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JOURNAL OF AFRICAN REAL ESTATE RESEARCH ● Volume One 2014

Analysing Option Values to Delay Development of Land in Windhoek, Namibia

Residential Satisfaction in Southern Johannesburg, South Africa

Exploring the Impact of Personal Connections and Selected Individual Factors on the Ethical Judgment and Behavioural Intentions of Nigerian Estate Surveyors and Valuers

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Editorial

Welcome to the first issue of the 2014 edition of the Journal of African Real Estate Research.

The good news is that we have finally set up a formal production process to support an editorial process that is fully sanctioned by AfRES. Our thanks goes to Mr Mark Pettipher and his team at MPDPS (Pty) Limited from Cape Town for partnering with AfRES to get this project off the ground. We are also grateful to the executive board of IRES and, in particular, the tireless efforts of Karen Gibler, in financially supporting the journal and allowing it to become a stable source of high-quality research that originates in Africa. Last year's successful conference and this year's conference should provide a good source from which another 2014 issue can be produced. AfRES still faces the challenge of attracting seasoned academics to its events, and of positioning the journal as the medium of choice for good papers on the same level as other journals. The way we plan to meet these challenges is by ensuring a quick turnaround time for submissions and by constituting an expanded team of reviewers of international repute to supplement the selfless efforts of the current team.

The first paper by Nalumino Akakandelwa (formerly of Wits University) focuses on some of the uncertainties surrounding the current costs of holding on to vacant land and the potential future benefits of delaying a development project in Windhoek, Namibia. A practical benefit of this paper is to introduce practitioners to the options embedded in development opportunities to increase the degree of sophistication of their decision-making processes.

The second paper by Abel Olaleye, Oluseyi Adegoke and F. M. Araloyin from Obafemi Awolowo University introduces an issue that gradually fell off the radar in education and practice, with devastating consequences for everyone: ethical decision-making. The results of their study are equally worrying: those most highly educated in the real estate profession in the Nigerian context (with professional certification) are more likely to develop unethical behavioural intentions, which runs against the stated goals of any professional certification process. It may also provide indirect evidence that the way ethics is taught during the certification process needs to be revised. In addition, our degree programmes need to increase the ethical dimensions of professional practice in different contexts. This process needs to emphasise not only the consequences of unethical behaviour but also the advantages of ethical business practice.

The third paper by Roby Simons (CSU, Ohio), Aly Karam (Wits University) and Jing Wu (CSU, Ohio) evaluates residential satisfaction in Southern Johannesburg. One value of this paper is that developers can use it as a guide to increase the attractiveness of existing or new residential developments in similar neighbourhoods. It also provides a guide on how to direct public investment designed to address the ills of the past in these neighbourhoods.

A critical part of investment decision-making in real estate is the feasibility study. This is the subject of the fourth paper by Olaleye, Adegoke and Araloyin of Obafemi Awolowo University. It highlights one of the consequences of lack of quality data on the development of viable commercial real estate markets. Since the feasibility models are "black boxes", the outcome depends on the quality of inputs used and the capacity of the analyst in correctly interpreting the data available. A lack of knowledge on the part of users (investors) does not help the situation. This paper only highlights the need to professionalise the production of real estate market data – and Lagos is a big enough market for this to happen.

The final paper, by Felicia Akinyemi, illustrates how the above could be done using geographic information systems, pointing the way forward to accelerating the development of commercial real estate markets in different African cities.

Samuel Azasu

EDITORIAL POLICY AND SUBMISSION GUIDELINES

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Purpose and scope of the journal

The journal aims to grow into becoming the best source of research on African real estate, providing high-quality research papers to academics and practitioners alike. The journal is broad in the scope of subjects it covers. Topics relating to land markets, valuation, property and asset management, real estate development, real estate finance, corporate real estate, facilities management, real estate company management and real estate education (all in an African context) will be considered.

Review of articles

Each submission will first be reviewed by the editor for suitability.

Once the editor approves a paper, it will then assigned anonymously by the editor to two specialist referees. These referees will submit a detailed report regarding whether the paper should be published in its current form, revised or rejected.

Under normal circumstances, referees would be required to submit their reports within four weeks; the turn-around time for papers is approximately six weeks. However, this may not be the case if a referee declines to review a particular paper and the editor finds it difficult to identify a replacement reviewer.

To facilitate the refereeing process and communication, email is the preferred procedure for submission of papers. The manuscripts have to conform to the prescribed format, which can be found by consulting the Emerald Guide for African Authors online. Each issue will attempt to reflect a diversity of property topics. The final decision on the content of specific issues will be made by the editor and his assistant.

One issue per year may be devoted to a special topic, with a guest editor appointed. Special issue topics will be determined by the editorial board and announced with sufficient lead-time.

Analysing Option Values to Delay Development of Land in Windhoek, Namibia

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Abstract

Real estate contributes a substantial portion of the gross fixed capital formation of an economy. However, it is susceptible to volatilities in land and development costs as well as the value of completed developments. Developers often face the challenge of timing the acquisition of land and executing the development. They have to compare the holding cost of not developing the land with the benefit of delaying the development of the project. Real option reflects the entrepreneurial view of an investor of a project development's flexibility and growth options, and the active decisions embedded in a project, rather than the traditional space, money and time triangle. By synthesising the characteristics of options attached to an investment opportunity, it is possible to establish the inherent options value in an investment opportunity. The objective of this paper is to establish option values in delaying development of acquired vacant commercial land in Windhoek, Namibia. The City of Windhoek municipality offers vacant development land for sale using open bidding for residential plots and sealed tender for commercial plots. Since bidders are not aware of the upset price and competing bids, it can be assumed that they act independently and base their bid prices on the inherent option value of the investment opportunities in the plots. The purpose of this paper is to elaborate the real option concepts and demonstrate their application in practice, contributing to enhancing real estate practitioners' critical thinking ability that will enable them to determine the timing and level of development that can be undertaken under given circumstances. Using data from the period 2008/2009 for 2010, we examine the option to delay in four suburbs in Windhoek, and consider densities of one dwelling per 200m², and one dwelling per 350m². We find real option value to delay at 1/200 density in one of the four suburbs and in three out of four suburbs at 1/350. We further establish that real option approaches can be used to estimate residual land values to inform developers about the timing of acquiring land before development becomes optimally viable. Lastly, the approach should be used only when it is justifiable to do so.

Keywords
real option, option to delay, vacant land development, timing, intensity, residual value

1. Introduction

Timing land development to maximise benefits to the investor can pose a challenge. The residual method has been the standard approach to valuing development land, but it is not capable of highlighting the benefits of executing the development at a particular time in future other than now. The real option approach recognises the entrepreneurial value inherent in the investor's perspective of the project.

For development land, option analysis informs a decision to buy land now and develop it immediately, or hold it for future development by quantifying the opportunity cost of a given choice.

From time to time, the City of Windhoek offers vacant development land for sale by auction through open tendering for residential land, and sealed tendering for commercial land.

We focus on commercial development land because we assume the bid price reflects the bidder's intrinsic value and is not a "hostile" price to secure the land. Between 2005 and 2010, there were two auctions of commercial land in Windhoek. Ninety-four and 53 plots were auctioned in September 2007 and July 2009 respectively in various suburbs.

We examine commercial land for town house development in four suburbs, namely Kleine Windhoek, Eros, Olympia and Kleine Kuppe, at densities of one dwelling per 200m² and 350m². By synthesising the characteristics of options attached to the investment opportunities in the development land, we seek to establish the value of inherent options attached to the investment opportunities.

2. Real Options in Real Estate Development

Real estate development accounts for a substantial contribution to gross fixed capital formation of an economy. It creates space that contributes as a factor of production to the generation of gross national income. Real estate development is, however, susceptible to volatilities, from demand for space to economic activity and the role of technology in commerce in the user market. It is directly affected by the vibrancy of the investment asset market.

The trend in asset prices derived in the investment market is crucial to timing real estate development. Development takes place when the asset market offers a higher price than the development cost, that is, when there is a payoff. Asset prices are subject to volatilities in rental levels as well as in asset yields. Development costs are influenced by ebbs and flows in land prices and construction costs. Traditional appraisal methods epitomise the inherent risk of these volatilities in a discount rate. However, they do not quantify the entrepreneurial flexibility to decide when or when not to exercise an option to develop, wait on or abandon a project. For vacant land, the option to develop or wait hinges on a comparison between construction and land costs with the value of the completed development.

Development takes place when the developer, believing they have sufficient information to justify the decision, expects to maximise the benefits over costs. The developer has to consider whether to develop the land now and forego the flexibility to exercise the option in future, or incur holding costs till the development is executed and completed at a future date, at which time the price could be more rewarding than now. Parthasarathy and Madhumathi (2010) acknowledge that there is no time limit for implementing a development project, but [that] it would be useful to know whether or not to delay a project till market prices are favourable. Development is targeted at the optimal time when there is a payoff to the developer in the development market, and investors in the asset market are indifferent between real estate and risk-free investments. Real option analysis quantifies the implications of choices made in view of flexibility to incorporate new information in future arising from these choices.

In principle, an option is a special contractual agreement giving the owner the right – but not an obligation – to buy or sell an asset at a fixed price at any time on or before a given date (Rubinstein and Leland, 1981).

It is a financial concept that seeks to quantify the opportunity cost of not exercising a right now but in future in anticipation of an in-the-money position. Investors intuitively understand that market valuations reflect a combination of known benefits and potential opportunities besieged by uncertainty. The stochastic behaviour of the underlying asset value creates a probable upside gain or downside loss. What managers require is an appropriate tool that will distinguish the contribution of luck from that of foresight and strategic decisions (Amram and Kulatilaka, 1999).

3. Determinants of Call Option Value

The real option value to delay a project is the payoff at a given point in time in future, in view of the market of the asset exceeding the holding and development costs. The optimal time when the option should be exercised is when the hurdle price is achieved. This is the point for the first time that the market value is higher than the development cost, including land holding costs (Patel *et al.*, 2005).

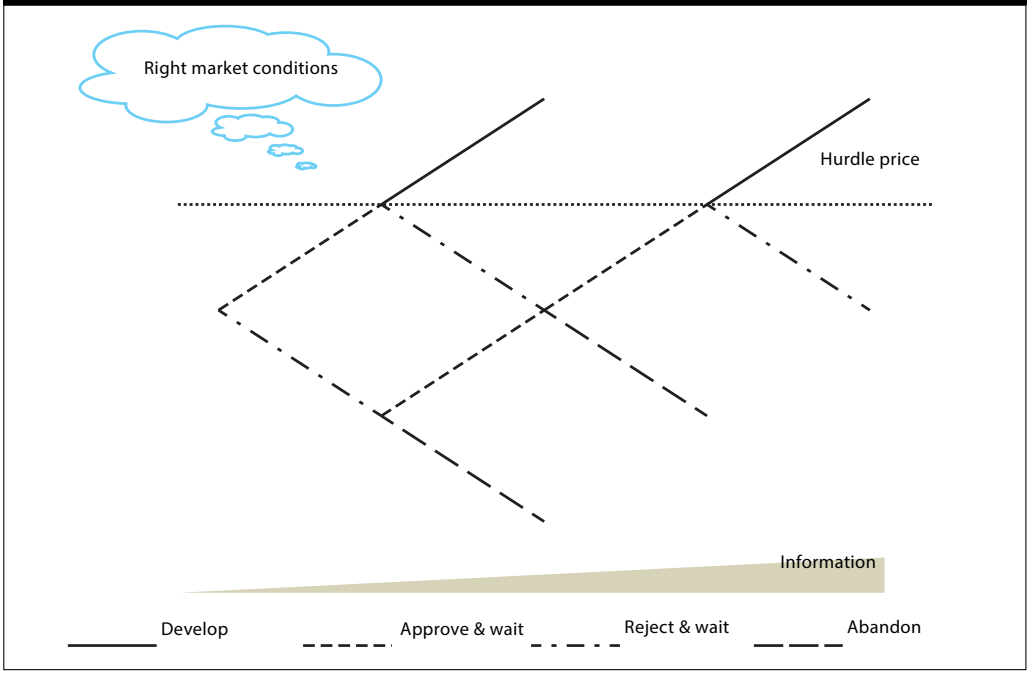
Real option in real estate development is similar to the US call option, which can be exercised at any time on or before the expiration date. The factors that determine a call's value are twofold, namely those that define the option contract, and those that concern characteristics of the underlying asset and the market (Rubinstein and Leland, 1981). The real option approach applies the financial option theory to real [physical, non-financial] investments such as manufacturing plants and R&D investments (Mauboussin, 1999). It provides a learning process that enables management to make better strategic decisions when a threshold of uncertainty is overcome through the passage of time (Mun, 2006). The theory is concerned with the effects of current uncertainty on investment. The uncertainty creates option value, hence managers should welcome and not fear it (Amram and Kulatilaka, 1999).

When there is uncertainty on the supply side there is delay in investment, and a higher asset

value could be achieved on the demand side (Yamazaki, 2000). Investment valuation based on option pricing theory thus recognises the uncertainty explicitly in terms of its source, trend and evolution (Amram and Kulatilaka, 1999). It quantifies the entrepreneurial flexibility to take advantage of the uncertainty (Lucius, 2001), to create, execute and abandon strategic and flexible options (Mun, 2006). Figure 1 below illustrates the possible options that can be taken at various points in time as more information is acquired.

Investment in development land is much like a call option – a right but not an obligation to develop a complete building at a future date (Ott, 2002; Lucius, 2001). The source of vacant land value derives from the right, but not the obligation, to develop the underlying asset – a complete building – by paying the relevant exercise price-cost of construction (Lucius, 2001).

Figure 1: Strategic investment decision-making



4. Characteristic of Real Options

Real options view real estate not only as a tripartite phenomenon of space, money and time, but further as an outcome of discerning choices made by integrating entrepreneurial flexibility into the space-money-time triangle (Lucius, 2001).

Unlike the neo-classical theory that assumes a homogeneous traded asset, ignores effects of idiosyncratic risk, and only takes systematic risk on the demand side, real options acknowledge the heterogeneous characteristic of real estate such as indivisibility, as well as fixity of location and income. They focus on specific investments and not the general market (Yamazaki, 2001), and admit that trigger prices and payoffs are non-linear, so aggregate investment studies may obscure these relationships (Bulan *et al.*, 2008; Amram and Kulatilaka, 1999).

The prerequisites of real option theory are perfect replication, irreversibility, uncertainty and existence of option (Yamazaki, 2001; Lucius, 2001). Heterogeneity and limited substitutability render real estate to seemingly fail to fulfil the perfect replication prerequisite. However, the combination of site and estate interpreted as an asset (Guntermann, 1994) with a risk-free asset allows for the construction of a duplicate portfolio that fulfils the perfect replication requisite.

Under the real options approach, a higher user cost should be applied to new investments in irreversible assets because the option to delay is lost when investment occurs (Pindyck, 1991; Bulan *et al.*, 2008). Irreversibility is a particular exception to real estate. Irreversibility may arise when resources are industry-specific and cannot be effectively productive if used elsewhere (Pindyck, 1991).

The standard irreversibility theory proposes that options are valuable when we cannot predict with certainty the changes in future events that could influence the decision to execute a development decision (Sing, 2001). Real estate development is essentially irreversible because construction extinguishes the delay option (Yamazaki, 2001). Duration of the development process and life cycle further complicates the prediction of value determining influences (Lucius, 2001). Uncertainty delays investment and may raise land prices above the discounted stream of rents in its current use (Moreno *et al.*, 2009).

Thus real estate has the potential to have real option value. However, not all opportunities have option value. The combination of asset value uncertainty, irreversible development and the flexibility to wait suggests development of land will not occur until the value of the completed property exceeds the cost of construction by a "waiting-time" option premium (Lucius, 2001; Patel *et al.*, 2005). Real option should be used only when there is a contingent investment decision, the uncertainty is large enough to justify waiting for information and make flexibility a consideration, and value hinges more on future growth than current cash flow (Amram and Kulatilaka, 1999).

5. Fundamentals of Call Option Valuation

To demonstrate how option pricing works, one can assume an asset with a known current price, but whose price may increase or decrease at the end of the year. An investor has two possibilities, namely either to buy a call on the asset or buy a portion of the asset using own resources and borrow a duplicating amount (that is, the amount necessary to make future payoffs from the "buy and borrow" the same as those from "buy a call" on the asset). Given that the project is currently priced at N$130/m^2, and the price at the end of the year may be either N$150/m^2 or N$110/m^2, an investor may buy a call at an exercise price of N$130/m^2, or buy the project now financed by 50% of end price from own resources and borrow the duplicating amount to equate the "buy a call" payoff. The investor can borrow at 10%p.a.

Δb is the proportion of the price the investors will buy with own resources; S_0 is the current asset price; S_u is the asset price on the expiration date; and Se is the call option exercise price. i is the interest rate on borrowed funds and n is the time to expiration. The future payoff structure of a call is duplicated by a "buy and borrow" option, and since, from the market point of view, the

Table 1: Investment strategies to replicate payoff

		If asset price is N$150/m^2	Cash flow	If asset price is N$110/m^2	Cash flow
Option 1	Buy call option	1*(N$150 - N$130)	N$20	-	0
Option 2	Buy 50% own Borrow N$50 @ 10%	0,5*N$150 N$50*1,1	N$75 N$55	0,5*N$110 N$50*1,1	N$55 N$55
	Payoff		N$20		0

Adapted from Rubinstein and Leland (1981)

The "opportunity cost" of the call option is thus:

Buy 50% of asset at current price N$130/m^2	N$65/m^2
Borrow N$50/m^2 @ 10%	-N$50/m^2
Cost of "buy and borrow"	N$15/m^2

$$\text{Call Option Value} = \left[\Delta_b * S_0 - \frac{\Delta_b * S_u - (S_u - S_e)}{(1+i)^n}\right] * \text{Units}$$

$$= \left[0.5*130 - \frac{0.5*150 - (150 - 130)}{(1+0.1)^1}\right]$$

$$= \$6 - \frac{\$75 - \$20}{1.1}$$

$$= \$15/m^2$$

trading strategies are equivalent, they are consequently taken to have the same cost. Thus the cost of the "buy and borrow" is ideally the value of the "call option". This Two-State Model (Rubinstein and Leland, 1981; Damodaran, 2005) is essentially a binomial option pricing model, based on a simple formulation for the asset price process in which the asset, at any time period, can move to one of two possible prices (Damodaran, 2005). In the illustration, we have simplified the assumptions that there will be equal probability of the price movement upwards and downwards, and to replicate the payoff, we have arbitrarily selected a 50% ratio on current and future prices. In reality, this may not be the case. The illustration depicts an investor's consideration to maintain the opportunity cost of investment while minimising exposure to risk on equity.

Typical call options are European and American call options. European call option is exercised on the expiration date (Figure 2 below). This type of option has limited application to real estate development because it functions on the premise that development can only be executed at the end of the given period. An American call option can be exercised any time on or before the expiration date. This implies that there are several possible exercise dates (Figure 3 below), each having its own value, but the later ones are more valuable than the earlier ones. American call options lend themselves far better to real estate development than do European calls because they accommodate the possibility of a developer exercising the call option at any time before the expiration date.

If the developer has a one-year call option, but decides to exercise the option in six months, the value of the option is determined by starting at the end node and folding backwards. By adjusting the combination from moment to moment, the call can be continually duplicated and the value of the option determined each time ad infinitum. The frequency of exercising the option has to be modified for real estate development to the timing of investment receipts. Real estate incomes are received at intervals, therefore the cash flow pattern is discrete rather than continuous.

Variance, a measure of future uncertainty (Moreno *et al.*, 2009) and the ultimate value of flexibility in a project is its ability to respond to the uncertainties of the future (Lucius, 2001), and is probably the most difficult to define (Haahtela, 2010). It can be measured as a deviation of probability return using the function:

$$\sigma^2 = \sum\left[R - \sum(R^*p)\right]^2$$

R = return at time t, and

P = probability of return R at time t

For real estate, the volatility of individual built properties is typically in the range of 10% to 20% per year (Guma, 2008; Patel *et al.*, 2005). Müller and Lausberg (2010) argue that volatility should not be used for measuring risk of real estate – neither within its asset class nor in a multi-asset environment fundamentally – because, according to the authors, real estate returns are not normally distributed.

Wheaton *et al.* (2001) contend that historical volatility overstates the future risk on real estate returns because it includes both the predictable and unpredictable risk components. Instead, based on the fact that real estate markets exhibit

Figure 2: European call option

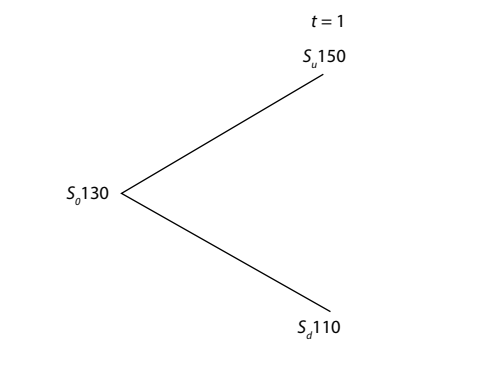
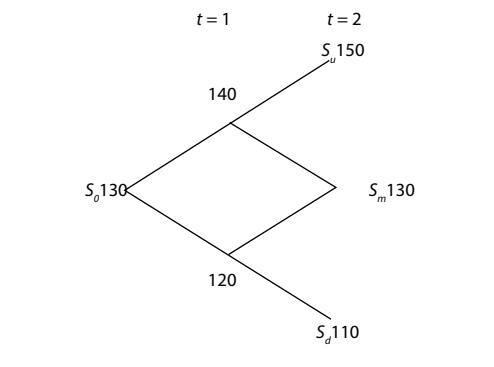


Figure 3: American call option



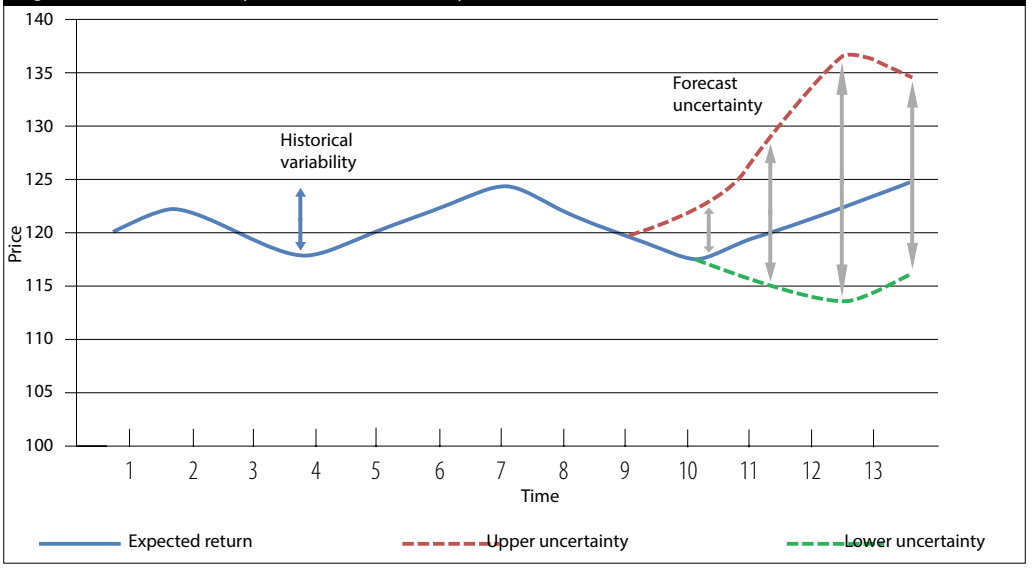
a significant degree of statistical predictability, real estate returns should be forecast by vector autoregressive (VARG) models so that they consist of the variability of future returns and the uncertainty surrounding that forecast. Thus it is possible to quantify risk as the standard error of the forecast for each variable in the real estate model (Wheaton *et al.*, 2001).

$$\sigma^2 = \frac{\ln\left(\frac{\delta_t}{\delta_{t-n}}\right)}{\sqrt{n}}$$

δ = return at time t, and

n = time period of the change in δ

Figure 4: Historical volatility versus future uncertainty



Adapted from Wheaton et al., *(2001)*

Müller and Lausberg (2010) advocate for a shift from one single risk measure to a set of risk and return measures, which yields a more comprehensive picture of riskiness of an investment (Müller and Lausberg, 2010). Chen and Khumpaisal (2009) advance that risk in each real estate development can be identified using brainstorming techniques, and define risk as events that could arise and affect critical factors of a project. They consider both subjective and objective issues to define criteria for risk assessment, which they categorise as environmental, social, economic and technological risks (Chen and Khumpaisal, 2009). While the model seems robust in supporting decision-making to select the most appropriate development plan, it still falls short of providing a quantitative measure of uncertainty that can be an input to estimating the option value.

We adopt the variance estimation that assumes a geometric Brownian motion of the upside u and downside d changes.

5. Real Option Models

The three common approaches to real option valuation are the Black-Scholes, binomial and Samuelson-McKean models.

Option value in real estate is not accurately captured by the Black-Scholes method mainly because the non-homogenous and discontinuous cash flow characteristics fail to meet the fundamental requirements of the Black-Scholes model. Thus it is not appropriate to use the model to assess option values in real estate.

The standard binomial approach is primarily a two-state situation where the investor is expected to exercise the option at the expiry date, which is like a European call option. The binomial approach works from a premise of a risk-neutral investor expecting a return given a probability of an upward gain and a possibility of a downside change. Often, the expected return as well as the upward and downward changes may be known, but the probabilities of changes to yield such a return are not known.

To be like an American call option, in which the holder may exercise the option at any time before or on the expiry date, some modification has to be done to estimate the call option value at shorter intervals to resemble a continuous return. One way is to make a binomial tree with nodes at shorter intervals and working backwards from the end to estimate the option value at each node (as shown in Figure 3). The key problem with creating more nodes comes when the upward and downward volatilities are different, because if not modified, the nodes may not recombine, rendering the effort futile. Trinomial trees have been proposed by Haahtela (2010) to cater for changing volatilities.

The second way to provide a continuous return in a two-state binomial and estimate the call value at shorter periods than the expiry date is by using the natural logarithmic growth functions. The Binomial approach is commended for its ability to account for dissimilar upward and downward risk to estimate option values at given points in time.

Both the Black-Scholes and Binomial models fail to establish the optimal asset price when the payoff equates the opportunity cost of investing in the asset.

5.1. Samuelson-McKean Model for Real Option Valuation

Samuelson and McKean (1965) developed a model for a perpetual American call option that has been hailed to be appropriate for real estate application. The model has five major variables embedded in it, namely:

1. S (or V_0), which is the current value of the underlying asset estimated by the discounted cash flows or the market value of future built properties
2. K_0 is the development cost, which is the present value of total expected capital expenditures on the investment
3. σ_S is the volatility of property price estimated by the standard deviation of annualised quarterly rate of return on properties
4. δ (or Y_v) is the property initial yield, and represents the opportunity cost of holding the vacant land
5. r_f is the risk-free interest rate proxied by the yield of a medium-term government bond, assumed to remain constant over the life of the option. It can also be expressed as the marginal return of the construction yield Y_k over the property yield Y_v

With these inputs, the Samuelson-McKean model presents three functions:

1. Option elasticity (η) – the percentage change in value on the unexercised option in response to a one-percentage change in the value of the underlying asset given by the mathematical expression:

$$\eta = \left(\delta - r_t + \sigma_s^2/2 + \sqrt{\left(r_t - \delta - \frac{\sigma_s^2}{2}\right)^2 + 2r_t\sigma_s^2}\right)/\sigma_s^2$$

2. Hurdle price (S^*) – the target asset price at which, for the first time, the payoff ($S - K_0$) equals or exceeds the option value

$$S^* = K\eta/(\eta - 1)$$

3. Option value (U) – the opportunity cost of holding land from development, analogous to the residualised vacant land value for that use

$$U = (S^* - K)(S/S^*)^{\eta}$$

(Hui and Ng, 2008; Patel et al., *2005)*

Figure 5 on the next page is an illustration of the timing of exercising a call option derived from the Samuelson-McKean model. The main feature of the model is the hurdle price S^*, which is a trigger price before which it is more valuable to wait than to exercise the option. Assuming property initial yield δ at 8,5%, risk-free rate of return r_f of 10% and annualised property price volatility σ_S 10,11%, the call option value of the asset from Table 1 would be N$15.71 and the hurdle price would be N$180.81.

Where other option models indicate the option value at a given asset price, the Samuelson-McKean model shows the asset value to be achieved for maximum payoff. Until the asset value (S) exceeds the development cost (K_0), there is no payoff for the project. Development is likely to take place at any point where S exceeds K_0. S^*, the hurdle price, is the target asset value that must be achieved to

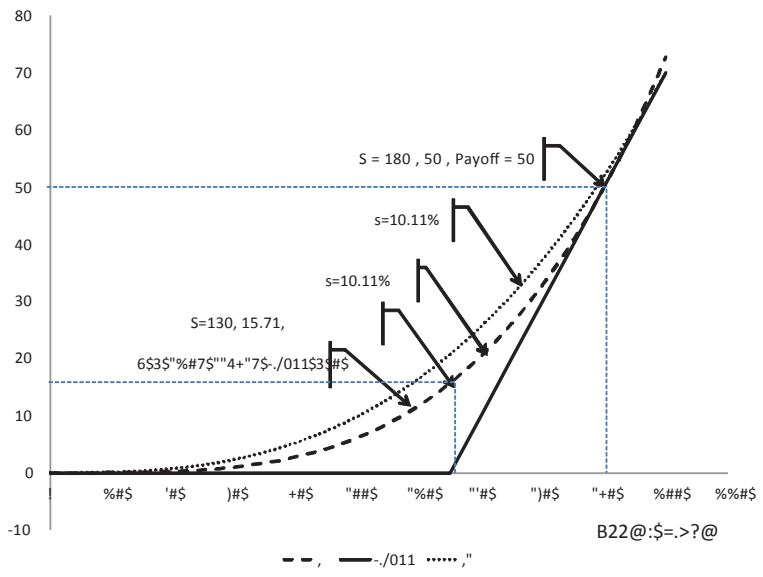
equate the project payoff to the opportunity cost of holding the land undeveloped. Between K_0 and S^*, the project pays off but less than the option value. The investment decision is made by comparing the current value of the asset with its "cost", which includes the investment cost and option value (Yamazaki, 2001; Parthasarathy and Madhumathi, 2010). The higher the option value achieved, the higher the exercise value (S_e), the higher the [hurdle] price (S^*) over the cost (k), the higher the volatility (σ), and the higher the interest rate (r_f) on delayed payment.

The major challenge to the acceptance of real option valuation in real estate is that its introduction focused on the technical aspects of modelling overlooking the fact that it is a way of thinking (Amram and Kulatilaka, 1999). It adopts a financial theory based on continuously traded homogenous securities for which non-market risk can be diversified. Real estate as a commodity is not homogenous and property-specific risk is inherent (Patel *et al.*, 2005). It is not continuously traded, and prices are estimated on expected [discounted] cash flows from leases. Hence cash flows are the traded assets in real estate (Laughton *et al.*, 2000). Lease cash flows occur at specified intervals for a finite period, which may be described as a discrete time series. A discrete time series is described as a series or sequence of values at a [distinct] point in time separated by a given time step (Haugen, 2005). The stochasticity of values in between the discrete interval points cannot be observed, but may be inferred to assume a geometric Brownian motion with up or down "kickers'" in the form of a binomial lattice.

6. Methodology and Data Modelling

This paper examines real option value in development land in Windhoek using the Samuelson-McKean model. Sample data is drawn from four high-cost suburbs in Windhoek, where town house development of density 1/350 was permitted in 2009. Real option analysis is used to identify optimal timing to execute a development action on a specific project. Real option values (payoffs) will thus vary from project to project.

Figure 5: Project call option value and payoff



Since the objective of the paper is to demonstrate the application of real option valuation to real estate development projects, standard developments are assumed based on average building and lot sizes, yields and costs. For the purpose of simplicity, we use lower and upper boundary values on 1/250 and 1/350 densities respectively, with 50% and 40% plot coverage ratio. The possible consequence of doing this is that the property-specific attributes that usually influence the purchaser's preferences are ignored (Bulan *et al.*, 2008; Yamazaki, 2001) and may therefore affect the external validity of the findings.

1. Current value of the underlying asset (S): We assume the projected asset value is the investment value of the discounted future cash flows for a standard property. A Namibian dollar (N$) rate per unit area is deduced from actual sales data and applied to the hypothetical property.
2. Exercise cost (K): It is assumed that construction cost is the only future expenditure on the project. Future capital projects on the properties are ignored. Further, we assume the exercise price S_e is the same as the current price S_0, which is equal to the construction cost K.
3. Price volatility of property (σ_s): We use the GBM approach to estimate the volatility of the property rate of return expressed as the unleveraged discount rate applicable.
4. Capitalisation rate (δ): Average capitalisation rates are estimated using asking rental and sale prices collected at quarterly intervals.
5. Risk-free interest rate (r_f): The GC10 Bond yield is used as the proxy for a medium-term government bond and is assumed to remain constant over the period the option remains not exercised.

7. Data Presentation

The baseline data used for analysis is presented in Tables 4 and 5. It was collected from various sources, including the City of Windhoek, property magazines and respondents who sought anonymity.

Table 4: Baseline data 1/200 density townhouse development 2009 data

	Klein Windhoek	Eros & Avis	Olympia	Kleine Kuppe
Ave. plot size m^2	870	780	1 200	1 850
Bldg cost N$/m^2 (K)	5 500	5 000	5 000	5 000
Bldg value N$/m^2 (S)	6 600	10 500	10 500	13 800
Ave. bldg size m^2	435	390	600	925
Number of units	4	3	6	9
Ave. unit size m^2	108.75	130	100	102.78
Ave. plot price N$	650 000	493 000	718 000	757 000
Ave. bldg cost N$ (K)	2 392 500	1 950 000	3 000 000	4 625 000
Ave. bldg value N$ (S)	2 871 000	4 095 000	6 300 000	12 765 000
Ave. unit value N$	717 750	1 365 000	1 050 000	1 418 333.33
Cap rate	7%	5.6%	7.7%	7.5%
Risk-free (r_f)	7%	7%	7%	7%
STDV (Rate of return)	0.339	0.192	0.355	0.406
Variance (Rate of return)	0.115	0.037	0.126	0.165

Table 5: Baseline data 1/350 density townhouse development 2009 data

	Klein Windhoek	Eros & Avis	Olympia	Kleine Kuppe
Ave. plot size m^2	870	780	1 200	1 850
Bldg cost N$/m^2 (K)	8 500	7 000	7 000	6 000
Bldg value N$/m^2 (S)	7 700	9 000	10 000	8 500
Ave. bldg size m^2	348	312	480	740
Number of units	3	3	4	6
Ave. unit size m^2	116	104	120	123.33
Ave. plot price N$	1 001 000	628 000	933 000	974 000
Ave. bldg cost N$ (K)	2 958 000	2 184 000	3 360 000	4 440 000
Ave. bldg value N$ (S)	2 679 600	2 808 000	4 800 000	6 290 000
Ave. unit value N$	893 200	936 000	1 200 000	1 048 333.33
Cap rate	7%	5.6%	7.7%	7.5%
Risk-free (r_f)	7%	7%	7%	7%
STDV	0.339	0.192	0.355	0.406
Variance	0.115	0.037	0.126	0.165

The data analysis is presented in Tables 6 and 7.

The hurdle price (S^*) is the optimal price at which to develop the project, but not necessarily the only time to do so (Parthasarathy and Madhumathi, 2010). The option to delay is sensible when the current asset price is lower than the hurdle price, and with the passage of time more information may be available to clear uncertainties about the project and improve market conditions. This is evident for Kleine Windhoek (1/200, 1/350), Eros (1/350) and Kleine Kuppe (1/350). Development at these densities in these areas currently yields lower market prices (S) than the hurdle prices (S^*). In Olympia (1/200), although the current market price is lower than the hurdle price, it is not justified to delay development at the given density. In Eros (1/200), Olympia (1/350) and Kleine Kuppe (1/200), developments at these densities have higher current market values than hurdle prices; thus there is no need to delay projects.

U, the option value, can be used to evaluate the market and optimal land values. From a residual valuation conceptual view, the residual land value is the maximum amount a developer may allocate to the acquisition of land. Assuming the developer's profit is incorporated as a project cost, U may be wholly allocated to land acquisition. It therefore becomes a useful benchmark to assess whether the project yields a residual high enough to cover land costs. If U is significantly lower than the asking land prices, then the project at the given development specifications generates a residual that is too low to compete for that land at that use and/or intensity at that particular time, and so is the converse. U_0 is a factor introduced to indicate residual land value at break-even point, when the project value (S) is equal to the project cost (K). It is estimated by interpolating the option value (U) at the point where the project value (S) is equal to the project cost (K) and the payoff is zero (0).

Table 6: Real option valuation – Kleine Windhoek and Eros

	Kleine Windhoek		Eros	
Density	1/200	1/350	1/200	1/350
S	2 871 000	2 679 600	4 095 000	2 808 000
K	2 392 500	2 958 000	1 950 000	2 184 000
σ2	11.49%	11.49%	3.7%	3.7%
δ	7%	7%	5.6%	5.6%
y_k	7%	7%	7%	7%
η	1.7117	1.7117	2.0703	2.0703
S*	5 754 147	7 114 218	3 771 847	4 224 469
U	1 022 602	781 336	2 159 846	875 998
U_0	749 687.45	#VALUE!	466 208.15	521 309.23
LP_M	650 500	1 000 750	493 500	628 060

Table 7: Real option valuation – Olympia and Kleine Kuppe

	Olympia		Kleine Kuppe	
Density	1/200	1/350	1/200	1/350
S	6 300 000	4 800 000	12 765 000	6 290 000
K	3 000 000	3 360 000	4 625 000	4 440 000
σ2	12.6%	0.3%	16.48%	16.48%
δ	7.7%	7.7%	7.5%	7.5%
y_k	7%	7%	7%	7%
η	1.7470	10.1761	1.5936	1.5936
S*	7 016 167	3 726 168	12 416 158	11 919 512
U	3 327 546	4 817 662	8 142 898	2 700 669
U_0	910 359.89	130 733.45	1 617 543.12	1 550 802.84
LP_M	717 800	933 020	757 400	973 690

The main distinction from U above is the timing of the land price estimate. U_0 is the optimal land price at break-even point while U is at the point that the hurdle price is achieved. It indicates the residual amount that could be available for land purchase if the project were to break-even. It provides a benchmark for assessing whether the available residual is enough to acquire market-priced land. When U_0 is higher than the market land price, it implies that the project, even at break-even, will have sufficient residual to cover the land cost. When U_0 is lower than the market price, the project cost (K) may be very high and close to the project value (S). In Olympia, for instance, at development density of 1/350, K = N$3.36-million and S^* = N$3.73-million; hence a residual land value of N$130 733. In the same location at 1/200 density, the residual value is N$910 360, generated from a project cost of N$3-million and S^*=N$7-million.

7.1. Real Option Development in Investment Decision Context

The Samuelson-McKean real option model has been hailed for its ability to provide substantial information for decision-making. It acknowledges that development can take place at any time. Figure 6 below presents a graphic perspective of how real estate development and investment decisions can be integrated in situations where developers and investors are different and operate in separate markets.

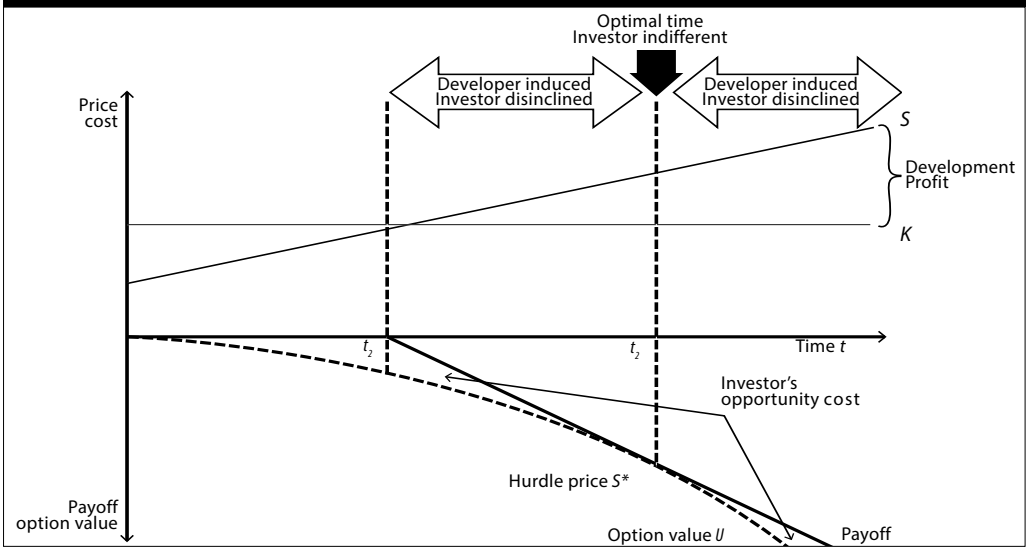
By applying real option models to decision-making, developers can position the timing of developments relative to investors' inclination to real estate investment. Development is likely to take place only after t_1.

Between t_1 and t_2, development is viable to the developer, but in the investment market, the opportunity cost of investing in real estate is higher than the payoff. Taking into account the irreversibility of real estate development, investors would rather wait for the optimal time than commit to investments. Developments that are offloaded during this period will likely be less attractive because growth in current value may under-perform the future market value of delayed projects, and alternative financial asset investments. Beyond t_2, investors may invest in real estate simply for diversification purposes and not actually for maximising returns.

8. Conclusion

The purpose of this paper was to demonstrate how real option valuation can be used to enhance real estate investment decision-making, using the Samuelson-McKean model. The paper adopted the Samuelson-McKean model to examine real option values in Windhoek, because it provides, over and above other models, a hurdle price, which is the price that the project value should exceed for it to be worthy of investment. Option value is the opportunity cost of "investing and borrowing" to duplicate the payoff of a wholly

Figure 6: Real option in the development context



equity-funded investment sold at market value. It is relevant to real estate because it is a common premise that investors seek to minimise the opportunity cost of investing in real assets. Developers can utilise real option analysis to establish when to release projects onto the market, to match the payoff with the opportunity cost to the investor of duplicating that payoff through alternative investments.

We find a justifiable option to delay in Kleine Windhoek (1/200, 1/350), Eros (1/350) and Kleine Kuppe (1/350), where the current market values are lower than the hurdle price. In the rest, the hurdle prices are lower than the current market values, so there is no need to wait.

It has also been demonstrated that real option approaches can be used by developers to verify whether a given project can generate sufficient residual to cater for land acquisition. Through the real option approach, developers can plan when to develop land and estimate the reasonable amount required for land acquisition if it is not owned. It should be noted that not all projects have option value, and for those that do, not all will justify a delay. The real option approach should be used only when it is a decision-point and there is no other way to do it, when the uncertainty is large enough to justify the waiting for more information and to make flexibility a requisite, and the asset value is based on future but uncertain growth rather than on current cash flows. Nonetheless, real option approaches should not be feared – they should be embraced by discerning managers who seek strategic investments to turn opportunities (from which the faint-hearted recoil) into fortunes.

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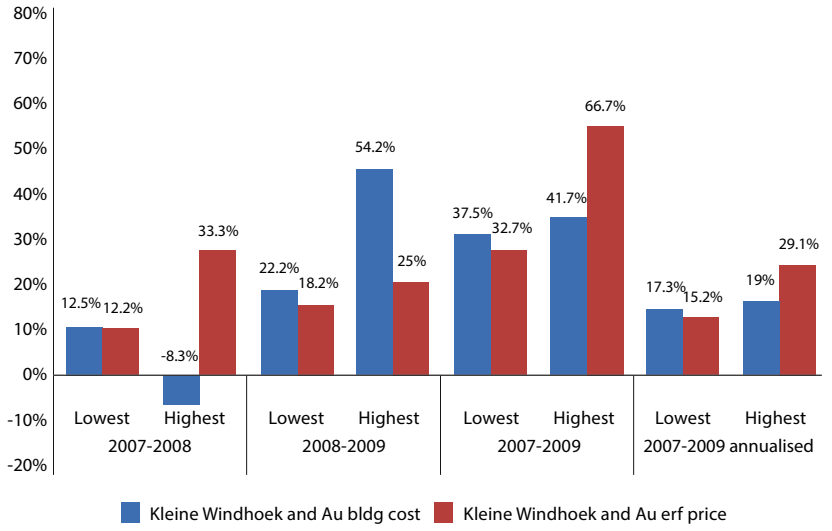
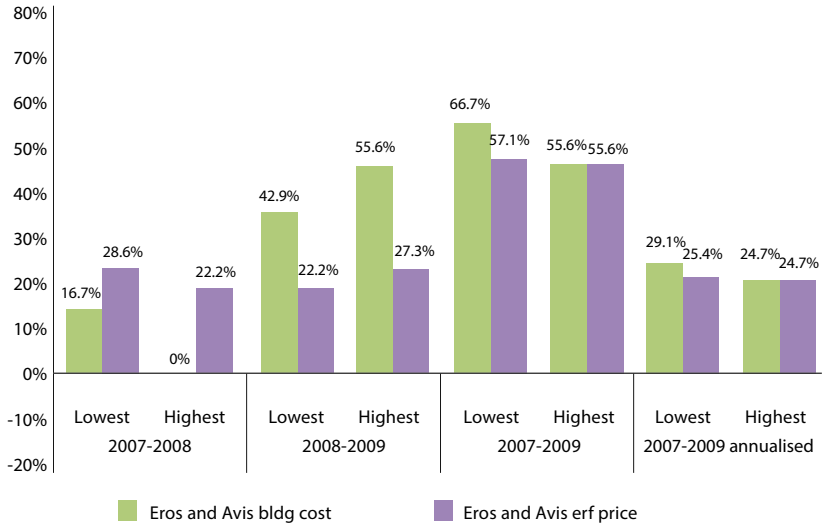
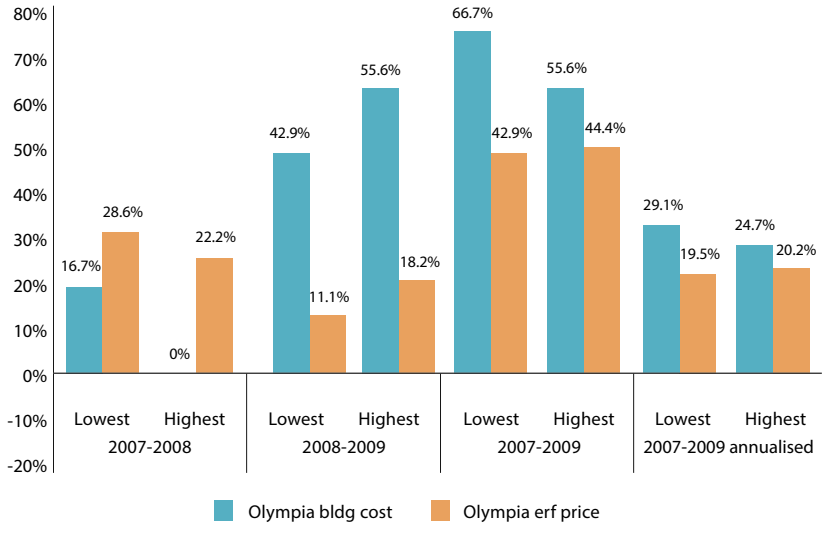
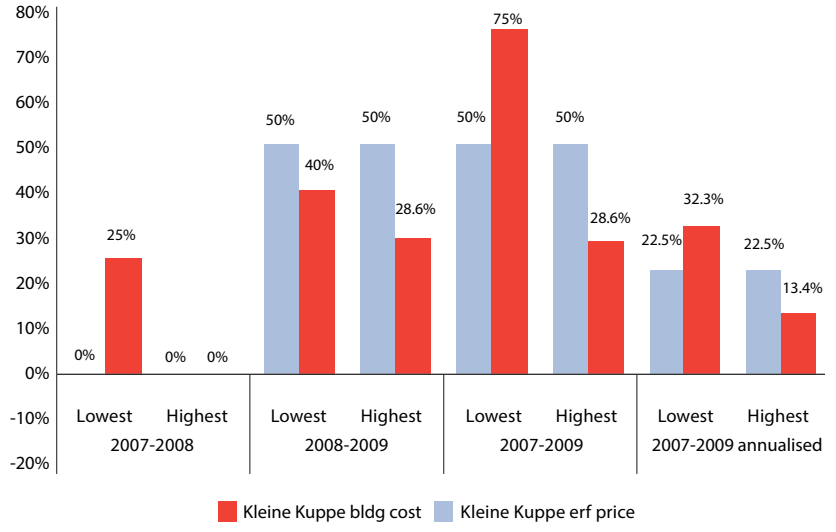
Appendix A: Building cost and price change, 2007-2009





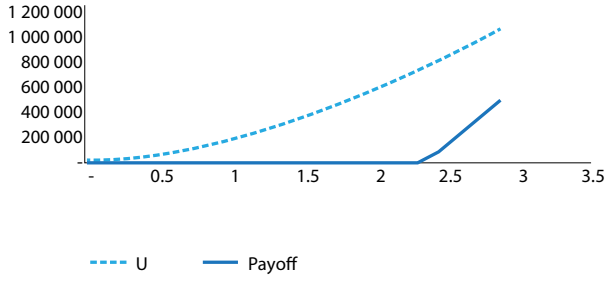


Appendix A: Building cost and price change, 2007-2009



Appendix B: Option value and payoff

Kleine Windhoek 1/200



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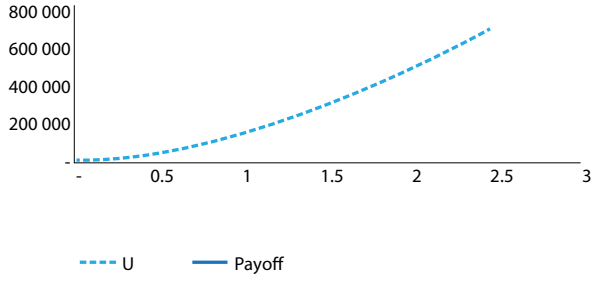
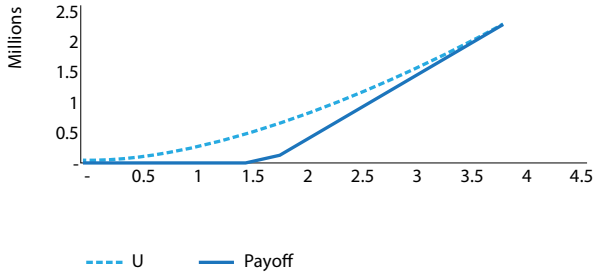


Eros 1/200



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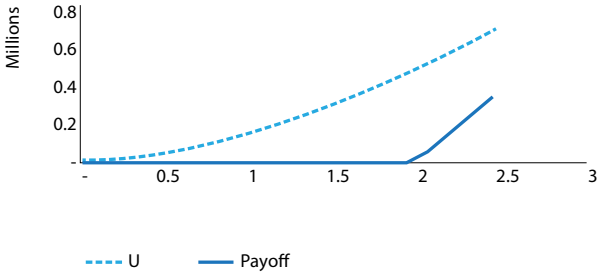
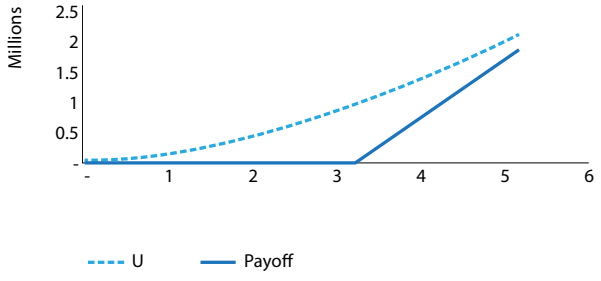


Olympia 1/200



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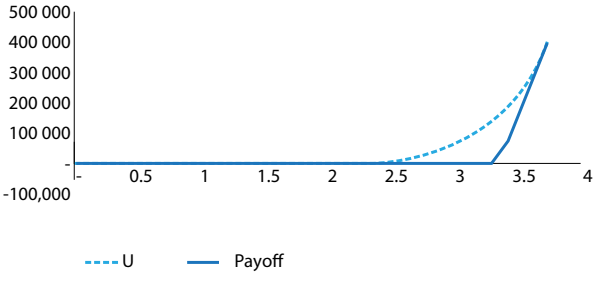
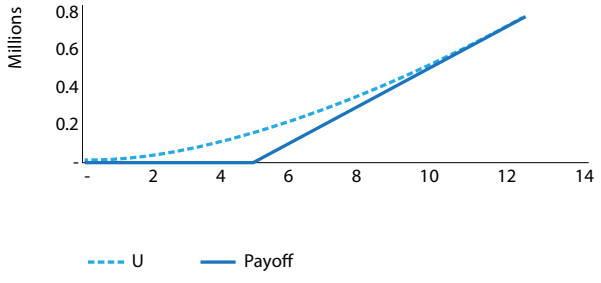


Kleine Kuppe 1/200



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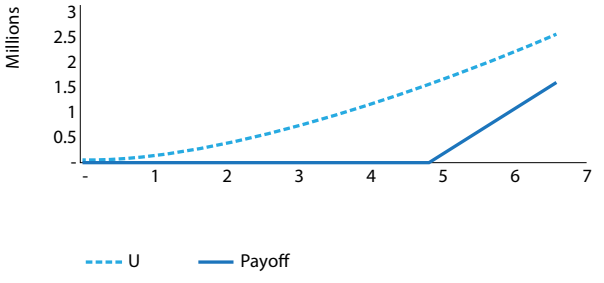

Exploring the Impact of Personal Connections and Selected Individual Factors on the Ethical Judgment and Behavioural Intentions of Nigerian Estate Surveyors and Valuers

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Key words
deficiencies, Nigerian property market, risk adjustment methods, viability studies.

Abstract

This study focused on two components (ethical judgment and behavioural intentions) of Rest's (1986) four-component model of ethical decision-making. More specifically, the study investigated ethical judgment of valuers and the impact of personal factors and personal connections on their ethical judgment and behavioural intentions. The results of this study, though somewhat counterintuitive, suggest that responding estate surveyors and valuers who have attained the highest level of professional certification are more likely to develop unethical behavioural intentions. However, the results of the study do provide new insights into the relationship between an estate surveyor and valuer's ethical judgment and personal connections orientation.

1. Introduction

Around the world, property valuation is an important component of the information used in the loan underwriting decision-making (Adair et al., 1996). This is basically the only way through which credit institutions such as banks can avoid the misrepresentation of assets values and thus monitor the loan-to-value ratios in the event of default by borrowers. The achievement of accurate valuations in lending decision-making requires valuers to subscribe to the code of ethics developed by professional property or real estate organisations. However, maintaining high professional ethical standards often relies on an understanding of the moral reasoning process through which decisions are made when an individual is confronted with ethical dilemmas (Au and Wong, 2000). Hence, this study examines the moral reasoning process of Nigerian estate surveyors and valuers within the theoretical framework of ethical development.

Although it forms part of individuals' ethical schema, the moral reasoning process is just one of the components of the decision-making process that professionals undergo in the course of their business dealings. There are many other factors that tend to encourage unethical conduct within a professional practice (Ponemon and Gabhart, 1994). These factors are embedded in influential theoretical ethical judgment and decision-making models (see for example the models of Bommer et al., 1997; Brass et al. 1998; Ferrell and Gresham, 1985; Hunt and Vitell, 1986; Jones, 1991; Rest, 1986 and Trevino, 1986 on ethical decision-making). Generally, these models have postulated that a number of individual (personal) and cultural factors influence ethical/unethical decision-making (Kahn, 1990).

Following the above, this study also examines the effects of selected personal factors and personal connection orientation on ethical judgment and behavioural intention. This is significant not only in expanding the empirical database of ethical decision-making research but also in providing intervening factors affecting ethical/unethical decision-making within the domain of the property valuation profession. This is supported by Hoyt and Wright's (2002) assertion that valuers are increasingly in a valuation ethical dilemma, where they may have to bend approved rules in favour of a client in order to generate valuable repeat business. For instance, Amidu and Aluko (2007a) observed that estate surveyors and valuers in Nigeria are of the opinion that a firm earning a large percentage of its income from a single client may be tempted to inflate valuation figures when a request for a higher valuation is made by such client.

2. Theoretical Framework and Precedent Research in the Valuation Profession

A variety of theoretical models has been proposed in an effort to explain and predict ethical decision-making. These models include the general theory of ethics of Hunt and Vitell (1986), which includes personal, organisational, industry and cultural factors on individuals' ethical judgment, intentions and behaviours; the contingency framework of Ferrell and Gresham (1985), which includes social, cultural, individual and opportunity factors; the behavioural models of Bommer et al. (1987), which include work, personal, professional, governmental, legal and social factors; and the situational-individual model of Trevino (1986), which includes individual, job and organisation factors.

Other models include Rest's (1979) Defining Issues Test; Kohlberg's (1969a; 1969b; 1984) three-level, six-stage Cognitive Moral Development (CMD); the four-component model of Rest (1986); and the moral intensity model of Jones (1991). Rest (1986) posits that a moral behaviour is contingent on an individual performing at least four basic psychological processes: (a) recognise the moral issue; (b) make a moral judgment; (c) establish moral intent; and (d) engage in moral behaviour. Jones (1991), on the other hand, synthesised Rest's (1986) four-stage process to link the ethical decision-making models of Hunt and Vitell (1986), Ferrell and Gresham (1985), Bommer et al. (1987), and Trevino (1986). Jones (1991) further concludes that ethical decisions are not just individual decisions, but are determined by social learning in the organisation.

In an attempt to operationalise Kohlberg's CMD model of ethical reasoning, for instance, Izzo (2000) provides a practical application of the model while incorporating Rest's (1979) Defining Issues Test (DIT), albeit in a real estate agency situation in the US. Utilising the DIT, which provides a set of hypothetical and standardised scenarios for measuring moral reasoning and development, the author offers an empirical methodology for evaluating the ethical reasoning ability of real estate sales professionals. Therefore, controlling for level of formal education and using standardised measures of Kohlberg's CMD, he analysed 365 survey data representing a 68 percent response rate from surveys administered on realtors from California, Tennessee and Florida. He concludes that real estate practitioners compared favourably with other professionals and societal groups in terms of their cognitive moral development. According to him, CMD is also a significant indicator along with education and experience, of success in real estate practice.

Certainly, any of the models could and have been used as the basis for empirical studies to investigate ethical decision-making (Paolillo and Vitell, 2002). However, this present study adopts Rest's (1986) model. The study focused on two aspects (ethical judgment and behavioural intentions) of Rest's (1986) model. The choice of these two components is partly borne out of the quest to ensure uniformity of stimulus with a well-defined ethical dilemma to all the subjects. The second consideration is the inherent difficulty involved in investigating the final component of Rest's (1986) model, which requires observing actual ethical behaviour of professionals in practice. The decision to probe personal factors such as personal attributes and personal connection on ethical judgment and behavioural intentions is based on the observation that all the ethical decision-making models recognise individual factors as potentially affecting individuals' ethical judgment and decision-making.

Ethical decision-making models have gained some level of empirical prominence in the accounting and auditing industry. Studies in this field have attempted to either investigate the fundamental ethical reasoning processes of subjects (Armstrong, 1984 and 1987; Buchan, 2005; Cohen et al., 2001; Ellas, 2002; Jeffrey and Weatherholt, 1996; Kite et al., 1996; Lampe and Finn, 1992; Ponemon, 1988, 1990 and 1992; Shaub, 1989 and 1994) or probe the correlation between ethical reasoning and auditors' behaviour (Allen and Ng, 2001; Arnold and Ponemon, 1991; Au and Wong, 2000; Chiu, 2003; Finn and Lampe, 1992; Gul et al., 2003; Ponemon, 1990; Ponemon and Gabhart, 1990 and 1993; Shaub and Lawrence, 1996; Uddin and Gillett, 2002).

The majority of prior research in real estate has been confined to examining the impact of

client influence (Amidu and Aluko, 2007b; Kinnard et al., 1997; Worzala et al, 1998) and feedback (Amidu et al, 2008; Gallimore and Wolverton, 2000; Hansz, 2000; Hansz and Diaz, 2001; Levy and Schuck, 1999; Wolverton and Gallimore, 1999) on valuers' judgment. For instance, Kinnard et al. (1997) found that expert commercial appraisers were willing to revise their reported value judgment upon client request. Worzala et al. (1998) and Amidu and Aluko (2007b) surveyed residential appraisers in the US and valuers in Nigeria respectively. Both studies confirmed the findings of Kinnard et al. (1997), but found no statistical relationship between valuers' decisions to readjust their valuation estimates and client influence.

With respect to feedback, Hansz (2000) and Hansz and Diaz (2001) demonstrated an inappropriate tendency by expert appraisers to adjust their valuation judgment when presented with market evidence that their initial judgments were "too low". Levy and Schuck's (1999) study of New Zealand valuers also concluded that expert valuation judgments were influenced by client feedback, which varies by client type and valuation purpose. Similarly Wolverton and Gallimore (1999) observed robust empirical results that US appraisers' role perception as price validators and exposure to client feedback were significantly correlated, while Gallimore and Wolverton (2000) and Amidu et al. (2008) found to the contrary in replicative studies of UK and Nigerian valuers respectively. These conflicting findings were attributed to differences in normative training and business practices related to specific countries and cultures.

In summary, no empirical study has investigated ethical judgments and intentions of valuers and the effects of personal factors such as individual attributes and personal connection orientation on valuers' ethical judgment and behavioural intentions in an ethical dilemma situation. In the business context, personal connection can be seen as the manifestation of group orientation through which interpersonal associations can replace formal organisational structure (Boisot, 1986; Coleman, 1993; Putnam, 1993; Walder, 1986). In the area of ethics, personal connections play a critical role in the decision-making process (Hunt and Vitell, 1986) and its system is regarded as the foundation for judgments (Douglas and Schwartz, 1999). Consequently, this study hypothesised that valuers' ethical judgment and behavioural intentions in a valuation conflict situation will be influenced by the existence of a personal connection in the valuation business environment in Nigeria

On the other hand, individual attributes are often posited by ethics theorists as variables influencing ethical decision-making process (Bommer et al., 1987; Hunt and Vitell, 1992 as cited in Chan and Leung, 2006). Empirical studies supporting this proposition have also shown a significant relationship between certain demographic factors and ethical judgment and sensitivity (see for example Colby et al., 1983; Karcher, 1996; Shaub, 1989; Shaub, 1994; Simga-Maugan et al., 2005; Spickelmier, 1983; Thoma, 1984; Thorne, 1999). Therefore, it is further hypothesised in this study that valuers' ethical judgment and behavioural intentions in a valuation conflict situation will be influenced by valuers' demographic attributes such as success in the real estate profession, proxy by job status, academic achievement, professional designation and years of valuation experience.

3. Research Methodology

3.1. Subjects and Sample Size

The sample for the present study consists of 143 estate surveyors and valuers working in private professional practice within Lagos metropolis, where the largest numbers of real estate consultancy firms in Nigeria are located. The survey was blind to the level of professional designation to ensure that each level of expertise is represented. The estate surveyors and valuers were contacted through their respective firms.

3.2. Instrument

A self-administered paper questionnaire was used as a medium of collecting data for this study. The questionnaire consists of three parts: (1) ethical judgment and intentions, (2) personal connections and (3) demographics.

In order to measure valuers' ethical judgment and behavioural intentions, the study adapts Kinnard et al.'s (1997) ethical judgment instrument. The instrument includes a valuation scenario embedded with ethical dilemma that involves personal connection and the professional integrity of a valuer. The purpose of the scenario is to investigate the ability of the respondents to comply with established professional practices and code of conduct, given the temptation to help a good friend. In particular, the subjects were provided with a moral dilemma relating to their professional integrity in maintaining client confidentiality and their personal responsibility to a close friend. In this scenario, the valuer's close and long-time friend who has helped the valuer and his/her family tremendously for many years, asked the valuer for professional advice on the value of a property for mortgage purposes. The valuation conflict arises when the valuer comes up with a value that is below the client's expectation. Just before the deadline for submission of the valuation, the client provides new, additional market data from a competing valuation firm that could potentially increase the value of the subject property. In addition, the valuer also knows that the close friend desperately needs to secure the loan from the bank; however, the valuer is unable to verify the new information within the stipulated time for the delivery of the report. Valuers in the survey were then requested to rate the ethical behaviour of the hypothetical valuer, who in this case has decided to incorporate the new, unverified market evidence, and also estimate the likelihood of acting as the hypothetical valuer did against a five-point Likert scale anchored on "Ethical and Unethical" and "Very likely and Unlikely" respectively. This is in order to provide single-item measures of ethical judgments and behavioural intentions.

Ang and Leong's (2000) nine-item scale for measuring individuals' attitude towards guanxi[1] was adapted to measure the dimensionality of personal connection. As evidenced in the studies of Yeung and Tung (1996) and Abramson and Ai (1999), guanxi is widely accepted as a motivating factor for long-term business success in the People's Republic of China. Given the nature of the business environment in Nigeria, which is considered to be one of the most corrupt in the world (Erondu et al., 2004), it is posited in this study that personal connections (guanxi) not only exist in the Nigerian valuation industry but also affect valuers' judgment and behavioural intentions when faced with an ethical dilemma. It is expected that valuers who are inclined towards personal connections will rate the questionable action of the hypothetical valuer as ethical and also have the tendency to develop unethical behavioural intentions. The original nine statements developed by Ang and Leong (2000) were reworded in valuation parlance to assess attitudes of valuers towards the acceptability of personal connections dimension in Nigerian valuation professional practice using a five-point Likert scale anchored on "Disagree" to "Agree". The mean response to the nine items provides a single measure of personal connection, with higher scores indicating higher degrees of personal connection orientation in valuation business dealings.

[1] Guanxi is a central idea in Chinese society, now widely adopted to describe the basic dynamics in personalised networks of influence. Essentially, it describes a personal connection between two people, in which one is able to prevail upon another (or be prevailed upon) and exert some influence to perform a favour or service. The two people need not be of equal social status and do not often have family relationships.

3.3. Instrument Administration

Questionnaires accompanied with introductory letters were personally administered to sampled surveyors and later retrieved personally. There were 121 responses from the valuers/surveyors which represents an 85 percent gross response rate. These 121 responses were examined for their completeness. Upon this examination, 14 questionnaires were excluded from the sample on the ground of no response to the scenario to measure ethical judgment and behavioural intention. This leaves 107 usable responses for this study, representing a 75 percent net response rate.

4. Analysis and Results

As indicated, 107 usable responses were used in this study. Table 1 presents a summary of the respondent characteristics. Of the 107 who indicated their success in the real estate profession, measured by job status, 16 are principal partners (15%), 11 are branch managers (10.3%), 19 are partners (17.8%), 49 are senior valuers (45.8%) and 12 are heads of a valuation department (11.2%). The breakdown of the academic achievement of respondents indicates

Table 1: Sample characteristics	
Variables	**Mean score (N = 107)**
Ethical judgment	2.26
Behavioural intention	2.46
Personal connection	3.73
Demographics	
Job status	**Sample percentage**
Principal partner	15
Branch manager	10.3
Partner	17.8
Senior valuer	45.8
Head, valuation department	11.2
Academic achievement	
HND	39.3
BSc	43
MSc	14
PhD	3.7
Professional designation	
Probationers	40.2
Associate	49.5
Fellow	10.3
Year of valuation experience	
1-5 years	35.5
6-10 years	36.4
11-15 years	19.6
16-20 years	4.7
More than 20 years	3.7

that 42 possessed a higher national diploma (HND) (39.3%), 46 possessed a bachelor's degree (43%), 15 had a master's degree (14%), and the remaining four possessed a doctorate degree (3.7%). The reported professional designations are 43 probationer (40.2%), 53 associate (49.5%) and 11 fellow (10.3%). The majority of responding estate surveyors and valuers (71.9%) had less than 11 years of valuation experience.

Since subjects have differing demographics, the study carried out a mean comparison between the research variables and the demographic characteristics. Table 2 shows the results of the comparison. The results in Table 2 indicate that principal partners are significantly (p=0.01) more orientated towards personal connection than other hierarchy of success in the real estate profession. Subjects with PhD (p=0.057) and Fellow designations (p=0.023) also exhibit a moderately higher unethical behavioural intention than other levels of academic achievement and professional designate respectively. Results of the four demographic variables, however, failed to show any statistical difference in the mean rating of the ethical judgment (at 0.1, 0.01 and 0.05 levels of significance).

The relationship between the research variables was further examined by a correlation matrix. Table 3 indicates the correlation coefficients and their level of using both the parametric (Pearson correlation) and the non-parametric tests (Spearman-rank correlation).

As can be seen in Table 3, both tests show that behavioural intention is significantly associated (at both 0.01 and 0.05 levels of significance) with both ethical judgment and professional designate of the responding valuers. A significant negative association between job status, other demographics and personal connection is found by the two tests. Only the parametric test shows that ethical judgment is significantly associated (at 0.1 level of significance) with personal

Table 2: Comparison of mean scores

Demographics		Ethical judgment	Behavioural intention	Personal connection
Job status				
Principal partner (N=16)		2.31	2.75	4.03
Branch manager (N=11)		2.09	2.27	3.72
Partner (N=19)		2.05	2.26	3.57
Senior valuer (N=49)		2.35	2.39	3.81
Head, valuation department (N=21)		2.33	2.83	3.27
	F	0.222	0.622	3.526
	p-value	0.926	0.648	0.010
Academic achievement				
HND (N=42)		2.55	2.76	3.70
BSc (N=46)		2.04	2.20	3.84
MSc (N=15)		1.93	2.13	3.62
PhD (N=4)		3.00	3.50	3.17
	F	1.825	2.595	1.878
	p-value	0.147	0.057	0.138
Professional designation				
Probationers (N=43)		2.03	2.12	3.79
Associate (N=53)		2.40	2.57	3.69
Fellow (N=11)		2.55	3.27	3.66
	F	1.223	3.921	0.394
	p-value	0.299	0.023	0.675
Year of valuation experience				
1-5 years (N=38)		2.13	2.39	3.68
6-10 years (N=39)		2.21	2.18	3.71
11-15 years (N=21)		2.71	3.10	3.88
16-20 years (N=5)		2.40	2.80	3.60
More than 20 years (N=4)		1.50	2.00	3.78
	F	1.065	1.953	0.430
	p-value	0.378	0.107	0.787

Table 3: Correlation matrix (Pearson correlation (Spearman-rank correlation))

	Ethical Jjdgment	Behavioural intention	Job status	Academic achievement	Professional designation	Year of experience	Personal connection
Ethical judgment	1.000						
	(1.000)						
Behavioural intention	0.561**	1.000					
	(0.618)**	(1.000)					
Job status	0.035	-0.010	1.000				
	(0.035)	(0.030)	(1.000)				
Academic achievement	-0.097	-0.082	-0.362**	1.000			
	(-0.120)	(-0.136)	(-0.320)**	(1.000)			
Professional designation	0.147	0.261**	-0.305**	0.347**	1.000		
	(0.183)	(0.244)**	(-0.222)*	(0.287)**	(1.000)		
Year of experience	0.046	0.094	-0.587**	0.502**	0.637**	1.000	
	(0.131)	(0.101)	(-0.573)**	(0.447)**	(0.626)**	(1.000)	
Personal connection	-0.166	-0.118	-0.208*	-0.091	-0.084	0.063	1.000
	(-0.101)	(0.117)	(0.156)	(0.015)	(-0.037)	(0.100)	(1.000)

**Significant at the 0.05 level **Significant at the 0.01 level ***Significant at the 0.1 level*

Table 4: Regression analysis of effects of independent variables on ethical judgment

Independent variables	Beta	T-value	Sig. level
Job status	0.013	0.103	0.918
Academic achievement*	-0.193	-1.710	0.090
Professional designation	0.170	1.349	0.180
Years of valuation experience	0.052	0.339	0.736
Personal connection*	-0.170	-1.691	0.094
F-value	**1.630**		
p-value	**0.159**		
Adjusted R^2	**0.029**		

**Significant at p = 0.1*

Table 5: Regression analysis of effects of independent variables on behavioural intention

Independent Variables	Beta	T-value	Sig. level
Job status	0.015	0.127	0.899
Academic achievement*	-0.204	-1.852	0.067
Professional designation**	0.327	2.645	0.009
Years of valuation experience	-0.013	-0.088	0.930
Personal connection*	-0.111	-1.131	0.261
F-value	**2.602**		
p-value	**0.030**		
Adjusted R^2	**0.070**		

**Significant at p = 0.1 **Significant at p = 0.01*

connection orientation. However, neither the parametric or non-parametric tests show any significant association (at the level of 0.01, 0.05 or 0.10) between personal connection and behavioural intentions.

A multiple regression analysis was also employed to test the relationship between the two dependent variables (ethical judgment and behavioural intention) and the independent variables (personal connection and individual personal factors). The results are reported in Tables 4 and 5.

Although the individual parameter estimates of the two regression models appear to have corroborated some of the findings of earlier analysis, the F-statistic suggests that both models are insignificant.

5. Discussion

This study examined the impact of selected individual personal factors and personal connections on Nigerian estate surveyors and valuers' ethical judgments and behavioural intentions in a valuation conflict situation. The findings of this research, although not generalisable, suggest that there is, in fact, a relationship between a valuer's ethical judgment and the existence of personal connection orientation. The absolute Pearson correlation coefficient between valuers' ethical judgment and personal connection is -0.166. This finding is consistent with the ethical decision-making models of Bommer et al. (1987), Ferrell and Gresham (1985), Hunt and Vitell (1986) and Trevino (1986), which all postulate that individual factors such as personal connection and ethical orientation can have a potential influence on individuals' ethical judgment and decision-making. The findings also provide the first empirical support for personal connection as a probable determinant factor for business success in the Nigerian valuation industry.

Out of the five individual personal factors investigated in this study, only professional certification appears to be significantly and positively related to behavioural intentions in both the correlation matrix and the regression model. This positive relation seems to suggest that responding estate surveyors and valuers who have attained a higher professional

certification are more likely to develop unethical behavioural intention. Clearly, this result is counterintuitive as people who have achieved the highest professional certification are usually considered to have more reputation capital to lose should they be caught participating in such morally questionable practices.

Overall, the findings of this study seem to have important implications for the valuation practices in Nigeria. The fact that personal connection can influence an estate surveyor and valuer's professional judgment is concerning, and could potentially compromise the role of an estate surveyor and valuer as independent and objective estimators of value. Furthermore, the relationship between professional certification and behavioural intention raises questions about the functionality and spread of such intervention in Nigeria's valuation industry.

6. Limitations of the study

Although the sample appears representative across different levels of valuation expertise, the generalisability of the findings in this study may only extend to estate surveyors and valuers in the Lagos metropolis. Also, the use of a quasi-experimental design means that the results of this study need to be interpreted in context. Furthermore, the use of convenient samples introduces a certain amount of self-selection bias because only those who were around and willing to participate in the survey were selected.

The above limitations notwithstanding, the findings of this study do provide several new insights into the relationship between some personal factors and the cognitive moral development of estate surveyors and valuers in Nigeria.

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Residential Satisfaction in Southern Johannesburg, South Africa

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Abstract

This paper examines the relationship between current and ideal housing characteristics, demographics, and location and its effect on overall housing satisfaction in Johannesburg, South Africa. A total of 316 in-person interviews were conducted by University of the Witwatersrand students with African respondents in Soweto and nearby areas. The survey examines the satisfaction levels with current housing location characteristics for access to food shopping, schools, transportation and other attributes. A regression model was used to determine the significance of these factors on the dependent variable of current overall housing satisfaction. The most important factors contributing to housing satisfaction are access to bus and other transportation, kids' school, family and food stores, plus living in a formal unit and being either high- or low-income. Detractors from housing satisfaction include having a mortgage, higher commuting costs, and frustration about access to infrastructure such as junior college, hospital and CBD, and lower-than-expected housing appreciation. This study has implications for public investment.

Keywords
housing satisfaction, Johannesburg, regression.

1. Introduction

Since 1994, the government of South Africa has been working hard at addressing two issues: the issue of supplying housing for primarily the urban poor and the issue of racially integrating urban centres. Yi (1984) states that "adequate housing" is not the same as "satisfactory housing". There have been limited studies of the factors affecting levels of housing satisfaction in South Africa, and the topic of housing satisfaction did not receive much attention in other developing countries either.

The primary purpose of this paper is to study the levels of housing satisfaction among suburban residents in South Africa. This is important because the country has been building large numbers of low-income ownership housing units for lower-income citizens. There has been some research conducted on some of the government housing that shows people are relatively satisfied with these houses, but this was limited, mainly qualitative research.

The research approach began with collection of primary data, in the form of 316 personal interviews with household heads in the southern part of Johannesburg, South Africa. Housing satisfaction questions were included in a battery of questions related to housing choices in the area. The data were then formatted for data analysis, and put into a multiple regression model to determine which housing factors influenced housing satisfaction. The study concludes with some important links between current and ideal housing factors, and satisfaction of respondents. The implications of this research shed light on how the municipality, other government or private parties could approach housing issues in Southern Johannesburg to improve the housing satisfaction there, primarily in the area of off-site public investment.

2. Literature on Housing Satisfaction

There have been few studies on residential satisfaction over the past few decades in developing countries. Okraku (1971) studied the relationship between mobility and housing satisfaction in Puerto Rico. His findings were limited to socio-economic characteristics and the relationship with extended family. Chi and Griffin (1979) conducted a comprehensive study on residential satisfaction, including housing conditions and some community variables. Their study was conducted in Costa Rica and confirmed the importance of housing characteristics, along with some of the important locational characteristics.

Mayo and Katz (1982) compared the levels of residential satisfaction between owners and renters in Cairo, Egypt, and concluded that renters are less satisfied than owners with their dwelling units. Dissatisfaction was more related to micro-housing

characteristics than broad location conditions. Karam (1993) also conducted research in Cairo on the relationship between housing and neighbourhood satisfaction, and the propensity to move. He concluded that people are more likely to consider housing adjustments before any consideration of moving. Reasons for housing dissatisfaction leading to adjustments were mainly related to space availability in the unit itself. Another interesting finding by Karam was that people living in informal units were more likely to consider housing adjustments than people living in formal units.

Ukoha and Beamish (1996) studied housing satisfaction among residents of public housing in the city of Abuja, Nigeria. They looked at the relationship between housing satisfaction and several factors that affect it, including structure type, housing conditions, and management and demographic characteristics. They concluded that there is a relation between housing satisfaction and different housing conditions, and mainly housing management.

Zack and Charlton (2003) conducted a study to look at the satisfaction with subsidised housing units built by the government all over South Africa. The study revealed that, despite people's dissatisfaction with the quality of a house, its location and surrounding problems, they were generally satisfied in the sense that they are better off than before moving into their present house. The Zack and Charlton study did not measure the determinants of satisfaction, just whether the respondents were satisfied or not with their housing conditions.

In 2004, Shisaka consultants undertook a study of the Township Residential Property Markets in South Africa. Besides their report on the property market, the study showed the existence of few sellers in black townships. Several reasons were given for the phenomenon of "few willing sellers", among them (Shisaka, 2004):

- Strong sense of community and place
- Desire to leave the property to children as an inheritance
- Household waited so long to obtain the house that it will never be sold
- House is security for the household and a back-up in times of stress
- Emotional attachments to the house

Housing satisfaction has also been linked with several housing and neighbourhood characteristics. Chi and Griffin (1979) used factor analysis to determine the loading of proximity to public transportation on the community location factor. Safety was also loaded on the same factor. In other studies, distance to employment was reported to have a direct significant effect on housing satisfaction (Speare, 1974). There are also other factors such as food shopping, health clinics and recreation facilities, which were found to be good predictors of housing and neighbourhood satisfaction (Galster, 1987; Ahlbrandt and Cunningham, 1979; Clark and Cadwallader, 1973; Rossi, 1955).

There are some housing and neighbourhood characteristics that might not apply to developed countries but can apply to developing countries. Utilities and services (water, electricity and sewerage) do not feature in studies of developed countries in housing and neighbourhood satisfaction, probably because all units there already have them. However, if they are not available or if they are novel, we expect them to have an effect on housing satisfaction.

Another important characteristic is the formality of the dwelling unit. It could be formal or informal, or – in the case of Johannesburg – it could be an RDP (a subsidised-ownership public housing) unit. Since the South African government has declared housing a "right" in the state constitution, we expect that people's expectations have been raised regarding overall housing quality. We therefore also examine the deficit between current housing factors and their ideal status (housing satisfaction deficit).

In addition to neighbourhood and housing characteristics, some socio-economic characteristics are also expected to have an effect on housing satisfaction. Education has a positive effect on housing satisfaction – as education increases, income increases and housing conditions improve, thus increasing satisfaction (Morris and Jakubczak, 1988; Varady, 1983). Also, the higher the education and the older the person is, the more likely that they will be owners and thus also experience an increase in the level of satisfaction (Kinsey and Lane, 1983). Income was also found to have a significant effect on housing satisfaction, with a relation the same as that of education – the

higher the income the more likely the person is satisfied with their housing (Landale and Guest, 1985; Varady, 1983; Newman and Duncan, 1979).

While these characteristics all contribute to why people do not intend to move, they do not suggest people are satisfied with their housing. This is the reason for this study.

3. Housing Conditions in South Africa

Housing was one of the ways in which the apartheid government controlled, or attempted to control, the influx of the Black African population into the cities (Beavon, 1982). There were segregated areas for them to live in, and they had no right to own their houses in these areas – they only were allowed to rent from the council (ibid.). A substandard school system existed to teach them in a limited manner. Because of housing for the African population being isolated and them being workers in most businesses, subsidised transport was supplied.

Most of the transport consisted of buses or trains. The buses are still running today and are heavily used; trains are used less because of security concerns. Another mode of transport that has grown in the past years is taxis: minibuses that transport people efficiently from different parts of town to the CBD, and then to places around the city. Hence transport has always played a massive role in livelihood for people living in previously "black" areas. It was their only means of accessing work and the city. After the abolishing of the Group Areas Act, government planning has been (and is still) trying to reverse the effects of apartheid planning. For housing, the government chose a subsidy system where subsidised housing was given to people earning less than R1 500 (about US$180) a month). The subsidised housing is not in a central location, but is rather built on the periphery (Sihlongonyane and Karam, 2004).

4. Model and Research Questions

This research examines some of the housing characteristics as well as the location of the housing, to determine their effect on overall satisfaction with the dwelling unit. Most data and work on housing satisfaction has been conducted in developed countries. Because this study was conducted in Johannesburg, South Africa, some of the problems left over from the apartheid regime prior to 1994, when most of the housing was built in the south of Johannesburg, are in play.

Based on the peer-reviewed literature and also taking into consideration the conditions in Johannesburg, the conceptual model towards determining current housing satisfaction is:

$$CURHOUSAT = \beta o + \beta 1OWN + \beta 2NEIGHB + \beta 3UNIT + \beta 4FAMILY + \beta 5TRANSPORT + \beta 6DEMOGR + \beta 7HDEFICIT + \varepsilon$$

Where:

CURHOUSAT = Current Housing satisfaction, the dependent variable, an index; and

OWN = A vector of dummy variables related to the respondent's housing tenure, including owning, renting, bond (mortgage) and informality; and

NEIGHB = A vector including proximity to neighbourhood characteristics such as shopping, daycare, hospitals and technical schools, etc., an index variable; and

UNIT = characteristics of the actual housing unit, such as rooms, size, quality, balcony and other features, some of which are dummy variables; and

FAMILY = A vector including distance to family and number of children, an index variable; and

TRANSPORT = A vector of variables determining time and money required to get to work, mode of transportation and car ownership; and

DEMOGR = A vector of other demographic factors, including age, income, education, gender, workers/household and native language, all dummy variables; and

HDEFICIT = A vector that considers how current satisfaction (cur) with neighbourhood and unit variables compares with ideal (id) levels, an index variable calculated from within the data gathered in this research.

The main research questions seek to determine which of these variables are associated with current housing satisfaction, both as enhancers and detractors.

4.1. Subjects and Sample Size

This study reports the results of a survey on current levels of satisfaction with housing location and also with desired housing location. The survey was conducted in face-to-face interviews in Johannesburg, South Africa. A total of 216 in-person interviews was conducted on black respondents in Soweto (south of Johannesburg) and nearby areas during the months of September and October 2005. A follow-up of 100 surveys using the same instrument was conducted in March 2006, bringing the total to 316 surveys. The quantitative questionnaire was designed for two purposes, the first being a contingent valuation for a study of housing development on contaminated land (see Simons et al., 2010), and a co-purpose of looking at housing satisfaction characteristics among respondents in the study area.

With respect to sampling, the researchers opted for the cluster sampling approach, where the team went to four predetermined locations over five days and asked people at the locations questions at random. There were several locations. One was a remotely located low-income area (Orange Farm); a second location was an upper-low-income to low-middle-income area in Orlando East (Soweto). The other two main locations were in shopping centres: Southgate Mall and East Gate Mall. Southgate Mall is located in close proximity to Soweto and other non-white communities in the south of Johannesburg. A few respondents were students at the University of the Witwatersrand, and were interviewed on campus. All the respondents were black, as were 17 of the 18 interviewers.

The survey asked questions regarding the levels of satisfaction with current housing conditions and also with ideal housing conditions. A list of location and housing attributes was read out, and the respondents assigned each item a grade on a scale from 1 (best, most desirable) to 5 (worst, or undesirable). The list included things of daily importance to the household, i.e. food shopping, schools, transportation. It is important to state that this was a cluster – hence non-random sample – of the Johannesburg population. Each survey lasted approximately half an hour. Simons et al. (2010) discuss the research design and data selection methodology in detail, so it will not be repeated here.

In preparation for the survey, a focus group of ten people from Soweto was convened, and the instrument was pretested/discussed with the participants for about two hours. Several changes were made.

Next, the interviewers were trained, along with pre-testing of the modified questionnaire. The main issue was the varied degree of education of respondents and the language. All the interviewers except one were master's students in the planning programme at the University of the Witwatersrand. All the official South African languages (isiZulu, isiXhosa, Afrikaans, Sepedi, English, SeTswana, Sesotho, Xitsonga, SiSwati, Tshivenda and isiNdebele) were represented among the interviewers.

4.2. Descriptive Statistics Concerning the Respondents

There are 11 official languages in South Africa (including English), so it was important to ensure that all the languages were represented among the interviewers to decrease the risk of losing respondents. Table 1 shows the languages used. More than 55 percent of the interviews were conducted in English, followed by Sesotho and isiZulu at about 20 and 16 percent respectively.

Because this survey was conducted under a larger project looking at the willingness of people to live on former mining dumps, respondents were surveyed in the vicinity of the former mining lands near the Johannesburg CBD. The interviews were conducted in Orlando East in Soweto, in Orange Farm, and also among weekend shoppers at the Southgate and East Gate retail malls (see Table 1).

The age categories of the people surveyed were varied, ranging from the age group of 20-29 (29 percent of respondents) to over 70 (one percent of respondents). The highest percentage of participants was in the age range of 30-39 (32 percent of respondents, as shown in Table 2).

As the age varied, so did the monthly household income measured in South African rands. (The 2007 summer exchange rate was about R7.35 per US dollar.) The lowest income range was less

than R2 500 a month (18 percent of respondents were in this category) to more than R7 500 a month (about 25 percent). Another well-represented group earned R2 501 to R3 500 per month (also 25 percent). This is shown in Table 3.

Table 4 shows the levels of education in the sample. The most common group surveyed finished high school (30 percent). This was followed by people who did not finish high school (20 percent) and college graduates (18 percent).

Table 1: Languages in which the interviews were conducted

Language	Number	% of total
isiZulu	50	15.8
isiXhosa	4	1.3
Afrikaans	1	0.3
Sepedi	6	1.9
English	175	55.4
SeTswana	7	2.2
Sesotho	61	19.3
Xitsonga	11	3.5
Tshivenda	1	0.3
TOTAL	**316**	**100**

Table 2: Age of respondents

Age Category	Number	% of total
20-29	90	28.7
30-39	101	32.3
40-49	83	26.5
50-59	21	6.7
70+	3	1
N/A	3	1
TOTAL	**316**	**100**

Table 3: Income of respondents

Monthly income (Rands*)	Number	% of total
Less than 2 500	57	18
2 501 - 3 500	80	25.3
3 501 - 4 500	28	8.9
4 501 - 5 500	36	11.4
5 501 - 6 500	19	6
6 501 - 7 500	16	5.1
7 500+	80	25.3
TOTAL	**316**	**100**

** 1 South African rand = US$0.17*

Table 4: Level of education

Level of education	Number	% of total
Less than Grade 8	38	12
Some high school	62	19.6
Finished high school	95	30.1
Some tertiary education	34	10.8
College graduate	57	18
Post-graduate qualification	29	9.2
N/A	1	0.3
TOTAL	**316**	**100**

With respect to current housing conditions for the sample surveyed, the majority of the people live in formal dwelling units (67 percent). Informal units, typically in the form of a shack on public land (12 percent), and RDP, a government-provided small concrete (owned) house with full utilities, (approximately eight percent) were also present. The questionnaire did not differentiate between formal housing built by private developers and housing built by the previous government in one of its housing programmes (prior to the RDP). The maximum stay in a unit was 69 years and the minimum was six months, with a mean of 13.6 years.

4.3. Descriptive Statistics: Index for Current Housing Satisfaction

It is also important to look at the respondents' level of satisfaction with their current housing conditions. The respondents were asked to rank 16 criteria (listed in Table 5) on a scale of 1 to 5, 1 being most satisfied and 5 being least satisfied. Results show that people were most satisfied with the location of their dwelling in relation to food shopping, and least satisfied with their dwelling units in terms of safety. It is important to note that access to public transportation and availability of full utilities were ranked closer to satisfied (1.91 and 1.96 respectively). These two items usually play an important role in satisfaction levels, especially in developing countries (Karam, 1993). It is important to note that items with a ranking of 2.5 and higher are closer to dissatisfaction, and are crucial items that would affect the levels of overall satisfaction with the dwelling unit. A low score (closer to 1) on this table means respondents are more satisfied with the item but does not tie it directly to current housing satisfaction or provide a weight to see how important that factor is. Regression analysis can provide these insights. This is discussed next.

5. Explanatory Work Using Regression Analysis

Multiple regression analysis is used to find out whether any relationships exist between current housing satisfaction (dependent variable) and the various independent variables. A data set based on survey responses was prepared and cleaned, and then the software program Minitab was used to process the data. From the regression results, we are able to find statistically significant independent variables that explain current housing satisfaction, holding all other variables in the model constant.

Several models were run prior to development of the best model, which is shown as Table 6. None of them had a higher R-squared, which is the generally accepted aggregate measure of a model's usefulness. Several variables were related to each other, so the Variance Inflation

Table 5: Current situation list of levels of satisfaction (scale 1 to 5, 1 being most satisfied and 5 being least satisfied)

Food shopping	1.59
Kids' primary and secondary schools	1.65
Hospital/Clinic	1.78
Creche/Daycare	1.84
Access to public transportation	1.91
Johannesburg CBD	1.96
Full utilities (water, electricity and sewerage)	1.99
Technikon (technical college) and university	2.11
Access to extended family	2.47
Safety	2.63
Housing quality	2.69
Housing satisfaction	2.69
Housing value increase (appreciation)	2.72
Avoiding environmental pollution	2.77
A vegetable garden	2.89
Housing size	2.93
Housing subsidy	3.33

Factor (VIF) was minimised (under 10) in order to control for this multicollinearity issue. An alternative model, ordinal regression, was also run using just the index variables, and these results are presented in Appendix 1, which features Table 7 (results of ordinal regression).

Because we had several sets of nested ordinal variables, in order to avoid the dummy variable trap we needed to exclude one from each set in Table 6. The omitted variables, which are implicitly included in the constant term of the model are: renter, age 40s, male and education high school (matriculation degree).

In order to interpret individual variables, three factors are important. The first is statistical significance. We report on variables that are statistically significant at an 85 percent level of confidence or better (p=.15 or smaller in Tables 6 and 7), with a smaller p having a higher level of statistical significance.

Assuming the variable is statistically significant, the second factor is the sign of the variable, positive or negative. Because the dependent variable CURHOSAT is an index variable with the lower numbers (1 is best) indicating higher levels of satisfaction, the interpretation of the sign of independent variables that are also on the same 1 to 5 scale (for example, CURFOOD-proximity of food stores, and CURCBD -proximity to central business district, or any other variable starting with a CUR***) is as follows: an index independent variable with a significant positive sign has the interpretation of being positively associated with increased housing satisfaction.

However, some variables are not an index, but have other forms. These may include dummy variables (a yes-no item such as gender, own car, rent home, etc.); or nested dummies in a series to reflect one of several age, income or education ranges; or continuous variables such as persons per household. The integer or dummy variables have the opposite interpretation: a negative sign indicates a positive effect on housing satisfaction (consistent with a larger number, which is lower satisfaction).

Finally, the housing satisfaction deficit vector variables are calculated as CUR-ID*** (current score for an index item less its corresponding ideal value for that same index item). This generates a positive number (or 0) – and the larger the positive number, the larger the deficit between ideal and current status for that variable. Thus, a positive sign on any CUR-ID variable is associated with a decrease in housing satisfaction.

The third factor important to interpretation is the magnitude of the variable, assuming it's statistically significant. A larger value indicates a larger effect on housing satisfaction than a smaller number.

5.1. Model Results

Overall, the best model had an adjusted R-squared of .424, indicating that the independent variables in the model combined explained 42.4 percent of the variation in the dependent variable. This is satisfactory for research of this type. Table 6 contains the results.

Table 6: Multiple regression results

Predictor	Coef	SE Coef	T	P	VIF
Constant	.1661	0.4501	2.59	0.010	
own	-0.0330	0.1376	-0.24	0.811	1.678
bond	0.2651	0.1571	1.69	0.093	1.793
curfood	0.2362	0.09948	2.38	0.018	4.767
curcbd	-0.01174	0.05718	-0.21	0.837	2.508
curcreche	0.0751	0.05819	1.29	0.198	1.812
curkidsc	0.1477	0.07838	1.88	0.061	3.177
curtechn	-0.11989	0.06816	-1.76	0.080	3.752
curhosp	-0.09291	0.08923	-1.04	0.299	5.279
curfamily	0.0867	0.05914	1.47	0.144	2.695
curvegg	-0.02884	0.05776	-0.50	0.618	2.863
curpubtr	0.0363	0.01997	1.82	0.070	1.452

Table 6: Multiple regression results (continued)

Predictor	Coef	SE Coef	T	P	VIF
curavpol	0.0128	0.06325	0.20	0.840	3.057
curutil	0.0343	0.04508	0.76	0.448	1.479
curhosub	-0.05625	0.05813	-0.97	0.334	3.697
curappec	0.03678	0.06045	0.61	0.543	3.356
cursafet	-0.01522	0.09050	-0.17	0.867	7.241
curhoqua	0.22967	0.05993	3.83	0.000	2.956
curhosz	0.1269	0.1061	1.20	0.233	8.982
wbus	-0.5813	0.2723	-2.13	0.034	1.279
wtrain	0.1810	0.2294	0.79	0.431	1.446
wowncr	-0.2478	0.1823	-1.36	0.175	2.787
wtime	-0.00154	.002906	-0.53	0.596	1.765
workrand	.009048	.005835	1.55	0.122	2.229
needhsub	0.1829	0.1909	0.96	0.339	1.602
chinf	0.1047	0.2243	0.47	0.641	2.163
chrdp	0.2216	0.2571	0.86	0.390	1.815
chformal	-0.2994	0.1868	-1.60	0.110	3.060
age20	0.0463	0.1706	0.27	0.786	2.379
age30	-0.1630	0.1518	-1.07	0.284	2.002
age50	0.2620	0.2367	1.11	0.269	1.352
age60	0.0274	0.2862	0.10	0.924	1.412
age70+	0.8727	0.7000	1.25	0.214	1.257
educ <gr10	-0.2699	0.2289	-1.18	0.240	2.150
educ_gr10	0.0742	0.1632	0.45	0.650	1.661
educ scol	-0.0489	0.2178	-0.22	0.823	1.756
educ cgrad	0.2916	0.2027	1.44	0.151	2.463
educ p grd	0.2897	0.2472	1.17	0.242	2.007
college	-0.02835	0.09446	-0.30	0.764	1.898
persons/hh	0.01136	0.04240	0.27	0.789	3.590
kids/hh	0.04663	0.05756	0.81	0.419	3.050
empl/hh	-0.06911	0.06916	-1.00	0.319	1.839
inc <2 500	-0.3628	0.2101	-1.73	0.085	2.500
inc 3 000	-0.2831	0.1708	-1.66	0.099	2.231
inc 4 000	-0.3032	0.2224	-1.36	0.174	1.625
inc 6 000	-0.1970	0.2539	-0.78	0.439	1.483
inc >7 500	-0.2841	0.1910	-1.49	0.138	2.745
gender	0.0867	0.1311	0.66	0.509	1.475
cur-id food	-0.1664	0.08676	-1.92	0.056	4.361
cur-id cbd	0.07577	0.05089	1.49	0.138	1.947
cur-id kid prm	-0.08391	0.06592	-1.27	0.204	2.490
cur-id tech	0.04788	0.05935	0.81	0.421	2.822
cur-id hosp	0.18218	0.07198	2.53	0.012	4.444
cur-id family	0.02764	0.04979	0.56	0.579	2.403
cur-id veg g	0.03650	0.04773	0.76	0.445	2.727
cur-id av pol	0.00304	0.05179	0.06	0.953	2.969
cur-id hous subsidy	0.05680	0.05184	1.10	0.274	4.267
cur-id hous appreciation	0.07722	0.05053	1.53	0.128	3.290
cur-id safety	0.08018	0.07920	1.01	0.312	6.468
cur-id hous size	-0.09910	0.08936	-1.11	0.268	7.850

We now evaluate the results of each vector of variables in turn.

OWN. This vector of variables is related to the respondent's housing tenure. The BOND variable (mortgage) had a parameter estimate of 0.26, and was statistically significantly related to housing satisfaction at a p=10 level. The positive sign means it is associated with decreased housing satisfaction, perhaps revolving around the stress of making payments, especially with an unstable economy/job market. The parameter on the FORMAL variable was -.30, and was statistically significant at p=11. The negative sign indicates it is associated with increased housing satisfaction. Both BOND and FORMAL variables had large parameter estimates. It is important to bear in mind that 35 percent of those who own a home have a bond. Since owners in general (according to the peer-reviewed literature) have a higher housing satisfaction level than non-owners, then this would mean that we should see a positive effect of ownership (rather than income) on housing satisfaction – but we do not. None of the other variables in this vector, such as OWNing a home, INFORMAL status (rent or own) and RDP home were statistically significant.

NEIGHB. This vector includes all neighbourhood variables concerning nearby amenities, off-site of the unit itself. There are several of these variables and, since they are an index, a positive and significant sign means more housing satisfaction. Three variables were positive, and one negative.

The CURFOOD variable shows the respondents' current satisfaction with access to a food shop. The sign was .23 and positive, meaning a change in food satisfaction was positively related to a change in housing satisfaction. However, the variable was only statistically significant at p=.15. Access to KIDSSCHool was likewise .14, positive and statistically significant at p=.06. Access to PUBlic TRansportation was also positive and significant (at p=.07) with a relatively small positive value of .04.

A negative and significant variable (at p=.08) was access to a TECHNikon (community college), which had an estimate of -.12, meaning this variable is associated with lower housing satisfaction. This requires further investigation with the data, or more research to determine the reason behind the negative relationship with housing satisfaction. Later we do find significance with expectations about access to this item.

None of the other variables, including access to the CBD, SAFETY, CRECHE (daycare), VEGG (vegetable garden, or HOSPital were statistically significant.

UNIT. The next vector is current unit characteristics. It contained several index variables, including utilities, housing size, housing quality, having a current housing subsidy and current housing appreciation. The only variable that was statistically significant was current housing quality, which had a parameter estimate of .23, positive and significant at over p=.01. It seems that housing quality (construction materials etc.) is strongly tied to housing satisfaction in a positive way. It's not necessarily that the other variables were not important, but their values may not vary (e.g., everyone now has utilities, or all areas are appreciating in line with the growth of the Johannesburg market, which at that point in time – late 2005/early 2006 – was increasing by about ten percent per year in many sub-markets). Another aspect is that housing quality is under the control of the person living in the house: they can paint it, improve it, redo the bathroom or kitchen, etc., all of which could increase housing satisfaction.

FAMILY. The CURFAMIL variable shows the respondents' current satisfaction with access to family. The sign was .09 and positive, meaning a change in access to family satisfaction was positively related to a change in current housing satisfaction. However, at p=.14, it was barely significant. The variable for KIDS/HH was not significant. Based on the magnitude of the parameter estimate, it would appear that family matters less to housing satisfaction than other factors.

TRANSPORT. This vector looks at the time and money required to get to work, as well as the mode of transportation and car ownership. Since all these variables are integer or dummy variables, a negative sign indicates a positive effect on housing satisfaction. There were five variables, three on how the respondent got to work, and two on commuting time and expenses.

BUS commuters had a parameter estimate of -.58 (strongly significant at p=.03), and hence were positively associated with higher housing satisfaction. CAR and TRAIN commuting were not significant, and neither was commuting time. Commuting cost was a positive at .009 (p=.11), indicating that for an extra rand of daily commuting expense, housing satisfaction went down a minute amount. Taken at the mean travel cost of 13 rand, this works out to a magnitude of .11 in reduction of housing satisfaction.

DEMOGR. The second-to-last vector is demography, including age, education, income, household size and gender. The significant variables all have a negative interpretation (a negative sign indicates positive housing satisfaction). The interpretation is relative to a man in his 40s, who has and income of 5 000 rand per month and has obtained a matric (high-school diploma). Most of the variables were not significant, and the only ones that were significant were income-related. Respondents with income of less than 4 000 rand per month (including the poorest group) reported significantly HIGHER satisfaction (both categories significant at better than p<.1), with magnitudes of between -.28 and -.36. The highest income group reported almost identical results, but with slightly lower significance (p=.14). That lower incomes have higher housing satisfaction, holding all else constant, appears counterintuitive, however.

HDEFICIT. Finally, the housing deficit vector is addressed. Adding the entire vector to a model without the vector increased the model R-squared by about two percent, indicating that the vector of housing deficit variables adds net explanatory power. The vector contains a dozen variables, all calculated to reflect the current score for an item, minus the ideal score (CUR-ID***). For example, if a respondent ranked current access to food as a 3, but ranked ideal access to food as very important (1), that score (current-ideal) would be scored +2. Alternatively, if the respondent was satisfied with access to family (both current and ideal scores were 1), this would net a deficit CUR-ID FAMILY score of 0. Four of the variables were statistically significant. CUR-IDFOOD scored a -.17 (with a p=.06), indicating that a perceived access to a food store exceed expectations and positively impacted current housing satisfaction. The other three significant deficit variables had positive scores but were tied to lower housing satisfaction: the parameter on CUR-ID CBD (proximity to the central business district) was positive at .08 (p=.14); the parameter on CUR-ID HOSPital was positive at .18 (p=.01); and the parameter on CUR-ID housing APPRECiation was positive at .08 (p=.13).

6. Conclusions

This study is the first that the authors are aware of that uses regression analysis in a developing country context to investigate the determinants of housing satisfaction, including housing deficits for specific factors. This research can also advise housing policy. The power of regression is such that each variable's interpretation holds constant all the other variables in the model.

Among the OWN vector, only the bond variable (showing decreased current housing satisfaction) and formal status (higher satisfaction) were statistically significant. The significance of formal status is obvious, because of the security and certainty of tenure status, and this demonstrates that providing people with formal ownership is an important housing policy. Bond being negative may be associated with the stress of making expensive mortgage payments.

Moving to the NEIGHBOURHOOD vector, access to food, public transportation and kids' school were all associated with more housing satisfaction, which makes sense. On the other hand, access to a technikon (trade school/junior college) had a negative sign, perhaps viewed as a dis-amenity due to nuisance. There could be other explanations, so this item deserves future research.

Within the UNIT itself, only housing quality (integrity of the structure) was statistically significant. Apparently, size itself does not matter, holding all else constant. As mentioned this is a major thing that the dweller can control, making the housing quality better by him/herself (sweat equity).

The TRANSPORTATION vector had two significant variables. Bus commuting was associated with higher housing satisfaction, although the reason is unclear: it's not purely

location because we already know (from above) that living near public transportation increases satisfaction. Increased commuting costs indicated lower housing satisfaction, for obvious reasons.

The DEMOGRaphy vector was surprisingly void of significant variables. Both lower- and upper-end income were associated with higher housing satisfaction, holding all else constant. Housing satisfaction at the upper end of the income ranges is obvious (money can buy happiness?) – but, curiously, less wealthy (poor, actually) respondents also exhibited satisfaction. Perhaps general optimism has rubbed off on them or they are enjoying puttering around the house in their leisure time; or they are retired, lower-income and enjoying life.

Finally, HDEFICIT variables that were significant included perceived access to food (just fine) and three negative factors (could be better, associated with decreased housing satisfaction): housing appreciation, access to the CBD and hospital. It seems respondents' expectations were not being met in these important basic service areas.

With respect to magnitude of the statistically significant variables, we rely upon the magnitude of the parameter estimates for significant variables. The top factors associated with greater housing satisfaction (signs normalised here to facilitate interpretation) are: bus (.58) housing formality (.30), income (.28 to .36 – both low and upper ends were more satisfied with housing), access to food (.23), housing quality (.23), exceeded expectations on access to food (.17), access to kids' school (.14), access to family (.09), and access to public transportation (.04). The top factors associated with lower housing satisfaction (signs again normalised here to facilitate interpretation) are: bond (-.26), unmet expectations on access to hospital (-.18), lack of access to a technical college (-.12), commuting costs (-.11 at the mean of 13-rand per one-way trip), unmet expectations on access to CBD (-.08), and unmet expectations on housing appreciation (-.08). More research needs to be done in this area.

Implications for public policy are somewhat cautioned, because we have a non-random sample. However, the attitudes of respondents are nevertheless interesting and could be instructive for public investment in south Johannesburg. The "big-ticket" items are that residents generally want better access to the CBD, technikon and hospitals. They are also stressed out about bonds (perhaps a lower interest rate) and wish their commuting costs were lower (subsidised transportation cost to work). They were frustrated that their housing appreciation was lower than expected, so homeowners should be educated on sub-market activity. Finally, housing formality was enjoyed, so moving people out of informal housing (legally and/or physically) would be beneficial. Since they are generally satisfied with access to public transportation, subsidies could be guided to reducing cost rather than creating new facilities

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Appendix 1: Ordinal Regression

Considering that the current variables in our data are mainly index variables, we alternatively used ordinal logistic regression to process our current variables. These are shown on Table 7. For technical reasons, interpretation of signs is reversed from the above analysis of index variables.

From the ordinal logistic regression model, we conclude that curfood, curtechn, curfamil, curpubtr, curappec, cursafet and curhoqua are statistically significant variables at a level of p<.15 or better.

The curfood variable shows the respondents' current satisfaction with access to food. The sign was negative, meaning when the access to food increases by one unit, the odds of the housing satisfaction score going up (meaning less satisfied) go down by 1-.84=.16=16%, increasing satisfaction.

The curtechn variable shows the respondents' current satisfaction with access to a technical college. The sign is positive, meaning when the access to a technical college increases by one unit, the odds of housing satisfaction increasing go down by .26=26%.

The curfamil variable shows the respondents' current satisfaction with access to family. The sign was negative, meaning when the access to family increases by one unit, the odds of housing satisfaction increasing go up by 1-.83=.17=17%.

The curpubtr variable shows the respondents' current satisfaction with access to public transportation. The sign was negative, meaning when access to public transportation increases by one unit, the odds of housing satisfaction increasing go up by 1-.86=.14=14%.

The curappec variable shows the respondents' current satisfaction with access to current housing appreciation. The sign was negative, meaning when the access to current housing appreciation increases by one unit, the odds of housing satisfaction increasing go up by 1-.82=.18=18%.

The cursafet variable shows the respondents' current satisfaction with safety near their unit.

The sign was negative, meaning when the safety near their unit increases by one unit, the odds of housing satisfaction increasing go up by 1-.80=.20=20%.

The curhoqua variable shows the respondent's current satisfaction with housing quality. The sign was negative, meaning when the housing quality increases by one unit, the odds of housing satisfaction increasing go up by 1-.55=.45=45%. Table 7 follows with the results.

Overall, many of the same variables are significant in this section as in Table 6, and a new variable – safety – is also statistically significant.

Acknowledgments

Thanks to the Fulbright Foundation for the Fulbright scholarship at the University of the Witwatersrand in Johannesburg, South Africa, that made this research possible.

Table 7

Predictor	Coef	SE Coef	Z	P	Odds ratio	95% super low	CI upper
Const(1)	-1.33372	0.720960	-1.85	0.064			
Const(2)	2.30270	0.459498	5.01	0.000			
Const(3)	3.65660	0.482031	7.59	0.000			
Const(4)	6.55922	0.582827	11.25	0.000			
Const(5)	7.68126	0.624716	12.30	0.000			
Curfood	-0.180226	0.103768	-1.74	0.082	0.84	0.68	1.02
Curcresh	-0.159861	0.114408	-1.40	0.162	0.85	0.68	1.07
Curkidsc	-0.029022	0.113330	-0.26	0.798	0.97	0.78	1.21
Curtechn	0.233040	0.090049	2.59	0.010	1.26	1.06	1.51
Curhosp	-0.106974	0.097338	-1.10	0.272	0.90	0.74	1.09
Curfamil	-0.187388	0.086746	-2.16	0.031	0.83	0.70	0.98
Curvegg	-0.000574	0.080110	-0.01	0.994	1.00	0.85	1.17
Curpubtr	-0.146503	0.100186	-1.46	0.144	0.86	0.71	1.05
Curavpol	-0.047616	0.084413	-0.56	0.573	0.95	0.81	1.13
Curutil	-0.017480	0.088041	-0.20	0.843	0.98	0.83	1.17
Curhosub	-0.031071	0.074654	-0.42	0.677	0.97	0.84	1.12
Curappec	-0.199478	0.088895	-2.24	0.025	0.82	0.69	0.98
Cursafet	-0.227193	0.093565	-2.43	0.015	0.80	0.66	0.96
Curhoqua	-0.590711	0.119125	-4.96	0.000	0.55	0.44	0.70
Curhosz	-0.130808	0.117918	-1.11	0.267	0.88	0.70	1.11

Inadequacies in Development Viability Appraisal Studies in the Nigerian Property Market

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Abstract

This paper examines the types of errors and flaws that have contributed to the low acceptance of development viability appraisal studies in the Nigerian property market. This is to ensure improvement in the quality of the appraisal studies. Questionnaires were administered on 70 randomly selected estate surveying and valuation firms (real estate practitioners) in the Lagos metropolis. The sample represented 31% of the 228 estate firms in the study area. The data collected was analysed with the use of frequency distribution and percentages as well as mean/standard deviation measures. The results of the analysis shows that low-quality service in viability appraisals is mainly the result of six factors. These are the criteria being used; the lack of market data; erroneous adoption of input values; in-attention to economic indicators; erroneous view of viability studies by investors; and the conservative attitude of most practitioners towards new developments in the real estate profession. The conclusion drawn centres on the need for improvement in the quality of viability appraisal services, and the provision of centralised and publicly available transactions.

Keywords
inadequacies, development viability appraisal, Nigerian property market, risk adjustment methods

1. Introduction

It is axiomatic that the main aspect of property development and investment, like any other investment medium, is the initial decision-making, where investors have to select the best investment opportunity among many available alternatives. Viability appraisal study deals with this process of assessing the profitability of alternative investments with a view to selecting the best. It is generally referred to as the second component of development appraisal, of which a feasibility study is the first component.

While a feasibility appraisal/study deals with the fundamental question of the practicability of development proposals prior to construction, a viability appraisal involves the use of financial models and calculations to analyse the profitability of development proposals, and to determine the return accruable to an investor from the proposed developments. Preparation of a viability study centres on deriving projections of variables such as rent, sales price, costs and other relevant variables to determine the profitability of a proposed development.

A well-prepared viability appraisal provides a substantial level of professional shielding of property developers from the ravages of risk and volatility (Baum et al., 1997). Thus for the past three decades, considerable attention has been devoted, in appraisal literature, to the course of real estate investment feasibility and viability studies in both the developed and developing nations. (See for example Adisa, 1997; Ajayi, 1996; Ajayi and Fabiyi, 1984; Eldred and Zerbst, 1978; Farragher, 1982 and 1984; Ibuoye, 2000; Louargand, 1992; Ogunba, 2004; Opaleye, 2000; Oyeduntan, 2004; Page, 1983; and Umeh, 1977.) It can thus be concluded that demand for feasibility and viability studies has increased.

After several years of practice with viability studies, it appears that experiences have shown that many potential clients and investors in Nigeria have become disenchanted with their use. Indeed, unless compelled by law, many investors will undertake development propositions without prior appraisal of the available alternatives. Paradoxically, recent surveys have suggested that the dominant reason for the high number of loan defaults and abandoned projects in Nigeria involves inadequacies in feasibility and viability appraisal studies preceding such projects (Adejumo, 2000 and Joseph, 2002).

Similarly, Olaleye (2000 and 2005) found evidence to support the fact that the risk and uncertainty problems were not recognised in the appraisal/diversification and property portfolio management practice in the Nigerian property market. Oyeduntan's (2004) findings also reveal that institutional investors/developers in the Lagos metropolis were dissatisfied with appraisers' reports in viability studies based on the differences between their reports and reality. The corollary of this discussion is that it appears that the investors/developers in the Nigerian property market are no longer feeling enthusiastic and have become disenchanted with using feasibility and viability studies as the basis of their property-investment decision-making.

The above rejection and disenchantment of investors with feasibility and viability appraisal studies notwithstanding, the concept of researching and appraising investments prior to large outlays of capital, as in property investment and development, cannot be ignored. Authors such as Hargitay and Yu (1993) opine that diversity in the investment market creates the problem of choice, requiring the establishment of criteria and rational bases for decision-making. Furthermore, because uncertainty is the prevailing climate within which property development takes place, it is important for an investor to evolve a judicious investment decision-making process devoid of intuition and rule of thumb. Economic forces are not understood well enough for predictions to be beyond doubt (Markowitz, 1991). The assessment of the desirability (or of an individual investment proposition) in terms of feasibility and viability studies is thus important.

As a result of the above, what needs to be done in the Nigerian real estate market is an improvement in the quality of the services being rendered in development appraisal, especially in terms of decision-making methods/criteria, rather than a discounting of the investment appraisal concept. As a first step towards improvement, there is a need to recognise the type of errors or deficiencies that have contributed to the disenchanted attitude of investors towards development viability appraisal practice in the Nigerian property market. This is the thrust of this paper.

The remainder of the paper is divided into four sections. Following the introduction, the second section focuses on the literature review. In section three, the methodology employed in carrying out the study is discussed, while section four presents the results of the survey. The paper concludes in section five.

2. Literature Review

A wide range of viability appraisal techniques (decision tools) can be identified. These range from a simple rule of thumb to full-scale quantitative risk analysis techniques. Meanwhile, approaches to pre-investment or viability analysis are divided into two main categories. The first is the traditional or conventional approach, which features residual valuation, payback period and return on cost; the second is the contemporary discounted cash flow analysis, which includes the net present value (NPV) method, internal rate of return (IRR), profitability index and net terminal value (NTV) method (Ajayi, 1996).

In addition, Ajayi (1996) and Ogunba (2004) subdivide viability appraisal techniques into two categories, following the manner in which risk is considered and taken care of in the development appraisal process. The first, which is the deterministic or point-estimate method, employs decision tools such as residual valuation, payback, return on cost, net present value or internal rate of return by assuming that the variables used in pre-development viability calculations are not subject to variations. Where variation is assumed to be present at all, this is taken care of by means of rule of thumb or rudimentary adjustment of volatile variables such as construction costs, rather than through quantitative analysis. In other words, when this method is used, appraisers correct for risk implicitly. Such a method, which may be adequate in circumstances where there is little or no volatility, is inadequate under circumstances of increasing unpredictability and volatility (Ajayi, 1996 and Ogunba, 2004). Thus a defective viability appraisal study is expected whenever this method is used.

The second approach, called the probabilistic development appraisal technique, in using any of the decision tools employs explicit analyses to scrutinise the variations in viability appraisal calculations (Louargand, 1992; Marshall and

Kennedy, 1992). This method, which uses tools such as sensitivity analysis, break-even analysis, risk adjusted discount rate, certainty equivalent or risk adjusted cash flows (mean variance analysis), stochastic decision trees and Monte Carlo Simulation approach to analyse risk in development appraisal, is considered appropriate under conditions of high volatility (Ajayi, 1996).

Relevant studies in developed property markets such as the US, the UK and Australia have identified shortcomings in viability studies in the past and have shown that the various appraisal methods came to varying degrees of usage among investors and practitioners. For example, in the US, Eldred and Zerbst (1978) examined 45 feasibility reports prepared by consultants, appraisers and market analysts and identified faulty financial calculation, unspecified research direction, omission of primary data, misrepresentation of supply and demand, and unwarranted recommendations as the main deficiencies in appraisal practice in the country.

The findings of Farragher (1982, 1984), McIntosh et al. (1987) and Page (1983) in the UK, which examined real estate investors' decision-making practices/processes, showed evidence to suggest that more investors were adopting sophisticated techniques of investment decision-making as found in theoretical developments. Marshall and Kennedy (1992) showed that five percent of UK practitioners used Monte Carlo Simulation, while Louargand (1992) found that 48 percent and seven percent of the sampled populations (real estate plan sponsors and advisors) in the US employed sensitivity analysis and mean variance analysis (certainty equivalent) respectively in their decision-making. Dirk and De Wit (1996) indicated that 21 percent of appraisers in the Netherlands employed risk adjustment when evaluating real estate returns. In Australia, Boyd and Schwartz (1991) showed that up to 90 percent of appraisers corrected for risk explicitly, even though most of the appraisers admitted that the only exercises undertaken were those of basic sensitivity. One should, however, be cautious in accepting the outcome of these studies when related to developing markets such as the Nigerian property market. This is because the studies examined conceptual and empirical data that are not related to the Nigerian real estate market. Thus, some of the variables examined in the studies may not be relevant in the Nigerian context.

In Nigeria, papers and studies have also been conducted in the area of feasibility and viability appraisal/studies. Examples include Adisa (1997), Ajayi (1996), Ajayi and Fabiyi (1984), Ogunba (2004), Opaleye (2000), Oyeduntan (2004) and Umeh (1997). Umeh (1997) examined the theories and methodologies that can be used in feasibility and viability appraisal or in real investment decision-making. However, the paper did not provide empirical evidence of the practicability and shortcomings of these methods in practice. The same can be said of Ajayi (1996) and Ibuoye's (2000) works. In a similar vein, although Adisa (1997) and Opaleye (2000) examined empirically the criteria for investment decision-making in development appraisal, they did not specifically examine the deficiencies/errors involved in the practice of viability appraisal by practitioners. Ogunba (2004) explored the perceptions of three stakeholders (development surveyors, development lenders and corporate developers) on what Nigerian property appraisers should do to fully adopt probability risk adjustment in development appraisal without examining the deficiencies in viability appraisal practice. The same can be said of Oyeduntan (2004), who examined corporate clients' perception of feasibility and viability studies, and the factors responsible for their perception, without actually looking at the deficiencies in appraisers' services.

In a related study conducted by Ajayi and Fabiyi (1984), the state of feasibility and viability studies in Nigeria was examined with a view to highlighting the shortcomings in estate surveyors' and valuers' reporting patterns. Through the examination of 33 feasibility reports prepared by various valuers in Nigeria, similar results as in the Eldred and Zerbst (1978) study conducted in the US were obtained.

Many changes have taken place in the institutional and economic structure of Nigeria after Ajayi and Fabiyi's (1984) work. For example, with the advent of pension reform in 2004 and increased participation of institutional investors in property development, property investment and decision-making assumed new dimensions. It therefore remains uncertain as to whether or

not the current criteria used by estate surveyors in assessing real estate investment propositions are meeting the challenges of the market or that there are still shortcomings to be removed. The current paper therefore re-examined the practice of real estate investment viability studies with a view to exploring the deficiencies in the practice and finding ways of improving it. The study not only updated Ajayi and Fabiyi (1984) study but also adopted a different methodology aimed at collecting first-hand information from practitioners as opposed to the examination of reports prepared by the practitioners.

3. Data and Survey Methodology

The paper collected data from estate surveying and valuation firms in the Lagos metropolis. The study area was divided into five locations, namely Ikeja, Ikoyi, Victoria Island, Yaba/Surulere and Lagos Island. The decision to restrict the data collection to the Lagos metropolis was taken because 52% (228 out of 439) of estate surveying firms in Nigeria have their head offices located in the metropolis (The Nigerian Institution of Estate Surveyors and Valuers Directory, 2002). This implies that most of Nigerian property development or real estate investment activities and development appraisal practices take place in Lagos.

The study used a sample of only the estate surveying and valuation firms as development appraisers. These are firms of real estate practitioners who engage in property valuations and development appraisals among other real estate functions in Nigeria. The practitioners are called estate surveyors and valuers. Therefore, as property experts, estate surveyors and valuers are assumed to have a better understanding of the peculiar characteristics of property and be able to apply this in the process of appraising property investment than other professionals.

A self-administered questionnaire was used to elicit information and find out the techniques that are being used by practitioners as decision criteria/techniques when conducting viability appraisal of real estate investments, with a view to identifying and highlighting the errors in the appraisal practice. The questionnaire contained 20 questions divided into two sections (A and B). Section A obtained information about estate firms' profiles, such as their years of establishment and experience with viability studies, among others. Questions in Section B obtained data on issues relating to the frequently used decision criteria by estate firms in viability appraisal, the objective(s) behind the development appraisals conducted in the past, sources of information for such appraisals, and methods for adjusting for variations in viability appraisal, among others.

A total number of 70 estate surveying firms, representing 31% of the 228 estate surveying firms in Lagos, were randomly selected for questionnaire administration having stratified the study area into five locations. Of the 70 administered questionnaires, 25 were returned. This represented a response rate of 35.71%, which can be regarded as low. The low response is, however, consistent with that encountered by most researchers in Nigeria, and reflects the natural reticence of practitioners to field research.

Data collected was analysed with the use of frequency distribution and mean of factors/methods examined. In using mean, scores of 1, 2, 3, and 4 were assigned to most frequently used, frequently used, of less usage and not in use respectively, where responding practitioners were expected to rank their frequency of usage of certain methods in practice. The mean shows the factors with the highest ranking by the respondents. As used in this paper, the factor with the lowest mean has the highest ranking among respondents.

4. Data Analysis and Findings

This section presents the results of data analysis, starting by examining the decision-making criteria used by practitioners in development appraisal.

4.1. Decision-Making Tools (Decision Criteria)

Practitioners were asked to state the decision techniques/criteria they frequently employed in development appraisal. Table 1 presents the detailed responses. It can be observed that the three methods most commonly employed by practitioners were payback period, NPV and IRR.

The payback period method has the highest ranking, with a mean ranking value of 2.04. NPV and IRR came second and third, with mean values of 2.20 and 2.88 respectively.

Table1: Methods of appraisal adopted by practitioners

Methods	Most frequently used		Frequently used		Less frequently used		Not in use		Missing			
	No of res	% of freq	No of res	% of freq	No of res	% of freq	No of res	% of freq	No of res	% of freq	Mean	Rank
Payback period	15	60	-	-	6	24	2	8	2	8	2.04	1
Return on cost	6	24	8	32	-	-	3	12	8	32	2.96	4
Residual method	6	24	-	-	8	32	8	32	3	12	3.08	6
Residual method	6	24	4	16	2	8	11	44	2	8	2.96	4
Net terminal value	4	16	2	8	-	-	17	68	2	8	3.44	7
Net present value	11	44	4	16	6	24	2	8	2	8	2.20	2
Internal rate of return	6	24	4	16	4	16	9	36	2	8	2.88	3

Source: Authors' field survey, 2006

No of res = Number of respondents
% of freq = Percentage of frequency
Total number of responses = 25

Table 2: Number of unprofitable projects recommended

No of unprofitable projects	Number of respondents	Percentage of response
10-20	11	44
21-30	2	8
31-40	2	8
41-50	4	16
51 and above	2	8
No response	4	16
Total	**25**	**100**

Source: Authors' field survey, 2006

4.2. Level of Success of the Method Used Most Often

To discover the level of success of the method used in viability appraisal, this paper examines the number of unprofitable projects recommended for implementation. This is with the belief that, all things being equal, the number of unprofitable projects recommended for implementation in the past should give an idea of the success/failure of the viability appraisal method used. The project must have been judged profitable before being recommended. The respondents' submissions are presented in Table 2.

It can be inferred from Table 2 that all respondents had a minimum of 10 unsuccessful development appraisals within the period of their establishment. A greater percentage (44%) of the responding estate surveying firms confirmed they had 10 to 20 unprofitable/unsuccessful projects within an average of 12 years that the firms had been in existence. This represents an average of 15 unprofitable projects within the period of 12 years (or 1.25 unsuccessful projects per year). This also represents a failure rate of 25%, given the fact that the firms were handling an average of five development viability studies per year.

It is therefore suggested that the methods of appraisal adopted are deficient when related to market sophistication vis-à-vis risk assessment in the market. This may explain why investors were disenchanted with their use, as found by Oyeduntan (2004). The analysis that follows thus tries to unravel the type of deficiencies in the practitioners' decision-making criteria and the reasons or factors responsible for the deficiencies.

4.3. Reason(s) for Carrying Out Appraisal

A question was asked as to whether viability appraisal studies were being carried out to select available alternative investments or to appraise a preconceived idea of a client (investor). This is necessary because it is considered that an analyst who agrees to carry out viability appraisal studies based on a preconceived idea (development) of his client will be tempted to prepare a viability study report with a false conclusion, apparently to establish his client's idea. The responses shown in Table 3 reveal that the main reason practitioners carried out feasibility and viability analyses of projects in practice is to verify the already-conceived idea of the investors.

Eighty percent of the practitioners supported this fact; only 20% submitted that they carried out an investment analysis in order to select among available alternative investments. This may, therefore, be responsible for errors in practitioners' decision-making criteria, and could explain why the practitioners normally derived their values (which in most cases are optimistic values) from some artificial standard. It also points to the fact that many of the investors who have commissioned market studies have done so only to obtain reinforcement for their preconceived ideas, as opposed to undertaking an objective analysis of various alternatives.

Thus one of the problems of inadequacies in feasibility and viability appraisal studies in Nigeria may have to do with the incorrect perception of many of the investors/developers with regard to the concepts. Many investors/developers are viewing feasibility and viability studies as a necessity required by law, rather than as a potentially effective aid to property development decision-making.

4.4. Sources of Information/ Data Inputs for Appraisal

As noted earlier, the preparation of viability study centres on deriving projections of supply and demand, to allow a prediction of relevant variables such as rent, sales price costs, and so on. To this end, the paper seeks to know the sources of information (input values) used by practitioners, and their adoption of those input values.

The results of the study show that 68% of the respondents agree that in-house data was most commonly used as a source of information for deriving primary data, while the same percentage (68%) agreed that market information from colleagues was only common in use. The usage of a centralised data bank was not common. This is not unexpected, since the property market in Nigeria lacks a centralised data bank and market index. The real estate appraisal practice has thus displayed imperfection mainly as a result of a lack of information, especially in the form of a centralised data bank. Information on transactions such as rental levels, sales prices and yields is woefully lacking in Nigeria. The usual practice is to access information through experience-cum-rule of thumb adjustment of in-house data. It is therefore difficult for estate surveyors as real estate practitioners to correlate or link the relationship of local economics with those at a regional or national level. The inability of the practitioners to make reference to leading economic indicators and their associated implications for the local market and the subject property must have added to the unreliability of viability reports in the Nigerian property market.

4.5. Deficiencies in Development Appraisal Methods Used

In an attempt to find out the deficiencies of the viability appraisal methods employed by estate surveyors and valuers, questions were asked as to whether the unprofitable developments were preceded by optimistic values, and whether they (the estate surveyors and valuers) provided for variations in their input values. Their responses are reported in Tables 4 and 5.

Table 3: Reasons for carrying out development appraisal

Reasons	Number of respondents	Percentage of response
To select among alternative investments	5	20
To appraise client's investment idea	20	80
Total	**25**	**100**

Source: Field data analysis, 2006

Table 4: Assessment of Optimistic Viability appraisal

View	Number of respondents	Percentage of response
Yes	9	36
No	12	48
No comment	4	16
Total	**25**	**100**

Source: Field data analysis, 2006

While 36% of the practitioners asserted that their appraisals were preceded by optimistic estimates of values, 48% said otherwise. Sixteen percent declined to comment (see Table 4).

On provision for variation or adjustments in input values (Table 5), 68% of the practitioners asserted that they normally provided for variation, while 12% said otherwise and 20% declined to comment.

While all of this points to the fact that appraisers take care of variations in input values in their practices, the analysis in Table 6 reveals that a greater percentage (72%) of the practitioners is adopting spot or deterministic values when appraising projects, leading to a single outcome of the appraisal's value. As such, their methods of provision for variations in data input still need to be investigated.

This will most probably reveal the deficiencies or the relevance of the estate surveyors' viability appraisal methods at protecting investors against the risk situation in the market. This forms the thrust of the next section.

4.6. Risk Adjustment Methods/ Provision for Variation

From the results of the analysis in Table 7 below, it is clear that upward adjustment of yield is the most favoured method being used when considering variations or risk in appraisal. It has the least mean value of 2.28. Upward adjustment of cost of capital or construction costs is also favoured and ranked second by the practitioners, with a mean value of 2.48. Although sensitivity analysis ranks third in the order of usage, the result shows that it is rarely used. Other methods of risk adjustment and analysis, such as risk adjustment discount rate, simulation analysis and decision tree, are rarely used.

It can therefore be inferred that practitioners' methods of analysing risk in their appraisal practices are by rule of thumb and intuition. This state of the art in the viability studies in Nigeria is thus at a level below the expectation/ development in the literature. For example, it is wrong to assume one value input for variables such as rent sales price, costs, expenses and yield

Table 5: Provision for variation in input data

View	Number of respondents	Percentage of response
Yes	17	68
No	3	12
No comment	5	20
Total	**25**	**100**

Source: Field data analysis, 2006

Table 6: Outcome of result from viability appraisal

View	Number of respondents	Percentage of response
Single outcome	18	72
Different outcome	7	28
Total	**25**	**100**

Source: Field data analysis, 2006

Table 7: Risk adjustment methods

Methods	Calculated mean	Standard deviation	Rank
Upward adjustment of yield	2.28	0.98	1
Upward adjustment of cost of construction	2.48	1.12	2
Sensitivity analysis	3.04	1.31	3
Risk-adjusted discount rate	3.20	1.15	4
Certainty equivalent cash flow	3.20	1.08	4
Monte Carlos simulation	3.44	0.74	6
Sliced income approach	3.60	0.76	7
Decision Tree	3.60	0.65	7

Source: Authors' field survey, 2006

No of res = Number of respondents
% of freq = Percentage of frequency

Eighty percent of the practitioners supported this fact; only 20% submitted that they carried out an investment analysis in order to select among available alternative investments. This may, therefore, be responsible for errors in practitioners' decision-making criteria, and could explain why the practitioners normally derived their values (which in most cases are optimistic values) from some artificial standard. It also points to the fact that many of the investors who have commissioned market studies have done so only to obtain reinforcement for their preconceived ideas, as opposed to undertaking an objective analysis of various alternatives.

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Source: Field data analysis, 2006

for use in the property market. A move towards this will mean that secrecy and confidentiality attached to property transaction data should be relaxed to allow for comprehensive data to be collated and analysed on a continuous basis. This will allow a near-accurate comparative analysis, linking the local economics with those at the regional and national level. As such, the current efforts of the NIESV, aimed at ensuring the compilation of historical and time series data or a centralised database in Nigeria, should be pursued speedily and to a logical conclusion.

iii. There is an urgent need for real estate practitioners to change their conservative attitude towards new developments in the profession (which could explain why they are not adopting contemporary methods of viability appraisal). Seminars, lectures and workshops should be organised to allow practitioners to develop and update their knowledge of new techniques and developments in feasibility and viability studies.

iv. In line with the above, investors and developers in the property market should be educated on the primary objective of feasibility and viability studies. Specifically, they should be encouraged, through enlightenment programmes by NIESV, to face the need to commission market and appraisal studies, with the aim of analysing different investment propositions and choosing the best, rather than obtaining reinforcement for their preconceived ideas.

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A Spatial Perspective to Managing Real Estate Information

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Abstract

Increasingly, the Geographic Information System (GIS), a component of the Information and Communication Technology (Geo-ICT) tool, is being used in the real estate industry to manage data and make intelligent decisions. Realising there is a spatial dimension to managing real estate, harnessing the GIS potential to real estate information handling is most logical and beneficial. This is because location drives most real estate decisions, including matching a home-buyer's criteria with a property portfolio. Moreover, several geographical elements – topography, availability of infrastructure, the setting of the estate (which is determined by the catchment areas, for example tenants in case of residential, shoppers in case of commercial) and selection of suitable sites for development – play an important role in real estate development. There is, therefore, a need to understand the potentialities of the GIS as applied to answering pertinent real estate questions. The power of the GIS lies in its analytical and mapping capabilities, via efficient desktop and/or web-based spatial and attribute data storage and handling. The paper describes the procedure utilised in designing and creating a database for urban real estate facility assessment and mapping. It is concerned with improving the effectiveness of managing urban residential housing at a neighbourhood level. An overview of the data model is presented, showing some relevant datasets and the relationships required for the application. In a bid to carry out this objective, the database is implemented using, as case studies, three neighbourhoods with differing residential densities in Ibadan metropolis, Nigeria (a UNCHS "Sustainable Urban Management Programme" city case study in 1996). The information will be particularly useful for those wanting to know and establish information systems or data banks for any aspect of real estate using the spatial framework provided by the GIS.

Keywords
database, data model, GIS, mapping, neighbourhood, real estate management, residential, spatial analysis, Ibadan

1. Introduction

Everything that concerns the built environment relates to property/properties located on parcels of land. Real estate is described as land and everything built on it, and the nature and extent of one's interest therein. The word "real" relates to immovable property; it refers to land as distinguished from personal property, and includes all property on the land and any rights attached to it. "Estate" is defined as the interest one has in property. Real estate may be acquired, owned and conveyed by individuals, business corporations, charitable organisations, religious organisations, and so on (Encyclopedia Encarta Premium Suite 2004 and 2008; Olaniyi et al., 2006).

The Geographic Information System (GIS) is particularly suited to data management, accurate analysis and mapping of real estate data. The essence of data management is to have data stored in an organised manner for easy retrieval to aid decision-making. The use of the GIS for real estate-related data handling is not only superior to manual (traditional) data-handling methods but also advantageous over other information systems, as it integrates data coming from different sources including graphics and pictures. Hundreds of layers of information can be put together for a real estate application, such as vacant parcels, building footprints and additional information including aerial photographs of the estate, road networks, topography, district or municipality zoning plans, utility distribution and demographics. A variety of information is required in order to plan and manage real estate development strategies. A lot of this information is spatial in nature, and therefore amenable to spatial analysis and presentation in the form of maps. About 80% of information used at all levels of development planning and decision making is spatial (Østensen, 2001 and Kolte et al., 2009).

Whether you work for a commercial real estate agency, multiple listing service, home builder

or a property management department in a corporation, harnessing the GIS potential to real estate management is most logical and beneficial because location drives the real estate industry. Several geographical elements – topography, availability of infrastructure, the setting of the estate (which is determined by the catchment areas, for example tenants in case of residential, shoppers in case of commercial) and selection of suitable sites for development – play an important role in real estate development (Olaniyi et al., 2006). By analysing data around locations using demographic data, aerial photographs, traffic counts, shopping centre usage, merchandise potential data and competitive influences, properties can be found to match exacting specifications.

The merits of one site over another can be modelled based on spatial parameters. From identifying the best fit for a new commercial development to matching a home-buyer's decision criteria, real estate practitioners are not just after finding any site but after finding the best site that meets their client's perceived needs (ESRI, 2007). To harness the full potential of the GIS for real estate in Africa in particular, it is essential for practitioners to understand the principles involved in data management using the spatial framework provided by the GIS (see Castle, 1998 and Fletcher, 2003).

Increasingly, the GIS is being used in several countries to inform real estate related decision-making and to design development strategies at different levels of operation. As customers more frequently want to get access to data via the internet, web-based GIS solutions are increasingly becoming popular.

An example of an existing application is the Real Estate Information System developed by the urban redevelopment authority of Singapore. It enables users to search by location (planning areas, postal codes, street names), contract date, type of property, transacted prices, etc. The stock database contains information on vacancy rate, available floor space, occupied floor space, and median rental rate by location for commercial and industrial properties (see https://spring.ura.gov.sg/lad/ore/login/findOutMore.cfm).

Other examples include the Real Estate Information System of Jinan City, China (Huiwu et al., 2001); the urban real estate valuation model, which incorporates a GIS that enables a spatial distribution analysis of urban industrial real estate asset values for Singapore, developed by Ming and Hin (2006); Trippi's (1989) examination of industry factors, design goals and functions of a decision support system used to improve major real property asset acquisition, improvement and divestment decisions; Fang et al.'s (2009) integrated information system for real estate agencies based on service-oriented architecture; and the Imapp system, which integrates a variety of real property information including property lines, tax roll data, area demographics, aerials, mortgage, and deed recordings and foreclosure information, with a specific focus on the real estate industry (see http://www.imapp.com/).

This paper describes a GIS-based residential real estate application. The steps utilised in the design and development of the spatial database are presented, as is their implementation. The data model consists of both spatial and non-spatial data sets, such as neighbourhood setting, that are used for assessing properties. Data modelling is required to better capture the components, processes and meanings of real estate assessment as any other geographic phenomenon, and translating the knowledge into a GIS (see Glennon, 2010). This work attempts to put together content for such a data model from looking at a developing country context. The paper outline is as follows: the introduction explains GIS use in real estate, some applications and a background to capturing real estate information in GIS. This is followed by a methodology section, and a description of the Entity-Relationship data model. Finally, some results from case studies are presented.

2. Background to Capturing Real Estate Phenomena in GIS

It is impossible to capture everything about real estate as it is in reality[1] (i.e., in the real world) on a computer. Instead, users must somehow abstract phenomena, or entities, as we see them in reality into symbolic representations amenable to spatial handling in a GIS. Real estate phenomena are a manifestation of an entity or process related to real estate that:

- Has a name and other characteristics
- Has a location (they are geographic and can be geo-referenced[2])
- Can be assigned a time at which it is/ was present

The relevant phenomena in a GIS application depend entirely on the objectives that are to be achieved through that application. For instance, in multipurpose cadastral administration, examples of the objects of interest are buildings, parcels, streets of various types, land uses and sewage canals, among other forms of urban infrastructure (Rolf et al., 2001).

2.1. Abstraction of Reality

The need to abstract (reduce complexity) arises as we try to represent reality, that is, our geographic space, which is vast on paper or a computer screen. We need to create an abstract model of that reality to help us interpret and analyse it. Three types of models that are mostly used in abstracting geographic space are object, field and network (Figure 1). Figure 1 is an illustration of these three perspectives of reality, with each emphasising different aspects of a phenomenon's location. Typical examples of field-based representations are phenomena that manifest themselves anywhere in the study area, such a temperature, elevation, land use classes and soil classes.

Other phenomena that do not appear everywhere, manifest only in certain localities and have well defined boundaries such as road, forest and buildings, are best represented as object-based. The choice of abstraction model for any application would depend on two main factors, namely the source of the original raw data and the questions required to be answered by the application.

In real estate management, concerned with capturing and mapping data at various levels (property, neighbourhood, administrative, etc.), an object-based perspective is best. The reason is each unit (land, property) must be distinguished, uniquely identifiable and individually measurable. (For details of abstracting models, see Heywood et al., 2002 Jones, 1997 and Rolf et al., 2001).

Success in GIS-based real estate application revolves around proper design and development of the spatial database. The analysis possible in a GIS is dependent on the way the data is structured and modelled in the database.

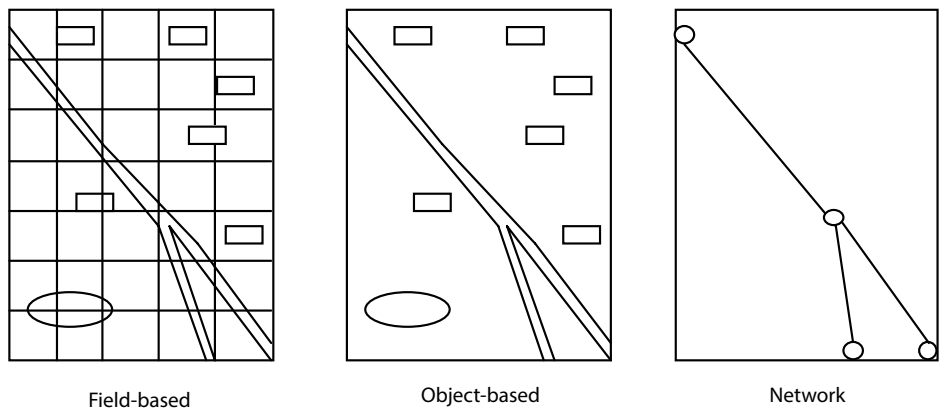
2.2. What is a Spatial Database?

A database stores data and provides the functions to manipulate the data. A spatial database is different from other types of databases because we are interested in storing geographic data – that is, data that have location attributes and provide functionalities to carry out, for example, distance and area measurements. All phenomena represented in a spatial database are linked to their location in the real world (where they occur), which is not possible in a non-spatial database (Rolf et al., 2001).

2.3. Database Design and Development

The design and implementation (construction) of the database are the two basic phases involved

Figure 1: Three widely used models of perceiving reality (Akinyemi, 1999)



[1] Reality is understood as being the real world, and sometimes it is referred to as geographic space.
[2] Geo-referencing implies that the object or phenomenon of interest has locational information with reference to where it occurs on the Earth's surface.

in database development. Database design is the information system planning activity where the contents of the intended database are identified and described. Database design is usually divided into three major activities (Elmasri and Navathe, 1989), namely conceptual, logical and physical modelling (see Figure 2).

Data modelling requires using rules, i.e. using a well-defined set of symbols (literal and/or graphic) with associated meanings to create the model and to communicate this model. In the next section, the Entity-Relationship model (ER model) is examined. The ER model is one of the most widely used methods for developing data models today (Ullman, 1988).

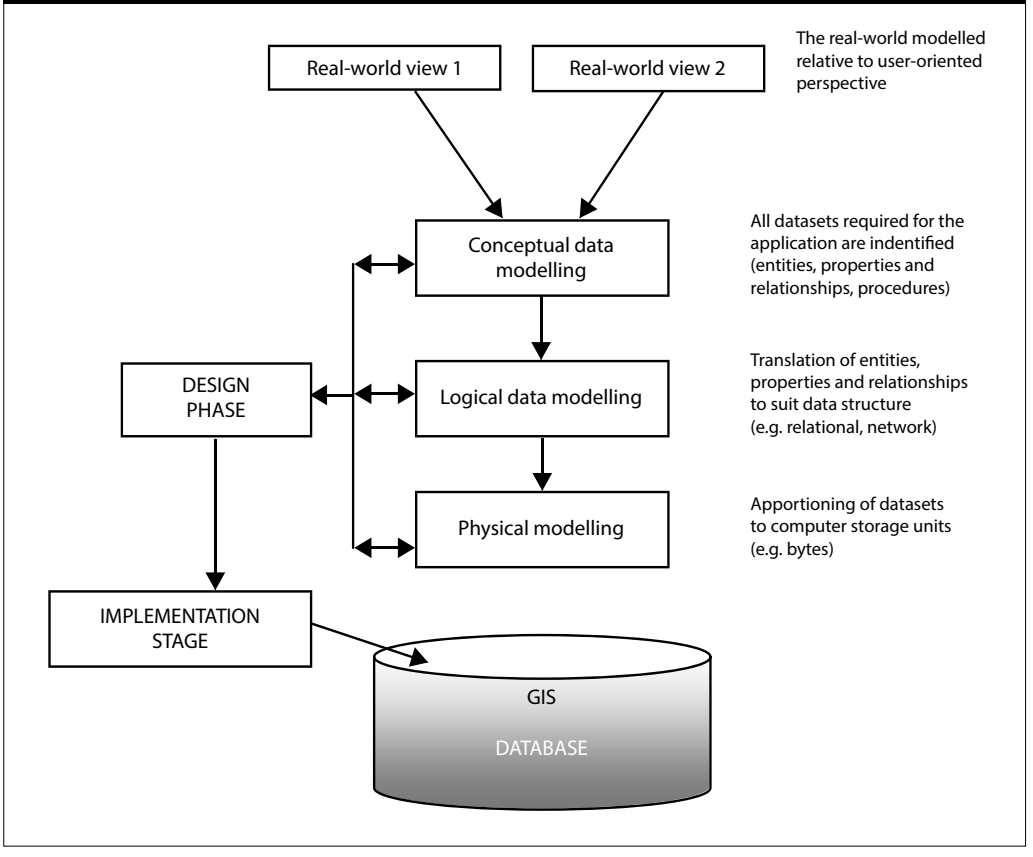
2.3.1. Entity-Relationship Modelling

The ER model adopts the more natural view that the real world consists of entities and relationships (Chen, 1976). It involves identifying, classifying, describing and relating parts of the real world to organise the information into a formal structure amenable to a computer form. Thus, it is useful to perceive reality as containing entities or objects, attributes or characteristics (properties) of the objects, and relationships between entities.

An entity is a thing that can be distinctly identified. A relationship is an association between two types of entities; it is usually identified by a verb or a preposition (e.g. Building Contained in Parcel). A relationship has a cardinality, which gives the number of times (minimum and maximum) it can occur between two specific entities (occurrences). For example, if we say that a Road Crosses a River a minimum of 0 times and a practical maximum of 5, and that, on the other hand, a River can be crossed by a minimum of 0 Roads and an unknown maximum of N, this leads to a relation to cross with a cardinality of 0,5 in one direction and 0,N in the other direction. An attribute is a characteristic of an entity type or a relationship (Bédard and Paquette, 1989; Akinyemi, 2010).

Entities and relationships are a natural way to organise physical things as well as information. The ER concept is the basic fundamental principle for conceptual modelling (Winslett, 2004, as cited in Akinyemi, 2010). ER modelling activities aim to:

Figure 2: Levels of data view in database development (Adapted from Akinyemi, 1999)



1) determine what entity types are involved;
2) determine which entity types are related; and
3) refine the definition of the relationships (see http://www.inf.unibz.it/~franconi/teaching/2000/ct481/er-modelling/).

Through the use of an entity-relationship diagram (or ER diagram), the logical relationships of entities are represented to create a database. In basic ER symbology, entities are portrayed as rectangles and relationships as diamonds, with the lines connecting the rectangular boxes defining the relationships between the entities. For example, 1:n, m:n and 1:1 relationship mappings are distinguishable in the ER diagram (see Table 1).

Table 1 explains some concepts used in the proposed residential properties data model. Location attributes of spatial data (e.g. parcel, neighbourhood) are formally expressed by means of the geometric features of points, lines or areal units (polygons) in the GIS. These levels of database modelling are further described when presenting the data model for urban residential real estate facility assessment and service mapping. (More notes on database modelling can be found in Date, 2003.)

3. Methodology

3.1. Study Area

The real estate information system described in this study is concerned with improving the effectiveness of managing residential housing at urban neighbourhood level in Ibadan Metropolis (a developing world context). Ibadan, Nigeria typifies a city that has recently metamorphosed from being traditional to modern (see Figure 3). With a population of 422 000 in 1950 and 2 509 000 in 2005, it is projected to have 4 234 000 inhabitants by 2025. (See UN, 2008 and http://nigeriannews.com/census/census2006.htm for additional details.) Factors that played a significant role in shaping its physical structure are government policies in designating Government Reservation Areas, where top government officials live, and the increase in the establishment of public and private housing estates.

3.2. Data

A questionnaire focusing on building characteristics was administered in three sample areas – neighbourhoods in differing residential density zones (RDZs) of the city, selected with the aim of capturing the city's heterogeneous socioeconomic and cultural situation.

The areas are Bodija, Mokola and Mapo (in Ibadan's inner city), representing a low, medium and high RDZ respectively. This method of neighbourhood zoning is based on Ayeni (1995), a study in which Ibadan was zoned using residential density as a basis for neighbourhood classification.

3.3 Methods

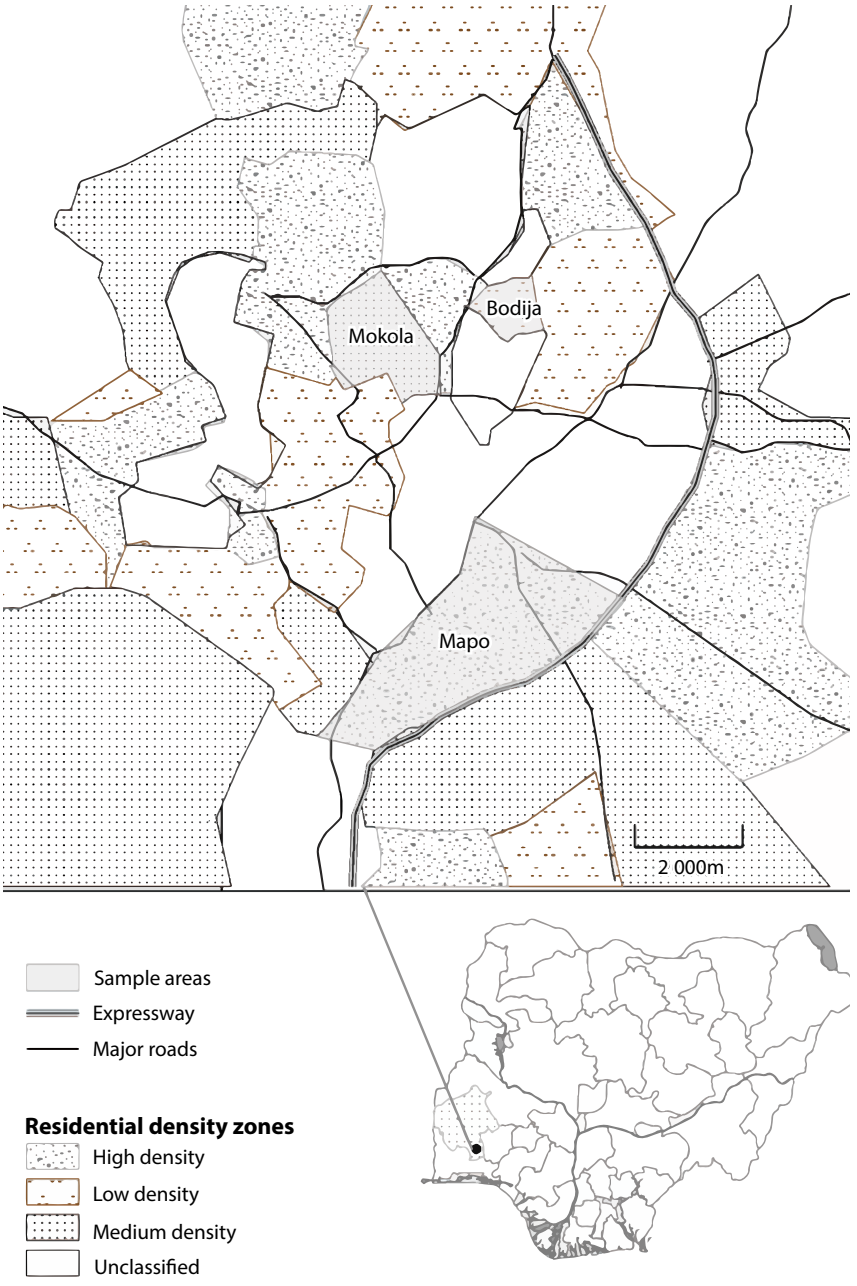
Using ILWIS 2.2 and ArcView 3.2 GIS packages, building outlines and roads were digitised from 1:1 000 scale cadastral maps with minimal update through fieldwork. In Mapo (high RDZ), the map shows several buildings as one, that is, a composite building formed by the merging of roofs. This occurred during aerial photographic capture due to the nearness of the buildings on the ground (high building density).

Table 1: Basic entity/relationship (ER) concepts

Concept	Informal definition	Examples	Symbol
Entity	A distinguishable object, person, concept or event about which we want information	Building, River, Road, Planning_Zone Parcel	Rectangle
Subtype	Entity whose existence depends on another entity; i.e. entity type Y is a subtype of entity type X if and only if every Y is necessarily an X	Residential, Commercial, Retail Outlet, Office, Educational are subtypes of Building Use	Double rectangle
Relationship	Describes the association interconnecting entities	Cardinality e.g. One to Many (1:m) relationship (Neighbourhood_Parcel)	Diamond
Properties or attributes	A piece of information that describes an entity	Building has size, number of rooms, use, value, amenities	Ellipse

Adapted from Akinyemi (2010)

Figure 3: Sample residential density zones in Ibadan / Inset map: Ibadan in Nigeria (Akinyemi and Elias, 2009)



Demarcating the buildings on the map proved difficult as we had no access to the original aerial photographs. Doing this arbitrarily could introduce error when digitising the map.

4. Urban Residential Data Modelling

4.1. Identifying Relevant Data Sets

There is a need to identify the relevant data sets needed in the application. Identifying typical data sets required for real estate management can be very daunting for practitioners such as property managers and agents. To have our application work well in managing residential housing, we needed to identify necessary data sets in the application. Let us have a look at typical information required for some real estate applications:

- Home listing service: type of property (e.g. single family); asking price; size (in m²); number of bedrooms, bathrooms, toilets; lot size; any other additional information such as garage size, school district;

- A client or broker looking for office space needs information such as address, name of building, rental rate, size, available space, amenities, and broker information.

The relevant information for a GIS-based real estate application can be augmented with aerial photographs, digital elevation models, building footprints, road networks and landmarks in the vicinity of the property. All required data sets must be identified prior to the design of the conceptual model. A data model is the product of the database design process, which aims to identify and organise the required data logically and physically.

4.2. Conceptual Data Modelling for Residential Properties

In conceptual modelling, all entities represented as spatial and non-spatial data sets, their attributes and the relationships between them are identified.

Based on the range of data sets identified for the residential properties application, key thematic layers to be represented in the database are identified (see Figure 4). Figure 4 is the conceptual model that uses the ER approach described earlier in subsection 2.3.1. The relevant entities are administrative areas such as municipalities, planning zones, neighbourhoods, parcels (developed and undeveloped) and buildings. It must be noted that the data sets described with their attributes (properties) are not exhaustive. More data sets can be added, depending on the types of query that are envisaged to be carried out within the application.

4.3. Logical Data Modelling

This is the representation of the conceptual data model to reflect the recording of the data in the computer system. Several data structures exist but we used the relational data structure in this paper since it is the popular structure supported by most commercial GIS packages. To translate the conceptual model in Figure 4 into a logical model, see below two examples of relations (tables) that were derived from the ER diagram in Figure 4.

R1 – Developed_Parcel (Polygon, Parcel_Id, BID, Owner_Name, C_of_O, LParcel, RParcel, PAddress, Area, Value);

R2 – Building (BID, Bno, Bname, Use, Type, Energy_Source, Wall, Water_Source, Nroom, Size, Amenities, Building_Value, Rental_Rate, Toilet, Bathroom, Broker, Available_Space, Floor, Address, Occupancy_Ratio);

Where "PARCEL" is one of the entities (relations);
"Parcel_Id" is the parcel identification number;
"Value" is the cash worth of the parcel of land.

4.4. Physical Data Modelling

At this stage, all the data types for the database are defined, and the computer storage space for the properties of an entity is determined. This is the implementation of the relational data structure (in subsection 4.3) in the format of the chosen GIS software – in this study, ESRI ArcGIS 9.3 is used. Data types for each of the attributes are defined according to those available in the software (see Table 2).

R1 – Developed_Parcel: [(Polygon, Parcel_Id short integer (3), BID short integer (4), Owner_Name Text (15), C_of _O short integer (4), LParcel short integer (5), RParcel short integer (5), PAddress Text (15), Use Text (15), Area Float (9,4), Value float (9,4)];

R2 – Building: [(Polygon, BID short integer (4), Bno short integer (3), Bname Text (15), Use Text (10), Type Text (2), Energy_Source Text (20), Nroom short integer (2), Wall Text (10), Water_Source Text (12), Size float (9,4), Building_Value float (9,4), Rental_Rate double (10,4), Toilet_type Text (10), Bathroom Text (10), Available_Space float (9,4), Broker Text (20), floors short integer (2), Address Text (20), Occupancy_Ratio float (9,4)]

Where C_of_O is the certificate of occupancy;
LParcel is the parcel on the left-hand side of the parcel of interest;
RParcel is the parcel on the right-hand side of the parcel of interest;
PAddress is the address of the parcel.

Figure 4: Conceptual data model for residential properties

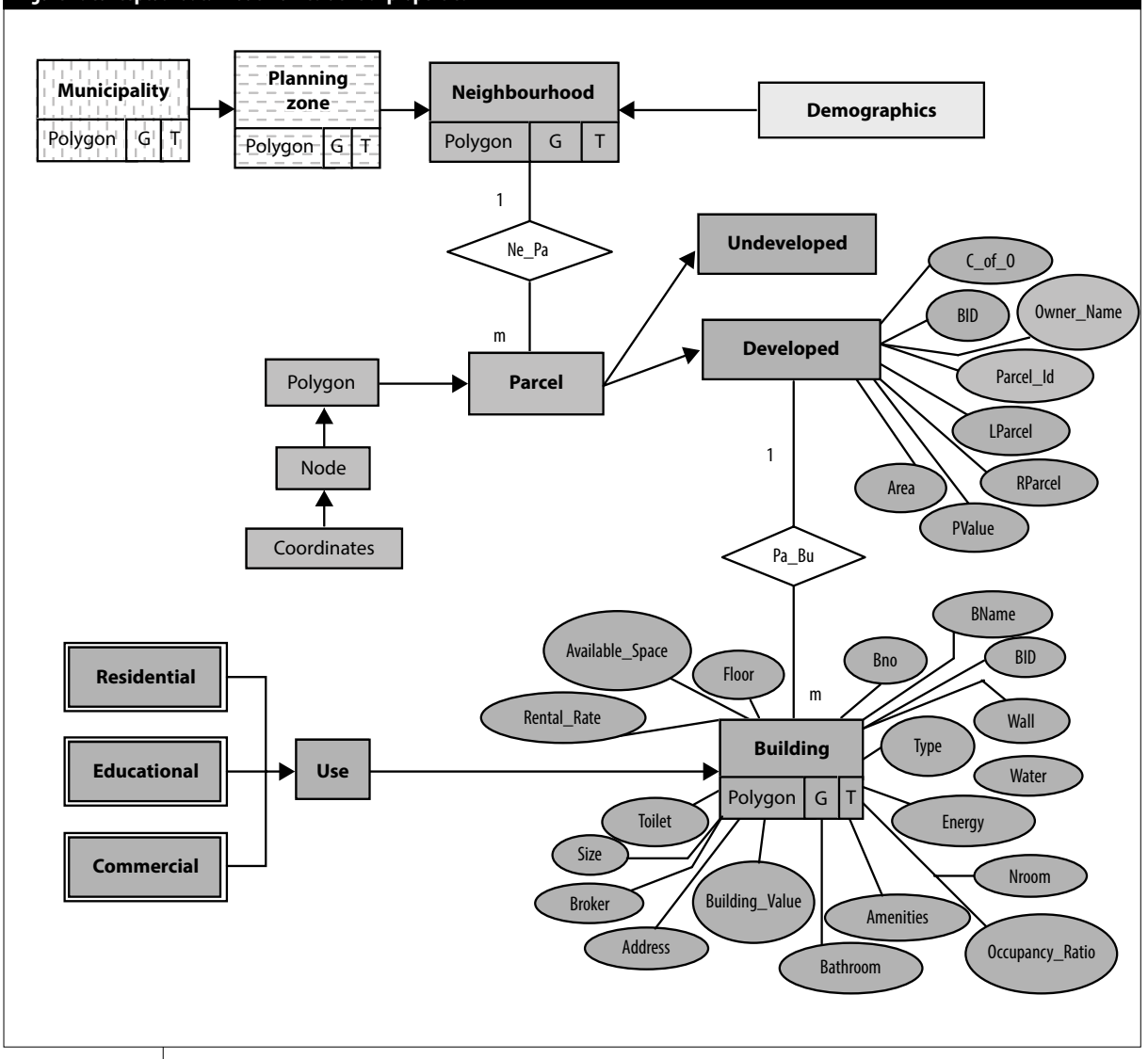
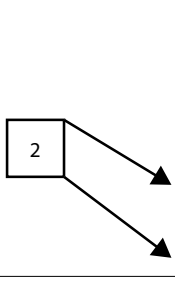


Table 2: Data types in ArcMap

Data type	Storable range	Size (bytes)	Applications
Short integer	-32 768 to 3 767	2	Numeric values without fractional values within specific range; coded values
Long integer	-2 147 483 648 to 2 147 483 647	4	Numeric values without fractional values within specific range
Float	Approximately -3.4E38 to 1.2E38	4	Single-precision numeric values with fractional values within specific range
Double	Approximately -2.2E308 to 1.8E308	8	Double-precision numeric values with fractional values within specific range
Text	Alphabet		
Date	Date format		

Source: ArcGIS 9.3 help

Figure 5: Illustration of the building entity using a relational data format and identification of some essential elements



ID	Bno	Area	Use	Type	Address
1010	12	700.06	Residential/Commercial	Storey Building	Oranyan Road
1011	2	451.12	Residential	Bungalow	Pepesi Road
1012	54	500.00	Residential	Traditional Compound	Alara Street

4.5. Database Development

After the database is designed, the development commences by entering the actual values for instances of each entity in a row of the database. The relational data structure uses a table-like format to arrange data in the database (see Figure 5). The properties of an entity correspond to the fields (columns) 1 in the relation (table) whereas the instances of each entity correspond to rows 2 of the relation in the database.

At the database development stage, it must be noted that the geometric properties (coordinates, nodes, polygon referred to in Figure 4) for all entities such as municipality boundaries, parcels, buildings, etc. are defined when the geographic data is created in the GIS environment. GIS manages both the geometry (graphics) and attribute properties of each entity in the database.

5. Results

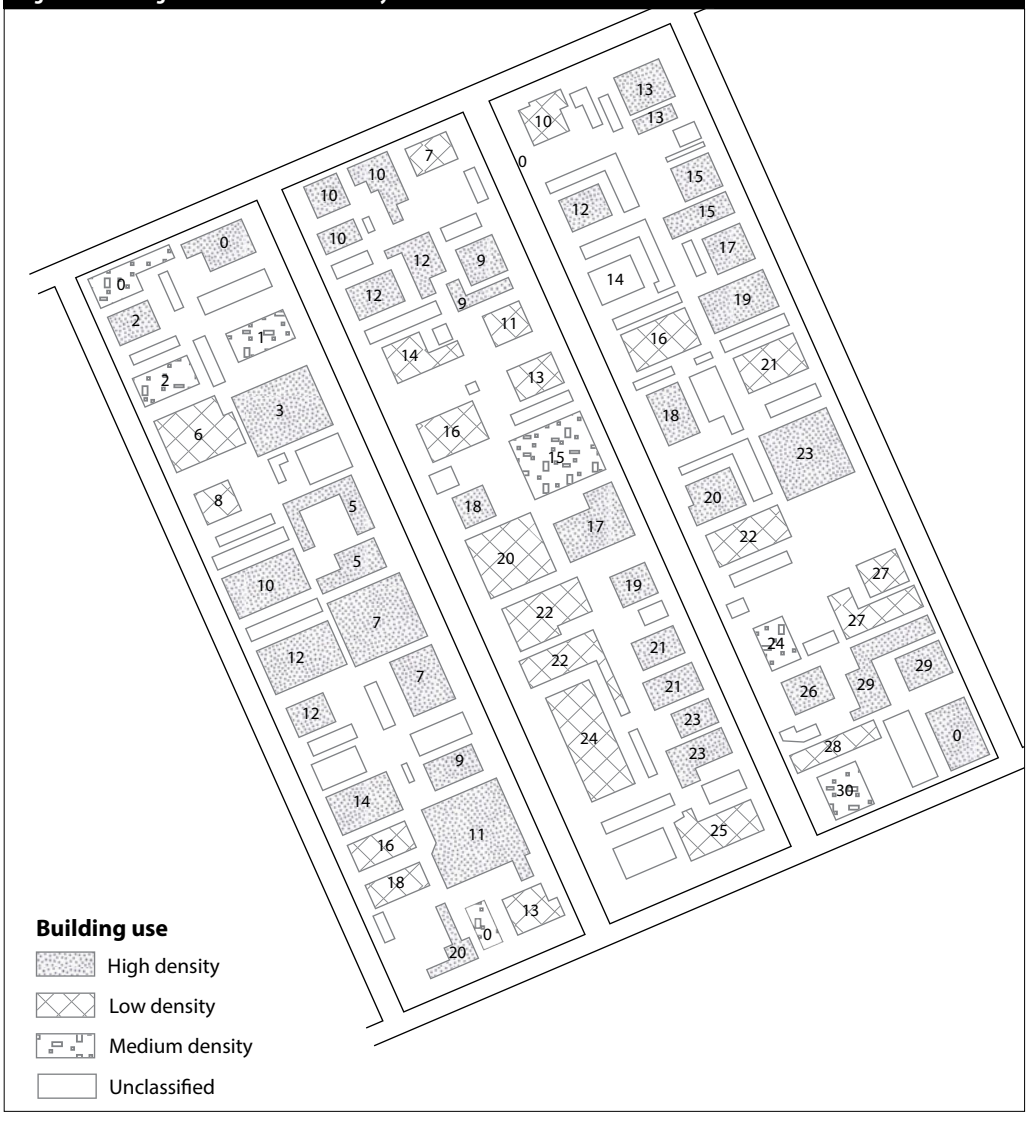
The survey data collected about the residential buildings in this study are stored together with their corresponding graphics in the database for mapping. Once the database is populated with actual values, the vast spatial analytical and mapping functions in the GIS can be used in the real estate application.

5.1. Building Usage

An example of output from the application shows the use to which each building in the selected neighbourhood is put (see Figure 6).

Figure 6 is the use of buildings in the medium RDZ. Building usage varies between residential, commercial and mixed use where, for example, a section of the property is used for residential purposes and the other part is commercial.

Figure 6: Building use in the medium density residential zone



As an RDZ, several buildings are constructed in one land parcel, which results in more than one building having the same number and address.

5.2. Occupancy Rate

Occupancy rate is one of the environmental factors that can be used as criteria in comparing sites and neighbourhood setting when a home-buyer looks for a suitable property. Occupancy rate of habitable rooms in buildings in a neighbourhood is an important indicator of quality of life. Other factors are a well-planned area with good layout, availability of infrastructure/facilities such as access roads, quiet, peaceful and safe (low crime). The occupancy rate expresses the number of persons per habitable room of a property.

The room is termed habitable in the sense that it is apart from other shared spaces and rooms such as the kitchen, toilet, bathroom, etc., which are normally shared by members of a household or between households in some low-cost multi-family properties.

Using the Nigerian standard, which stipulates two persons per habitable room, the buildings were mapped accordingly (see Figure 7 and Table 3).

Figure 7 shows the occupancy rate classes of the buildings in the high RDZ. Table 3 compares results in the three sample zones.

These classes are further interpreted in terms of the level of congestion, such as uncongested, congested, highly congested, very highly congested.

Figure 7: Building occupancy rate in the high residential density zone

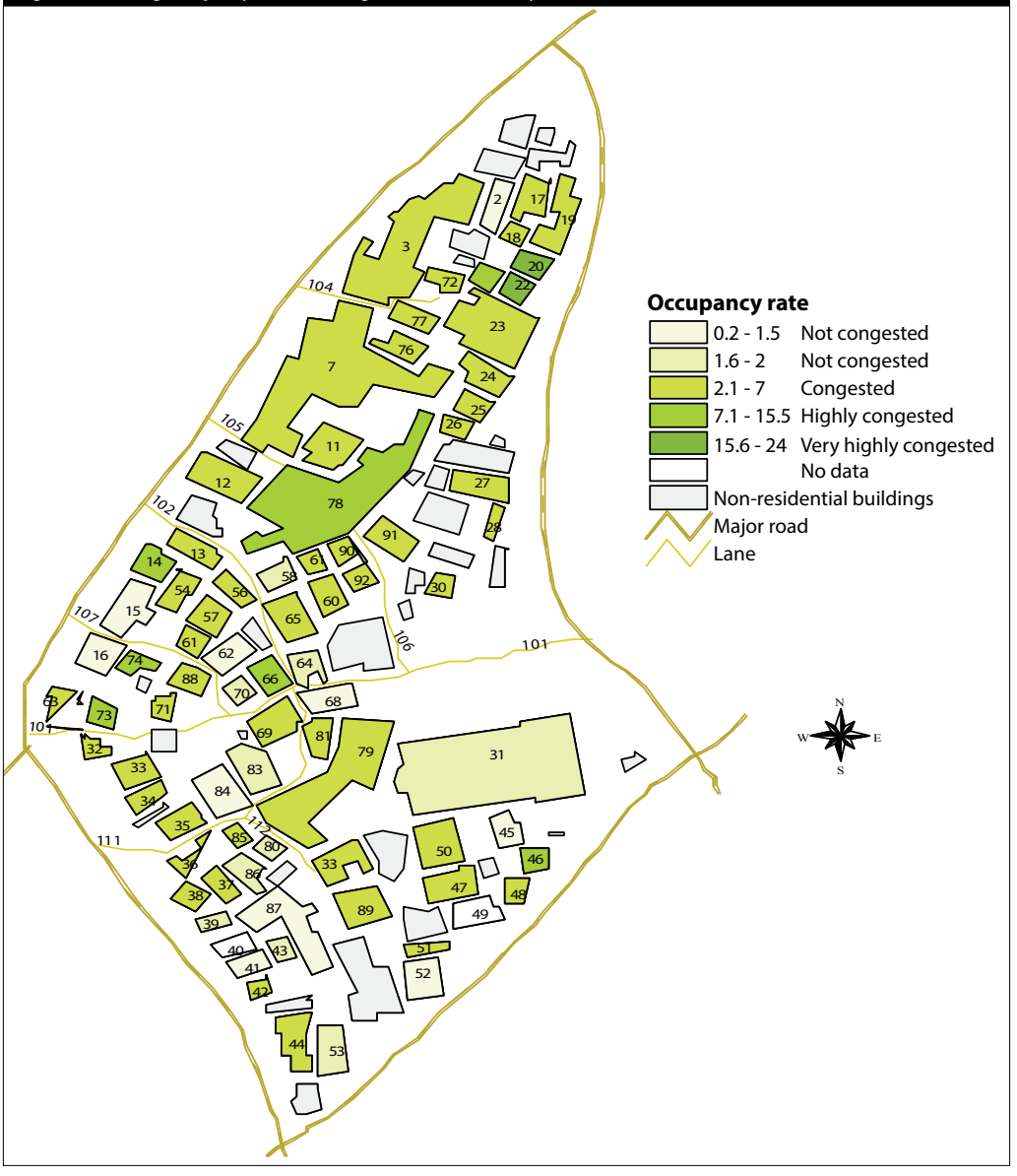


Table 3: Occupancy Ratio and Level of Room Congestion

Congestion level	High density residential zone		Medium density residential zone		Low density residential zone		Total	
	No	%	No	%	No	%	No	%
Uncongested	21	24	21	43	32	80	74	34
Congested	0	0	28	57	8	20	78	36
Very highly congested	58	67	0	0	0	0	58	27
Extremely congested	8	9	0	0	0	0	8	4

The percentage level of room congestion occurring in each neighbourhood is a good indicator of the neighbourhood quality of life.

5.3. Building Quality

Building quality is important in the determination of a property's value in real estate valuation.

The measure of quality includes the type of building construction materials, for example, as used for wall, foundation, roofing and flooring, among other attributes.

For convenience and space limitation, only the materials used for the ceiling finishing and the painting of buildings were selected for mapping (see Figure 8 and Table 4).

Figure 8: Building materials – (a) Type of ceiling materials and wall painting in the high density residential zone

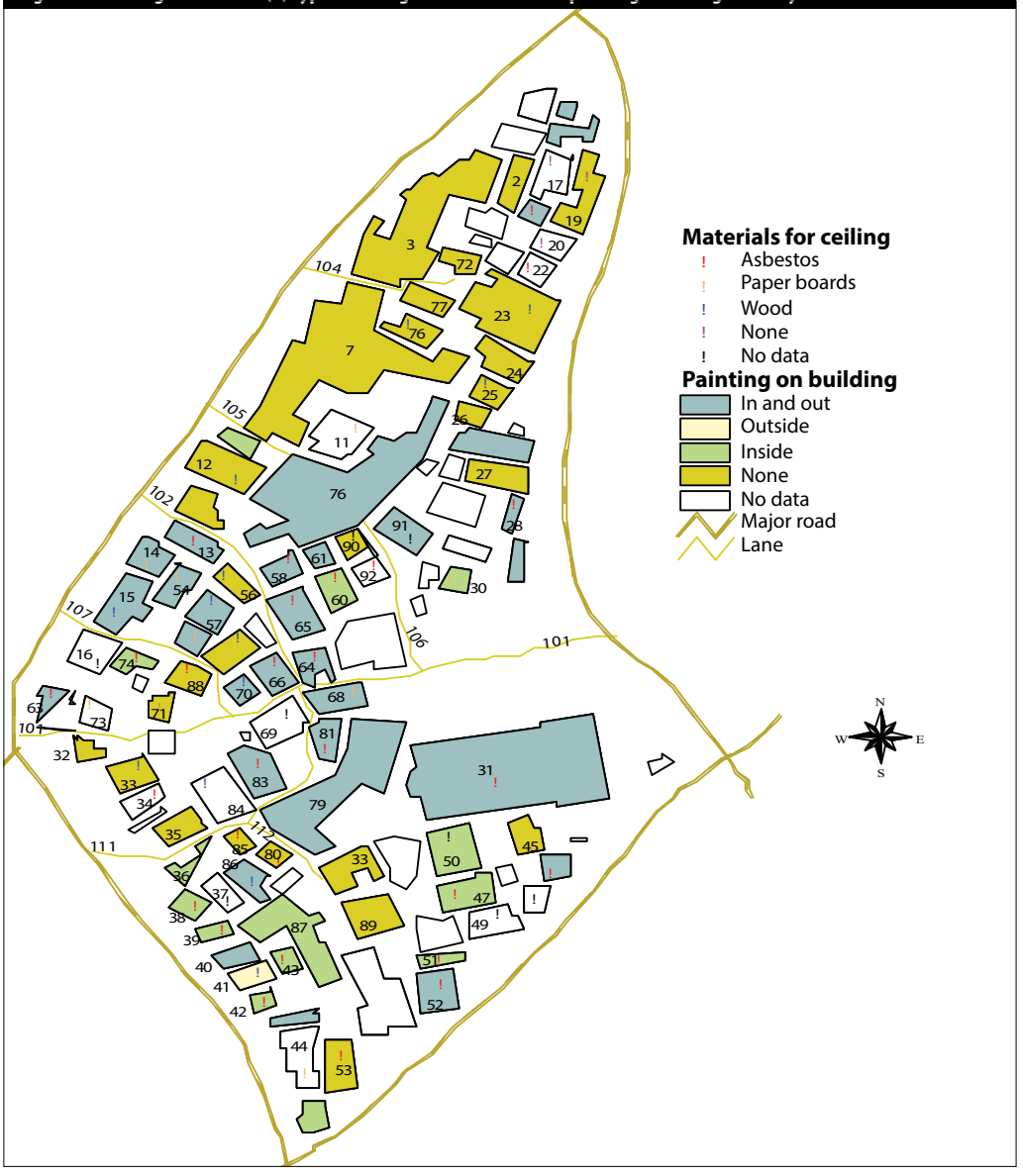


Table 4: Ceiling materials and the painting of buildings

Selected housing quality variables		High density residential zone		Medium density residential zone		Low density residential zone		Total	
		No	(%)	No	(%)	No	(%)	No	(%)
Ceiling	Asbestos	34	42	42	74	50	89	126	65
	Concrete	1	1.2	0	0	0	0	1	0.5
	Mat	0	0	4	7	1	2	5	5
	Paper boards	25	31	9	16	4	7	38	20
Painting	Plank	16	20	1	2	1	2	18	9
	None	5	6	1	2	0	0	6	3
	Exterior & interior	31	42	48	83	54	100	133	67
	Exterior	1	1.4	3	5	0	0	9	5
	Interior	14	19	5	9	0	0	28	14
	None	28	38	2	4	0	0	30	15

Figure 8: Building materials – (b) Type of ceiling materials in the low density residential zone

6. Conclusion

The main objective of the paper is to assist real estate practitioners in really appreciating GIS use in handling real estate information and in solving real estate problems that require data for decision-making.

This study set out to describe a GIS-based application for residential real estate information. A spatial database was designed, developed and implemented. Primary information about the properties was gathered through the survey that was conducted.

A data model was designed to capture the essential entities relevant in the real estate application, and this was presented using the Entity-Relationship approach. Both spatial and non-spatial data sets were utilised in assessing properties and examining geographic factors that influence the neighbourhood setting in which the property is located.

This study identifies the types of data used for some specific aspects of real estate, such as a home-listing service or when searching for office space.

Outputs in form of maps showing property usage, building occupancy rate and building materials were compared in three sample neighbourhoods in the study area.

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