate into a reduction in the level of project cost overrun. The study recommends that construction-project managers as well as the construction practitioners should encourage the management of material-waste causes, as it has the potential to minimise the causes of cost overrun for a project.

Keywords: Construction Industry, Cost overruns, Contract wtages, Material waste

1 Introduction

The construction industry is one of the driving forces behind the socio-economic development of any nation. However, it is faced with the severe problems of cost overruns, time overruns, and construction waste (Abdul-Rahman *et al.*, 2013; Osmani *et al.*, 2008; Nagapan *et al.*, 2012). Material wastage has become a serious problem, which requires urgent attention in the construction industry and it has affects the delivery of many projects (Adewuyi and Otali, 2013).

The problem of construction waste all over the world remains unresolved, as has been shown by various authors reporting on the situation: for example, 28.34% of the total waste sent to landfills in Malaysia originates from construction activities (Begum *et al.*, 2007): the US generates 164million ton of construction waste annually representing 30-40% of the country's Municipal Solid Waste (MSW) (Osmani, 2011): China alone generates 30% of the world's MSW, out of which construction and demolition waste represents 40% of the country's MSW

(Lu and Yuan, 2010): and 10% of the materials delivered to sites in the UK construction industry end up as waste that may not be accounted for (Osmani, 2011). Accordingly, Ameh and Itodo (2013) noted that for every 100 houses built, there is sufficient waste material to build another 10 houses.

On the other hand, cost overrun is a common problem in both developed and developing countries which makes it difficult for many projects to be completed within their budgeted cost (Memon *et al.,* 2013). Being a common problem, cost overrun was found across twenty nations and five continents of the world (Allahaim and Liu, 2012). The argument in the construction industry on how to reduce or totally remove cost overruns from projects has been on-going among the built environment professionals, project owners, and the users for the past seventy years (Apolot *et al.,* 2010; Allahaim and Liu, 2012), but there is no substantial improvement nor significant solution in mitigating its detrimental effects (Allahaim and Liu, 2012); while on-site wastage of material leads to increase in the final cost of a building project. As materials are wasted, more is required, thereby affecting the estimated cost of the project (Ameh and Itodo, 2013; Teo *et al.,* 2009). This is regardless of the 5% allowance made to materials in the process of bill-of-quantities production in order to take care of waste. Moreover, Ameh and Itodo (2013) reported that in the UK, material waste accounts for an additional 15% of construction project cost overruns and also accounts for about 11% of construction cost overruns in Hong Kong. In the same vein, a study conducted in the Netherlands revealed a cost overrun of between 20-30% as a result of construction-material wastage. Ameh and Itodo (2013) emphasise that most managers of construction projects pay little attention to the effects of material waste generated on cost overrun. Many studies have been carried out in this field, but still, there is need for a research that provides an objective assessment of the relationship between the causes of material waste and those of cost overrun in the construction industry. Hence, this paper examines the relationship between the causes of material waste and those of cost overruns with a view to suggesting the possible ways of minimising their effects at the pre-contract and the post-contract stage of a project.

2 Literature Review

2.1 Relationship between material waste and construction cost overrun

Construction waste is generally classified into two, namely: the physical waste and the non-physical waste (Nagapan *et al.,* 2012). Physical construction waste is the waste from construction, renovation activities, including civil and building construction, demolition activities, and roadwork. It is, however, referred by some directly as solid waste: the inert waste which comprises mainly sand, bricks, blocks, steel, concrete debris, tiles, bamboo, plastics, glass, wood, paper, and other organic materials (Nagapan *et al.,* 2012 and Ma, 2011). This type of waste consists of a complete loss of materials, due to the fact that they are irreparably damaged or simply lost. The wastage is usually removed from the site to landfills (Nagapan *et al.,* 2012).

Conversely, the non-physical waste normally occurs during the construction process. By contrast with material waste, non-physical waste relates to time and cost overruns for a construction project (Nagapan *et al.,* 2012). Similarly, Ma (2011) defines waste as not only associated with wastage of materials, but also to other activities such as repair, waiting time, and delays. Besides that, waste can be considered as any inefficiency that results in the use of equipment, materials, labour, and money in the construction process. In other words, waste in construction is not only focused on the quantity of materials on-site, but also overproduction, waiting time, material handling, inventories, and unnecessary movement of workers (Nagapan *et al.,* 2012). Memon *et al.* (2014) added that non-physical waste includes undesired activities, which can cause the physical waste, such as rework, unnecessary material movements, and so

forth. Figure 1 shows the general classification of construction waste and further depicts that, since construction waste entails both the physical and the non-physical waste, there is a relationship between material waste originating from the physical waste and cost overrun from the non-physical waste, since they originate frome the same waste family. This is supported by the summary of the causes of material waste and those of cost overrun in Table 1.

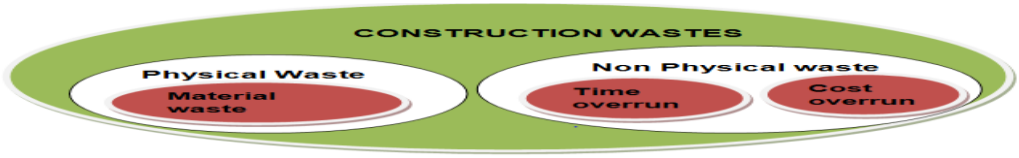

Figure 1. Classification of construction waste (Source: Nagapan *et al.*, 2012)

2.2 The pre-contract stage of a project

The pre-contract stage of a project comprises a lot of activities from the inception to the final stage of award of contract. These activities include the feasibilities, outlined proposal, scheme design, detail design, bills of quantities/estimation, and so forth. These activities, if not properly managed and controlled, would contribute to the generation of material waste and cost overruns (Ashworth, 2008). Hence, it is appropriate to understand the main causes of material waste that relate to the causes of cost overrun at this stage of a project.

2.3 The post-contract stage of a project

The activities involved in the post-contract stage of a project include the following: construction on site, supervision, inspection, approvals, valuations, completion, hand over to client and user occupation, correction of defects, and completion of contract requirements and settlement of the final accounts (Ashworth, 2008). However, this aspect of research would only focus on construction related issues.

3 Research Methodology

The research employed the desktop methodological approach. This involves comparing the causes of material waste and those of cost overruns from the review of the related literature in order to determine the possible relationship. The relevant secondary source of data for this research include: published materials (books, journals) and unpublished reports, such as: periodicals, conference proceedings, building codes, and policies and guidelines relating to material waste and cost overruns in the construction industry.

The analysis was performed by comparing the causes of material waste and those of cost overrun identified from the literature. The results were expressed in frequencies and percentages and presented in tables and figures. The causes of material waste that relate to those of cost overruns are ticked as shown in Tables 1 and 2.

4 Findings and Discussion

4.1 The pre-contract stage of a project

Table 1 reveals that the causes of material waste and those of cost overruns identified from the literature are similar. These causes occur as a result of one, or combination of several causes at the pre-contract stage of a project and they are very important to identify for effective cost performance and sustainable construction.

All the causes of material waste were also found to be identified as the causes of cost overrun at the pre contact stage of a project but not *vice versa*. For instance, the causes of cost overrun and those of material waste in Table 1 shows that, 31 out of the 32 causes of cost overruns considered at the pre-contract stage of a project also cause material waste showing a 96.88%

relationship (pre-contract stage). Reason being that 'the practice of assigning the contract to the lowest bidder,' which is a cause of cost overrun is not a cause of material waste.

Table 1. Causes of material waste found in the causes of cost overruns at the pre-contract stage

S/N	Causes of Cost overrun	Cost overrun	Material waste
1	Design error	✓	✓
2	Deficiencies in cost estimates	✓	✓
3	Insufficient time for estimate	✓	✓
4	Improper planning at on stage	✓	✓
5	Political complexities	✓	✓
6	Insurance problems	✓	✓
7	Changes in material specification	✓	✓
8	Laws and regulatory framework	✓	✓
9	Poor design management	✓	✓
10	Practice of assigning contract to the lowest bidder	✓	x
11	Lack of experience of local regulation	✓	✓
12	Communication error among parties in planning	✓	✓
13	Poor knowledge of the changing requirements	✓	✓
14	Lack of design information	✓	✓
15	Designing irregular shapes and forms	✓	✓
16	Different methods used in estimation	✓	✓
17	Improper coordination	✓	✓
18	Delays in design	✓	✓
19	Optimism bias	✓	✓
20	Complicated design	✓	✓
21	Inadequate specifications	✓	✓
22	Incomplete drawings	✓	✓
23	Inexperience designer	✓	✓
24	Error in design and detailing	✓	✓
25	Inadequate site investigation	✓	✓
26	Difficulties in interpreting specification	✓	✓
27	Delay in preparation and approval of drawings	✓	✓
28	Designing uneconomical shapes and outlines	✓	✓
29	Frequent demand for design changes	✓	✓
30	Poor communication flow among design team	✓	✓
31	Unsatisfactory budget for waste management	✓	✓
32	Lack of communication among parties at pre contract stage	✓	✓
	Summary=31/32X100=96.88%		

(Sources: Le-Hoai *et al.*, 2008; Memon *et al.*, 2011; Love *et al.*, 2011; Allahaim and Liu, 2013; Olawole and Sun, 2010; Kasimu, 2012; Malumfashi and Shuaibu 2012; Nagapan *et al.*, 2012; Osmani *et al.*, 2008; Wahab and Lawal; 2011; Oladiran, 2009; Ameh and Itodo, 2013; Aiyetan and Smallwood, 2013; Osmani, 2011)

This relationship is further summarised in Figure 2, which shows that, at the pre-contract stage of a project, the causes of cost overruns also cause material waste. This means that all causes of material waste also cause anticipated cost overrun at the pre-contract stage of a project. But only 96.88% of the causes of cost overrun cause material waste. The remaining 3.12% 'the practice of assigning the contract to the lowest bidder,' are not related. This implies that, managing material waste at this stage denotes managing a 96.88% of cost overruns.

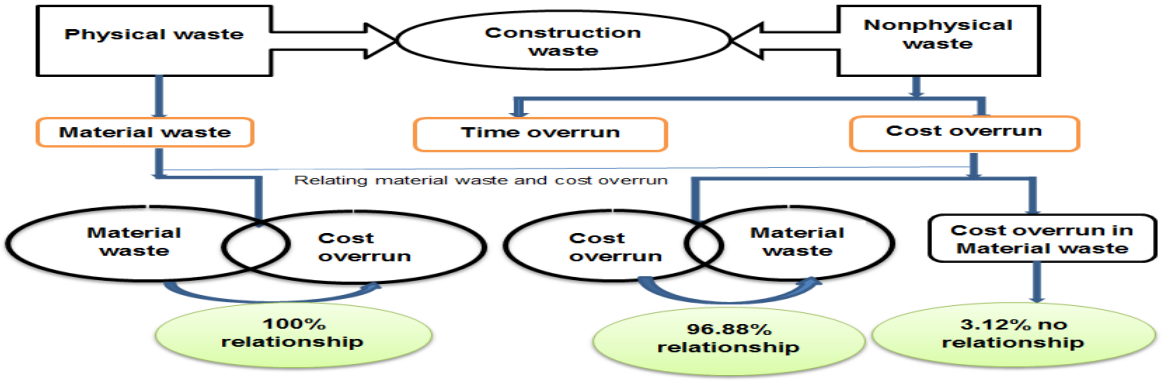

Figure 2. Relationship between cost overruns and material waste at pre-contract stage

4.2 The post-contract stage of a project

Table 2 shows the causes of cost overrun that are related to the causes of material waste at the post-contract stage of a project. Out of the 66 causes of cost overruns considered, 54 also cause material waste showing an 81.81% relationship at the post contract stage of a project.

Table 3. Causes of material waste found in causes of cost overrun at post-contract stage

S/N	Causes of Cost overrun (post-contract stage of project)	Cost overrun	Material waste	S/N	Causes of Cost overrun (post-contract stage of project)	Cost overrun	Material waste
1	Monthly payment difficulties	✓	x	34	Unforeseen geological conditions	✓	✓
2	Poor planning by contractors	✓	✓	35	Financial difficulties of contractor	✓	✓
3	Heritage material discovery	✓	✓	36	Social and cultural impact	✓	✓
4	Market conditions	✓	x	37	Inaccurate site investigation	✓	✓
5	Cash flow and financial difficulties faced by contractors	✓	x	38	Inadequate use of modern equipment & technology	✓	✓
6	Slow information flow between the parties	✓	✓	39	Obtaining materials at official current prices	✓	x
7	Escalation of material prices	✓	x	40	Labour problems	✓	✓
8	Increase in wages	✓	x	41	Increase in material prices	✓	x
9	Poor management assistance	✓	✓	42	Owner interference	✓	✓
10	Exchange rate fluctuation	✓	x	43	Slow payment of works	✓	x
11	Deficiencies in the social structure	✓	✓	44	High interest rate charged by bankers on loans	✓	x
12	Additional works	✓	x	45	Fraudulent practices	✓	✓

13	Optimism bias	✓	✓	46	Labour disputes and strike	✓	✓
14	Labour cost increased due to environment restriction	✓	**x**	47	Improper coordination amongst parties at post contract stage	✓	✓
15	Insufficient equipment	✓	✓	48	Poor technical performance	✓	✓
16	Deficiencies in the infrastructure	✓	✓	49	Equipment availability/failure	✓	✓
17	Lack of communication among parties	✓	✓	50	Number of works being done at same time	✓	✓
18	Change in the scope work	✓	✓	51	Poor financial control on site	✓	✓
19	Delay payment to supplier/subcontractors	✓	✓	52	Poor site management and supervision	✓	✓
20	Shortage of materials	✓	✓	53	Site constraint	✓	✓
21	On-site waste	✓	✓	54	Lack of skilled labour	✓	✓
22	Project size	✓	✓	55	Mistakes during construction	✓	✓
23	Lack of constructability	✓	✓	56	Delay in decision making	✓	✓
24	Unrealistic contract duration	✓	✓	57	Shortage of site workers	✓	✓
25	Delay in material procurement	✓	✓	58	Disputes on site	✓	✓
26	Poor site management and supervision	✓	✓	59	Late materials/ equipment delivery	✓	✓
27	Inexperience contractor	✓	✓	60	Unpredictable weather condition	✓	✓
28	Shortage of site workers	✓	✓	61	Mistakes during construction	✓	✓
29	Work security problem	✓	✓	62	Unforeseen site conditions	✓	✓
30	Rework	✓	✓	63	Earth conditions	✓	✓
31	Experience in contract	✓	✓	64	Management-labour relationship	✓	✓
32	Workers problems health	✓	✓	65	Inexperience of project location	✓	✓
33	Unexpected subsoil conditions	✓	✓	66	Lack of experience of project type	✓	✓
	Summary=54/66X100= 81.81%						

(Source: Flyvbjerg, Holm, and Buhl, 2004; Singh 2009; Allahaim and Liu, 2013: 13-14; Olawole and Sun, 2010; Koushki, Al-Rashid and Kartam, 2005; Ejaz, Ali and Tahir 2011; Kasimu, 2012; Malumfashi and Shuaibu 2012; Le-Hoai, lee and lee, 2008; Memon *et al.*, 2011; Love *et al.*, 2011; Allahaim and Liu, 2013; Olawole 2010; Kasimu, 2012; Malumfashi and Shuaibu 2012; Nagapan *et al.*, 2012; Osmani *et al.*, 2008; Wahab and Lawal; 2011; Oladiran, 2009, Ameh and Itodo, 2013; Aiyetan and Smallwood, 2013; Osmani, 2011)

The relationships in Table 2 are further summarised in Figure 3 below showing that, at the post-contract stage of a project, there was also a 100% relationship between the causes of material waste and those of cost overruns. This means that, all material waste causes are also responsible for cost overruns. But on the other hand, when causes of cost overruns are considered, there is an 81.81% relationship with causes of material waste. The remaining 18.19% are not related and are mostly, the micro and macro-economic factors. This implies that managing material waste at this stage denotes managing 81.81% of cost overruns.

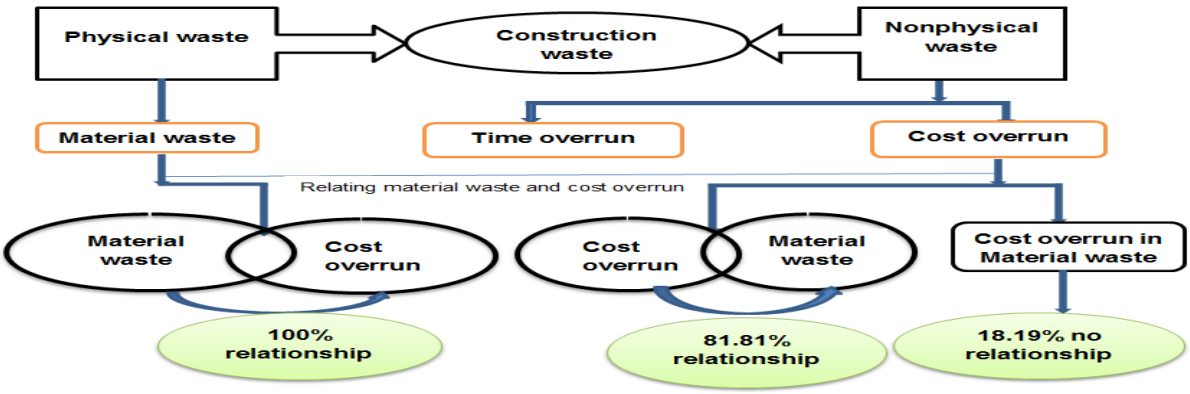

Figure 3. Relationship between cost overrun and material waste at the post-contract stage of projects

4.3 Pre-contract and post-contract stages of a project

Summing all the causes at both the pre-contract and the post-contract stages, 32+66 =98, a total of 85 out of 98 causes of cost overruns also cause material waste showing 85/98X100=86.74% relationship. These findings are also graphically represented in Figure 4.

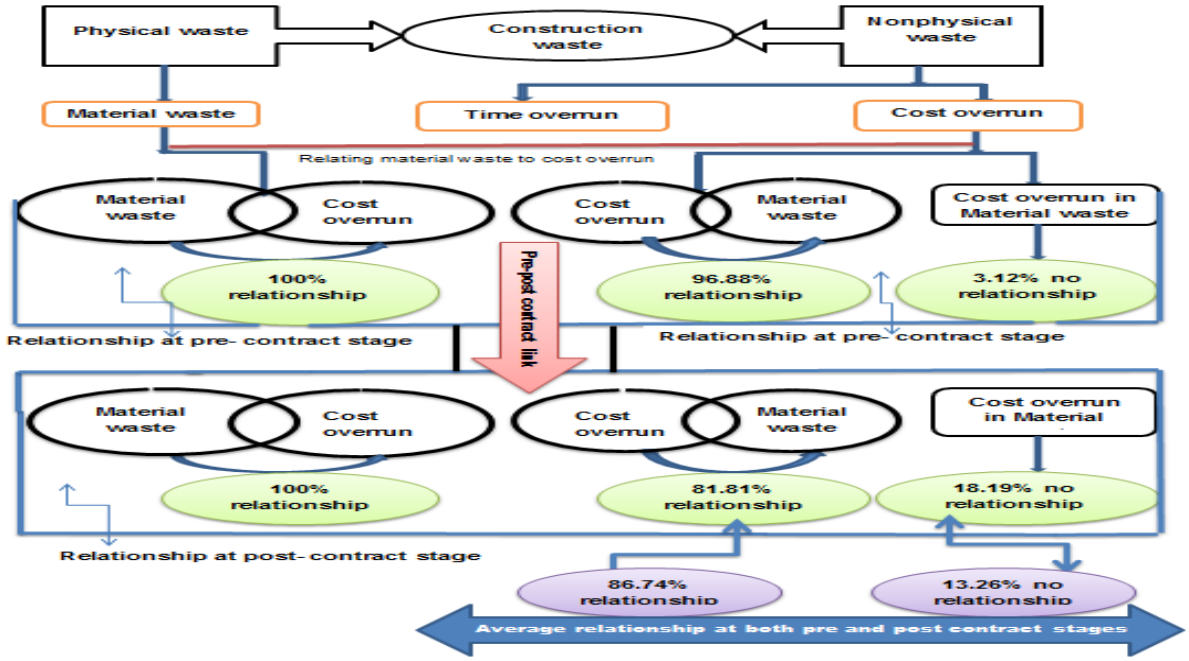

Figure 4. Relationship between material waste and cost overrun at all stages of a project

4.4 Managing material waste and cost overrun

Figures 5 and 6 show the interrelationship between project stages (pre-contract and post-contract), control measure, waste sources, waste causes and the identified percentage of cost overrun (86.74%). Figure 5 shows that unless control is tight at all sources and causes of material waste and at the stages of a project otherwise, cost overrun is bound to occur.

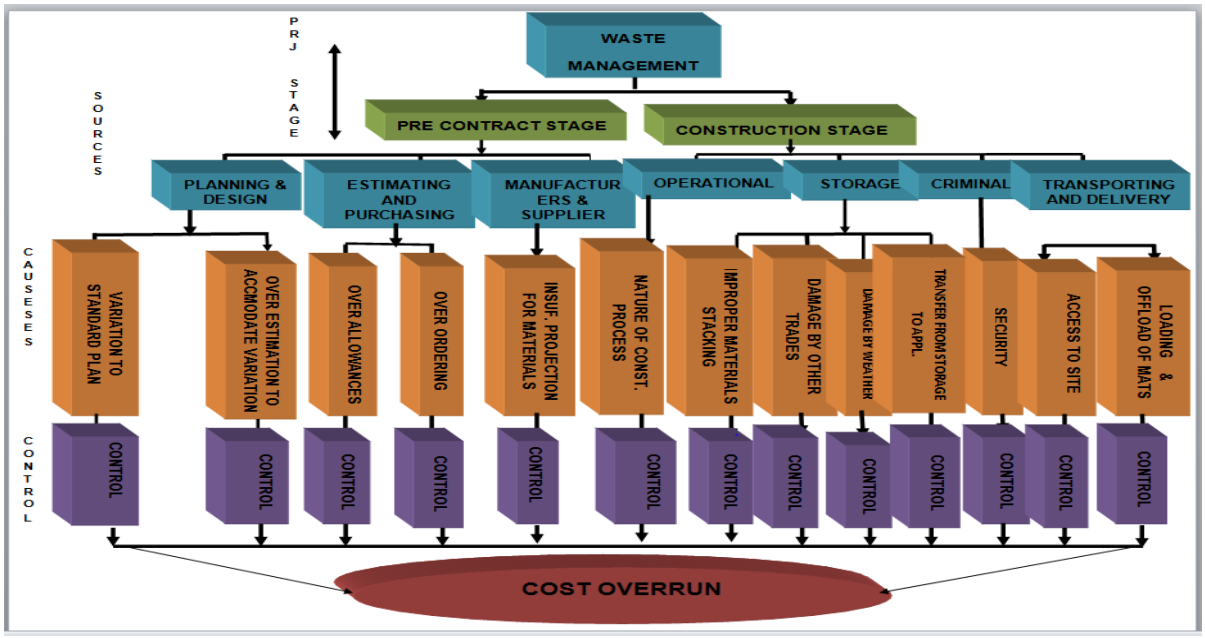

Figure 5. Summary of the relationship in Figure 4

This interrelationship is further represented in Figure 6.

Figure 6. Relationship between project stages, waste sources, waste causes, management and cost overrun

This relationship is further represented mathematically showing how cost overrun is minimised with Effective Waste Management (EWM) from each scenario.

Line 01, A-B:

$Project\ stage\ +\ waste\ sources - EWM = 86.74\%\ Cost\ overrun$ ……..01a

Making "EWM" the subject, by having a positive EWM, the equation would therefore, minimise cost overrun by 86.7%. This means that an effective waste management at the project stages and waste sources would effectively minimise project cost overrun by 86.74%.

$EWM = Project\ stage\ +\ waste\ sources - 86.74\%\ Cost\ overrun.$ ……..01b.

Line 02, A-C:

Project stage + waste causes-EWM = 86.74% cost overrun……...02a

Project stage + waste causes – 86.74% cost overrun = EWM…… 02b

This means that an effective management (EWM) of waste causes at project stages would effectively minimise project cost overrun by 86.74%.

Line 03, B-C:

Waste causes+ waste sources-EWM=86.74% cost overrun……03a

Collecting the like terms by making "EWM" the subject, the equation will be:

Waste causes+ waste sources-86.74% cost overrun=EWM……03b

Therefore, an "EWM" would minimise the occurrence of "cost overrun" by 86.74%. However, Poor "EWM" would lead to occurrence of "cost overrun" as shown in the equation below:

−EWM= Project stage + waste sources+86.74% cost overrun.

Scenario 1 (Line 01, A-B), shows that waste sources within the project stage. Figure 6; cause an 86.74% cost overrun. Therefore, to effectively control the project waste, there must be an Effective Waste Management (EWM) at the project stages and at the waste sources, which will in turn, minimise cost overrun to 13.26%. The same applies to the remaining two scenarios.

These findings imply that an increase in material wastage on site leads to a corresponding increase in the amount of cost overruns for a project. 100% of the causes of material waste also cause cost overruns at the pre-contract and the post-contract stages of a project, while 96.88% and 81.81% of the causes of cost overruns cause material waste at the pre-contract and at the post-contract stages respectively. These results corroborates the findings of the studies conducted in the UK, Hong Kong, Netherlands, and Nigeria; that wastage of construction materials contributes to additional project cost by reasonable percentages (Ameh and Itodo, 2013). The result also supports the findings of Teo, Abdelnaser and Abdul (2009).

Though, these results are literature based, they however, refute the findings reported by Ameh and Itodo (2013: 748) that in the UK, material waste accounts for an additional cost of 15% to cost overruns as stated in the section 1 of this study.

5 Conclusions and Further Research

Material waste and cost overrun are identified as global problems which affect the success of many construction projects. Moreover, most managers of construction projects pay little attention to the effects of waste generated on cost overrun (referring to section 1). The aim of this research was to examine the relationship between the causes of material waste and those of cost overruns with a view to suggesting the possible ways of minimising their effects at the pre-contract and the post-contract stage of a project. The study concludes from the findings that effective management of material waste would translate into a reduction in the level of cost overrun for a project. It is recommended that construction-project managers as well as the construction practitioners should encourage the management of material-waste causes, as it has the potential to minimise the causes of cost overrun for a project.

Since this is an ongoing research, further study would focus on the collection of empirical (field) data on the issues relating to material waste and cost overruns in the construction industry.

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A CONCEPT: STRATEGIC MAINTENANCE MANAGEMENT FOR BUILT FACILITIES OF UNIVERSITIES

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Abstract
The built facilities of universities are essential facilities that are procured to support smooth administration of the primary functions of the institutions, which is the dissemination of specialist knowledge that will boost development of human capital. However, the degree of deterioration of built facilities at many educational institutions, including universities has been hinged majorly on ineffective maintenance management systems. To address problems related to ineffective maintenance systems, a strategic approach to maintenance management has been suggested by researches in the maintenance related fields both in the building construction and the manufacturing industries. This paper provides an understanding of the concept of maintenance management of built facilities using the strategic management approach. The methodology adapted for this investigation was basically an intensive literature review of related publications that underpin the theories and concepts of maintenance and strategic management. The exercise enabled an indepth understanding of the importance of strategic management principles towards achieving an effective maintenance mangement system for built facilities. The articulated concepts and principles from the existing theories of which maintenance mangement is imbedded informed the concept of strategic maintenance management which is needful for managing the esteemed built facilities of universities. The paper recommends the integration strategic maintenance management principles in the development of a maintenance management system by maintenance management unit/department of universities.

Keywords: Maintenance management, Strategic management, Built facilities, Universities

1 Introduction

Maintaining built facilities in best possible condition on a university campus is important for the well-being of the staff and students that use or occupy these facilities (Iyagba, 2005). Maintaining buildings is an optimum initiative and intervention for preserving and supporting the values of the built environment and the entire community (Dann *et al.,* 2005; Idrus *et al*., 2009).

Unfortunately, maintenance of buildings and incorporated facilities in many organisations including universities is perceived to be of less important as compared to construction or procuring new facilities (Cleote, 2002). However, maintenance has a major influence on the reliability and safety of buildings (Abdul Lateef *et al.*, 2010), therefore, well defined strategies are vital for maintaining all facilities in the best condition possible (Buys and Nkado, 2006),

that will create a conducive environment for academic activities which is the prime function on any university campus.

The consequences of neglecting maintenance in the built environment are less visible in the short-term, and as a result, management groups short-sightedly cut down maintenance budgets (Mc Duling *et al.*, 2004). In the United Kingdom (UK), Chanter and Swallow (2007) have observed a decline in the condition of built assets of educational institutions since the early 1980s, which they hinged on resource constraints. According to Adenuga *et al.* (2010) the United Nations (UN) Centre for Human Settlements found that many Developing Countries (DCs) lack effective maintenance management systems for the efficient utilisation of available resources. In addition, Bowazi and Buys (2009) observed that these DCs lack adequate maintenance policies to guide the maintenance operations of their built environments. Cloete (2002) also found that information on the current condition and maintenance requirements are inaccurate and unreliable. Furthermore, maintenance management is not a strategic issue at most tertiary educational institutions in South Africa (Buys and Nkado, 2006).

2 Overview of the Concept of Maintenance

Maintenance is a key support function in building performance and it deserves a strategic position in the management structure in an organisation (Abdul Lateef, Khamidi and Idrus, 2010; Olanrewaju, 2013) because it ensures that the functional, structural and aesthetic conditions of the built facilities are upheld throughout their service life (Waziri and Vanduhe, 2013). In so doing, safety of occupants/users would be enhanced, and the quality of life of the community would be improved. However, the concept of the term 'Maintenance' has evolved from a non-core but integral production function in manufacturing to a strategic management function (Pintelon and Parodi-Herz, 2008). The evolution of maintenance is believed to be influenced by the changes in concept of maintenance function due to a steady growth in the realisation of its importance to achieving core goal of an organisation. Dunn (2003) argues that changes in the expectations of maintenance are linked to the perceptions about failure patterns of facilities and that these perceptions determines the maintenance approach that are adapted by managers. Dunn (2003) described four generations of maintenance perceptions and expectations over six decades (1940-2000). A summary of the decennial analysis is presented on Table 1.

Table 1. Concepts and expectation of maintenance

Generation	Concept	Expectation
the 1940s "Necessary evil"	"Fix after it breaks"	"All wear out."
1960s "Technical matter"	Fix before it breaks" predict, plan, conscious of cost	Higher equipment availability Lower equipment life Lower maintenance cost
1980-1990s "Important for production"	Improve it" Value focus (minimise defects, improve precision, redesign)	Higher equipment availability & reliability Safety, product quality longer equipment life & cost efficiency
2000 "Strategic issue"	"Optimisation" Maintenance management (align vision, integrate skills, improve performance)	Excellence

(Source: Dunn, 2003)

2.1 First and Second Generation (Necessary Evil - Technical Matter)

In the first generation (1940s) the maintenance approach was mainly fundamental repair skills because facilities where expected to be fixed only when a failure occurs. This view changed in the 1960s because of a growing realisation that the life span of facilities could be increased which implies that the facilities could be used effectively and efficiently for a longer period. The need for cost reduction of maintenance activities informed the ushered in the second generation In addition, the cost of maintenance is reduced. Thus, the maintenance approach for facilities generation that characterise the second generation of maintenance focuses majorly on scheduled overhauls, employing management techniques such as Program Evaluation and Review Technique (PERT) for planning and controlling the maintenance operations.

2.2 Third Generation (Technical Matter - Necessary for Productivity)

The early 1980s to the late 1990s witnessed another change in the concept and practice of maintenance management in many industries. Main changes in the expectations of maintenance that characterised the third generation (in addition to the second generation perspectives) are: the need for greater safety, reliability, a growing consciousness of sustainable environment and improvement in the quality of production. The focus was not only on availability but also on reliability. The pattern of failure by Nowlan and Heap (1978) known as the 'PF-curve' which is believed to have ushered in the concept of Reliability Centred Maintenance (RCM). The 'PF' concept is applicable to any facility, the 'P' represents part of the facility (likely failure point) is observed using a condition monitoring method, which enables identification of an impending failure. 'F' refers to the failure point as the letter suggests (Sondalini, 2007). RCM, focuses on sustaining the functionality of the facility while maximising its availability and reliability. The maintenance approach in the third generation which is the RCM concerns itself with condition monitoring, maintainability and reliability and considered at design stage of a facility that is achievable with teamwork and empowerment (Smith, 1993).

2.3 Fourth Generation (Necessity for Productivity - Strategic Issue in an Organisation)

Towards the end of the 1990s and early 2000, the concept of the term maintenance of built facilities changed especially in the manufacturing industry. Reason for the change in concept has been attributed to the heavy reliance on mechanised or built facilities for production by many organisations of both goods and services (Murthy *et al.*, 2002). Maintenance during this period is considered a strategic issue that requires strategic management skills to aid the planning and execution of maintenance operation programmes. According to Pintelon and Parodi-Herz (2008), the concept of maintenance in the generation fourth is realistically perceived and valued by facilities owners, owing majorly to the rapid changes in the construction and manufacture of facilities (changes in technology). Technical approaches to maintenance without strategic planning skills was no longer effective and efficient. A rethink on the maintenance management system was inevitable. Many manufacturing organisations consider maintenance as an internal or external partner for success in pursuing prime goals (Lee and Scott, 2009b; Khazraei and Deuse, 2011; Selvik and Aven, 2011). Smith and Hinchcliffe (2004) argue that the maintenance approach of the fourth generation is an improvement on the RCM.

2.3.1 Principles of Strategic Maintenance Management

The term 'maintenance management' combines two important and distinct functions viz. operational and managerial. The range of skills required for operational functions is very different from those required for managerial input. The operational aspect requires purely technical skills, while the managerial deals with decision making, precisely "*what and how to decide"* (Pintelon and Parodi-Herz, 2008). However, maintenance personnel are more

concerned with technical issues and less concerned with strategic plans of the maintenance department and the strategic goals of an organisation (Lee and Scott, 2009b). Therefore, an understanding of the relationship between executive management at a strategic level and maintenance personnel at an operational level is important for effective management of facilities maintenance functions.

The operational function consists of various tasks to be executed in accordance with a maintenance policy (Marquez and Gupta, 2006). This is necessary for achieving the maintenance objectives as set by an organisation for maintaining a facility and its associated services (Abdul Lateef *et al.,* 2010). The basic tasks in this process are corrective or preventive operations; where the former refers to all activities undertaken after the occurrence of a failure, the latter refers to activities in anticipation of a failure occurring (McLean, 2009). The execution of maintenance tasks involves one or a combination of the following activities: Service, rectification or replacement (Buys, 2004; Olagunju, 2011).

3 Research Methodology

An intensive literature search was conducted with the aid of maintenance related published journal articles, books , conference papers and a few unpublished PhD thesis. The concept of a strategic maintenance management for universities was articulated from the concepts and principles of maintenance management for facilities from the reviewed literature.

4 Strategic Maintenance Management

Maintenance management has evolved from a stand-alone technical function to a multi-functional process that involves key management units (strategic and operations managements) of an organisation (Yahya and Ibrahim, 2010). Therefore, strategic management plays an important role in the strategic maintenance process.

According to Tse (2010) "Strategic management is a process that requires the input of top management's analysis of the environment in which the organisation operates prior to formulating a strategy, as well as the plan for implementation and control of the strategy". Strategic management is in the domain of executive management of a university. Its main function in relation to maintenance management is the formulation of maintenance policies that will guide maintenance managers in preparing programmes and choice of maintenance strategy (Lee and Scott, 2009a). A strategy is insufficient and has little or no value to an organisation without a strategic plan for deployment and implementation of resources as well as operations (Wells, 2000). Major roles and importance of strategic management include:

i. it has a major influence on maintenance management processes in an organisation because the maintenance objectives must align with the main objectives of the organisation (Yahya and Ibrahim, 2010);
ii. the position of a maintenance department within an organisation is dependent on the strategic objectives of that organisation and the importance it attaches to the condition of its buildings (Chanter and Swallow, 2007); and
iii. strategic management guides the formulation of maintenance policy, determines the strategic direction, approves the budget and other necessary resources for maintenance management (Lee and Scott, 2009b).

A strategic maintenance management is a world class maintenance management method used by many industries for optimizing the valuable assets such as built facilities. The maintenance process is considered a cost efficient which enables focus on resource management for best return on investment and avoids intrusive maintenance, it adapts performance evaluation

techniques which produces results that aids strategic planning to improve maintenance strategies (Smith and Hinchcliffe, 2004).

5 Conclusion and Further Research

This paper presented an evolutionary perspective of maintenance especially in the manufacturing industry. Understanding the strategic stand point of maintenance management is the crux of the study, which has been achieved through theoretical search. In conclusion, the paper contends that a sustainable maintenance management approach for built facilities in a university must integrate strategic management. In so doing, facilities serve for a longer period with minimal maintenance cost and the safety of users/occupants is also enhanced. Therefore, strategic maintenance management is recommended as a key agenda for preserving valuable built facilities that universities procure to support their primary goal of human capital development. The paper suggest an empirical study of current maintenance management systems at universities to enable the development of a framework and model for sustainable maintenance of their built assets.

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EVALUATION OF THE GLOBALISATION READINESS OF MEDIUM SIZED CONTRACTORS IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY

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Abstract
The developing countries are on the verge of developmental take-off, most especially the African continent with its emerging economies. The current competitive forces are intense both on the global and domestic in the construction market. The global thrusts have generated the concepts of globalization business strategy as one of the drivers of competitiveness of many countries and organisations. The objective of this study is to evaluate the globalization readiness amongst the medium enterprise (MEs) contractors in Port Elizabeth, Eastern Cape Province of South Africa (SA). This paper is a qualitative study which adopted in-depth interviews for 10 contractors in the Civil Engineering and General Building contractors within the cidb grade 4 to 6 between the months September to October 2015. These MEs are perceived as potential large scale construction organisations in the nearest future. Findings of the study shows that most of the contracting firms interviewed are currently sustainable and competitive organisations in the domestic market but significantly lacking the readiness and the strategic business approach to penetrate and participate in the global construction market. It can be concluded that the competitive forces emanating from globalization thrust may have the capability to erode the potential and opportunities of the SA medium contractors for growing and maturing into large construction organisations in the African continent, due to lack of globalization business strategy amongst local contractors. This study recommended that the SA construction contractors should endeavour to develop and implement globalisational business strategies that would foster their global competitiveness.

Keywords: Competitiveness, Globalisation readiness, SME contractors, South Africa

1 Introduction

The global attention that African countries are receiving is due to its needed calls for massive infrastructure development and its maintenance that would worth around US$100 billion per year on the continent over the next decade (KPMG, 2014). It is obvious that developing countries, most especially those in the Africa continent are on verge to take-off on its massive infrastructure and mega cities building projects development; and as such the construction organisations both the small, medium and large firms should be encouraged to take advantage of this strategic positioning in order to heighten its global competitiveness. Dlungwana & Rwelamila (2004:349) advise that industries in the developing countries such as South African construction industry must strategically enhance the capacity at the base levels in order to improve its readiness to deliver effectively on local and global projects. The local contractors'

readiness to deliver effectively on the future infrastructure projects would increase their competitiveness in the local and global construction market.

Martin (2010) and Orozco et al. (2011) note that current competitive forces are intense both on the global and domestic market. This has posed a major challenge for many industries including construction. Given the increasing pace of globalization in the commencement of the twenty-first century; it is imperative for domestic organizations in African continent it strategically tap into this upsurge of opportunities. However, it is crucially for South African construction industry to create the readiness to develop, compete and adopt business strategies that would embrace international business management approach. According to Porter (1985) competition remains the center-focus of firms in any given marketplace (locally and internationally). It streamlines a firm's activities and resources; and it can lead to innovation, a cohesive culture and competitiveness (Riley, 2012; Blunck, 2006).

Blunck (2006) reveals that competitiveness emanates from superior productivity or performance in a business environment. However, enhancing the survival rate and competitiveness of the construction industry should be one of the most important strategic tasks for construction players. The construction industry has been an important venture for material production and is playing an important role especially in today's conditions where the rate of industrialization and globalisation in this sector is growing fast. The construction industry is important for the South African and global economy. According to the ECORYS SCS Group (2011) and the National Research Council (2009:2), the construction industry is of strategic importance to the European Union (EU) countries and the U.S.A, as it delivers the buildings and infrastructure needed by the rest of the economy and society; and it is a major generator of jobs. The South African construction industry contributes about 3.7 and 4.0 of the country gross domestic product GDP in the year 2012 and 2013 respectively (Kumo et al., 2015). Therefore, it is vital to ascertain the survival rate and competitiveness; and globalisational readiness of the construction industry especially the MEs contractors. Thus, this paper seeks to evaluate the globalization readiness amongst the active medium enterprise (MEs) contractors in the South African construction business. It was necessary to engage with the medium contractors and organisations that participated in the study as they are been perceived as potential large scale construction organisations in the nearest future. The paper consists with synopsis of the related literature reviews on the MEs contractors' competitiveness and globalisational readiness and it subsequently depicts the research design and method adopted; and presentation of the findings and discussion as well as the conclusion and further research areas.

2 The Medium Contractors' Competitiveness and Globalisational Readiness

According to Ngowi et al. (2004) the competitive force of globalization in the construction industry (CI) has presented new opportunities and challenges which have an impact on all countries in different perspectives. It can be convinced that the globalisation tends would erode the competitive strengths of the local CI. The lack of tenacity and readiness amongst local CI contractors to participate actively in global construction market would consequently undermine any protection policy provided national government that intended to shed the local contractor from the harsh reality of global forces. Ngowi et al. (2004) maintain that construction firms in developing countries have no choice, but to develop skills capacity and tactically position and differentiate their organisations in the market in a way that would ensure their sustainability and competitiveness. Such would also create the readiness for them to compete both in the domestic and global market.

The numerous advances in communication technology, transportation and air travel, and contemporary knowledge on business management and strategies have made global business environment so conductive to initiate and develop a rapid expansion of international business on from any country in the world (Howes and Tah, 2003). According to the, KPMG Global Construction Survey 2013, it was found that, about half of 165 senior leaders in the construction and engineering industry globally, are strategically planning to move into new geographies and most of them focus their business direction towards the African continent, which has been listed as the most popular and prospect to run a business (KPMG, 2014). KPMG (2014) further revealed that most of the organisations that are planning to gain entrance in the construction market in African continent have their headquarters in Europe and the Middle East, and many of these organisations are small companies with a turnover of up to US$5 billion.

These global thrusts have generated the concept of globalisation and internationalisation in today's business world. The concept of globalization and internationalization is a dominating source of competitiveness for countries and organisations, and well as economic sustainability in the global construction businesses. Globalisation is the movement of people, resources, goods, services, ideas, language and skills across international spaces (Ibrahim, 2013; Dlungwana and Rwelamila, 2004). According to Tallman and Fladmoe-Lindquist (2002), globalisation can be regarded as the managerial process of integrating worldwide activities into a single world strategy. This can be achieved through organisations managing business networks of differentiated, but integrated subsidiaries, affiliates, alliances and associations.

Globalization and internationalization of a business organisations as be regarded as one drivers of any countries competitiveness. Broadly, the World Economic Forum (2014) defines "competitiveness as a set of institutions, policies and factors that determine the level of productivity of a country". The World Economic Forum (2014) further asserts that the stability of the macro-economic environment in any country enhances or deters its holistic business survival and performance as it impacts significantly on a nation's general level of competitiveness. According to Orozco *et al.* (2011) the concept of competitiveness in the construction industry can be divided into four sections, namely the country, industry, firm and project. The World Economic Forum (2014) indicates that South Africa's competitiveness has fallen to 56th out of 144 countries in the Global Competitiveness index for 2014, compared to 2013 when it was ranked 53rd out of 148 countries. It can be said that the country's competitiveness factors are determinants of its firms' international competitiveness; because it is evident that a country's international competitiveness is represented by its firms' competitiveness in comparison to other countries' firms. More so, the government should endeavour to create an enabling environment for MEs contractors through provision of easy access to finance, and creating awareness regarding available technologies, business opportunities and innovation which would boost their productivity and competitiveness globally.

The concept of competitiveness at the industry level is often considered as the results of the strategies and actions of organisations that operate in it. According to Momaya (1998) competitiveness of an industry depends on its ability to obtain inputs at competitive terms, to gain effective value through efficient processes, effective application of business management practices and the successful marketing of its output to downstream industries and international markets. In addition, Momaya (1998) claims that there are three components and facets of competitiveness in the construction industry, namely, competitive assets (factor costs, human resources, industry infrastructure, technology, demand conditions, government); competitive processes (strategic management, formal business plans and models, implementation, human resources development, R&D synergies); and competitive performance (productivity, human resource, quality/effectiveness, cost, financial, international, technological). The relative

market positions of the construction organizations in a particular country would determine their survival rate and competitiveness in global landscape of its industry. The competitiveness of a country and its levels of industrial development impacts heavily on the firms that operate within the system. It is therefore important that a firm compares and defines its competitiveness as per its own strategy and management practices. A systematic evaluation of competitiveness will be of great help to firms. According to Depperu and Cerrato (2005) a firm's competitiveness can be treated as a dependent or independent variable: the first approach looks at competitiveness as driver of a firm's survival and performance whereas the second one considers competitiveness as an outcome of a firm's competitive advantages. However, the concept of competitive advantage is central in strategic and business management and model.

Ambastha and Momaya (2004) add that understanding the firm's level of competitiveness helps to provide a broader and more comprehensive view on sources of competitiveness. These sources have been categorized under 'Asset', 'Processes' and 'Performance' on spectrum of strategic and operational levers both in local and international markets.

- Asset - includes firm's brand, reputation, culture, system, structure, human resources, and technology;
- Processes - involves strategy, innovations, competencies, capabilities, quality, persuasion power, flexibility, adaptability, IT applications, managing relationship, design and deploy talent, marketing, manufacturing; and
- Performance – consists of value creation, customer/client satisfaction, market share, productivity, new product/service development, price and cost, profitability.

Wadiwalla (2003) suggests that economic integration in Southern Africa has been enhanced significantly through assistance of regional protocols relating to trade, finance, investment, transport, telecommunications, laws, amelioration of cross border trade barriers, facilitating efficient movement of goods between countries and frameworks for good governance. This economic integration has brought about internationalization of business organisations. Ellis & Williams (1995) state that organisations should have integrated approaches to international business strategies (such as international business, strategic management, international finance, organisational development and international marketing) relating to international aspects of industries, companies and their strategies. Daly (1999) suggests that inter-national literally means between or amongst nations. The basic unit remains the nation, even as relations amongst nations become increasingliy necessary and important. However, the integration of international business strategies into contemporary organisations is applicable to small businesses and contractors.

According to Daly (1999) globalisation is inevitable wave of the future in a business environment; because the process of globalization has eliminated the natural barriers over the protection for local economies, and it has brought together the standardized outputs; and businesses across different sectors and countries (Gonov and Genova, 2001).

However, it is a fact now, that globalisation impact in developing countries is real, irreverable, and it has potential force to eliminate all the uncompetitive organisations and contractors within the construction industry in Africa continent (Dlungwana & Rwelamila, 2004). The strategic readiness for the African organisations to harness globalisation as a competitive advantages is their last life-belt that will enable them to strategically weather the storms of globalisation. Tallman and Fladmoe-Lindquist (2002) globalisation stands as new dynamic and strategic dimension to do business, because there is potential for competitive advantage through globalization; because it has becomes an important source for knowledge transfer and new market development. According to Ofori (2000) globalization is an inescapable fact for the construction industries in developing countries. However, Africa continent is no longer

immune to external influences and cannot be insulated from global effects. Wadiwalla (2003) opined that South African construction organization have globalised as a result of expansion, diversification, deepening of trade and to eliminate the cyclical nature of the construction market within South Africa. Furthermore, Wadiwalla (2003) said that contracting business in Southern Africa is dominated by South African Contractors. However, recent, and massive penetration and domination of the Chinese, European and Indian contractors in African continent should be wakeup call for indigenous organisations.

3 Research Methodology

The study made use of the qualitative research method using in-depth interviewing. However, the phenomenology paradigm was adopted in order to holistically understand the phenomenon about the medium contractors' perspective on globalisational readiness. This method in the study is considered the most appropriate and effective to elicit useful and authentic information- experiences, opinions and perspectives through the interviews with the medium construction business owner's and executive managers as firms' representatives. The primary data for this study emanated from face-to-face interviews conducted in Port Elizabeth between the Months of September to October 2015 and on-going PhD research. The interviewees were ten (10) construction business owners and executive firms' representative under the Construction Industry Development Board (cidb) register of contractors in the civil engineering (CE) and general building(GB) organisations within grade 4-6 (medium contractors- see Table 1). The interviewees comprise those organizations that have been competitive and sustainable and; actively operating their business beyond five (5) years in the construction industry.

Table 1. The background profile of interviewees

Interviewee code	Organisational Position	Years of Experience in Industry	Highest Level of Education Qualification	Cidb register of contractors grade
CC1	Executive Member(Owner)	40 years	National Diploma	6 GB
CC2	Director (Owner)	17years	Matric	5 CE
CC3	Managing Director (Family Business)	24years	Bachelor's Degree	5CE
CC4	Director (Shareholder)	40years	Matric	5 GB
CC5	Executive Manager (Family Business)	30years	National Diploma	5CE
CC6	Manager (Owner)	7years	Matric (studying Bcom)	4GB
CC7	Director (Owner)	10years	Bachelor's Degree	4GB
CC8	Managing Director (Owner)	42years	National Higher Diploma	6CE
CC9	Director (Owner)	32years	National Higher Diploma	6CE
CC10	Executive Managing Member	13years	Bachelor's Degree	4CE

(Source: Anugwo and Shakantu, 2015)

The information gathered during the study interviews was analysed thematically. However, the interview was purposively composed into themes as its links and reflects that of the research questions. These themes were emerged by pertaining the research questions within globalizational readiness and participation; international business strategy; and strategic partnership with foreign organization(s), as it were emerged from the transcribed interviews. Although, the research population response rate may seems low, but the data collected was still

significant and meaningful as most interviewees (contractors) were business owners and had wealth of experience in the South African construction industry.

4 Findings and Discussion

Theme 1: Globalization Readiness and Participation

Interview question: *Does your organization have business plans of operating internationally? And why?*

The issue of global participation amongst the medium scale construction contractors is worrisome as it only one (1) organization is actively operating outside South African construction market whilst 70% of organization the interviewed indicates that they have no strategic business intention to engage in international construction market. CC-1 explained that: "*At this moment, you can call us international company because we got subsidiary in Namibia, and have started a new project this year in Oshakati".*

The common challenges deterring the medium construction expanding the businesses internationally are; lack of awareness, readiness and knowledge on opportunities in the international construction markets, risks of resources transfers, lack of interests and resources; and strong attachment to have absolutely control in the activities of their organizations. The CC-3 *"our organization have not done international project, and to be honest with you, it is a matter of awareness. I think there are lots of business opportunities internationally, but we are not ready for it yet".*

From the reviewed literature, it has been confirmed that about 165 senior leaders as small construction companies in Enrope and the Middle East are strategically planning to penetrate and compete in the African continent as the continent expected to be spending about US$100billion on infrastructure development and its maintenance per year. This notion presents the evidence that integration of international business and operational strategies is applicable to small businesses and contractors across the Africa continent, most especially those contractors who are proactive to strategically penetrate and to actively participate in the global construction markets. CC-2 "*At this point in time, our organization doesn't have any business to engage in international construction market and I'm not in a position where I'm going to be looking for them",* and other organization- CC-8, added that "*No, we don't operate internationally and I don't want to, because I'm too old and it is too risk"* and similar responses emanated from the contractor CC- 9, "*No, I have never really thought about operating internationally. It hasn't crossed my mind to strategically expand or gain competitive advantage in our business through that way ".* It seems the readiness is greatly lacking amongst the contractors as CC-5 states *"Our organisation haven't thought or create that readiness about expanding our business on international level, so we don't engage in international business".* Remarkably, it take a brave organization to explore into international construction business as; CC-4 responses was *"No, to go internationally, no we are not that brave enough to expand our business internationally"*

Coincidentally, both CC-7 and CC-10 contractors have a long-term strategic goal to grow their resource base nationally but not internationally. CC- **7** *"No, not yet. We are still developing our business locally, but we might get to the international in future, but not really sure".* And according to CC-10 **"***Not really operating internationally but we currently have the business plans to expand nationally for the next five years".*

Theme 2: International Business Strategy

For an organization to operate successfully in international market it must possess a competitive international business strategy. However, various factors foster or deter an organization to consciously develop international business strategy for its business expansion;

and these are economic crisis, comfort zone, local opportunities and advantages, family concerns, technically and administrative challenges, international alliances. According to CC-1 "*We have strategically chosen to this route of international business because of the economic challenging here in South Africa and obviously for expansion of our business network".* In addition, CC-2 **"***Running a family business successfully and within the immediate local market, and trying to be strategically the market leader locally required you full time attention. However, our business is strategically structured, that we don't have time to go and engage in an international businesses".*

Interacting with foreign business organizations can stimulate local contractors' interest to starts nursing the need and business ideas to develop business strategy and go into international business landscape. According to CC-6 *"our business, is tentatively developing international business strategy. I have been engaging on business trips specifically to China and I'm strategically studying and learning how the Chinese operate their businesses in terms of construction operation and management"*. Shockingly, some the organisations deliberately undermine globalization thrust in the construction international market especially in African continent. The contractors' CC-7, CC-8 and CC-9 stated that it is unnecessary for them to develop globalization business strategy. However this notion is a warning flag as it's capable for undermining the country as well as the continent globalization readiness and competitiveness within the global market. CC-7 "*We don't have concrete strategic business plans on that direction"* and CC-8 "*Our organisation don't have a business strategy for international activities because it not necessary for us"*. Whilst, CC-9 said *"We don't have any international business strategy for our organisation because it not necessary for us as we always wanted to be a small organisation and strategically cope on our own".* However, only one organization have a long term business plan to development international business strategy, as CC-10 said that *"we don't have international business strategy at this moment, perhaps in next ten years we may develop business plan to actually expand our business operation into international markets"*

Theme 3: Strategic Partnership with Foreign Organisation(s)

Interview Question: *Does your organization have any form of partnership with a foreign organization? And why?*

In today's business world, strategic alliance and partnership are the emerging drivers of competitiveness and globalization for numerous organisations. It is unfortunate that the medium scale construction contractors have been perceived as potential large scale construction organization in future, they are not tapping into the concepts of organizational alliance which is capable to strategically facilitate their business expansion into global construction markets. All the organisations interviewed indicated that they didn't have any form of business alliance and partnership both locally and internationally. CC-1 "*We don't have any strategic alliance or in partnership with any foreign organization at this moment. Our organization is very cautious in partnership or alliance because it comes with a lot of uphill tasks and it would involve an extensive feasibility study and business protocol".* The organization CC-2 added that "*We consider our organization has not been grown big enough to strategically forming international partnership"*.

In addition, some organisations are striving to solely develop themselves into large scale construction businesses locally and nationally, as CC-3 *"Our organisation haven't explored the possibilities and advantages for partnering with foreign organisation at this point in time. Our business intention is to strategically develop and grow our resources locally"*. However, two contractors CC-5 and CC-10 indicates that they may consider partnering with foreign organization on joint venture project within South Africa; as CC-5 said, *"Our organisation doesn't have any foreign partnership in our business; maybe because of the opportunities*

haven't presented itself to our business landscape and we are not ready to starts searching for it".

It can be said that the strategic partnership as one pillars of competitive advantage for various organizations in today's business is not being utilized or adopted by the medium construction contractors in Port Elizabeth, South Africa, both on local and global landscape of business operations. All the organisations interviewed indicated that there are not in any form of business partnership. Accordingly, the contractor CC-10 said, *"Currently our organisation is not into any form of partnership with foreign organisation as we have not look into that depth of business strategy"*. However, it is an open discussion in most of the organizations to consider it, but they have generally lack the interest to see the needs to strategically ascertain the pros and cons for engaging in it and how it would be beneficial to their business performance. Also, CC-10 further added that *"... I see businesses especially in the construction industry "big players" engage with lots of foreign organisations in their business and they are quite competitive and well off. As such, we are not entirely close-minded about it"*. Unfortunately, about 40% of the contractors interviewed considered that any form of business partnership or alliance is unnecessary as the lack interest to engage in it. CC-.4 "No, we don't have interest" and CC-9 *"No, we don't have any partnership and we consider it not necessary for us".*

5 Conclusion

The article set out to evaluate the globalisational readiness and competitiveness amongst the medium scale contractors in the Port Elizabeth, Eastern Cape province, South Africa. The critical review on literature has shown that African continent is attracting huge global interest in their construction market; and it as obvious that globalization is becoming one of the emerging drivers of competitiveness for various countries and organization in the construction market. As such, the globalization forces are inevitable and the local contractors in SA must consciously create higher level of readiness to strategically participate in the infrastructure development that taking-off within the continent and beyond. In this fact, the South African construction industry as one of the most structured and coordinated construction industry within the continent; should encourage its contractors especially the medium scale contractors. They should seize up the advantage of its strategic positioning within the continent to develop and adopt business strategies that would embrace its international business management approach; sustainability and competitiveness. This is possible as researcher commentators have highlighted that contracting business in Southern Africa is been dominated by South African Contractors. However, the new strategies on the increasingly penetration and domination of the Chinese, European and Indian contractors within the continent; should serves as serious wakeup call for indigenous construction organisations in Africa.

It can be said that the further persistence of lack interest and for global readiness and willingness to strategically explore global markets amongst local contractors will under-mind their sustainability and competitiveness in the nearest future. As such, the strategic readiness for the South African construction organisations should target to harness the trends of globalisation as a competitive advantage. However, strategic positioning remains the last life-belt for the continent to improve its global pentration and participation as it would enable them to weather the storms of globalisation challenges; and to harvest the benefits emanating from it. Hence, it was found that most challenging and imitigating factors for the medium contractors not be able to internationalising their busineses are lack of knowledge and awarness of opportunities on global markets; focusing only risk aspect of going globally and neglecting advantages; short-sighted on the strategic positioning on the continent; confort zone and not willing to grow big and highly structured organisations (may lose control of the business); and lack of strategic resources and willpower to explore the global market.

Therefore, this study was based on pilot study with a small sample of contractors; the result has revealed valuable and strategic insights for raising awareness on globalisational readiness amongst contractors in the study area and South Africa generally. Thus, it can be recommended that the construction industry players and contractors should drastically develop interest in exploring and, to actively penetrate and participate in the construction global market most especially within the African continent. Because, having the ability to develop globalization business strategy amongst the construction contractors would heighten the economic sustainability and competitiveness globally. If these commendations are adhered, there will be significant improvement amongst medium contractors that would develop and grow into large scale construction business in the Port Elizabeth, Eastern Cape Province of South Africa.

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ASSESSING THE IMPLICATIONS OF PUBLIC SECTOR PROCUREMENT ON CONSTRUCTION HEALTH AND SAFETY MANAGEMENT IN ZIMBABWE

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Abstract
The construction industry significantly contributes to economic and social development of nations. Yet the industry also contributes extensively to fatal and non-fatal work-related accidents. Regrettably, investment decisions in the industry continue to be made with disregard of Health and Safety (H&S), and where it is given attention it is mostly too late in the project lifecycle. However, upstream decisions made at procurement stage have a considerable impact on site H&S management. This research therefore explores the level of H&S integration in public sector procurement, and its impact on construction H&S management in Zimbabwe. The primary data was collected in Harare and Bulawayo though self-administered questionnaires, and a review of public sector procurement regulations, while the secondary data was collected through a review of published literature. The results of the study show that traditional factors such as bid amount, financial status, and project delivery time are given preference ahead of H&S when procuring contractors for public sector projects. Tight budgets, late appointment of contractors, and weak contractual provisions collectively create ideal conditions for disregarding H&S at procurement. Although these results are consistent with those obtaining in other developing countries, they depict a situation in which H&S management is not holistic. A review of procurement frameworks and commitment of clients to financially support the contractor's H&S programme are expected improve the situation. The results of this study are expected to influence public procurement policy direction and the setting of priorities for action to improve construction H&S management in Zimbabwe and elsewhere.

Keywords: Health and Safety, Procurement, Public sector, Zimbabwe

1 Introduction

The construction industry significantly contributes to economic and social development of nations. Yet the industry also contributes extensively to global statistics of fatal and non-fatal work-related accidents. To demonstrate the extent of the H&S management problem, the International Labour Organisation (ILO) estimates that accidents and work-related diseases cause 2.34 million fatalities annually around the world (ILO, 2013; ILO, 2014). In the construction industry, 60 000 fatal accidents are recorded per year on construction sites worldwide (Lingard *et al.*, 2008; Phoya, 2012). In Zimbabwe, the building and construction sector has the highest rate of H&S non-compliance (Mutetwa, 2010; NSSA, 2012) and against that background; Government admits that the country is a long way from attaining the optimum level of OSH performance (NSSA, 2015).

The cost of occupational injuries is borne by employees and their families, government, and employers (ILO, 2013). The effects, which include compensation, medical expenses, lost earnings, and replacement training (ILO, 2014) play a significant role in the spread of poverty and have a negative impact on sustainable development (ILO, 2013). Globally, several response strategies have been put in place to address the H&S problem and these include, but are not limited to institutionalisation of H&S management, formulation of H&S policies, passing of legislation, and the establishment of H&S institutions. However, a major shortcoming of these interventions is their dependence on contractors to manage construction H&S. Consequently, too many workers remain exposed to an unacceptable level of hazards and risks in the industry (WHO, 2006; Abbas *et al.*, 2013). Previous studies note that contractors perceive H&S compliance as an economic burden, which severely impinges on their already slim profit margins (WHO, 2002; Agumba and Haupt, 2009), hence insufficient resource provision for H&S.

Studies pertaining to root cause analysis of accidents reveal that many on-site accidents can be attributed to professional or managerial decisions arising well before work commences on site (Lingard *et al*., 2008; HSE, 2003). Accordingly, there is a growing trend for H&S management responsibility to be driven up the supply chain, and be partially borne by construction clients, and the designers of buildings and facilities (Lingard *et al*., 2008). However, the fact that little has been written regarding the impact of choice of contract strategy on H&S performance indicates a major oversight in the way the issue has been dealt with thus far (Lingard and Rowlinson, 2005). McAleenan (2010) notes that H&S in construction is an integral aspect of the whole process from the time the initial thoughts are scribed down and the concept developed through to the final stages of the structure's life. A study conducted by Smallwood (1997) demonstrated that clients can positively or negatively influence H&S through pre-qualifying contractors in terms of H&S, and directly through conducting H&S audits. Therefore, integrating H&S in procurement should go a long way to improving H&S performance on construction projects. According to Harding (2014), responsible procurement should take into account not only the financial value of the contract, but also the risks of the tasks involved.

In public sector procurement, government has a leadership role to play in preventing work-related deaths and injuries by ensuring their construction projects are managed safely (Worksafe Victoria, 2010; McAleenan, 2010; ASCC, 2006; Okorie *et al*., 2014). Public authorities can exert influence on duty holders by making improved H&S performance a condition of eligibility for them to participate in government contract / tender processes (Lingdon, 2011). Unfortunately H&S is not a priority when businesses are choosing contractors – it is overlooked altogether (Harding, 2014; Okorie *et al*., 2014). In Botswana, Mwanaumo *et al*. (2014) note that H&S is non-existent during project planning stages, while Lingard *et al.* (2008) indicate that in the UK, client-led H&S management in the planning and procurement of construction work was not well established. In that case, Longdon (2011) implores that more could be done to embed H&S guidance among public sector clients. This research, which is part of a broad research project pertaining to integrating sustainability principles in construction H&S management, explores the level of H&S integration in public procurement, and its effects on construction H&S management within Zimbabwe's public sector construction.

2 Literature Review

Public procurement refers to the acquisition of goods and services by government or public sector organisations (Uyarra, 2014). It is one of the key economic activities of government utilised for achieving economic, social, and other objectives (Thai, 2001). The economic significance of public procurement outlays is phenomenal and is conservatively estimated as

follows: over €2 trillion in 2009 (European Union, 2011), approximately 10 % of the Korean GDP (Choi, 2010); the public sector commissions approximately 40% of total construction output in the UK each year (Longdon, 2011). The considerable size of public procurement has far-reaching implications for H&S management. Previous studies (ASCC, 2006; Worksafe Victoria, 2010; Okorie *et al*., 2014) confirmed that the public sector as a major procurer of building and construction services, policy maker and regulator, has a direct influence on construction H&S management. According to Smallwood & Venter (2012), clients make key decisions concerning project budget, project objectives, and performance criteria and some of the objectives may create the type of pressures and constraints known to have a significant impact upon H&S during construction. The Australian Safety and Compensation Council (ASCC) (2006) and the American Industrial Hygiene Association (AIHA) (2005) note that if governments, at all levels, integrate H&S requirements into all stages of the procurement process, suppliers will need to demonstrate their ability to meet these requirements. According to Rwelamila and Smallwood (1999), incorrect choice and use of procurement systems contribute to neglect of H&S by project stakeholders. Previous studies (ASCC, 2006; Alli, 2008; Worksafe Victoria, 2010) observe that including H&S during procurement leads to improved productivity, reduced costs, better prediction and management of production and operational costs over the lifecycle of the project, and innovation in design and construction. Research further shows that the cost of investing in H&S is less than the cost of occupational hazards (cidb, 2009; Huang 2011; Emuze and Smallwood, 2012).

In spite of this evidence, Lingard *et al.* (2008) argue that constructors bear the largest portion of responsibility for construction H&S. Unfortunately, dependence on contractor-centric H&S management has not yielded the required results. The problem is further compounded by lack of government commitment (Mwanaumo *et al*., 2014; Mwombeki, 2006 in Chiocha *et al*., 2011), bribery, corruption and political interference (cidb, 2011; Okorie *et al*., 2014). In the UK, Crosthwaite (2007) reports that public sector clients still have a relatively narrow view of their involvement in project H&S. A study by Gibb & Bust (2006) involving five African countries (Botswana, Egypt, Malawi, Nigeria, and South Africa) noted that clients are not supportive of H&S initiatives. In Botswana, Mwanaumo *et al*. (2014) point out that H&S within the contract is not even a point of discussion for inclusion at the planning stage.

2.1 Procurement Method

The client's selection of project procurement method is particularly important because this dictates when and how other key project stakeholders will be engaged to advise on H&S in the project (Lingard *et al*., 2008).The two primary methods of contracting are single prime contract (the design-bid-build model) also known as traditional contracting and design-build construction (AIHA, 2005). The traditional method is characterised by the separation of design and construction processes. However, the high level of differentiation and specialisation associated with the traditional approach leads to a situation where H&S is not considered during the early phases of the project (Lingard and Rowlinson, 2005). However, to counter this problem, clients can prequalify and select only those contractors who are fully qualified by virtue of their H&S programs and performance (Huang, 2011; Blarke, 2013; Lingard *et al*., 2008). On the other hand, the design-build method is a unitary approach characterised by single-point responsibility offered to the client by the contractor, and the opportunity for overlapping the design and construction phases (Lingard and Rowlinson, 2005). Design-build projects go under many names; for example, design-build, design and build, design manage construct, design and manage, build operate transfer (BOT), build own operate transfer (BOOT), build own operate (BOO), or turnkey. By adopting single-point responsibility, the management of H&S should be more readily possible in design-build than with other contract strategies (Lingard and Rowlinson, 2005).

2.2 Contractor Selection Criteria

Contractor selection is a critical activity that plays a vital role in the overall success of any construction project (Palaneeswaran and Kumaraswamy, 2001). Among all factors that may affect the selection of a contractor, cost or price consideration has for a long time been the main evaluation factor (Huang, 2011). Although the public sector has a long history of using the lowest bid as the award criterion for contracts, reliance on non-price criteria is increasing (Waara and Bröchner, 2006; Lorentziadis, 2010) and the best or most economically advantageous tender is becoming a widespread approach for contractor selection . For instance, Bergman and Lundberg (2013) note that in the EU, lowest price is used less frequently, and instead, supplier selection methods that combine price and quality into a total score are used more often (Ballestros-Perez, 2015). Apart from enhancing H&S through the use of multi-criteria weighting of different variables, it also enhances the integrity of the evaluation process and to reduce the risk of unfair bias or corruption (Lorentziadis, 2010; Bergman and Lundberg, 2013). A diversity of factors are used to evaluate contractors and these include quality, technical merit, aesthetic, delivery date and delivery period, or period of completion and such additional criteria including safety, durability, security, and maintenance (Zedan and Skirtmore, 1997; European Union, 2004) and functional characteristics, environmental characteristics, running costs, cost effectiveness, safety, after sales service and technical assistance (European Union, 2004); contractors' current work load, contractors' past experience in terms of size of projects completed, contractor's management resources, time of the year (weather) and contractors' past experience in terms of catchment, i.e. national or local (Holt *et al*., 1994); technical expertise, and cost (Watt *et al.*, 2010); the bid amount; time of execution, and quality of previous work (Herbsman, 1992 cited in Zedan & Skirtmore, 1997). Nonetheless, H&S features less frequently among the aforementioned criteria signifying that little consideration is given to it during contractor procurement. However, the selection criteria in public sector procurement is sometimes circumvented due to corruption (cidb, 2011; Okorie *et al.*, 2014) and other unethical behaviour by public officials leading to the award of contracts to contractors with poor H&S records (Okorie *et al.*, 2014).

3 Research Methodology

The study used an exploratory design due to a dearth of Zimbabwean literature pertaining to this subject. An exploratory design explores the possibility of obtaining as many relationships as possible between different variables (Panneerslvam, 2004) and is particularly suitable for subject areas where there is little experience to serve as a guide (Kothari, 2004). The primary data was collected through questionnaire surveys, and interviews. Purposive sampling was used to select survey respondents. According to Leedy and Ormrod (2013), in purposive sampling, people or other units are chosen, as the name implies, for a particular purpose. Thirty (30) semi-structured questionnaires, developed based on a review of previous work by Huang (2003), ASCC (2006), Worksafe Victoria (2010), and Langdon (2011), were administered to members of the procurement technical committee within government departments, statutory agencies, and local authorities in Harare and Bulawayo. In addition to questionnaires, 5 follow-up interviews were also conducted. In a related study in Malawi, Chiocha *et al*. (2011) distributed 30 questionnaires and 21 responses were received and analysed. In spite of the small sample, the results of the survey can still provide a valuable purpose and provide enlightenment for follow-up research (Huang, 2003). A sample size of 30 items is often adequate (The Economist, 2003). According to Chan *et al*. (2001) cited by Priyadarshani *et al*. (2013) the sample or group size could be from 10 to 50 participants. Qualitative and quantitative procedures were employed for data analysis. Quantitative analysis was done using the Statistical Package for Social Scientists (SPSS) version 21 and Microsoft Excel, while content analysis was used for the interpretation of the qualitative data.

4 Findings and Discussion

4.1 Demographics of the Respondents

A total of 20 questionnaires, representing a 67% response rate, were successfully completed and analysed. The completed questionnaires were received from central government departments (50%); quasi government (45%) and local authorities (5%). The respondents were distributed as follows: Directors (25%), Deputy Directors (10%), Chief Quantity Surveyors (10%), Engineers (30%), Admin Officers (15%), Safety Officers (5%), and Accountants (5%). The respondents' work experience spanned from 4 to 30 years and the mean work experience is 14.05 years. The qualifications of respondents are as follows: Master's Degree (35%), Honours Degree (50%), Higher National Diploma (10%), and National Diploma (5%). It is evident from this demographic analysis that the respondents were highly experienced and qualified to provide valid and reliable assessments of issues raised in questionnaires and interviews.

4.2 Public Procurement Regulations in Zimbabwe

Public sector procurement is governed through the Procurement Act (Chapter 22:14) and its subsidiary regulations, Statutory Instrument (SI) 126 of 2015 Procurement (Amendment) Regulations. The Procurement Act is modelled along the United Nations Commission on International Trade Law (UNCITRAL) Model Law on Public Procurement. UNCITRAL Model Law is premised on achieving competition, transparency, fairness, economy and efficiency in the procurement process (UN, 2014). These values are also enshrined in the Constitution of Zimbabwe and the Procurement Act which requires that public funds are expended transparently, prudently, economically and effectively. The Procurement Act mandates procuring entities (ministry, department or other division of the Government; or statutory body that engages in procurement; or any local authority) to procure goods, construction works and services for the state, statutory bodies, and other persons, with the supervision of the State Procurement Board (SPB). Prior to the promulgation of SI 126 of 2015, the SPB would procure, on behalf of procuring entities, construction works of a value exceeding $2million. Although the Act defines multi-criteria to evaluate tenders, the criteria are, however, 'devoid' of H&S aspects. Reference to H&S is implied through section 34(1) (d) which requires suppliers to have paid all taxes, duties, and rates for which they are liable in Zimbabwe, together with any contributions or payments due under the National Social Security Authority Act. This is, however, inconsistent with the Constitution which 'treats' H&S as a fundamental workers' right wherein every employee is entitled to just, equitable and satisfactory conditions of work.

4.3 H&S Considerations at Contractor Procurement

Table 1 shows the respondents' degree of concurrence relative to selected procurement issues and their impact on H&S management in terms of responses to a scale of 1 (strongly agree) to 5 (strongly disagree), and a mean score (MS) ranging between 1.00 and 5.00 and the midpoint score of 3.00. The results show that 6 out of 11 aspects have a MS $\geq$3.00 which indicates that respondents can be deemed to agree with a majority of the statements.

Table 1: Degree of concurrence with H&S related procurement statements

Statement	Response (%)						MS
	Unsure	Strongly Disagree (1)…...Strongly Agree (5)					
		1	2	3	4	5	
Considering H&S at procurement stage lead to reduced work-related accidents and diseases	0.0	0.0	5.0	0.0	30.0	65.0	4.55
The Procurement Act is silent on the need to consider H&S when procuring projects	17.6	5.9	5.9	23.5	41.2	5.9	2.82
Conditions of contract for public sector projects are silent on matters of H&S	10.5	21.1	21.1	5.3	42.1	0.0	2.47
Competitive nature of bidding for public sector projects forbid contractors to sufficiently provide for H&S in their tender	5.0	10.0	25.0	10.0	40.0	10.0	3.00
Public sector projects consider issues of H&S mainly at project implementation stage	5.0	5.0	15.0	10.0	50.0	15.0	3.40
Procurement officers lack requisite skills to evaluate tenders for construction H&S	10.5	15.8	10.5	21.1	36.8	5.3	2.74
Tight budgetary constraints contribute to non-considering of H&S by Procurement entities	0.0	5.0	10.0	10.0	60.0	15.0	3.70
Late appointment of contractors in the procurement process contributes to poor H&S performance during project execution	5.0	5.0	20.0	15.0	35.0	20.0	3.30
Tender documentation and processes provide for assessments at tender/contract award stage of contractors' proposals and potential performance with respect to H&S	10.0	5.0	40.0	15.0	25.0	5.0	2.55
H&S related information or risks are given to prospective bidding contractors	5.3	10.5	47.4	15.8	15.8	5.3	2.42
Construction H&S laws in Zimbabwe provide for minimal H&S provisions	5.3	5.3	21.1	15.8	42.1	10.5	3.16

The results from Table 1 reveal that consideration of H&S during contractor procurement can positively contribute to reducing work-related accidents and diseases. This variable has MS 4.55. A MS > 4.20 ≤ 5.00 equates to between agree to strongly agree / strongly agree. This result corroborates the contention of Cameroon *et al*. (2005) who concluded that effective planning for H&S is essential if projects are to be delivered without experiencing accidents or the health of site personnel.

The research also reveals that respondents perceive that certain procurement related practices may contribute to poor H&S management and these are discussed below.

- Tight budgetary constraints (MS 3.70). When MS>3.40≤4.20 it indicates that the interventions can be deemed to be taken between neutral and agree / agree. The majority of respondents (75%) perceive that budget constraints bedevil the public sector as a result of a non-performing economy, which contributes to non-consideration of H&S by public procurement entities;
- Late appointment of contractors (MS 3.40). In 58.8% of selected cases projects completed within the last five years, respondents indicate that contractors were procured at tender stage. Although this finding is consistent with the traditional procurement approach used on 78% of the selected projects, however, the stage of

contractor procurement is probably too late to take advantage of contractors' expertise (in terms of buildability and health and safety issues) (Longdon, 2011);

- Consideration of H&S during project implementation stage (MS 3.40). Respondents perceive that H&S is mainly considered during the construction phase of the project. This approach 'exports' H&S responsibility to the contractor. The results are, however, consistent with earlier findings (Lingard *et al*., 2008) that the constructor bears the largest portion for responsibility for construction H&S. Nevertheless, it is at variance with several studies (AIHA, 2005; ASCC, 2006) who argue that if government at all levels, integrate H&S in all stages of the procurement process, supplies will demonstrate the ability to meet these requirements, and
- Minimal provisions for H&S in Construction Regulations (MS 3.16). This finding reveals that respondents perceive that H&S issues are not sufficiently incorporated in construction regulations. Respondents also perceive that tender documentation and processes do not provide for assessments at tender / contract award stage of contractors' proposals and potential performance with respect to H&S.

The remaining aspects have MS>2.40≤3.00 which can be deemed to be taken between disagree to neutral / neutral. For instance, the effect of competitive bidding on H&S is rated at the midpoint (MS 3.00). On the other hand, respondents do not agree with statements that: procurement laws (MS 2.82) and conditions of contract (MS 2.47) for public sector projects are silent on H&S issues; procurement officers lack requisite skills to evaluate tenders for construction H&S (2.74); and H&S related information or risks are given to prospective bidding contractors (2.42).

4.4 Criteria for Selecting Contractors

The study noted that clients consider a number of factors when procuring contractors and these are presented on Table 2. The results show, in descending order, that traditional evaluation factors such as cost (bid amount), financial standing, project delivery time, and technical expertise and experience, are important when procuring contractors on public sector construction works because their MS are greater than the median value 3.00. However, H&S considerations, environmental considerations and quality fall below the median value 3.00 meaning that they are less important when procuring contractors for public sector projects. This finding concurs with conclusions of previous studies where the 'need for cost certainty' was the highest ranked criteria (Longdon, 2011) while the requirement to manage H&S is not a priority when choosing contractors (Longdon, 2011; Harding, 2014; Okorie *et al*., 2014; Mwanaumo *et al*., 2014).

Table 2: Criteria for procuring contractors

Criterion	MS	Rank
Cost (bid amount)	3.69	1
Financial standing	3.56	3
Time of execution	3.38	3
Technical expertise & experience	3.31	2
Quality	2.88	5
Environmental considerations	2.31	6
Health and Safety (H&S) record	1.94	7
Others (e.g. previous ligation & company requirements)	0.44	8

5 Conclusion and Further Research

Public sector procurement has the potential to influence construction H&S management. However, due to a number of factors, clients do not seem to emphasise H&S at this stage. This research determined that clients know that inclusion of H&S at procurement stage has a momentous impact on improving H&S performance on their projects. However, tight budgets, the competitive nature of procurement, late appointment of contractors, and weak contractual provisions provide ideal conditions for disregarding H&S during upstream decision making. Consequently, H&S aspects are left until project implementation stage. Accordingly, economically advantageous contractors who do not systematically manage H&S risks may be appointed at the expense of workers' H&S. The research therefore recommends a review of the procurement processes and frameworks to allow for participation on public projects of contractors and other stakeholders who are committed to improving the H&S of their workers and the public. On the same note, clients have an obligation to financially support contractors' H&S programmes, and partake in project H&S activities, and to engage stakeholders who can effectively manage H&S. Moreover public sector procurement provides an opportunity for governments and their agencies to raise the bar for construction H&S. This research provided exploratory evidence based on public sector procurement, and further research can include the private sector and other stakeholders such as contractors, and consultants. In addition, an empirical study can also address the relationships between public procurement and accident trends based on case study projects.

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FRAMEWORK FOR CONTRACTORS' BID SUCCESS IN NIGERIA: SWOT APPROACH

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Abstract
Models concerning bid/no bid decision have been worked upon by different types of researchers. However, to maintain fee schedules at a level that will assist contractors run a profitable and high quality business that best serves the need of clients who rely on their products and services, successful bids are required. Therefore, building contractors need to consider both internal (strengths and opportunities) and external (weaknesses and threats) factors necessary to develop a framework for successful bids. SWOT tool is considered as a structured approach that could help management to systematically analyze issues that may affect the fulfilment of their goals and objectives. An examination of the factors influencing contractors' bidding activities in Nigeria was considered with a view to developing a framework that could enhance bid success. One hundred and seventy-one useable responses were retrieved through questionnaire administration on randomly selected building contractors. The responses were used to elicit information on the factors identified, and were later classified into internal and external factors using SWOT tool as a structured approach to contractors' bid success. The classification identified availability of equipment and materials, size of contract, strength of the firm in the industry - internal factors; while government policy, tax liability, timing requirement - external factors. The study concluded that building contractors in Nigeria must always conduct initial project research and embark on evaluation processes during bidding activities, and base on SWOT tool come up with an approach for a successful bid before committing much resource on the project.

Keywords: Bid success, Contractors, Framework, Nigeria, SWOT

1 Introduction

Bidding is a method used for procuring major construction projects such as building and infrastructures in the construction industry. Public sector bidding therefore guarantees transparency, publicity and equal opportunity to all bidders as it reduces the risk of bias and corruption (Auriol, 2006; Celentani *et al.,* 2002). The search for a competitive advantage is an idea that is much sought for by contractors in the construction industry (Tan *et al.,* 2008). The construction industry is one of the largest job creators in developing countries and has become highly competitive with the advent of globalization (Garbharran, *et al.,* 2012; Nguyen *et al.,* 2004). The construction industry in Nigeria has grown tremendously over the years and it has become a multi-billion naira business (Olatunji, 2011). It is an industry that is rich enough to drive the economy of the country.

In the construction industry, projects are usually awarded through bidding process and the goal of contractor's is to be successful by winning a bid award. Tan *et al.* (2008) asserts that, being involved in bids help maintain fee schedules at a level that will support and ultimately assist in running a profitable and high quality business that best serves the need of clients who rely on the contractor's products and services. Hoffmann (2000) confirms that the fundamental basis of long-run success of bids by construction firms is the achievement and maintaining of a sustainable competitive advantage. By knowing the intense nature of competitors, construction firms would be more creative and environment conscious in their strategic planning than just lowering price. This study therefore aims at identifying factors influencing contractors' bid activities in Southwest, Nigeria, with a view to developing a framework that could enhance bid success.

2 Contractors' Bid Success/SWOT Approach

2.1 Bid Success

The variations in contractors' bids are expressed as a function of time relative to winning a bid, which carries implications for capacity level of a construction firm (Bee *et al.*, 2012). It is important for contractors to strike a balance between a bid price and bid success, as bidders would always bid low. Bidding low at the expense of the actual profit to be accrued into the contractors' organization makes them less competitive in the construction market. Bee *et al.* (2012) posits that bidders in general bid low for time periods before a winning bid and they are less competitive in time periods after a winning bid.

However, by considering the individual bidders' characteristics that relate to differences in bidding competitiveness, it is shown that there is remarkable heterogeneity among the bidders in bid pricing decision for pre and post winning periods. Nevertheless, the statistically significant bidding trends before and after a winning bid strengthen the notion that systematic changes in bidding behaviour over time in reality in responses to changes in firm capacity level. These changes in capacity level therefore brought to the fore the reason for SWOT analysis to be employed in order to classify and identify internal (strengths and opportunities) and external (weaknesses and threats) factors necessary for recording success in bids.

2.2 Factors Influencing Contractors' Bid Success

Contractors need to understand their specific resources that generate competitive advantage and accordingly develop strategies to win contracts (Tan *et al.*, 2010). Improving the construction industry's competitiveness according to Green *et al.* (2008) has long been of interest to the international construction management research community. Egemen *et al.* (2007) investigated a framework for contractors to reach strategically correct bid/no bid and mark-up size decisions. The study identified the key determining factors and their importance weights by presenting survey findings of eighty (80) contracting organizations from Northern Cyprus and Turkish construction markets. Among these factors are; current workload, need for work, contractor involvement in the design phase, availability of cash to carry out the work, availability of skilled workers, availability of qualified site management staff, size of head office overhead, government policy, tax liability, availability of reliable subcontractors, reliability of company pricing, portion of nominated subcontract, portion of domestic subcontract, overall economy (availability of work), timing requirement, past experience in managing similar project, availability of labour, availability of equipment, quality of available labour, risk of fluctuation in labour prices, risk of fluctuation in material prices, availability of other projects for tendering (Bagies *et al.*, 2006; Ling *et al.*, 2005).

2.3 SWOT Analysis

SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats. It is a device that helps business managers evaluate the strengths, weaknesses, opportunities and threats involved in any business enterprise, including construction activities (Ahmad *et al.*, 2011). SWOT analysis can help construction firms gain insights into the past and think of possible solutions to existing or potential problems, either for an existing business or for a new venture (USDA, 2008; Nouri *et al.*, 2008). SWOT is a basic and candid model that assesses what a business can and cannot do, as well as its potential opportunities and threats. The method of SWOT analysis is to take the information from an environmental analysis and separate it into internal (strengths and weaknesses) and external issues (opportunities and threats). Once this is completed, SWOT analysis determines what may assist the firm in accomplishing its objectives, and what obstacles must be overcome or minimized to achieve the desired results (Singh, 2010).

SWOT analysis has been in use since the 1960s as a tool to assist strategic planning in various types of enterprises including those in the construction industry (Lu, 2010). It has its origins in the 1960s (Learned *et al*., 1965), and was popularized by Weihrich's (1982) work. It is commonly adopted for the analysis of internal and external situations, in turn encouraging the development of strategies which can cope with these situations. The usage of SWOT analysis has been reported in many fields including that of the construction sector. For example, Shen *et al.* (2006) use the tool to analyze the situations for foreign-invested construction enterprises in China. Lu *et al.* (2009) used it in relation to Chinese construction companies in the international construction market.

Ayub *et al.* (2013) explained that SWOT helps in identifying organization's potential strengths and utilizing those in exploiting opportunities and counteracting threats; and identifying weaknesses in order to diminish them. Hence, SWOT analysis is considered as a structured approach that helps management to systematically analyze the issues that may affect the fulfilment of their vision, mission, goals and objectives. In order words, SWOT analysis is a convenient and concise way of evaluating the past, present and the future in order to make best use of data in utilizing opportunities, linking those with organization's strengths, identifying major threats, and minimizing weaknesses.

Lu (2010) in a critical review believe that SWOT is a widely used tool for analyzing internal and external environments in order to attain a systematic understanding of a strategic management situation. In turn, it encourages contractors to adopt a strategy that can best cope with the situation. The philosophy behind the SWOT analysis is that the strategies an organization adopts should match the environmental threats and opportunities with the organization's weaknesses and especially its strengths.

3 Research Methodology

Being a descriptive and quantitative study, the survey method was used to gather primary data. The scope of the study was confined to public sector projects alone and the target population were building contractors registered with the Bureau of Public Procurement. The investigation was therefore limited to the building contractors in categories A, B and C according to BPP registers. These categories were purposively considered due to the kind of projects they are eligible to bid for and manage in the construction industry. For the purpose of this study, population details of active contractors from each category were obtained, indicating 60, 82 and 95 contractors for categories A, B and C respectively. Since the population size was relatively small, questionnaire was administered and data was collected from every member of the population. The response rate constitutes 42 (70%), 61 (72%) and 68 (74%) contractors in categories A, B and C respectively.

The questionnaire was divided into two sections. Section one comprises of the background information relating to the respondents and their respective firms while the second section seeks to identify the factors in relation to the SWOT required by building construction firms for success in their bidding activities. Using SWOT analysis technique, these factors were classified into their different categories (internal and external factors). The questionnaire preparation comprised of closed-ended questions using a five point likert scale (extremely important-5 and not important-1). Closed ended questions were preferred in order to reduce the level of bias and to facilitate coding (Akintoye and Main, 2007), considering the fact that construction professionals are often too busy to attend to academic works. Data retrieved were analyzed using frequency tables, percentages and weighting values.

4 Findings and Discussion

4.1 Background Information of the Respondents

Results shown in Table 1 revealed that, more than 90% of the respondents for categories A, B and C are male (91%, 98% and 99% respectively). This is an indication that males are more dominant in the construction industry when compared to their female colleagues. Likewise, majority of the respondents were found within the age range 20-39, with 64% in category A and 75% and 87% in categories B and C respectively. Implication is that, respondents within this age group have a minimum of twenty years to be involved in public sector projects, thereby becoming experts in bidding for building construction projects. This was further highlighted by the result on the years of experience in the industry. More than 70% of the respondents have between five to ten years of experience. This indicates that their knowledge on bidding is limited, and cannot compete favourably with individuals who have more than ten years of experience on the subject of bidding. Further results show that the respondents are practicing professionals in the construction industry, majority of whom are builders and engineers, with 38%, 46% and 57% found in categories A, B and C respectively. In addition, results in category A also revealed that 21% and 29 % of the respondents are architects and quantity surveyors respectively. Quantity surveyors are referred to as project cost estimators; therefore, their services are very important during bidding process.

Table 1. Background details of respondents

Respondents	Category A (N=42)	Category B (N=61)	Category C (N=68)
Gender			
Male	90.5	98.4	98.5
Female	9.5	1.6	1.5
Total	100.0	100.0	100.0
Age			
20-39	64.3	75.4	86.8
40-59	31.0	24.6	13.2
60 & above	4.7	0	0
Total	100.0	100.0	100.0
Years of experience in the industry			
Less than 5 years	0	0	10.3
5 – 10 years	71.4	83.6	77.9
Above 10 years	28.6	16.4	11.8
Total	100.0	100.0	100.0
Professionals			
Architects	21.4	8.2	0
Builders	38.1	45.9	36.8
Engineers	11.9	26.2	57.4
Quantity Surveyors	28.6	19.7	5.8
Total	100.0	100.0	100.0

4.2 Factors base on SWOT Approach

This section describes the respondent's opinion on the factors itemized in relation to the SWOT aspect of their organization. The items were categorized into internal factors (strengths and weaknesses) and external factors (opportunities and threats).

4.2.1 Internal factors (strengths)

Table 2 shows the overall major strengths factors ranked in order of importance as considered by the respondents. Relationship with owners was ranked first with an average weight of 0.767. This is an indication that building contractors generally place much emphasis on relationship which was considered as an area of strength in their organisation. Other factors ranked according to their order of strengths include availability of cash to carry out the work, availability of skilled workers, availability of reliable subcontractors, availability of site management staff, availability of equipment and materials among others. In order for contractors to gain entry to an approved standing list of the clients, Merna *et al.* (1990) opined meeting up with the requirement of financial stability, managerial capability, organizational structure, technical expertise and the previous record of comparable construction.

Table 2. Strength related factors

	Internal factors	Category A (weight)	Category B (weight)	Category C (weight)	Average Weight	Rank
Strengths	Relationship with owner	0.922	0.713	0.666	0.767	1
	Availability of cash to carry out the work	0.812	0.802	0.672	0.762	2
	Availability of skilled workers	0.771	0.879	0.556	0.735	3
	Availability of reliable of subcontractors	0.846	0.650	0.695	0.730	4
	Availability of site management staff	0.802	0.668	0.663	0.711	5
	Availability of equipment and materials	0.879	0.571	0.531	0.660	6
	Past experience in managing similar projects	0.760	0.650	0.557	0.656	7
	Strength of business partners	0.802	0.518	0.580	0.633	8

4.2.2 External factors (opportunities)

Results from Table 3 shows that majority of the contractors capitalise majorly on their strength in the industry which gives them an opportunity of landing projects when bidding. Degree of buildability was also captured among the SWOT as an opportunity to the contractor when bidding for projects. This is as a result of clear design and specifications provided by the design team for the project. Size of the contract has also been harnessed by contractors as an opportunity when bidding for public works.

Table 3. Opportunities related factors

	External factors	Category A (weight)	Category B (weight)	Category C (weight)	Average Weight	Rank
Opportunities	Strength in the industry	0.802	0.731	0.571	0.701	1
	Degree of buildability	0.663	0.760	0.663	0.695	2
	Size of contract	0.838	0.665	0.558	0.687	3
	Completeness of drawings and specifications	0.879	0.553	0.580	0.670	4
	Degree of technological difficulty	0.760	0.700	0.518	0.659	5
	Nature of the project	0.879	0.556	0.502	0.646	6
	Market condition	0.719	0.583	0.624	0.642	7
	Government policy	0.760	0.559	0.538	0.619	8

4.2.3 Internal factors (weaknesses)

Table 4 is a reflection of the weaknesses level of construction firms. Past experience in managing similar projects, relationship with owner, availability of equipment and materials, strength in the industry and degree of buildability were identified by the respondents as top weaknesses required in achieving bid success.

Table 4. Weaknesses related factors

	Internal factors	Category A (weight)	Category B (weight)	Category C (weight)	Average Weight	Rank
Weaknesses	Past experience in managing similar projects	0.724	0.663	0.624	0.670	1
	Relationship with owner	0.650	0.580	0.719	0.650	2
	Availability of equipment and materials	0.879	0.500	0.556	0.645	3
	Strength in the industry	0.670	0.518	0.602	0.597	4
	Degree of buildability	0.760	0.518	0.500	0.593	5

4.2.4 External factors (threats)

Results from Table 5 shows that government policy, tax liability, timing requirement and market conditions pose a big threat on building contractors and their success when bidding for public works. Government policies and regulations are very rigid external factors which influences the construction industry of any country (Wijewardana *et al.,* 2013). Inability of contractors to fulfil their responsibility by paying their tax will deny them the opportunity of bidding for public works. This is a major threat on the part of the contractors.

Table 5. Threats related factors

	External factors	Category A (weight)	Category B (weight)	Category C (weight)	Average Weight	Rank
Threats	Government policy	0.700	0.879	0.623	0.734	1
	Tax liability	0.724	0.879	0.556	0.720	2
	Timing requirement	0.667	0.587	0.719	0.658	3
	Market condition	0.737	0.558	0.663	0.653	4

5 Framework

Highlight of the SWOT factors that make up the framework for contractors' bid success is shown in Figure 1. Factors found important and benefiting to the contracting firms' in the realization of their goals and objectives as they bid for success includes relationship with owner, availability of cash to carry out the work, availability of equipment and materials, size of contract, strength of the firm in the industry and degree of buildability of the work. These among others has opined by Merna *et al.* (1990) will give entry to the contractor to be included among the standing list of contractors with the client capable of executing work with them. However, some factors will limit a contractor's entry to the standing list. These among others includes past experience with managing similar projects, relationship with the owner, availability of equipment and materials, strength in the industry, government policy, tax liability, timing requirement and market condition. Bowen *et al.* (2002) noted that timely completion of a construction project is frequently seen as major criteria of project success by clients, contractors and consultants.

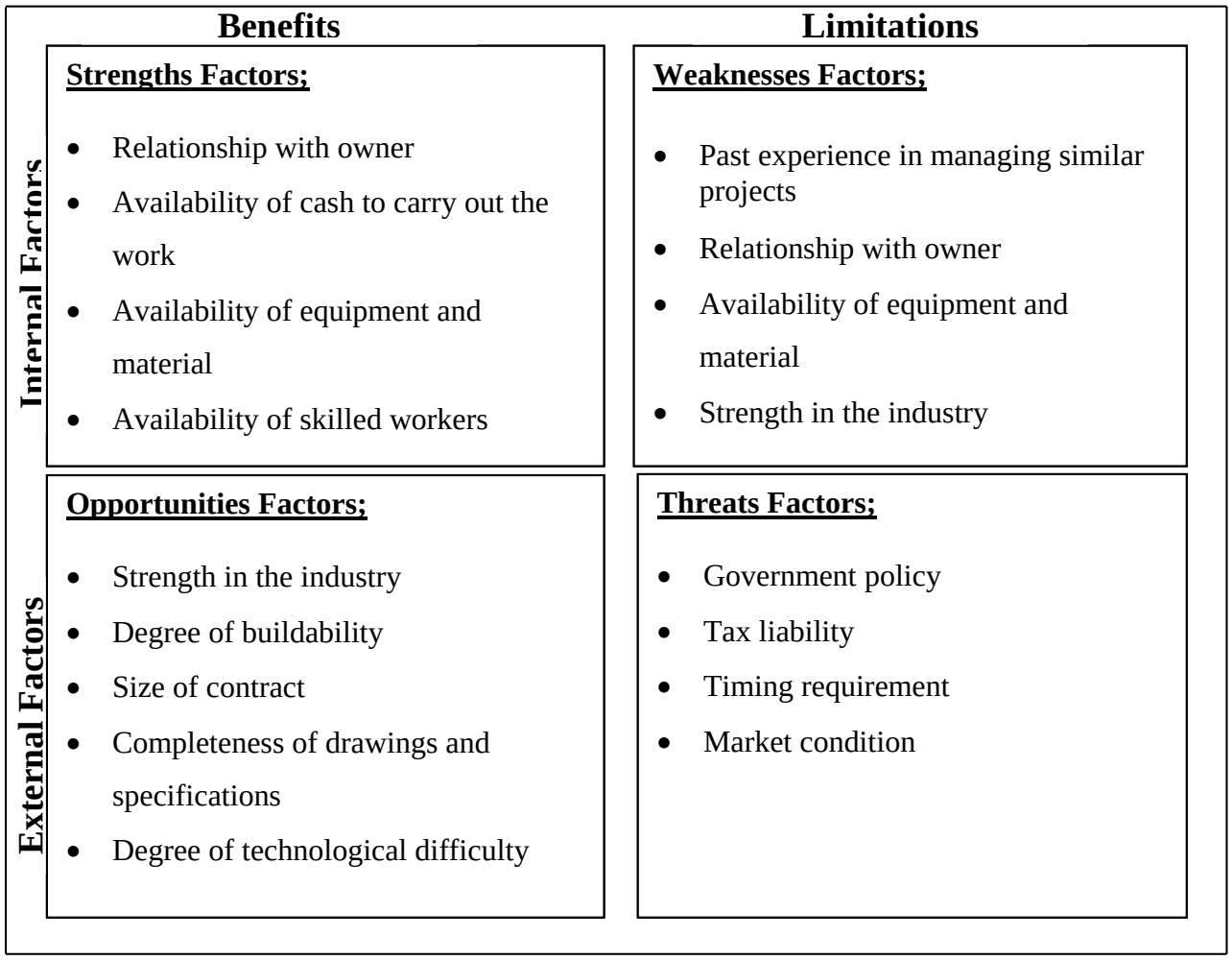

Figure 1. Framework for contractors' bid success

6 Conclusion

Generally in the construction industry, award of public projects has been based on a competitive process of bidding. Contractors are faced with the challenge of gaining entry into the standing list of the client and therefore must meet up with the required standard of technical and financial strength, social and economic conditions, management skills, good organization structure and operations and marketing ability (Shen *et al.*, 2006; Shen *et al.*, 2003). These among others are necessary for the achievement and maintenance of a sustainable competitive advantage as contractors bid for success. This study therefore reports the outcome of factors considered by contractors among others as shown in the framework that could influence their bidding activities. It is imperative for contractors to always conduct initial project research and embark on evaluation processes during bidding activities, and base on SWOT tool come up with an approach for a successful bid before committing much resource on the project.

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THE EFFECTS OF ARCHITECTURAL DESIGN ON SOUTH AFRICAN EXPANDED PUBLIC WORKS PROGRAMME GOALS.

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Abstract
Increasingly in South Africa, architects are requested to design buildings that meet the job-creation and training goals of the Expanded Public Works Programme (EPWP). In so doing, architects have a mandate to both design buildings and to design work for the poorest of the poor. This purpose of this study is to develop a useful framework for the assessment of measurable EPWP outcomes within architectural projects in this context. Based on Case Study research that utilized semi-structured interviews and data collection, this paper seeks to link data to the popular narratives of two reportedly successful projects, the Mapungubwe Interpretive Centre in Limpopo and the Ocean View/Mountain View Housing Development in Cape Town (Constable, 2013; Fagan, 2010). This paper proposes labour-intensity and certified training outcomes as key areas of measurement and presents data for each project. Findings from the two cases reveal great variability in the intensity of EPWP usage and the nature of the relevance of worker training for future employment prospects. The paper concludes with key areas for future projects to consider regarding labour-intensive construction and worker training goals, including identifying the challenges in aligning architectural innovation with certification standards for construction skills. Recommendations include careful selection of building technology to maximize labour-intensity and worker training outcomes. With the continued growth of the EPWP anticipated in coming decades, this paper takes initial steps to identify unique architectural strategies and establishes a quantitative baseline from which to compare future projects. (National Planning Commission, 2012).

Keyworks: Architecture, EPWP, Labour-intensive construction, South Africa

1 Introduction

With the advent of the nation-wide EPWP in 2005, a methodology of labour-intensive construction was adopted by all public bodies in South Africa, prioritizing job creation and training in the delivery of infrastructure and new buildings (DPW, 2015). There are three primary EPWP goals: to provide income distribution through employment opportunities, to provide training and skills development to beneficiaries, and to build cost-effective and quality assets (DPW, 2015). This requires finding a balance between short-term employment goals and long-term building construction quality goals.

A review of the existing literature revealed no existing research specifically focused on architectural projects and the EPWP. This paper is an initial attempt to fill this gap by investigating the links between architectural design and EPWP outcomes through a pair of project level investigations.

Architects in this context are challenged to design economically empowering processes, not simply to design beautiful buildings. Most architectural design precedes the tender for building contractors. Therefore, architects must anticipate work outcomes even though it is at the discretion of building contractors to execute the work and manage workers on site. "*Architectural design "at the drawing board" is never neutral. It predetermines a set of relations around production."* (Low, 1998). As this paper will reveal, *"imagination is certainly required in order to find ways to create employment*." (McCutcheon, 2001)

The aim of this study was to explore the potential for architects to contribute to empowering others to work, to earn, and to grow in skills and independence.

2 Literature Review

2.1 Public Works Programmes

Anna McCord (2008) defines Public Works Programmes (PWP's) as: "all activities which entail the payment of a wage (in cash or in kind) by the state, or by an agent acting on behalf of the state, in return for the provision of labour, in order to i) enhance employment and ii) produce an asset (either physical or social), with the overall objective of promoting social protection." PWP's are most commonly implemented in conditions of extreme poverty or seismic shifts in a nation's economy prompted by war, famine, market collapse or conditions of structural unemployment (del Ninno, Subbarao, and Milazzo, May 2009). It is widely held that the first large-scale PWP to be established was the New Deal programme in the United States in the 1930's (Auer & Leschke, 2005). During the period from 1935 to 1943 this programme produced 40,000 new and 85,000 improved buildings including an array of public buildings ranging from park houses and schools to libraries (Leighninger Jr, 1996). While elements of the New Deal included a modicum of training for workers, these programs primarily focused on employing already skilled people through economic stimulus (Ermentrout, 1982; Leighninger Jr, 1996). Globally a vast range of PWP's operate with various programme designs and goals ranging from short term employment and job-counseling for the temporarily unemployed to income guarantee schemes that provide seasonal employment for participants. (McCord, 2008).

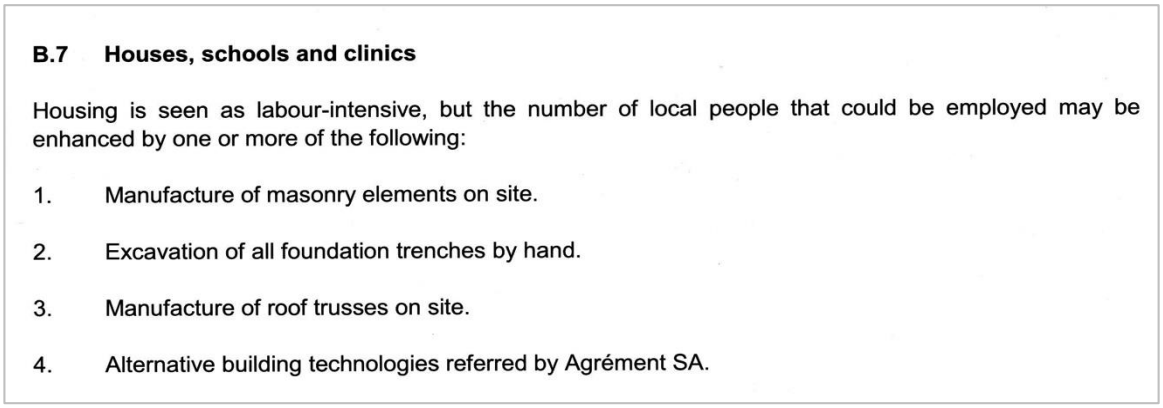
The EPWP is characterized as offering a single short-term episode of employment with an emphasis on skills training (McCord, 2008). Since its inception, a range of criticisms have been brought against the program, including critique of the fitness of the programme's design to the context of South Africa's economy. In 2008 the EPWP had only reached 11 percent of the officially unemployed, leading researcher Charles Meth (2011) to suggest that the program in South Africa is nowhere near sufficient in scale to address the need. Meth (2011) also evaluates the individual work opportunity, which averaged 4-6 months and involved 8-12 days of training, a very brief tenure to expect significant up-skilling. McCord (2005) echoes this concern; "The implicit assumption is that workers will metamorphosize from unskilled workers to skilled workers for whom there is unmet demand." This lack of demand for low skilled workers is linked to the core problem of structural inequality present in South Africa (Philip, 2010).

The up-skilling of beneficiaries is central to the EPWP emphasis on certified trainings aligned with National Qualification Framework (NQF). Exiting the EPWP with an NQF recognized training certificate represent a best-case outcome of the program.

2.2 Labour Intensive Construction

McCutcheon (2008) explains that "labour-intensive construction results in the generation of a significant increase in employment opportunities per unit of expenditure by comparison with conventional capital-intensive methods." Much of the literature related to labour intensive

construction focuses on the work of civil engineers and particularly road-construction as a labour-intensive output for beneficiaries**.** This is largely due to the potential to increase labour-intensity in this area through the selection of appropriate road-buildings methods. By contrast building construction, "is regarded as being inherently labour-intensive" due to the nature of the task work, which is by convention largely dependent on manual labour versus machines (A. Fitchett, 2009). While building construction has room for increasing labour it is seen to have less potential than many other areas such as roads. CIDB outlines a series of tactics for labour-intensification of building construction including recommended building technologies (CIDB, 2005). In Figure 1 EPWP identifies key areas with potential to increase labour-intensity within infrastructure projects involving building construction:



B.7 Houses, schools and clinics

Housing is seen as labour-intensive, but the number of local people that could be employed may be enhanced by one or more of the following:

1. Manufacture of masonry elements on site.
2. Excavation of all foundation trenches by hand.
3. Manufacture of roof trusses on site.
4. Alternative building technologies referred by Agrément SA.

Figure 1. Excerpt from: Guidelines for the Implementation of Labour-Intensive Infrastructure Projects under the EPWP (2015)

2.3 Labour Intensive Architecture

Within the field of architecture less rigorous assessment of labour-intensive building technologies exists. Fitchett's PhD (2009) contributes to an emerging knowledge in the South African context of building technologies and resultant labour-intensity. This builds on the work of Egyptian architect Hassan Fathy's in the development of New Gourna in the 1970's, an important precedent involving extensive local production of building materials and training of local people for construction. Fathy meticulously documented the strategies and decision within these labour-intensive construction projects (Fathy, 1973).

The recent publication of Afritecture (Lepik, 2014) popularized the narrative of job-creation and training goals within architectural projects across the African continent, including recent high-profile work by Mass Design Group in Rwanda. For the 6040m² Butaro Hospital in rural Rwanda, a reported 12,000 short term unskilled jobs were created while nearly 3900 skilled craftspeople were reported to be employed and received training on the job. (Murphy & Ricks, 2012) Here labour-intensive materials development and construction work was enabled through a design extensively using locally plentiful lava rock.

3 Research Methodology

The Case Study method was selected as appropriate to study this contemporary phenomenon in context. Given the enormous range of EPWP projects, two cases were selected to represent a divergent pair, rural and urban, once off and replicable. This research relied heavily on semi-structured interviews with key project participants. Interview protocol includedtenstandardized for each intervieweeselect customized questions24The method of analysis involved making notes on the key content of each interview in order to construct a project narrative informed by the perspective of different participants. Following these

interviews, formal letters were submitted requesting official data for each of the two projects in addition to a database of all current EPWP projects. Data collected from the two projects was then amalgamated into a spreadsheet to generate new comparison between the two projects to assess how architectural design decisions affected EPWP outcomes.

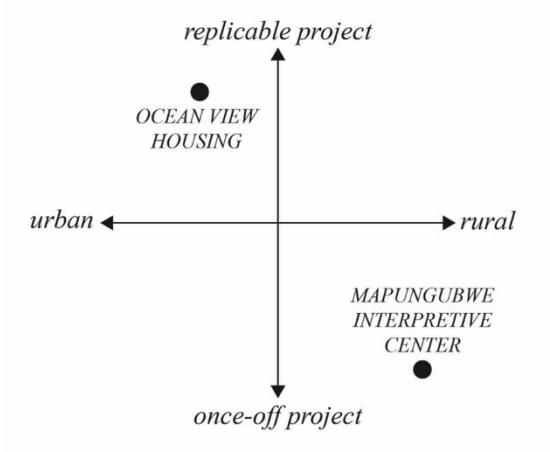


Figure 2. Project selection diagram

4 Findings and Discussion

4.1 Abbreviated Case Histories

The interviews revealed within each project unique forms of material and architectural innovation in pursuit of achieving the EPWP goals of labour-intensive construction.

4.2 CASE #1. Mapungubwe Interpretive Centre

4.2.1 Background

In 2005 South African National Parks (SANParks), a public agency within the Department of Environmental Affairs, embarked on the development of the Mapungubwe Interpretive Centre (MIC). They formed a competition brief to solicit design ideas from architects for a *"World-class Interpretive Centre to orientate all audiences regarding the Mapungubwe Landscape (cultural and natural)"* with a key mandate: *"The design of the building should be such that the construction methods should maximize the use of labour, job creation and skills development."*(SANParks, 2005).

4.2.2 Architectural Design

From this competition Lerotholi/Rich Architects from Johannesburg lead by Peter Rich was selected as the winning design. Previously Rich had done extensive research of the Ndebele culture and had a unique understanding of the regional vernacular. In addition, he had worked in several community-based projects involving local production of material, primarily through the use of Hydraform pressed blocks. (Joubert, 2011) Uniquely with this project the design was conceived in conjunction with two MIT based engineers who had worked together at to develop a tile vaulting construction system used at the Pines Calyx in England to. The key innovation in this project was found in the use of high-tech engineering to create a dramatic structure built using low-tech site-made tiles. To achieve this intensive research and development was required.

4.2.3 From Design to Labour-intensive Construction.

Despite the identification of regionally available industrial made tiles, the team chose to build them on site using local unemployed people to both minimize environmental impact and maximize job-creation (Rich, 2015). In May 2005, a research team formed between MIT and the University of the Witwatersrand to develop an earthen tile that could be created on-site using a modified cinva-ram style hand-operated block press (Ramage et. al., 2010). To minimize the building's environmental impact, the team opted to design for only 5% cement content, creating the weakest tile that could safely support the structural loads (P. Rich, personal communication, April 6, 2015). Following a two-week demonstration-based on-site training (M. Hodge, personal communication, June 16, 2015), the tile manufacturing commenced in the production of 200,000 tiles.

To manage the tile production six Small, Medium and Micro Enterprises (SMME's) were developed. SMME development involved NQF Level 2 business training of individuals leading to registration with the CIDB. Each SMME was then responsible to manage a tile making team, typically comprised of eleven EPWP workers. The overall construction was managed by a local building contractor, who was charged with maximizing EPWP work opportunities for all aspects of labour within the construction.

4.3 CASE #2: Ocean View/Mountain View Housing

4.3.1 Background

Since 1994 over 2.8 million RDP houses have been built in South Africa with scores of currently ongoing projects throughout the country (EPWP, 2015; SA News, 2014). This sector of EPWP has high potential for scalable strategies for labour-intensive construction and is recognized within the National Housing Code. Ocean View/Mountain View Housing (OV) is a People's Housing Process driven RDP housing scheme of 543 houses located forty kilometers south of Cape Town. A community board selected Mellon Housing Initiatives to lead the construction and project management with over site from the City of Cape Town's Department of Human Settlements, who issued a tender for architectural services.

The rocky mountainous site had for years delayed development on this land earmarked for housing. However in 2006 civil site work commenced, grading the land for sites and roads and stockpiling the quarried stone (Constable, 2013). A breakthrough in the project occurred when the City of Cape Town approached the Provincial Department of Human Settlements with a proposal to approve funding to develop a stonemason training programme and retain the stone for housing construction instead of removing the stone to a landfill site (P. Houniet, personal communication, July 15, 2015). In addition, the project accessed the Mayor of Cape Town's Special Job-Creation Fund to support the stonemasonry training.

4.3.2 Architectural Design

In March 2012 the City of Cape Town advertised a Request for Services seeking architects experienced with stone masonry design. This tender did not specifically indicate the presence of EPWP within the project nor the necessity to design for labour-intensive construction but did solicit architects with stone construction experience. Cape Town based Two Think Architects and Greenhaus Architects formed a joint venture to respond to the unique context of the project and were awarded the tender.

4.3.3 From Design to Labour-intensive Construction.

Early house designs featured up to 80% stone facades (A. Spies, personal communication, May 12, 2015). Along with an expert stonemason one of the two project architects co-lead the design and implementation of the 6-month stone-masonry training, involving 30 trainees in both

classroom and site-based learning. By working with engineers to develop a load bearing stone wall that utilized both dressed stones for the façade and rubble infill, the architects were able to maximize the use of the available site material while generating additional work for the stone mason team. Uniquely, this involvement both in the design and training of stonemasons had a direct effect on the housing design, encouraging increased variety in the stone facades to provide useful training experiences for the stonemasons and visual intrigue to the neighborhood. Here goals for a diverse site plan aligned with goals to broaden the experience of the stone masons in the execution of a range of structural corners, curved walls, and other challenging skills (E. Bruwer, personal communication, July 10, 2015).

At Ocean View the innovative use of the site stone belies the fact that the majority of the construction method was more conventional and much of this also utilized EPWP trainees. While stone collection, refinement and installation increased the opportunities for EPWP beneficiaries, an abundance of conventional building elements including concrete block, cement tile for roofing, and gang-nailed wooden trusses were purchased and delivered to site from regional industrial producers. These too offer possible opportunities to further increase EPWP in the onsite production of buildings materials. In addition, as the project continued, plans were adjusted to decrease stone masonry and increase concrete block walls to save time and cost. Interviews revealed the challenges in managing EPWP workers and the high rate of turnover particularly in the early phases of the project.

As seen in Figure 3 in addition to this stonemason training at OV the EPWP Job Training took on a broad range of forms. With the exception of the stonemason training these were initiated by the Department of Human Settlements and Mellon Housing Initiative and independent of the architects' involvement.

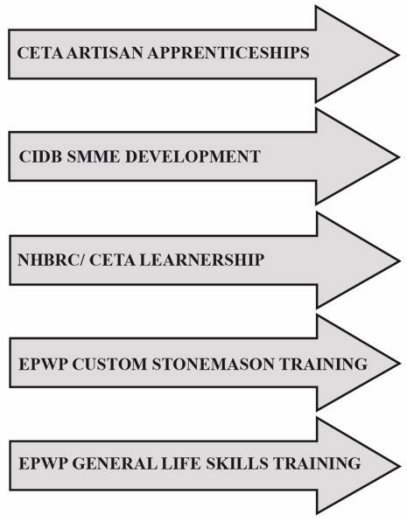


Figure 3. Training at Ocean View

4.4 Presentation of Collected Data

In this paper each of these projects is considered in relation to two key metrics; overall EPWP person-days and construction skills training deliverables. EPWP person-days (1 person day=8 hours of work) correlate to the goal of income relief through financial support transferred to participants. MIC generated 47,867 person days whilst OV (80% complete at time of data collection, including 2591 person/days of initial civil site work) generated 40,311 person days.

Table 1. EPWP wage transfer/labour-intensity evaluation table

Project	Mapungubwe Interpretation Centre	Ocean View Housing *(Current August 2015)*	Ocean View Housing *(Projected Totals)*
% Complete	100%	80%	100%
Total EPWP Person Days Worked	47876	40311	49741
Total Area of Building m²	2753	23023	28779
EPWP Person Days/m²	17.39	1.75	1.73

Table 1 reveals the total EPWP person-days for each project, and the ratio of EPWP person-day to the size of the constructed buildings. The purpose of this table is to isolate the use of EPWP as this programme aligns with particular government objectives for poverty relief and training distinct from the general labour market. This table does not refer to the total labour utilized in the completion of each project, which in both projects also featured the work of sub-contractors independent of the EPWP programme.

This study suggests a metric particularly relevant to understanding intensity of EPWP usage in architectural projects is EPWP Person Days/m². MIC featured EPWP usage of approximately 17 EPWP Person Days/m². The major contributor to this labour effort was in the production of 200,000 tiles for the vaults that totalled 28, 512 of the 47, 876 overall EPWP person-days. (SanParks 2015). The productivity of tile production at Mapungubwe and the efficiency of on-site materials production emerges as a key area in need of further investigation. Initial estimates for the expected output per tile-press were significantly higher than actual output, although the low wages associated with EPWP workers meant the overall costs for material production remained relatively low. (Fitchett, 2009a; Ramage et. al., 2010) Interviews revealed high levels of breakage in the transportation of the fragile tiles across the site as well as challenges in on-site vs. laboratory conditions of the tile production. (A. Fitchett, personal communication, March 28, 2015, F. Prinsloo, personal communication, July 12, 2015).

Based on the reported average of other RDP housing developments, the comparatively high level of EPWP hours at OV is apparent (EPWP, 2015)**.** However, at OV the overall level amounts to 1.75 EPWP Person Days/m², much lower than MIC. Areas of potential increase to the EPWP Person Days/m² at OV include decreased purchasing of industrially produced materials in favor of on-site material production using EPWP beneficiaries.

The second measure of significance for this paper is "Construction Skill Training Deliverables" that emerge as outcomes that potentially enable workers to have improved job prospects beyond the time of the project.

Table 2. Construction Skill Training Deliverables

Project	Mapungubwe Interpretation Centre	Ocean View Housing *(Current Aug. 2015)*	Ocean View Housing *(Projected Totals)*
% Complete	100%	80%	100%
# CETA Construction Skill Certificates	0	24	48
# Non-Accredited Construction Certificates	0	32	32
% Workers Earning Construction Certificates	0.00%	2.15%	5.78%
Total SMME's Developed	6	2	2

Table 2 seeks to categorize key measurable training outcomes and SMME's development for each project. As indicated in Figure 3, a range of possible outcomes exists within the training

of EPWP workers. Here CETA certified trainings are prioritized as specific evidence of construction skill development, with additional non-certified Construction Certificates also accounted for. This table shows that MIC generated 6 SMME's but no reported construction certificates. During the MIC project, accredited training was the responsibility of the Department of Environmental Affairs and information was not made available for this study. However, based on interviews with MIC project leaders, while general life skills training were facilitated throughout the project no reports of formalized construction skills trainings emerged.

Ocean View generated 24 CETA certificates for trainees in Painting and Carpentry/Joinery and 32 informal non-accredited certificates for the Stonemasons. It is projected that among the current Plumbing and Electrical trainees an estimated 24 will likely be certified by project completion. However, while many of these trainees were selected from the pool of EPWP workers, once entering the CETA 3-year apprenticeship programme they are no longer EPWP beneficiaries. This creates some ambiguity in assessing outcomes.

Architectural design had no apparent effect on these opportunities. Despite the best efforts of the project team, the stonemasonry trainings at OV failed to be recognized by CETA and to achieve an NQF Unit Standard. Ultimately participants were given a non-accredited certificate from the trainers in order to have tangible proof of their dedication and newly developed skills.

To construct the vaults at MIC, workers received on-site training in specific vault building techniques but this was not associated with any certifiable skill. Similarly the tile-making training, though useful to the production of tiles required for the construction was not associated with any NQF validated training to substantiate the workers efforts beyond the project. Beyond the SMME trainees, no MIC participants were reported to have received any form of skills training certificates.

The relevance of taught skills with respect to regional employment opportunities is an important consideration when architects select building technologies. While MIC generated high levels of EPWP person/days this was largely based in the production of tiles for a construction system anomalous to the region. By contrast, at Ocean View the stone masonry training shows initial signs of enabling future work opportunities, with the City of Cape Town and others in discussion concerning employment potential in the maintenance of historic stone structures, and stone walls on public roads. In addition, there are many stone buildings in the neighbouring suburbs that may allow for work opportunities in the open market.

Nonetheless, the SANParks brief called for a world-class building, and in 2010 MIC was selected as the World Building of the Year (Fagan, 2010). There can be little doubt this design has achieved this goal in addition to achieving high levels of EPWP wage transfer.

5 Conclusion and Further Research

A primary lesson from this research has been that architects should recognize, from the outset of projects, that material production on site offers the single greatest potential to increase EPWP labour opportunities (A. Fitchett, personal communication, March 28 2015). Additionally, it is important to anticipate the areas within the domain of architects to affect EPWP outcomes and those areas outside of their control. Finally, given the option, architects should choose building technologies and designs that align with certifiable skills, regionally useful techniques, and encourage management structures that develop local SMME's.

This research process has also revealed the challenges of utilizing data collected by agencies for EPWP reporting requirements to trace the specific impacts of architectural design on EPWP outcomes. In the future, focused researcher-lead data collection would assist in more precisely evaluating labour-increasing strategies and their connection to the work of architectural design.

5.1 Recommended Areas for Future Research
This study has identified the following areas for further research:

5.1.1 Project Level Studies of Training within EPWP
Further project level studies of training and certification processes within EPWP architectural projects are warranted. These should include understanding the duration, training costs and management structures within training programmes. Additionally, both projects of this paper raise questions concerning how "unit standards" can more flexibly align with innovative building technologies to validate training efforts.

5.1.2 Tracer Study of Ocean View Stonemasons
With Ocean View's construction completion anticipated in early 2016, a follow up study on the work outcomes for this stonemason-training group may yield important understandings of the transition from EPWP work opportunities to finding employment in the labour market. This case appears to represent a real application of the EPWP ideals of "a better equipped work seeker" with potential for self-employment and a newly marketable skill.

5.1.3 RDP Housing and Local Material Production
The use of site based stone at Ocean View while defaulting to factory based materials for the majority of building components raises important questions about site-based material development and the inherent limits in terms of cost and management. Further exploration of this area could lead to a more defined position in future RDP developments.

5.2 Closing Thoughts
The EPWP presents a challenge and an opportunity for South African architects. Continued assessment and innovation within EPWP architectural projects can yield a South African architecture well suited to its cultural and economic context and expand the social and economic impact of architectural design.

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This paper emerged from MPhil Research within the School of Architecture at the University of Cape Town. I would like to thank the Postgraduate Funding Office for their support of my research through the International Student Fund Scholarship and my thesis supervisor Iain Low for both critical feedback and encouragement. This research was made possible thanks to the cooperation of officials at SANParks, the City of Cape Town Department of Human Settlements, and the EPWP office in Pretoria. Willingness to be interviewed and to share project information afforded unique insight. Additionally, I am indebted to those interviewed from the project teams at Ocean View and Mapungubwe for their participation and feedback. Finally, I would like to thank Rae for support, good humour and encouragement throughout this research.

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IMPEDIMENTS TO IMPLEMENTATION OF GREEN BUILDINGS IN SOUTH AFRICA

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Abstract
The South African building industry has incorporated an energy standard, SANS2004 (Green Building in SA) and is busy incorporating a new standard, SANS 10400 XA, which aims to provide energy-saving practices as a basic standard in South African context. There is lack of speedy implementation of Green Building in the South African Republic. The purpose of implementing Green Building standards is to make the South African environment sustainable which will provide comfort to the end-users. Open-ended interviews were adopted to dig deep into challenges surrounding the poor implementation of Green Building standards. The respondents were construction professionals (Architects and Quantity Surveyors) that deal directly with the construction clients. A purposeful sampling strategy was adopted to identify professionals that have wealth of experience with Green Building projects. Thematic content analysis was used for data analysis. The finding shows that there are challenges with the implementation of Green Building standards, such as; Green Buildings are too expensive, lack of good communication, lack of team integration, the use of expensive technologies, etc. Therefore, for the South African building industry to achieve environmental sustainability there should be commitment to team integration and proper communication between all stakeholders involved to achieve its stated primary objectives of giving comfort to the end-users. It is recommended that further studies be conducted on the professional networking on sites, green washing problems, and encouraging developers to embrace green building techniques. It is also recommended to conduct further research in the public sector projects, such as the South African National and Provincial Departments of Public Works for purpose of comparison.

Keywords: Environment, Green Building, Implementation, Strategies, Sustainability.

1 Introduction

A Green Building is a building which is energy efficient, resource efficient and environmentally responsible. It incorporates design, construction and operational practices that significantly reduce or eliminate the negative impact of development on the environment and occupants. Buys and Hurbissoon (2011) have defined Green Buildings as the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle. Furthermore, the Green Building Council of South Africa (GBCSA) defines Green Buildings as a building which is energy-efficient, resource-efficient and environmentally responsible (GBCSA, 2013).

1.1 The state of Green Building in South Africa

South Africa has incorporated an energy standard, SANS2004 (Green Building in SA), which aims to provide energy-saving practices as basic standards in the South African context. There is, however, a need for The Green Building Council of South Africa (GBCSA) to investigate further in terms of the challenges affecting Green Building implementation in South Africa. The construction industry is responsible for a large amount of pollution that is produced around the world (Howard *et al.*, 2012). Buildings are one of the main users of electricity and therefore play a role in contributing towards global warming and the depletion of our natural resources (Rosenberg and Winkler, 2011). In order to reduce the effects caused by the built environment, there is a need to have changes in construction methods. These changes need to be implemented as quickly as possible in order to prevent more harm to the environment. These changes in construction methods are the changes from conventional construction methods to using Green construction methods. The developing world has started to adopt these strategies of sustainable construction and many developed countries are implementing Green Building techniques at an effective level (GBCSA, 2013). However, the developing world has been left behind. Only recently has South Africa started to take an active role in this evolution. According to Shi and Wei (2011), the GBCSA had awarded Green Star SA Ratings to only seven buildings in South Africa. The demand for going green does however, seem to be on the rise (GBCSA, 2013). The rapid growth of the building industry over the past few years has created a complex challenge between construction and its environment. Sustainable construction is an attempt made to restore this balance between the natural and built environments. South Africa's government and its private sector are becoming more conscious (Shi and Wei, 2011) of the need to practice construction in a sustainable way and to protect its environment.

However, compared to most developed countries, South Africa is still far behind (GBCSA, 2013) in this category. It is realized as though the environmental impact assessments (EIA) are struggling to balance the impacts linked with the social and the economic sides of the building environment. The Sustainable Building Assessment Tool (SBAT) has been used to fix this imbalance (Marelli, 2010). When it comes to "new" methods of developing sustainable construction, South Africa lacks the skills to achieve this successfully (GBCSA, 2013). Most small to medium sized companies cannot afford workers with technical and managerial skills as well as qualified professionals (Kats, 2003) to address these sustainable construction needs of the industry.

A conference on Public Involvement and Social Impact Assessments (Marelli, 2010) showed that public participation can play an important role in impact assessments and this resulted in stakeholder's consultations having a large impact on these assessments. This shows that a wider range of people are involved and have an influence in the construction process and that is why proper communication is vital to achieve success for sustainability (Korkmaz, 2012).

2 Literature Review

The world is currently facing a crisis with regards to global warming (Rehm and Ade, 2013). It is acknowledged that the construction industry plays a significant role in aiding the expansion of the global warming crisis. According to studies conducted by Rehm and Ade (2013), the construction industry is responsible for 40% of primary energy usage and it is also responsible for 36% of the emissions in the world which result from construction in industrialized countries. These emissions originate from the materials that are used in conventional buildings such as concrete and steel while others result from the use phase of buildings (Rosenberg and Winkler, 2011). According to a study conducted by Marelli (2010), the construction industry is responsible for about a third of the greenhouse gas emissions in the world and they contribute to the change in climate. Buildings in the European Union have been recorded to using up to 16% of the world's potable water; along with using up to 50% of raw materials and 40% of the

land waste comes from the construction industry (Rehm and Ade, 2013). With all of these negative impacts that the construction industry has on the environment, it is still a mystery why people are not embracing the implementation of Green Building. This clearly shows that there are various problems which are unsolved that are hindering the progress of Green Building implementation, especially developing countries like South Africa, such as: there is a gap between Green Building practices and legislation requirements; a high degree of unawareness of Green Building legislation/practices by construction company stakeholders; selective implementation of health and safety legislation requirements; and management staff had a more "positive" attitude to Green Building practices than site-based staff who tended to be less motivated and open to such practices (Windapo and Gaulding, 2015). Table 1 shows the rating based on the Green Star in South African building industry.

Table 1. Rating Achieved based on points in Green Star SA

Score	Rating	Remark/Title
10-19	One Star	Not eligible for certification
20-29	Two Star	Not eligible for certification
30-44	Three Star	Not eligible for certification
45-59	Four Star	Best Practise
60-74	Five Star	South African Excellence
75 and above	Six Star	World Leadership

(Source: GBCSA, 2013)

2.1 Climate Change in the City of Cape Town, South Africa

Assessment of current climate trends and future projections as an initial step towards developing a City Adaptation Plan of Action (CAPA) consolidates and integrates existing adaptation and climate proofing initiatives of the Western Cape Provincial Government, Cape Peninsula National Park and participating municipalities (Muheibir and Ziervogel, 2006). An initial step towards developing a CAPA would be to consolidate and integrate existing adaptation and climate proofing initiatives of the Western Cape Provisional Government (Muheibir and Ziervogel, 2006; Slabbert, 2013). Table 2 shows the Green Star rating based on best practice, South African excellence and World leadership.

Table 2. Distribution of Green Star SA rating

Rating	No of Buildings
Four Star	28
Five Star	5
Six Star	3

(Source: Derived from GBCSA, 2013)

2.2 Adapting to Climate Variability and Change

United States Aid for International Development's (USAID's) development activities proceed through a design process that is generally refer to as the project cycle and it includes four basic steps, such as problem diagnosis, project design, implementation and evaluation (USGBC,

2009). USAID's Global Climate Change Team, in the Bureau for Economic Growth, Agriculture and Trade (EGAT), has been working to address the causes and effects of Climate change since 1991. USAID has funded programs that have reduced growth in greenhouse gas (GHG) emissions while promoting energy efficiency, forest conservation, biodiversity, and other development goals (USGBC, 2009). A cursory review of the U.S. Foreign Assistance Guidance on Operational Plans suggests that all five Objective Areas could feature projects and programs potentially impacted by climate.

To help project planners to understand and address the climate's impacts on their projects, the USAID Team has developed a Guidance Manual. This manual provides guidance on how to assess vulnerability to climate variability and change, as well as how to design or adapt to projects so that they are more resilient to a range of climatic conditions (USGBC, 2009). Climate change involves not only changes in an extreme weather patterns of wet and dry, hot and cool periods, but also changes to average climate, which means that systems and activities that are adapted to the average climate can be affected and that natural vegetation, such as forest or grasslands, exists in certain locations because the climate is favorable for particular species (Rehm and Ade, 2013).

2.3 Benefits of Sustainable construction

Sustainable construction is not only about implementing Green Building with internal measures that are energy efficient, but it also includes external measures such as the adoption of green roofing, for instance (Shoniwa, 2008). This is the process of buildings having a roof which has plantation, where buildings have materials like grass and trees that are planted on the roof. For instance, Green Buildings that have implemented green roofing have lots of advantages, such as a reduction in ambient temperature due to the cooling effect of the evaporation caused by the plants (GBCSA, 2013). The green roofs also provide shading, which in turn leads to a cooler space on the roof (Shi and Wei, 2011). Green roofs also create thermal comfort for occupants on the top floor who are directly under the green roof (GBCSA, 2013). Then the occupants under the green roof found the temperature comfortably moderate throughout the year. The main reason for the floor under the green roof being naturally cooler in summer is because of the evaporation and the water retention from the soil (Shoniwa, 2008). After understanding the benefits of Green Buildings, the question that arose was that "why do people not implement Green Buildings and always complain about the heat during summer and cold during winter"? Some of the answers that might come to the mind are that these facts have not been communicated to the construction clients. Moreover, the challenges within the context of South Africa is legislation enacted to control the design and construction of Green Buildings (in order to move towards a greater construction industry) are perceived to be "constraints/limited" (Windapo and Goulding, 2015), especially, compared to the implementation of Green practices within the building industry (Naidoo, 2008; cited in Windapo and Goulding, 2015). There is also the lack of sufficient knowledge from stakeholders' perspectives in understanding legislation to influence attitude and perceptions of Green Building legislation and practices to create a Green Building "mindset" (Naidoo, 2008; cited in Windapo and Goulding, 2015).

2.4 Green Building Rating Systems

This study has looked into the green building rating systems that are found in the world. In Australia, they have adopted a green building rating system which is called the "Green Star", this rating system was developed by the Green Building Council of Australia (Green Building Council of Australia, 2006). How this rating system works is that it rates a building's ecological performance by its functional factor and allocates a star to it.

In the United Kingdom, the Building Research Establishment Environmental Assessment Method (BREEAM) rating method is used. BREEAM classifies functionalities of the buildings

under categories such as: management; energy usage; health and wellbeing; pollution; transport; land use; ecology; materials and water (Lowe *et al.*, 2000). Then it assesses each factor and provides points to each factor then the points are added up to formulate an overall score. Once the score has been calculated, the certificate classifies the scores as pass, good, very good or excellence.

Japan has a green rating system that is called the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE). The CASBEE rates the building's environmental efficiency (performance and quality = Q), when it rates the environmental efficiency it looks at: indoor environment; quality of service and outdoor environment on site. Then it also rates the building's environmental loading (L), which comprises energy; resource and materials and the offsite environment (Adapted from United State Green Building Council, 2009). Then they divide Q by L in order to get a ratio which will rate the building's green measures. Then the certificate will sum up the calculated ratios and have symbols that represent the scores, which are: "C" for poor; then there is a "B" rating; "B+"; "A" and the last one is "S" for excellent.

In the United States, they use the LEED rating system which stands for the Leadership in Energy and Environmental Design (United States Green Building Council, 2009). This rating system categorises the green measures into six categories which are: Sustainable site; water efficiency; energy and atmosphere; materials and resources; indoor environmental quality and innovation in design process. All of these categories in a building are rated and then all the separate scores are put together in order to make one score rating of the building out of 69. Then in the certificate the final score out of 69 will be given a specific classification which will be either bronze; silver; gold or platinum which is the highest qualification.

The GBCSA (2013) has launched the Green Star SA, known as Public and Education Building Rating Tool that will allow all public spaces to be rated whether they are publicly or privately owned. The Council provides the commercial property industry with an objective measurement for Green Buildings and recognises and rewards environmental leadership in the property industry, whereby scoring is done in nine categories such as: Management, Indoor environment quality, energy, transport, water, materials, land use and ecology, emissions and innovations. A building development can receive either a 4-Star rating signalling that it has employed best practice, and a 5-Star rating which recognises ''South African Excellence'' or the coveted 6-Star rating indicating that the project is a world leader.

In the first quarter of 2012, South Africa had one building with a Green Star Rating and this has now grown to nine, this year three were added just in the third quarter of 2012. The first development to receive a 5-Star rating was Aurecon Century City Office in Cape Town for its office design, indicating excellence in South African Standards, followed by Nedbank's new regional head office at the Menlyn Maine precinct development in Pretoria, which was awarded a 4-Star rating by Green Building Council of South Africa (GBCSA) for green office design and this is the third Nedbank building to achieve a four-star rating, joining the Nedbank head office in Sandton, Johannesburg and the Nedbank Ridgeside office development in Umhlanga, Durban (GBCSA, 2013).

A four-star rating indicates "best standards practices'', but the most important aspect of the entire Menlyn Maine project is its highest goal to become climate positive and once the full precinct – a mixed–use development of office blocks, shops, and living and entertainment spaces is complete, it will work toward reducing on-site greenhouse emissions to zero (GBCSA, 2013). Menlyn Maine is set to becoming Africa's first green city, one of 17 worldwide that fall under the Climate Positive program. Some of Menlyn Maine's green features include storm water tanks built into the structure and roof of buildings. The water will then be treated and circulated for reuse inside as well as outside the building and is expected to

provide non-potable water for almost a full year (GBCSA, 2013). The program, a Clinton Climate Initiative, recognises that while increased urbanisation is inevitable, cities can still grow in climate positive ways (USGBC, 2009).

3 Research Methodology

A qualitative research method was adopted for the study. This is to dig deep (Yin, 2009) to uncover facts (Saunders *et al.*, 2012) underpinning the phenomenon under investigation (i.e. Green Building implementation). The reason for the adoption of qualitative strategy is because the researcher wants to uncover the facts from construction professionals (Architects and Quantity Surveyors) that dealt with Green Building projects in South African building industry. It should be noted that there are no specific or permanent formulas for conducting a qualitative study (Leedy and Ormrod, 2010). Unstructured (in-depth) interviews were adopted to understand the meanings interviewers attach to issues and situations in contexts that are not structured in advance by the researcher (Easterby-Smith, 2008). The research was conducted in Johannesburg metropolitan council which is one of the three metropolitan councils in Gauteng province. Based on the literature reviewed, the best research strategy is by conducting in-depth interviews with construction professionals who deal directly with construction clients. Although interviewing is often claimed to be 'the best' method of gathering information, its complexity can sometimes be underestimated (Easterby-Smith *et al.*, 2008). Though, in this study, an in-depth interview was used, which was based on carefully prepared set of questions piloted and refined until the researcher was convinced of their validity. Interviews vary in accordance with the philosophical starting points that underpin them. Therefore, the epistemological and methodological bases of interviews and interviewing are necessary prerequisite in research designs that involve them (Silverman, 2001). The research was conducted with five (5) construction companies (where one professional was chosen from each company) that have dealt with Green Building projects in Johannesburg, Gauteng Province of South Africa. Five (5) relevant and experienced construction professionals (3 Architects and 2 Quantity Surveyors) who were registered with their professional bodies and have 20 years and above working experience with construction clients were interviewed for an hour. The construction professionals (i.e. Architects and Quantity Surveyors) are the once who construction clients consult for advice before embarking on Green Building projects. The construction professionals were chosen from grade 7 to 9 registered with the South African Construction Industry Development Board (CIDB).

4 Findings and Discussion

The private sector clients were chosen for the studies because of the wealth of experience gathered working with Green Building implementation over 20 years in the South African building industry. Thematic content analysis was used in the analysis of the data to identifying the recurring material or subject matter as well as identifying content that is noticeably different. The themes and constructs were identified from the interview transcript. The themes and constructs were ranked in frequency percentages (%) and results obtained are shown in Fig.1. From the analysis, four (4) factors were frequently ranked 100% (i.e. green buildings are too costly, lack of good knowledge about green buildings, lack of information on its benefits, and developers are building to sell not considering end-users comfort. Two (2) factors were frequently ranked 75% (i.e. lack of team integration between stakeholders and the use of expensive technologies). Three (3) factors were frequently ranked 50% (lack of good communication, no enough building regulations and the lack of stakeholders buy-in to the technology). From the outcome of the studies four major factors which all the five (5) respondents (3 Architect and 2 Quantity Surveyor) agreed were the most frequent impediments to the rapid implementation of Green Buildings. The major challenges uncovered by

construction professionals that led to poor Green Building implementation in the South African building industry include:

- Green Buildings are too costly
- Lack of proper knowledge of the advantages of Green Building
- Lack of information about its benefit to the construction clients
- Developers build to maximise profit only, not for users' comfort
- Lack of team integration within stakeholders
- Use of expensive technologies
- Lack of proper communication strategies
- No effective enforcement by professionals and government by-laws
- Lack of stakeholders buy-in to the technology

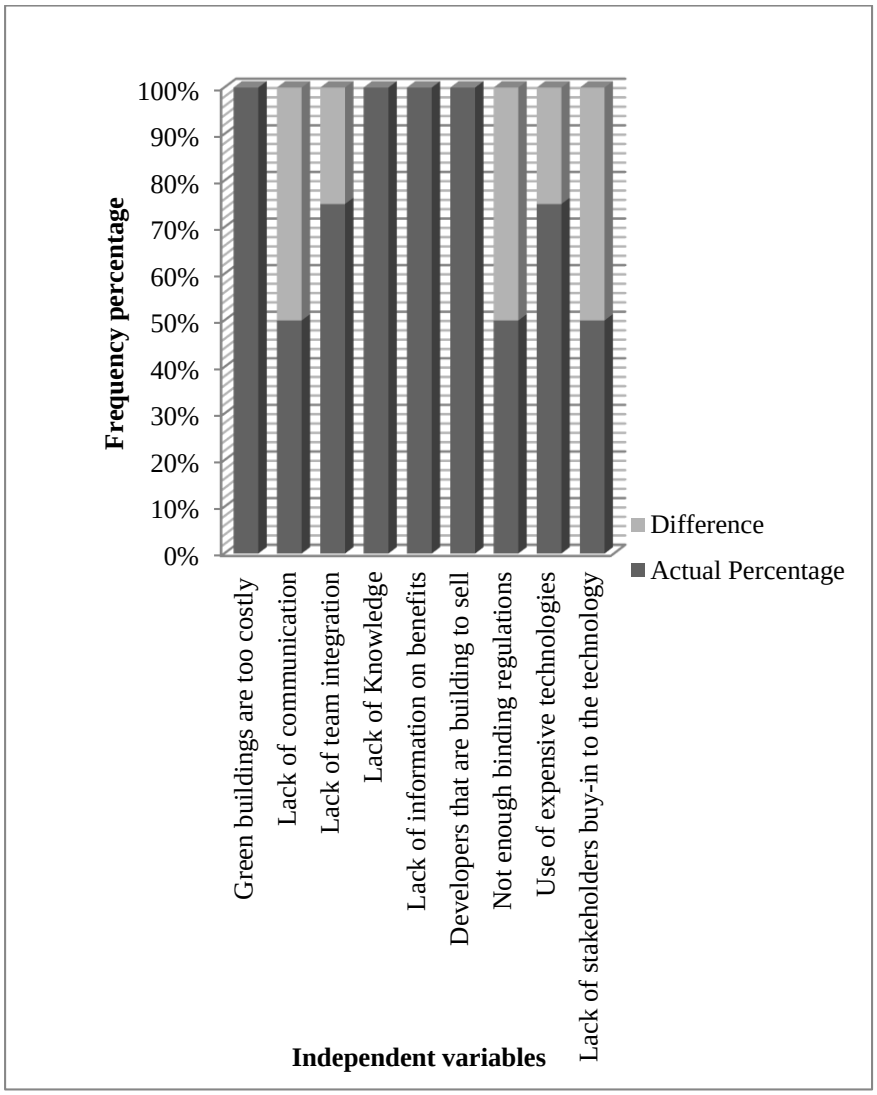

Figure 1. Challenges with the implementation of green building in South Africa

5 Conclusion and Further Research

From the data collected it is clear that Green Building implementation faces many challenges. The four (4) challenges that needed to be addressed as quickly as possible because of the alarming rate (i.e. 100%) are: Green Buildings are too costly, lack of proper knowledge of the

advantages of Green Building, lack of information about its benefit to the construction clients, and developers build to maximise profit only not for end-users' comfort. Despite the fact that these four (4) issues were the most challenging, does not mean the others challenges should be relaxed. For the South African Green Building implementation to succeed, the nine (9) challenges raised by this study need to be looked at critically and addressed to facilitate the speedy implementation of Green Building in South Africa.

The main recommendations of the study are that the concept of green development be broadened into other spheres apart from planners. As such the Green Building Council of South Africa (GBCSA) should broaden the awareness to the construction clients on the strategic advantage of implementing Green Buildings for the comfort of end-users. Again, based on the global warming challenges not only in developing economies, like South Africa, but the world at large, a reduction of green gas emission should be adopted in South Africa. It is also recommended to conduct further research in the public sector projects, such as the South African National and Provincial Departments of Public Works for purpose of comparison.

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THE PERCEIVED BARRIERS TO THE CONSTRUCTION OF GREEN BUILDINGS IN NELSON MANDELA BAY, SOUTH AFRICA

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Abstract
The awareness of the need for the construction of Green Buildings (GB's) in South Africa has increased dramatically in recent years. There are numerous perceived benefits that are to be reaped from the construction of GB's that may provide long-term advantages for the owners of such buildings, however, obstacles to the construction of these projects continue to exist. This study therefore aims to identify what particular aspects are deemed to impact on the viability of constructing these projects when compared with traditional buildings and whether these perceptions are valid for all building types. Alongside a detailed literature review, a structured questionnaire was distributed amongst medium to large general contractor members of the East Cape Master Builders Association and members of the Eastern Cape Institute of Architects residing in Nelson Mandela Bay. The results of the research indicate that there is demand for GB's but that the perceived increased upfront costs, aligned to high material costs, minimum standard requirements and specialist knowledge required of the construction team, are the main obstacles that hinder the full adoption and construction of GB projects. The findings highlight that this is primarily due to insufficient knowledge and awareness existing amongst working professionals in the built environment of the region in terms of the requirements needed for the construction of GB's.

Keywords: Cost, Green Buildings, Specialist knowledge

1 Introduction

According to Harrison and Seiler (2011: 551) the past decade has seen recognition of the need for the awareness and implementation of sustainable initiatives within the construction industry through Green Building (GB) projects. GB's are a relatively new concept with regards to the Republic of South Africa (RSA) and numerous challenges still confront their construction. The establishment of the GBCSA in 2007 and the progressive development of the Green Star SA rating tool have provided the industry with an initial framework for financing, developing and investing in sustainable buildings (Windapo, 2014). Other countries such as the United Kingdom (UK), the United States of America (USA) and Australia are far more experienced and familiar with the construction processes and viability studies of green projects (McGraw-Hill Construction, 2013). However, the results from this research also show that South Africa, although starting from a low base of only 16% in 2012 is likely to see a 36% increase by 2015 to 52%, the greatest increase of those countries surveyed, a significant indication of the trend towards GB's now occurring. In addition, the research also identifies that South Africa has the highest level of green activity in the residential marketplace, with over a third (36%) of firms

reporting planned green activity for low-rise residential projects (one to three floors) by 2015. This statistic collides with the reported main challenges for GB's of higher initial capital costs and lack of political support/incentives. Pearce (2008) states that a significant barrier to sustainable construction is the perceived likelihood of a first cost premium linked to such projects. Jackson (2009) finds that almost three quarters of developers believe green construction developments add more than 5% to construction costs, whilst more than 40% of those respondents believe that costs actually exceed 10% when compared with conventional projects.

Globally, the construction environment generates many more pollutants when compared to other forms of industries and has an adverse effect on the natural environment, resulting in pollution of the earth (Ding, 2008; Durand *et al.*, 1996). It is therefore essential for the modern built environment industry to become aware of the need for the implementation of sustainable developments to reduce the amount of environmental impacts that the construction industry leaves on the natural environment. According to Verbruggen *et al.* (2010), contemporary society considers sustainable development as the best possible way to address these complex and interrelated problems, not only for the sake of current and future generations, but mainly for the future integrity of the planet and its natural environment. This is supported by McGraw-Hill (2013) showing that 44% of South African respondents believe the main reason for future GB's is that it is the right thing to do and Kibert (2013). This therefore suggests that there is great opportunity within the South African construction industry to grow sustainably by creating sustainably constructed buildings!

The greatest obstacle to implementation remains viability relating to the business case, which often results in the client omitting green building features (Milford, 2009). Due to the fact that construction professionals in South Africa are not entirely comfortable and practically acquainted with regards to the construction of GB's (Le Jeune et al., 2013), this study is therefore highly important with regards to the analytical process followed when assessing the perceived reasoning for a GB. A vast number of professionals in the construction environment have as a perception that GB's cost more to construct when compared to conventional type buildings (GBCSA, 2012; McGraw-Hill Construction, 2013). The aim of the research was therefore to determine what aspects of GB's were perceived to be more expensive whilst the objective of the research was to identify whether: the acquisition of green/sustainable materials causes GB's to be more costly to construct; contractors impose higher profit mark-ups when undertaking green projects; the design phase is more expensive when compared to traditional type buildings, and; the acquisition of expertise relative to green projects is expensive.

2 Literature Review

2.1 What is a Green Building?

A GB incorporates design, construction and operational practices that significantly reduce or eliminate its negative impact on the environment and its occupants whilst providing an opportunity to use resources efficiently while creating healthier environments for people to live and work in (Indian GBC, 2007 & GBCSA, 2008). Chang *et al.* (2011) state that a GB is a structure that is designed, renovated, built, operated, or reused in an ecological and resource-efficient manner to incorporate energy efficiency, water conservation, waste minimisation, pollution prevention, resource-efficient materials, and indoor environmental quality in all phases of the building's life. There exist standardised benchmarks that are set globally in order to establish exactly which buildings do indeed meet the requirements to be able to be labelled as a GB with several rating systems in use, namely LEED (USA), BREEAM (UK) and Green Star (Australia). The GBCSA uses the Green Star South Africa rating system which is based on the Australian rating system but customised for the South African context (GBCSA, 2008).

With regards to GB projects, a holistic and integrated design process is utilised at the very beginning of the project process due to the fact that a GB comprises of many unique design features that are not necessarily found in conventional buildings (Kibert, 2008).

2.2 The need for Green Buildings

According to Dorsey and Hedge (2013) the global population is increasingly becoming more urbanised and as of the 23rd May 2007, over 51% of the world's population now live in urban environments (Hanlon, 2007). As buildings worldwide produce a vast scale of GHG emissions due to the fact that buildings constitute more than one third of total energy usage, the implementation of green practices and green projects have the largest potential for mitigating such adverse emissions into the natural environment (UNEP, 2009; Ade and Rehm, 2013). According to Jain et al. (2013) buildings do not stop impacting the environment once they are built – they have serious adverse effects on the natural environment throughout the life of the structure. Bhatia (2009) states that by implementing green practices, it is the best possible way to make the earth healthy for future generations; therefore all project stakeholders and civilians globally, are responsible to promote and adopt the concept of building green. Kneifel (2010) states that the implementation of energy efficiency measures within buildings can reduce their carbon footprint by 16% on average, therefore improving the GB LCC effectiveness.

The USGBC identifies that the optimal performance of a GB will be achieved when it is both energy efficient and effectively promotes the occupants' comfort within the building environment (Dorsey and Hedge, 2013). According to research in the Northern Hemisphere (Bayer-Oglesby et.al, 2007), the average citizen spends more than 85% of their time indoors, therefore it is in their best interests that the built environment be created to provide for well-equipped ergonomically fit indoor environments to allow for high occupancy satisfaction rates and improved worker production outputs. Hedge *et al.* (2011) identify that amongst many traditional or conventional (non-green) office buildings there has been inadequate ergonomics design with regards to office workstations which results in the regular occurrence of work-related musculoskeletal disorders, a significant financial cost to any organisation. According to Arsenault et al. (2013) 'green buildings' prove to possess superior indoor environmental performance when compared with similar conventional type buildings' with a variety of physical features resulting in improved occupancy outcomes. Results from occupancy satisfaction surveys show that GB's score a much higher occupancy satisfaction rate when compared to conventional type buildings (Dorsey and Hedge, 2013).

According to McCown and Qualk (2009: 20) a theory referred to as the "triple bottom line", has become inherent in decision making when it comes to the construction of high-performance buildings. The theory posits that there is substantial occupancy satisfaction and the construction of the building enhances environmental conservation, with the building owner experiencing financial prosperity. The benefits can be measured and reproduced independently across a variety of project types and building locations. An example of this is energy efficient installation savings within the GB and the ability for the building owner to charge higher rental rates. Other quantitative benefits include water savings and carbon tax benefits, whilst qualitative benefits include fewer vacancies and better overall occupant health.

2.3 Obstacles identified with regards to the adoption of GB's

The primary obstacle facing the adoption of GB's is the perception that it costs more to construct such projects (Langdon and Morris, 2007; Hwang and Tan, 2012), whilst McCown and Qualk (2009) state that green design within a building is considered to be a feature that is added to the original cost of the design. Fletcher (2009) states that despite the benefits of long-term returns, it does indeed cost more to build green, however, evidence from LEED-certified GB's suggest a maximum of 1 to 2 percent more expense is incurred. In some circumstances,

this barrier inhibits sustainability construction from a business perspective as well as completely excluding consideration of such projects.

According to Pearce (2008) despite the overwhelming commitment to developing sustainable structures and buildings in the modern era, many organisations are experiencing difficulty with regards to implementing the concept of GB's due to the way in which funding is allocated. Ade and Rehm (2013) argue that the GB soft costs are higher than conventional type projects due to incremental costs incurred that are associated with the process of actually achieving a GB star rating. According to Baetz *et al.* (2010) these incremental costs include both application costs as well as additional consulting required with regards to the various rating tools.

Henn *et al*. (2008) states that there is always a risk that human bias towards traditional or conventional type building projects can hinder the adoption of green or sustainable projects. According to Tulacz (2008) although some contractors have already delivered and executed several LEED projects, most contractors remain sceptical with regards to the wholesale adoption of the GB agenda because it is perceived to pose additional requirements and risks. Duckles (2009) states that the process and the relative documentation is still evolving and burdensome for professionals in comparison with conventional projects whilst the USGBC Research Committee (2011) has identified strategic issues facing the GB community. According to Edwards *et al*. (2012) the shift to adopt GB projects has resulted in new industry boundaries and has presented contractors with unique challenges that could hinder or eliminate the achievement of green project goals. In both this research and that conducted in India (Jain *et al.*, 2013) similar obstacles were identified including the lack of professionals with the required knowledge and expertise to implement new or unfamiliar technologies and products; Sceptical sub-contractors who may instigate myths about sustainable construction and the administration costs associated with supporting compliance; The conflicts between existing building codes and GB strategies or standard requirements, and; The scarcity of the specified high-efficiency products or green materials that are included in the contract documents, crucial with regards to compliance with GB standards.

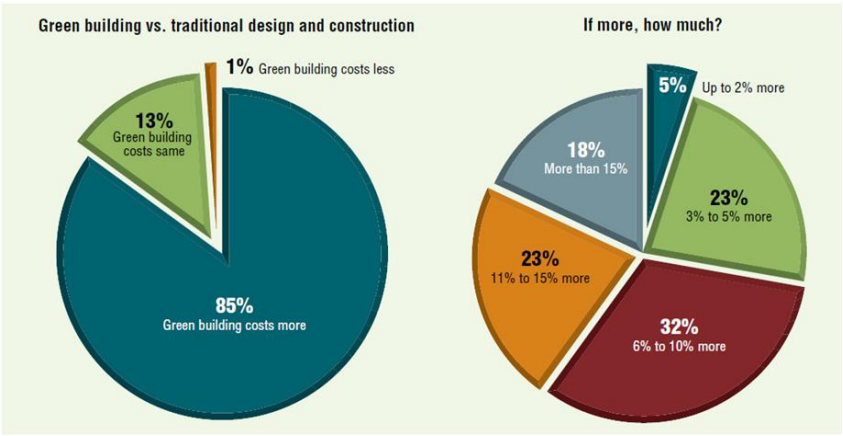

Figure 1. Market perceptions of GB construction costs (McCown and Qualk, 2009)

Malin (2000) states that environmentally friendly materials do in fact cost more due to limited production linked to these specialised materials and they need to be specially ordered – either through local supply yards or directly from the manufacturer. Extra costs are also incurred when additional technology is invested into responsible manufacturing. The most common misconception is comparing the cost of the green project with the original project budget / anticipated cost of the project. The outcome of this process results in contractors comparing the difference between what the final project was estimated to cost and how much it actually cost to complete. Cole and Sterner (2000) state that although LCC accounting is superior to

initial capital costs alone, it remains a limited approach to account for the broader environmental and social costs associated with GB's operating benefits such as lower energy and water consumption. Yudelson (2008), suggests it is a challenge to convince the developer to undertake a green project when there is unequal distribution of the benefits to the builder and tenants. According to Hwang and Tan (2012), developers have to often pay high upfront cost premiums for GB developments with inadequate information available with regards to green products or materials, while the tenants accrue the benefits from the improved performance in the indoor environment quality and cost savings, mainly related to water and electricity.

3 Research Methodology

The research was undertaken by conducting an empirical study using a quantitative approach in conjunction with a literature survey. The primary data for this study was obtained through a structured questionnaire sent randomly to 35 medium to large GC members of the ECMBA and 55 members of the ECIA drawn from a list of active members provided by each organisation. 17 members of the ECMBA responded and 13 members of the ECIA responded, providing a response rate of 48.57% and 23.64% respectively. Two Likert scale questions were used, the first ranges from 0-5, 0 being does not and 5 being major extent, whilst the second ranges from 1-5, 1 being minor extent, not at all, or strongly disagree and 5 being major extent, very, or strongly agree. Descriptive statistics in the form of frequencies, and a measure of central tendency, a mean score (MS), were computed from the data gathered using Excel. The responses are tabulated in terms of percentage responses in the range of 1 (minor) to 5 (major), and a MS with a minimum value of 1.00 and a maximum value of 5.00. MSs > 3.00 indicate that respondents can be deemed to perceive the extent of certain aspects affecting the need for the implementation of GB's are of a major extent as opposed to a minor extent, as in the case of MSs $\leq$ 3.00. These descriptive statistics were organised, analysed, and presented in tables.

4 Findings and Discussion

Table 1; Table 2, and Table 3 indicate the extent to which certain aspects may affect the need for the implementation of GBs.

Table 1. The factors affecting the need for the implementation of green buildings

Aspect / Factor	Response (%)						Mean Score (MS)	Rank
	Unsure	Minor……Major						
		1	2	3	4	5		
The global increase in carbon emissions and greenhouse gases	0.00	0.00	10.00	30.00	50.00	10.00	4.44	1
The high maintenance costs linked to the life-span of traditional buildings	3.33	10.00	20.00	26.67	30.00	10.00	3.78	2
The increase of waste production on traditional construction sites	0.00	10.00	30.00	30.00	26.67	3.33	3.76	3
The adverse effect that the current traditional building industry has on the natural environment	0.00	13.33	33.33	20.00	30.00	3.33	3.69	4
The ever increasing levels of water pollution generated by the global construction industry	16.67	10.00	13.33	33.33	20.00	6.67	3.32	5
The current ineffective methods of traditional construction	0.00	23.33	43.33	13.33	16.67	3.33	3.24	6
The ever increasing levels of air pollution generated by the global construction industry	3.33	16.67	6.67	33.33	30.00	10.00	3.10	7
The current usage of VOC (Volatile Organic Compound) materials in traditional buildings	20.00	6.67	10.00	30.00	23.33	6.67	3.04	8
The ever increasing levels of noise pollution generated by the global construction industry	3.33	23.33	23.33	23.33	20.00	6.67	2.62	9

Eight out of the nine (88.89%) aspects listed in Table 1 have MSs > 3.00, which indicates that the grouped respondents of the GCs and architects can be deemed to perceive the aspects affecting the need for the construction of GB's as of major extent as opposed to minor extent. The grouped respondents perceived that the need for the implementation of GB's is mainly due to the fact that the current traditional building environment is emitting ever increasing levels of GHGs and carbon emissions with regards to the natural environment. This factor is ranked first with a MS of 4.44. None of the individuals responded 'Does not' to the factors which may imply that the respondents believe that all the factors listed do have a role to play with the implementation of GB's. When the responses for Architect's and GC's are separated in order to do a comparative analysis of the results an interesting dynamic occurs (see Tables 2 and 3).

Table 2. The factors affecting the need for the implementation of green buildings (Architects)

Aspect / Factor	Response (%)						Mean Score (MS)	Rank
	Unsure	Minor……Major						
		1	2	3	4	5		
Passive design within a green building provides better occupancy usage	0.00	7.69	7.69	0.00	38.46	46.15	4.08	1
Clients' preferences are changing towards the favour of green buildings	0.00	7.69	7.69	30.77	30.77	23.08	3.54	2
The inadequate ergonomics design with regards to office workplaces	7.69	15.38	7.69	15.38	30.77	23.08	3.42	3

Table 3. The factors affecting the need for the implementation of green buildings (GC's)

Aspect / Factor	Response (%)						Mean Score (MS)	Rank
	Unsure	Minor…….Major						
		1	2	3	4	5		
Passive design within a green building provides better occupancy usage	5.88	5.88	11.76	23.53	35.29	17.65	3.50	1
Clients' preferences are changing towards the favour of green buildings	11.76	0.00	17.65	29.41	29.41	11.76	3.40	2
The inadequate ergonomics design with regards to office workplaces	11.76	5.88	23.53	29.41	23.53	5.88	3.00	3

All of the factors listed in Table 2 have MSs in the range of between > 3.42 ≤ 4.08, which indicates that the architect respondents perceive these factors to have some extent to near major extent / near major effect in terms of the factors affecting the need for the implementation of GB's. In contrast, 66.67% of the GC factors listed have MSs > 3.42, which indicates that they perceive only one of these factors to have the same affect. With regards to the architects' responses, they believe the no.1 ranked factor affecting the need for the construction of GBs is due to the fact that passive design within a GB provides for better occupancy usage. As a design based question, architects were more likely to respond in a more favourable manner towards this so it is notable that the GC's scored these aspects in the same order.

All but one (an unsure contractor) perceived GBs to cost 'More' to construct when compared with traditional buildings. This shows a very definite trend in opinion in terms of the perceptions of built environment professionals towards GBs. Respondents were also asked to choose an amount by how much more they believed GBs would cost (see Figure 2). The MSs of the responses proves to be quite a substantial amount, for both the architects and GCs. The architects' average percentage is 28.23%. The GCs' average percentage is 28.67%, a remarkably similar average, showing that built environment professionals believe it costs nearly a third more to construct a GB than a traditional building.

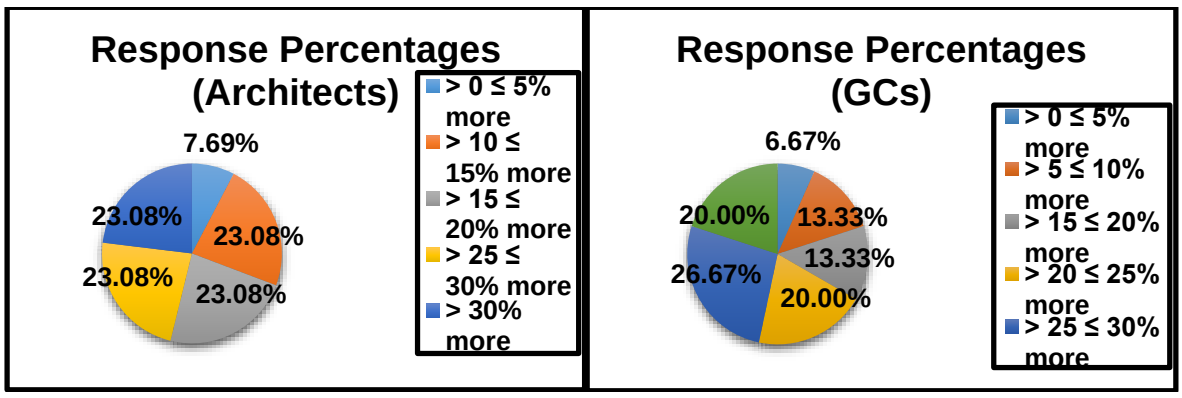

Figure 2. How much more GB's cost to construct when compared with traditional buildings

Having identified that both groups of respondents perceive there to be a cost implication when constructing Green buildings, understanding what factors are perceived to affect the construction from a cost perspective becomes paramount to not only better controlling those costs but also in terms of mitigating for those costs (see Table 4).

Table 4. The factors affecting the construction costs of green buildings

Aspect / Factor	Response (%)						Mean Score (MS)	Rank
	Unsure	Minor……Major						
		1	2	3	4	5		
The expertise utilised	0.00	0.00	0.00	16.67	46.67	36.67	4.20	1
The building type	10.00	0.00	3.33	13.33	40.00	33.33	4.15	2
Materials used	0.00	0.00	10.00	20.00	33.33	36.67	3.97	3
The design process	0.00	0.00	13.33	13.33	50.00	23.33	3.83	4
The accreditation phases	10.00	3.33	13.33	23.33	20.00	30.00	3.67	5
Construction methods	0.00	0.00	13.33	26.67	43.33	16.67	3.63	6
Recycling of waste materials	3.33	10.00	6.67	23.33	30.00	26.67	3.59	7
The project location	6.67	3.33	16.67	36.67	16.67	20.00	3.36	8
The method of procuring materials	3.33	3.33	23.33	30.00	20.00	20.00	3.31	9
The site conditions	3.33	10.00	16.67	50.00	13.33	6.67	2.90	10

Respondents perceive 90% of the factors listed to have an important effect with regards to the construction costs of GB's with 7 having MSs in the range of $> 3.40 \leq 4.20$, which indicates that the respondents perceive the factors listed to have an important to more than important / more than important affect. The no.1 ranked factor perceived to affect the construction costs of GBs are the expertise utilised for the construction of the green projects.

Respondents were also requested to expand on the extent to which they believe certain benefits may exist with regards to the occupancy usage of GBs. The 1st to 6th ranked benefits listed have MS's that are in the range of between $> 3.34 \leq 4.17$, which indicates that the grouped respondents may perceive that the existence of these benefits with regards to the occupancy usage of GBs has some extent to near major extent / near major extent impact. In general these responses followed a similar pattern to that of the literature with "Improved indoor thermal conditions" ranked 1st whilst "Better speech privacy" was the only benefit that scored below 3.

Table 5. The extent to which respondents agreed with the following statements

Aspect / Factor	Response (%)						Mean Score (MS)	Rank
	Unsure	Minor……Major						
		1	2	3	4	5		
The specialised materials utilised for the construction of green buildings imposes additional expenses with regards to the construction process	0.00	0.00	0.00	6.67	53.33	40.00	4.33	1
Green building developments are the best method of construction in which to improve the future integrity of the planet and its natural environment	6.67	0.00	0.00	10.00	43.33	40.00	4.32	2
There needs to be an improved awareness for the construction of green buildings	0.00	3.33	3.33	13.33	36.67	43.33	4.13	3
Green roofs pose high upfront costs	23.33	0.00	0.00	16.67	33.33	26.67	4.13	4
The accreditation phases required to obtain green star ratings imposes additional expenses to the project	16.67	0.00	6.67	6.67	40.00	30.00	4.12	5
The construction methods related to green buildings impose additional expenses	3.33	0.00	0.00	26.67	36.67	33.33	4.07	6

The life cycle cost benefits related to green buildings out-weigh the high upfront costs linked to such projects	**26.67**	**0.00**	**3.33**	**13.33**	**33.33**	**23.33**	**4.05**	**7**
The design process linked to green buildings imposes additional expenses to the project	**3.33**	**0.00**	**10.00**	**10.00**	**43.33**	**33.33**	**4.03**	**8**

Finally, respondents gave their opinion on a number of factors highlighted by the literature review as having an impact on the construction of green buildings. All of the statements listed have MSs > 3.00 which indicates that the respondents agree with all of the statements listed to some extent to near major extent / near major extent. According to the 1st ranked statement listed which has a MS of 4.33, the respondents perceive that the specialised materials utilised for the construction of GB's imposes additional expenses with regards to the construction process.The 2nd ranked statement listed in the question provides a MS of 4.32, confirms however that respondents perceive that GB developments are the best method of construction in which to improve the future integrity of the planet and its natural environment.

5 Conclusion and Further Research

The researchers have concluded that there is a certain amount of demand relative to the construction of GB's, however, due to the perception by the respondents of high upfront costs linked to the construction of such projects, the adoption of such projects is hindered. In addition, the respondents perceive there to be benefits reaped from the reduced LCC of GB's that out-weigh the high upfront costs of such projects, which challenges the notion that this should be a barrier to greater uptake of GB's in the region. However, respondents noted that GB materials are perceived to cost significantly more when compared to materials used for the construction of traditional buildings and that on the back of these higher material costs, general contractors tend to impose higher profit mark-ups when undertaking GB projects. Furthermore, individuals surveyed perceive the design phase relative to GB projects to be more expensive when compared to traditional buildings. Adding to this, respondents strongly agree with the fact that the expertise utilised for the construction of GBs imposes higher expenses. It was further noted by respondents that there needs to be an improved awareness and education required with regards to the working professionals within the built environment in order to increase their knowledge of what aspects constitute the construction of GBs.

As a result of this research, it is the opinion of the researcher that in consideration of those undertaking tertiary education as built environment professionals, there is a need to have specific education and training to acquire GB knowledge before they enter professional practice. Furthermore, in order to increase the adoption rate of GB's in RSA, it is recommended that the government should subsidise portions of the construction costs of GB projects in order for GB's to assist in meeting South Africa's commitments on climate change. The exact nature of these subsidies, possibly in the form of tax rebates or similar incentivisation schemes, should be investigated in future studies. Additionally, it is recommended that further studies should be undertaken to focus on the physical cost of materials used in the GB construction process, comparisons of the cost of expertise or the standard requirements that need to be met to achieve a GB rating in order to calculate the impact of these aspects on the total build cost.

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THE PRACTICE OF DESIGN-BUILD PROCUREMENT METHOD IN SOUTH AFRICA

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Abstract
A well implemented good practice of Design-Build procurement method brings different disciplines and aspects of construction process together, which in turn minimises the incidents of constructors having to repeat work, and thus, result in cost and time savings. This type of procurement method increases the probability of a successful project that meets the expectations of all stakeholders. A bad practice of Design–Build procurement method increases the probability that the project's performance will be compromised and that some or all of the stakeholders disappointed. Data were collected from consultants and contractors using a structured questionnaire via personal contact and email. The collected data were subjected to descriptive statistical analyses. This paper argues that design-build procurement is not correctly practiced in South Africa. This may be due to the late introduction and the level of understanding of the procurement method.

Keywords: Construction procurement, Contracting for Design-Build services, Design-build practices, Executing Design-Build projects, Procuring Design-Build services

1 Introduction

The design-build system is probably the oldest in the world. Master builders were providing buildings to meet the client's individual needs long before architecture became divorced from the building process (traditional procurement method). Design-build is, therefore, a return to a former system which re-emerged in the post-war USA mainly for industrial and commercial projects, when architects tended to ignore their code of practice which precluded them from becoming contractors. By the 1970s many American architects were involved in design-build to the point where their institute was virtually forced to acknowledge the trend and approve it (Masterman, 1996).

Design-build started being used in America during the early 1900s (Greenfield, 1982). In the 1970s and 1980s, design-build was used extensively, especially in major power and industrial projects (Poirot et al, 1994). In 1991, about 5% of all construction in the USA was based on design-build (Setza, 1991). In the mid 1990s, more than one-third of construction projects were using the design-build approach and in response to the growing demand for it, the "Design-Build Institute of America" was set up.

The client's knowledge and understanding of the construction and project implementation has been regarded by many researchers like Morledge (1987) as critical characteristics in terms of client behaviour when dealing with the construction industry. Behavioural responses exert a

significant influence on the effectiveness of the project management process because of the views of the various professions and skills involved, many of which have strong allegiances and perceive projects from very different positions (Walker, 1996).

An empirical survey conducted by Mbanjwa and Basson (2003) indicates on a scale of 1 to 5, with 1 indicating no knowledge and 5 indicating excellent knowledge, that the traditional procurement system was rated the most favoured form of procurement systems, followed by construction management (ranked 2nd), management contracting ranked 3rd; design and build (turnkey) ranked 4th; and design and manage including (build, operate and transfer) ranked 5th. This shows that design-build is still not well understood in South Africa thereby affecting the way design - build is practised and implemented.

Problems stemming from design-build practice may be traced to the following two factors:

Firstly, the late introduction of this procurement system into the South African construction industry compared to other countries especially in Europe. Construction Industry Development Board (CIDB, 2008) stated that construction procurement emerged in South Africa in 1994; one should compare this to a country like the United Kingdom in which different procurement systems were very much in use as early as 1950 (Masterman, 1996). The second is that of perception; South Africa being a developing country where information about this new procurement method is still lacking, clients may view design-build projects in a certain way influenced by their level of understanding of the method. Galbraith (1995) suggested that all clients will be influenced more by experience when choosing their procurement strategy than by project-specific factors.

This paper argues from stakeholders' opinion that design – build is not well practised in South Africa and also lack of understanding of the design – build procurement method. A better understanding of the practices of design-build procurement method will allow more clients to use this procurement route which has been proven to demonstrate superior performance in some types of projects. Studies have shown that its use results in improved time performance (Ling, 2004).

2 Literature Review

2.1 Design – Build Defined

Richard (1975) referred to "design-and-build" (also known as design-build) as a situation when a client contracts with a single firm in both design and construction. For Harold (1976) it is present when a substantial amount of building is accomplished under a single contract, covering both the design and building of the project (construction). According to Balogun (1992), design-build is a contract in which a building contractor does some or all of the design work and produces the building very quickly, particularly if the contract is a negotiated one. Ellis (1990) pointed out that with design and construction work under one roof, the contractor's knowledge of the building process is incorporated in the design process.

Forms of suspicion are eliminated because those responsible for design-build are able to perceive themselves as members of the same team, unlike in the traditional method. In addition, the line of communication becomes short and relatively informal. Arguing the case for design-build, Titmus (1982) remarked that the traditional competitive tender process is increasingly losing favour, especially as competitors are often unequal in standing and ability, which causes the project to be eventually executed in an atmosphere of "them and us".

According to Finlay (1983), this form of project procurement may be on a fixed price or cost reimbursement basis. It may also be competitive or negotiated. Examples of such projects include factory buildings, medical clinics, and schools using a proprietary system, where benefits can be obtained. Also, where a contractor's proprietary system can be used without

detriment to the client's requirements, economic advantages stem from a modified form of design-build. Jones (1984) referred to this system as one where the designer is also the builder of a project. All these definitions can be summarized thus:

"Design-build system is when both design and construction are included in a single contract between the owner and the contractor either on a lump-sum or cost-plus basis e.g. housing and industrial constructions or an arrangement where one contracting organization takes sole responsibility, normally on a lump sum fixed price basis, for the bespoke design and construction of a client's project. The fundamentals of this procurement method are that the responsibility for design and construction lies with one organization and project carried out to meet the needs of the client".

Asides the introduction and reference sections, sub-sections are allowed as outlined here. Similarly, further sub-sections are allowed as seen below

2.2 Construction Procurement in South Africa

According to CIDB (2008), construction procurement in South Africa evolved in 1994 when the South African Ministry of Public Works identified an urgent need for public sector procurement reform as regards construction projects. After an initial review of the regulatory environment that impacted upon procurement, it was concluded that such reform could not be undertaken on a sector by sector basis since a fundamental review of the entire public sector procurement system was required.

As a result, a joint initiative was embarked upon by both the Ministries of Public Works and Finance, the outcome of which was the release of the Green Paper on Public Sector Reform in 1997. A Procurement Focus Group was established by the Inter-ministerial Task Team for Construction Industry Development in 1999, at the request of the construction industry stakeholders, in order to examine aspects of construction procurement and delivery management. In 2000, this Group recommended that a uniform and standardized procurement system be established for the construction industry. In the process of doing so, CIDB was faced with a major challenge to develop a procurement system that would:

- Be compatible with the supply chain management framework that was being established by the National Treasury in terms of the Public Finance Management Act, 1999 and the Municipal Finance Management Act, 2003;
- Serve the needs of a decentralized public procurement system in terms of which the accounting officers or accounting authorities in organs of state would be responsible for their own procurement processes, and
- Be attractive to and serve the needs of the private sector

2.3 Design-Build Practices

DBIA (2014) identified best practices of design – build that can be applied to any type of design-build project and can effect project performance as divided into three primary sections. These include the following:

A. Procuring Design-Build Services,
B. Contracting for Design-Build Services and
C. Executing the Delivery of Design-Build Projects.

A. PROCURING DESIGN-BUILD SERVICES

DBIA identified the following as three (3) best practices for owners:

(1) Conduct a proactive and objective assessment of the unique characteristics of its program/project and its organization before deciding to use design-build. (2) Implement a

procurement plan that enhances collaboration and other benefits of design-build and is in harmony with the reasons that the owner chose the design-build delivery system. (3) Use a competitive design-build procurement that seeks price and technical proposals should: (a) establish clear evaluation and selection processes; (b) ensure that the process is fair, open and transparent; and (c) value both technical concepts and price in the selection process.

B. CONTRACTING FOR DESIGN-BUILD SERVICES

DBIA identified the following as three (3) best practices:

(1) Contracts used on design-build projects should be fair, balanced and clear, and should promote the collaborative aspects inherent in the design-build process. (2) The contract between the owner and design-builder should address the unique aspects of the design-build process, including expected standards of care for design services. (3) The contracts between the design-builder and its team members should address the unique aspects of the design-build process.

C. EXECUTING THE DELIVERY OF DESIGN-BUILD PROJECTS

DBIA identified the following as four (4) best practices:

(1) All design-build team members should be educated and trained in the design-build process, and be knowledgeable of the differences between design-build and other delivery systems. (2) The project team should establish logistics and infrastructure to support integrated project delivery. (3) The project team, at the outset of the project, should establish processes to facilitate timely and effective communication, collaboration, and issue resolution. (4) The project team should focus on the design management and commissioning/turnover processes and ensure that there is alignment among the team as to how to execute these processes.

3 Research Methodology

65 questionnaires were distributed, 40 completed forms were received, representing a response rate of 62 percent. Fifteen (37.5%) were construction managers, seven (17.5%) were engineers, 13 (32.5%) were quantity surveyors, one (2.5%) civil technicians, one (2.5%) town planner, one (2.5%) building surveyor and two (2.5%) others. Unfortunately, there was no response from architects which causes the results not to reflect the latter's' opinions.

Research was carried out through the use of questionnaires in two ways:

1. Structured interviews with managers and directors of companies who are known to be stakeholders in the South African construction industry using questionnaires. These included the construction managers, quantity surveyors, project managers, engineers Interviews were conducted by running through the questionnaire and;
2. Emailing questionnaires to managers and directors of companies who were known to be stakeholders in the South African construction industry. The questionnaires were self-administered by the respondents and expected to be sent back via email.

The respondents were asked to rate the extent to which they agreed that design-build is not correctly practised in South Africa, where 1 = strongly agree/always/very good; 2 = agree/often/good; 3 = undecided/regularly/average; 4 = disagree/rarely/bad; 5 = strongly disagree/never/very bad depending on the type of question. Respondents were also invited to furnish their comments, state other design-build related problems and rate them.

This study adopted an opinion research approach to gather useful information on the design-build method. Data from the survey were first entered manually on a data sheet with coded variables. Data from the forty questionnaires were then analysed and evaluated using the Statistical Package for Social Sciences software (SPSS). A chi-square test of the mean and

Spearman's rank correlation were carried out with the help of SPSS to find out whether the stakeholders' opinions agree with the statements or not. In addition the frequency tables were computed using the SPSS and results presented using bar charts.

The major study was carried out in Gauteng Province which includes both Pretoria and Johannesburg while the remaining study took place in Kwazulu Natal and Mpumalanga Provinces. This is because the majority of construction activities are concentrated in Gauteng Province both in terms of size and complexity.

4 Findings and Discussion

The chi-square test results show that design-build contracting is not correctly practised in South Africa ($X2 = 11.4000$, $P \leq 0.05$). The results also show there is a significant level of agreement by the respondents that there is a problem in the way design-build contracting is practised in this country.

Table 1. Design-build contracting is not correctly practised in South Africa

Q2.3 (V8) Rating	Frequency	Percentage	Cumulative %	Cumulative Freq.
Strongly agree (1)	3	7.5	7.5	3
Agree (2)	10	25.0	32.5	13
Undecided (3)	18	45.0	77.5	31
Disagree (4)	9	22.5	100.0	40
Chi-square test (X^2) = 11.4000		P. value = 0.0097 ≤ 0.05		

Explaining the problem further as reflected in the frequency table (Table 1, column 2), most respondents are not sure whether design-build is correctly practised in South Africa. This can be attributed to the discussion above that the design-build method is not well understood due to late introduction of the method in South Africa and wrong perception about how its processes are carried out, see figure 1 below illustrating the frequency. A total of 18 (45%) were undecided, followed by ten (25%) in agreement, while only nine (22.5%) disagreed and the remaining three (7.5%) strongly agreed.

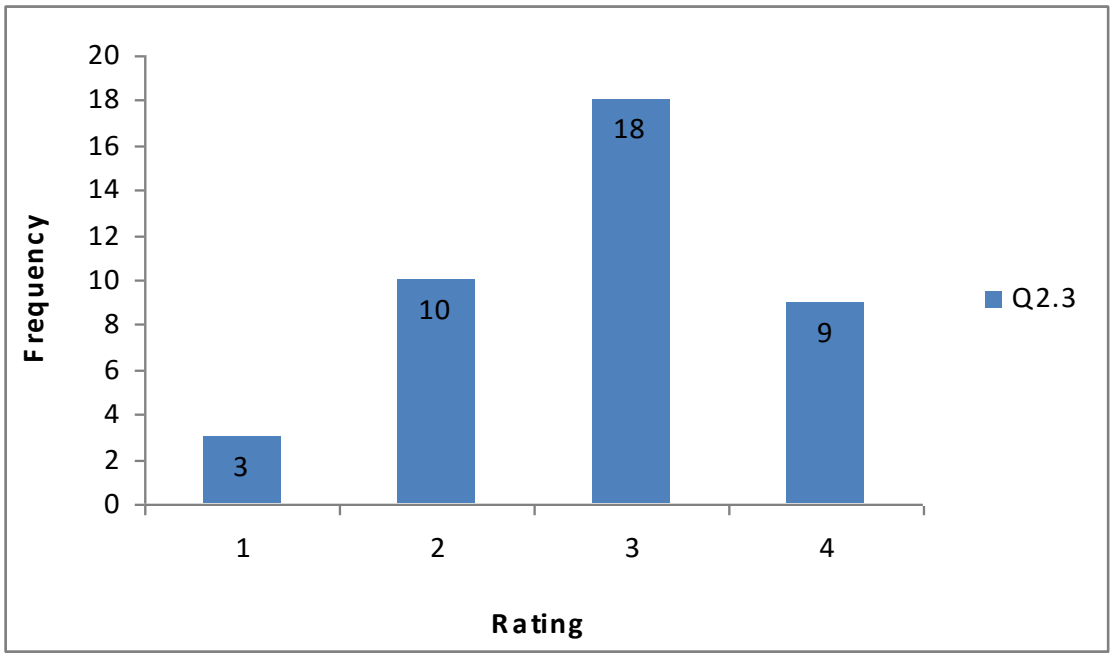

Figure 1. Frequency of responses regarding whether design-build is correctly practised in South Africa (Bar chart).

5 Conclusion and Further Research

From the findings design-build procurement method is not well practiced in South Africa. Also design-build is not well understood due to lack of experience and exposure. In order to effectively improve the practice of design-build projects in South Africa, it is recommended during implementation the clients should use a procurement process that: (a) focuses heavily on the qualifications of the design-builder and its key team members rather than price; and (b) rewards design-build teams that have a demonstrated history of successfully collaborating on design-build projects. Also the clients must identify and involve key project stakeholders at the early stages of project. All design-build team members should be educated and trained in the design-build process, and be knowledgeable of the differences between design-build and other delivery systems.

This study contains several limitations. Firstly, the responses gathered from stakeholders were based on their perceptions, which are subjective. Secondly, different respondents may hold different views on the points of the rating scale. While two respondents may have rated an answer as 3 (undecided), they may nevertheless not encounter the same level of difficulty as regards the issue identified. Lastly, the composition of the respondents did not include any architects because no responses from the questionnaire sent out stemmed from these professionals. Thus, there may be biases in the results against the architects' perception. In future, more data should be collected involving the architects and the public sector so that a more balanced comparison and conclusion can be made.

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PLANNING, HOUSING POLICY AND LOW INCOME HOUSING DEVELOPMENT IN SOUTH AFRICA

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Abstract
Since the advent of democracy in 1994, post-apartheid South Africa spatial development policies have attempted to mitigate the severe, negative effects of the apartheid settlement patterns and to create more compact, efficient and sustainable settlements. As the government attempts to redress the legacy of apartheid, low cost housing provision remains its major focus. The White Paper on Housing of 1994 prioritised the needs of the poor, encouraged community participation and the involvement of the private sector. Since the inception of the White Paper several policies, programmes and legislation followed. However, two decades after the inception of such policies and significant levels of public and private sector investments, the South African low income housing landscape remains unchanged. Planning systems set rules and guidelines to control the supply and location of land usable for a full set of legally defined purposes independently of price and so influence the level, location and pattern of development activity. Using a literature survey, the aim of this paper is to examine the relationship between planning and low income housing development in South Africa, investigate the extent to which the planning system is aligned to the low income housing policies and evaluating whether planning regulations enable or constrain the provision of low income.

Keywords: Spatial planning, Low income housing development, Housing policy

1 Introduction

The impact of public policy on land and property markets is the subject of much interest and research. White and Allmendinger (2003) assert that many aspects of fiscal and regulatory policy impinge upon and affect markets in property and housing. However, it is the planning system in its various guises that has the most significant impact. While spatial planning is concerned with coordinating and guiding land uses and linkages between them, to balance demands for development with the need to protect the environment and to achieve social and economic development objectives, land use management is a regulatory mechanism which aims to increase the efficiency of the use of land and to ensure greater equity in that use (*Evans, 2004* in Whitehead, 2006). According to Cheshire *et al*. (2002), planning systems set rules and guidelines that control the supply and location of land usable for a full set of legally defined purposes independently of price and so influence the level, location and pattern of activity. The ultimate role of planning is to promote a balance of environmental, social and economic welfare that meets the needs of current and future generations. According to Beer *et al*. (2007), planning as a form of regulation has been seen to occupy an equivocal position with respect to housing affordability in Australia. Planning can be seen to restrict the supply of land for residential development and impose additional costs on developers, at the same time planning bonuses and similar tools are considered potentially valuable in meeting the housing needs of low

income households. Adams & Watkins, 2002 and Whitehead (2006), attested to the idea that planning constraints impact on different groups of actors including developers, existing landowners and new purchasers since they lead to higher prices, densities, restrictions in the quantity of homes supplied and convergence in the type and design of homes.

According to Musvoto (2011), in the South African context, unsustainable and inefficient patterns of apartheid era planning persist for more than 20 years into the post-apartheid settlements. Compounding this situation are new, unsustainable emerging trends such as the continuing peripheral location of mono-functional low income housing developments (Musvoto, 2011). Although the planning system has remained largely unchanged for more than 20 years, attempts have been made through the Development Facilitation Act (DFA) and other planning policies to restructure the segregated cities. Huchzermeyer (2003) argues that the reason why segregated dormitory developments have prevailed since 1994 despite the vision and integrated planning tools was the neo-liberal and Marxist perspectives that cities and their residential component are shaped by the way they are financed.

As noted by various authors, the South African housing landscape is marred by a massive backlog of about 2.1 million houses, the low income housing units are poorly built (40 000 units have poor workmanship), located at the periphery of towns far away from amenities, thereby intensifying urban sprawl and increasing the daily reproductive costs of the poor (Newton and Schuermans, 2013; Seekings, 2000; Jenkins, 1999). The apparent reasons for this as noted in Venter *et al*. (2004) include greater affordability of land on the urban periphery as opposed to expensive land in the more central areas, coupled with insufficient subsidy amounts to build at higher densities to offset the higher land costs. The debate on combating urban sprawl has been highly supported by various policies in South Africa as it makes the core principles of the DFA which was intended to guide all the all physical planning and development and are embedded in the White Paper on Urban Development (1997), the Breaking New Ground policy of 2004, the Inclusionary Housing Policy of 2007, and the Spatial Planning Land use Management Act of 2013. Todes (2003) highlights that emphasis on restructuring away from an apartheid urban form and on creating more integrated cities has meant that the location and form of housing for low income households is a key concern, as such, the urban form of cities is continuously being challenged by urbanisation.

As the Government attempts to redress the legacy of apartheid, low income housing provision remains its major focus. The aim of the White Paper on Housing (1994) was to "*create viable, integrated settlements where households could access opportunities, infrastructure and services...*" Besides the focus on the budgets, subsidies and other institutional arrangements, the White Paper on Housing focused on land and planning issues as they impacted housing delivery. It clearly states that, "*The historical and existing patterns of land use and allocation as well as the legislative framework associated to land, provides an immense challenge and constraint. A fundamental approach will be required to make the housing programme a sustainable reality".* In this instance, the White Paper acknowledged the dysfunctional human settlements that were inherited from the apartheid era. These are still the same issues that are the cause of criticism in today`s low income housing settlements. According to Berrisford (2011), despite a widely acknowledged causation between old planning laws and the spatial legacy of apartheid, South Africa has been unable to effect major changes to the legal frameworks governing land use and land development. Until 2013, when the Spatial Planning and Land use Management Act, 2013 (Act 16 of 2013) was promulgated, the same laws that were used to implement apartheid`s segregation and inequality policies remained in use, with the exception of the Development Facilitation Act, 1995 (Act 67 of 1995) which was an interim law to speed up development with low income housing development in mind, until its demise in 2010, when most of its chapters were declared unconstitutional. This implies that some of

the problems associated with low income housing delivery in South Africa are linked to spatial planning and land use management.

While this paper examines the relationship between spatial planning and low income housing development in South Africa, it investigates the extent to which the South African planning system is aligned to low income housing policies, in the process giving a perspective on whether planning regulations enable or constrain the provision of low income housing from a theoretical perspective. It will be presented in 6 Sections. The second section discusses the evolution of post-apartheid housing and planning policy intervention. This is followed by the review of international literature on housing and planning in practice in Section 3. Section 4 presents the impact of planning on low income housing development in South Africa. This is followed by the gaps in literature and implications of the research in Section 5 and the conclusion in Section 6.

2 The Evolution of Post-apartheid Housing and Planning Policy Intervention

2.1 White Paper on Housing (2004)

The promulgation of the White Paper on housing in 1994 set the pace for all the housing policies, legislation and programmes that followed. According to Jenkins (1999), the White Paper on Housing of 1994 prioritised the needs of the poor, encouraged community participation and the involvement of the private sector to deliver 1 million houses in 5 years. While it incorporated the principles of spatial planning concepts such as compact cities, densification and unification of the urban fabric as highlighted in Restructuring Development Programme (RDP), the White Paper focussed on issues of budgets, subsidies and other institutional arrangements as well as the land and planning issues as they impacted on the delivery of housing. It highlighted the challenges associated with land and planning issues. As noted earlier, the White Paper acknowledged the dysfunctional human settlements that were inherited from the apartheid era which led to issues such as high rates of urbanisation, inefficient and inequitable cities marred with urban sprawl and dispersed rural settlement structures hampering service delivery, accessibility and there was a lack of a housing strategy defining the roles and responsibilities of all role players. One of the goals of the policy was to replace the land use and spatial planning system with a new approach and legislation that acknowledged the scarcity of land in the Republic, promoted higher densities and encouraged planning techniques that enabled social cohesion and had an impact on costs and efficient resource utilisation (water and energy).

2.2 Development Facilitation Act, 1995 (Act 67 of 1995)

According to Du Plessis (2013), the Development Facilitation Act, 1995 (Act 67 of 1995) (DFA) through its provision for the preparation of Land Development Objectives, represented the first step to a new spatial planning framework. Furthermore, the DFA provided for far reaching set of general principles for land development (the DFA Principles), the establishment of a development and planning commission and the establishment of one development tribunal for each province (Berrisford, 2011). These principles provided the legal source to guide post-apartheid spatial planning and were factored in all planning and land development decisions whether taken under the DFA or any other legislation (Du Plessis, 2013; Berrisford, 2011).

2.3 GEAR (1996) and ASGISA (2006)

The economic related policies such as the Growth, Employment and Redistribution Programme (GEAR) in 1996 and the Accelerated and Shared Growth Initiative for South Africa in 2006 identified planning and land use management as key areas requiring institutional reform, with

great emphasis on integrated planning and service delivery by all spheres of government (Harrison *et al.* 2008). Integrated Development Planning Process had to include a Spatial Development Framework (SDF) in each municipal IDP. Furthermore, important initiatives in planning arena included the adoption of the White Paper on Spatial Planning and Land Use Management of 2001, which proposed a much stronger role for national legislation rationalising the provincial laws into one uniform set of national rules and procedures (Berrisford, 2011).

2.4 Breaking New Ground (2004)

Despite all the well-intended measures, the inequalities and inefficiencies of the apartheid space economy had lingered on. This led to the shift from developer to municipal oriented development through the birth of the Breaking New Ground Policy of 2004 (BNG). Based on the principles of the White Paper on Housing (1994), BNG was not introducing a new policy direction but merely emphasizing and outlining a comprehensive plan for the development of sustainable human settlements (Charlton and Kihato, 2006). According to Sishaka (2011), the policy substantially increased emphasis on the role of the State in determining the location and nature of housing as part of a plan to link the demand for and supply of housing. It also envisaged that municipalities would assume a greater responsibility for housing programmes in their areas of jurisdiction. Key elements of the BNG included (i) pursuing a more compact urban form through the introduction of fiscal incentives to promote the densification of targeted human settlements while introducing disincentives to sprawl, (ii) facilitating higher densities by investigating aspects of promoting densification such as planning guidelines, property taxation, zoning, subdivision, land swaps and consolidation as well as drafting a densification policy, (iii) mixed land use development, and (iv) integrating land use and public transport planning, so as to ensure more diverse and responsive environments whilst reducing travelling distances. The National Spatial Development Perspective (NSDP) and the draft National Urban Strategy were adopted to implement the elements of the BNG.

2.5 Inclusionary Housing Policy

A Social Contract for Rapid Housing Delivery which stated that, "every commercial development including housing developments that are not directed at those earning R1500 or less, spend a minimum of 20% of project value on the construction of affordable housing" was forged between the government and the private sector. This led to the 2007 Framework for Inclusionary Housing Policy (IHP) which aims to achieve a "more balanced outcome of the built environment creation in the direction of a more racially integrated and income inclusive residential environments (Tissington, 2011).With the Town Planning Compliant component, the IHP aimed to ensure that the rapid housing delivery of affordable housing was set off using mandatory requirements and process of land use planning and development such as township establishment procedures, zoning and rezoning development approvals in return for incentives such as density bonuses, allowance for multi-storey units, some commercial rights and public investment in bulk and connector infrastructure. According to Tissington (2011), the inclusionary housing policy has been implemented in metropolitan municipalities like Johannesburg (Cosmo City and Brickfield) and Cape Town (N2 Gateway). Other municipalities have been lagging behind due to a lack of capacity to implement such a complex policy. However, its impact on urban integration and inclusion has remained negligible.

2.6 The National Housing Code (2009) and Outcome 8 (2010)

The National Housing Code of 2000, revised in 2009, seeks to improve the coordination and alignment between different planning instruments and economic policies; emphasizing on the need to develop a single planning authority or instrument in order to provide macro level

guidance on the development of sustainable human settlements. The government launched "Outcome 8" in 2010 which aimed to deliver 400,000 upgraded units in informal settlements by 2014 principally by scaling up and reinvigorating existing upgrade programmes (Patel, 2015). It consolidates the policy shift in the revised Housing Code to a focus on informal settlement upgrading and supporting the market to develop affordable housing. With 4 outputs, it reiterates the need for a proper functioning of the land use management system to improve development and zoning processes and systems by fast tracking the development of a new comprehensive land use development and management legislation.

In an attempt to implement the outputs of "Outcome 8", the government promulgated the Spatial Planning and Land use Management Act, 2013 (Act 16 of 2013) (SPLUMA) after chapters of the DFA were declared unconstitutional and repealed in 2010. Its main objective is to provide a uniform, effective and comprehensive system of spatial planning and land use management. It sets a legal obligation for SDFs to provide an estimation of the housing needs and identification of the planned locations and densities of future housing (Section 21*(b)* and *(c)*). A land use scheme must give effect to and be consistent with the SDF and determine the use and development of land within the municipal area. Housing (and its location) is no longer simply a concern of the housing department, as it will be included as part of the municipality's spatial planning framework (Denoon-Stevens, 2014).

In terms of aligning the housing and spatial planning policies, the DFA was the only post-apartheid legislation that dealt with spatial development principles and provided a land use mechanism; yet, all the housing policies emphasized the importance of spatial planning in the delivery of low income housing. The Housing Act and the housing code stipulated that housing should form an integral part of the IDP at municipal planning level. The link between SDFs and the housing chapter in IDPs has been investigated by Graham *et al.* (2014) in the assessment of whether the existing municipal framework facilitates or hinders integrated planning for sustainable human settlements. Drawing from the case studies of Johannesburg, Buffalo City and EThekwini, Graham *et al., (*2014) concluded that cities have achieved a level of integration in the long term vision and to a large extent, in the IDP that synthesises the various sector plans into an overall strategy. However, sector plans are still drawn up independently, and the level of integration is determined by the degree to which municipal departments' liaise with each other. This implies that there are still serious concerns about the alignment of spatial and housing policies. This maybe in vigour of the housing programmes relative to the sluggish planning framework (Charlton and Kihato, 2006) or in the amount of effort required to translate policy sentiments into specific realisable projects (Charlton, 2003).

3 Housing and Planning in Practice: An International Perspective

According to Adams and Tiesdell (2010), the impact of spatial planning is direct in the property development market but indirect in the user and investment markets. This impact operates through three types of policy instruments, intended respectively to shape, regulate and stimulate. Furthermore, the economic interpretations of relations between planning policy and property markets can be viewed through neoclassical economics which asks how far planning policy directly affects the overall quantity of market supply and demand, while welfare economics concentrates on the extent to which planning policy is able to overcome market failure, and new institutional economics focussing on its capacity to reduce (or indeed increase) market transaction costs. In each of these approaches, the market is essentially viewed as dichotomous to planning: open, of course, to influence, but characterised by the unfamiliar terrain of profit-driven behaviour. This implies that any planning system has both benefits and costs. There are direct costs and indirect costs. The direct costs arise from the application of a complex system but more importantly from the costs falling on the private sector in order to comply with the system (Cheshire *et al.*, 2012). The indirect costs arise from the higher costs

of space brought about by the constraint on its supply, and the controls imposed on the choice of location. It is this direct view of costs that planners have that causes a lot of spinoffs in the property industry.

3.1 Availability of land for housing

Internationally, much attention has been paid to the extent to which planning policies make land and property more expensive through constraining supply. Cheshire and Sheppard, 1989; Adams and Watkins, 2002; Meen, 2005 covered the UK, while Maclennan and others (1998) several European countries and Glaeser and Gyourko (2003) the United States. For instance, Glaeser and Gyourko's work was the first where the data permitted fully specified hedonic models to estimate the effects of regulations on the value customers place on the underlying land. Similar, if not less, robust quantitative results on the effect of policy on housing have also been obtained for developing countries. For example, Malpezzi and Mayo (1997) used a simple regression model to compare housing supply elasticises in the Republic of Korea, Malaysia and Thailand to show how various public interventions constrain supply elasticity especially in the Malaysian housing market. They found that interventions such as the provision of publicly constructed housing and inappropriate building and land use standards, cause supply to be considerably less elastic. According to Baken and Van der Linden (1993) in Buckley and Kalarickal (2005), the study ignored political and cultural frameworks within which land markets function. This implies that supply inelasticity is not only caused by the regulations but by the broader policy framework that governs land supply. Buckley and Kalarickal (2005), further argue that the effects of housing policy on the supply of housing has provided empirical support for the view that housing the public sector enable rather than control or displace the private sector. This is essential to improve the affordability of housing in general.

3.2 Affordability

Bramley (1993) argues that the absence of planning cannot solve all the problems of housing supply, even theoretically because housing supply would not be completely elastic. Planning in practice can be quite responsive to the market. For instance, Whitehead (2006) investigates the use of land use planning in providing affordable housing in England. She pointed out that policies to address the issues of how to ensure affordable housing for particular groups arising from the misadministration of income within a market framework include income supplements, targeted price reductions or regulatory mechanism that separates the housing market into two or more segments. Furthermore, land use planning can be used in principle to achieve the goal of lower house prices overall by enabling more land to be provided by using the zoning system which states that particular areas are designated for housing. However, Bramley (1993) highlights concerns about speculative withholding of land by private owners or developers as an issue to the development process.

In investigating the relationship between land use regulation and residential construction, Mayer and Sommerville (2000) characterised regulations either as adding explicit cost, uncertainty or delays to the development process. Using data from 44 United States metropolitan areas, they found that the land use regulations lower the steady state of new construction and the regulations that lengthen the development process or otherwise constrain new development have larger and more significant effects. Cheshire and Sheppard (1989) applied a sophisticated intra-urban model to measure the impact of planning controls and planned amenity provision in a limited number of cities. They concluded that British planning control, by containing urban extension, tends to increase house prices moderately but has its main (adverse) welfare impact in the form of increasing densities and house-type mix. These conclusions are consistent with the qualitative observations of Evans (1991) concerning the

type of housing produced under the relatively tight planning regime which is characteristic of southern England.

4 Impact of Planning on Low Income Housing Development in South Africa

4.1 Constraint to the ability of the poor to acquire and develop land

In investigating the challenges faced by the poor in accessing land and housing, Berrisford *et al.* (2008) cited the inconsistent or inadequate policies and legislation, confusion between myriad agencies involved, lack of clarity over responsibilities and accountability, lack of capacity of the implementing agencies, the rising costs and delays in accessing building materials, corruption and a lack of training for both government officials and housing hopefuls as major challenges experienced in Ethembalethu, Mogale City. Furthermore, they concluded that planning implementation systems are extremely complex and laden with transaction costs, for instance the township establishment process runs parallel to the Environmental Impact Assessment (EIA) process, stifling the capacity of all actors and constraining the ability of the poor to acquire and develop land. Consistent are the conclusions of Kitchin and Ovens (2013) who pointed out the increase in construction and handling costs due to the delays in the application and approval delays. Oranje *et al.* (2010) investigated the perceptions and everyday experiences of developers and municipalities around urban land development. The general perception of the developers in the case study was the cost implications associated with bureaucratic delays.

Kihato and Berrisford (2006) examined the role of regulatory frameworks in the management of urban land in South Africa and how it influences access to land among the urban poor. They cited that regulatory frameworks are intended to protect and enhance an investment, for instance zoning and other regulations that prevent uses of land that negatively affect property values. Furthermore, regulatory laws are too technocratic and highly procedural thereby hindering the activities on land like densification. Also consistent are the conclusions of Rubin (2008) in his study of the contemporary land use management systems and their operation at both policy and practical level who concluded that the existing planning schemes, zonings and the cadastral system are in many ways exclusive of the needs of low-income households and communities and seem to result in the disempowerment and alienation of those that they intend to include and empower. By initiating a search for an appropriate criterion for land use management system in South Africa, Görgens and Denoon-Stevens (2012) characterised the traditional land use management system as zoning emphatic and argue for a more flexible system that responds to the dynamics of the urban land market and directly addresses the needs of the poor.

4.2 Affordability

Zille *et al*. (2008) conducted a qualitative analysis on the dynamics of urban land markets in South Africa. They argue that restrictive town planning regulations and an inflexible institutional environment limit the supply of land, increases development risk, raises the price of land and therefore impacts on development activity. They further argue that planning regulations alter land prices, for instance, a decision by public authorities to bring public land to the market may also alter land availability and price of land- as supply increases, so the price will drop. Napier *et al.* (2007) discusses the balance between state allocation of urban land and market distribution of land as a resource. He noted that the outcome of the distortions is that house prices at the upper end of the market have seen unprecedented growth, while low income house owners have not benefited from the same growth. This implies that while there is little research on the tradable values of subsidised housing, it is widely understood that there has

been substantial depreciation in formal sales. It is clear that the house prices in low income housing developments are not at par with their counterparts in affluent areas because of the location, neighbourhood influences and access to bank loans. Low income housing developments are stagnant, non-active housing markets where investors make losses, getting no return for their investments. These problems having been created partially by planning mechanisms and can be addressed by proper planning. It is at this stage that Adams & Tiesdell (2010)'s call for planners to see themselves as market actors intricately involved in framing and reframing local and property markets, hence operating as a significant constitutive element of such markets becomes relevant.

5 Gaps in the Literature and Implications for Research

In the literature review, housing policies (BNG, IHP, and housing code) highlighted the importance of spatial planning in the delivery of low income housing and the need to incorporate the housing chapter in the municipal IDPs in a bid to align housing delivery and spatial planning. None of these studies have followed up on the link between housing policies and spatial planning, whether the spatial planning aspects highlighted in the housing policies have been incorporated in the planning tools and used in practice.

The Inclusionary Housing Policy introduced the use of incentives such as density bonuses and allowance for multi storey units to ensure the rapid delivery of affordable houses. There is need for further research in incorporating the housing concepts highlighted in the BNG and IHP into the land use management tools such as integrated development plans, spatial development frameworks and zoning schemes in order to develop a framework to deliver low income housing through the planning system.

6 Conclusion

The aim of the paper is to examine the relationship between planning and low income housing development in South Africa, investigate the extent to which the planning system is aligned to the low income housing policies and evaluating whether planning regulations enable or constrain the provision of low income housing. The study concludes there is relationship between planning and the availability and affordability of housing yet such relationship has not been well articulated in low income housing developments. However, the complex approach to housing delivery relies on the implementation of policy and legislative frameworks for both planning and housing across different spheres of government. Moreover both housing and planning officials should be empowered to handle the planning and delivery of housing in a holistic manner.

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