JOURNAL OF VALUATION AND PROPERTY SERVICES

Vol 17

Sustainable Strategies and Financial Performance of Malaysian Property Developers
- Boon Tik Leong, Lam Tatt Soon, Khen Jhun Kam, Shir Men Tay

Enhancement of Users' Requirement Assessment For Sustainability of Existing Public Office Building Using Lean Thinking Approach
- David Martin, Adegbenga Adeyemi, Rozilah Kasim

Making Sense of Stigmatised Property: A Cross-Professional Perspective
- Rosli Said, Rohayu Ab. Majid, Chuah Teong Geng

The Effect of Spatial design Modification on Batu Pahat Low-Cost Residential Property Value: A Hedonic Price Model
- Abdulazeez Umar Raji, Christy Pathrose Gomez, Rameson Nallusamy

Assessment of Sustainable Housing Affordability in Malaysia Based on People's Perception Using COPRAS Method
- Rosli Said, Rohayu Ab. Majid, Amir Saufi Nozin

Announcement

Notes to Contributors

National Institute of Valuation (INSPEN)
Valuation and Property Services Department (JPPH)
Ministry of Finance Malaysia

Publication / Printing
National Institute of Valuation (INSPEN)
Valuation and Property Services Department
Ministry of Finance Malaysia
Persiaran INSPEN
43000 Kajang
Selangor Darul Ehsan
Malaysia

Tel: +603-8911 8888
Faks: +603-8925 0640
E-mail: research@inspen.gov.my
Website: www.inspen.gov.my

Subscription rate:
RM50.00 plus postage RM10.00 for each copy

ISSN: 1511-3345

Objective

The Journal of Valuation and Property Services is a publication specifically intended for property professionals to keep abreast with the developments in the property industry as well as the real estate profesion.

This journal serves as a platform for the exchange of information and ideas on property issues. It seeks to:

i. address areas of major interest and practical relevance to the real estate profesion.
ii. create awareness of new theories, techniques and applications as well as related concepts relevant to the real estate profesion.
iii. discuss policy issues and regulations and their implications on the property market.

We therefore welcome articles with theoretical and practical relevance to the real estate industry and profesion, property valuation, property management, property investment and market analysis.

Copyright Reserved

JOURNAL OF VALUATION AND PROPERTY SERVICES
VOLUME 17

CONTENTS **PAGE**

Sustainable Strategies and Financial Performance of Malaysian Property Developers 1-10
- Boon Tik Leong, Lam Tatt Soon, Khen Jhun Kam, Shir Men Tay

Enhancement of Users' Requirement Assessment for Sustainability of Existing Public Office Building Using Lean Thinking Approach 11-26
- David Martin, Adegbenga Adeyemi, Rozilah Kasim

Making Sense of Stigmatised Property: A Cross Professional Perspective 27-44
- Rosli Said, Rohayu Ab. Majid, Chuah Teong Geng

The Effect of Spatial design Modification on Batu Pahat Low-Cost Residential Property Value: A Hedonic Price Model 45-62
- Abdulazeez Umar Raji, Christy Pathrose Gomez, Rameson Nallusamy

Assessment of Sustainable Housing Affordability in Malaysia Based on People's Perception Using COPRAS Method 63-80
- Rosli Said, Rohayu Ab. Majid, Amir Saufi Nozin

Announcement 81-84

Notes to Contributors

REFEREE PANEL

SUSTAINABLE STRATEGIES AND FINANCIAL PERFORMANCE OF MALAYSIAN PROPERTY DEVELOPERS

Boon Tik Leong[a], Lam Tatt Soon[b], Khen Jhun Kam[c], Shir Men Tay[d]

[a c & d]School of Architecture Building and Design,
Taylor's University,
Subang Jaya, Selangor, Malaysia

[b]Heriot-Watt University Malaysia,
Putrajaya, Malaysia

*Corresponding author
Email: boontik.leong@taylors.edu.my

Abstract

Property development in developing countries provides space for economics activities however property development process and operation of the property are known to be the major contributor to environment degradation. These activities consume substantial resources and energy, and release greenhouse gasses. By using content analysis, this paper first summarized and categorized the sustainable strategies of listed property developers in Malaysia from 2010 to 2014. This paper also evaluated financial performance of the said developers following by further examined the correlation of the sustainable strategies with the company characteristics, including size, growth, profitability, leverage. The analysis shows there is no significant correlation between sustainable strategies and the company size. However, there are correlation between sustainable strategies and other financial performance, in which, green developers are more sensitive in term of revenues. Both assets and liabilities of green developers grow faster that than conventional developers. On the other hand, the share market show more confident towards conventional developers than the green developers. This research provides important insight for the industry players for strategic planning and act as a reference to authority to plan for policies related to sustainable development.

Keywords: *Malaysia, Property Developer, Sustainable Strategies*

1. INTRODUCTION

The Bruntland Commission, formerly known as World Commission on Environment and Development defined Sustainable Development as the development which meets the needs of the present without compromising the ability of the future generation to meet their needs.

Property development and property operation support economics development and at the same time known as the major contributor to environment degradation. Its activities require continuous energy comsumption, resources consumption, waste generation, and green house gases emmission.

Pivo and McNamara (2008) first defined Sustainable and Responsible Property Investment (SRPI) as maximizing the positive effects and minimizing the negative effects of property ownership, management and development, on society and the natural environment in a way that is consistent with investor goals and fiduciary responsibilities.

Mokthsim and Salleh (2014) mentioned that Malaysia has yet to acheive the status of "sustainable development nation", but the government had looked in-depth on the development planned that would not destroy the good environment quality. This was proven when the Malaysia government established the Ministry of Energy, Green Technology and Water (MEGTW) through the reshuffling and restructuring of ministries in April 2009. The function of the newly formed ministry include planning, formulating policies and programs in green technology and green township. MEGTW is also responsible to coordinate the legislation, policies, guidelines, programs, activities and role of responsible agencies in implementiation of Green Neighbourhood. On the other hand, the government had allocated RM 1.5 billion as soft loans to the private sector through the Green Technology Financing Scheme.

Despite of the government's effort, the property developers play the important roles in developing green and sustainable building or even township.

Zainal Abidin's (2010) research found the developers in Malaysia are aware of the rising issues on sustainability, but little efforts were generated to support. Bueren & Priemus from Research for Netherland Sustainable Construction pointed out in 2002 that not the technical factors but the institutional factors that contrigute to the failure of sustainable constrution.

Stefan and Paul (2008) had illustrated in their research, the conventional wisdom concerning environment protection which comes as an additional cost imposed on firms, and will erode the competitiveness. However, they discovered the paradigm is being challenged in the 2000s.

In 2005, a study done by Rao on ISO 14001 has shown that certified companies had proven that the integrated green supply chain ultimately leads to competitiveness and economics performance .

It is clear that the property developers wish to know how a developer with sustainable strategy will benefit the company as a whole.

Newell and Manaf (2008) studied the significance of sustainability practices by the Malaysian property sector and conclude that a number of property companies take a strong leadership role in implementing best practice regarding sustainability. Expanded from Newell and Manaf's research, Razali and Adnan (2015) identified 16 attributes to measure companies' sustainability levels. The

attributes assessment revealed that only 15 per cent of listed property were seriously commited in implementing sustainable concept. There are several companies demonstrated leadership in sustainable practices through their projects. However these acheivements still fall below those of international players in other countries.

Anyway, there is yet an attempt to investigate the correlation of companies performance and the sustainability strategies which the industry players are keen to know.

This paper aims to study the correlation of the sustainable strategies and the company characteristics which include size, growth, profitability and leverage of property developers.

2. METHODOLOGY

Leong et. al. (2015) describe Green Developer as developer which incorporate additional green technologies in their project(s) and market themselves as developer that promote green and sustainable development .

The population of this study is the property developers listed in BURSA Malaysia under property sector. As at December 2015, there are total of 97 companies that are listed on main board – property. The companies which had changed the financial year end during the study period – 2010 to 2014, will be eliminated from the population, because the annual reports will consist of finanical information which is not on a 12 months basis. The companies which are not listed throughout the whole study period will also be eliminated.

A total of 72 companies are listed as sample in this study, which consist of 74% of population The companies were categorized into 4 ranks according to the following criterion.

Table 1: The sustainable strategy ranking criterion

Rank	Description
1	The project won green/sustainable award or Project certified GBI, LEED, Green Mark or Green/sustainable certification or and Published the achievements
2	Organised green/sustainable conference or Sponsored green/sustainable conference or Introduced green/sustainable features at project level or Adopted green technologies/materials at project level and Published the achievement
3	Adopted green/sustainable practises at company level
4	Complied to government regulation

Companies with rank 1 and rank 2 qualified as Green Developers with sustainable strategies.

Companies with rank 3 and rank 4 are considered as companies without sustainable strategies.

Following are number of property developers in each rank. 20 out of 72, which is around 28% of property developers qualify as green developers. 52 out of 72, which is 72% of property developers ranked 3 or 4 hence not qualified as green developers.

Table 2: Number of companies according to rank

Rank	No. of Companies
1	9
2	11
3	9
4	43
Total	**72**

The required financial data for each company was obtained from the annual reports filed in BURSA Malaysia and Thomson Reuters Data Stream. Full financial details, including balance sheet, income statement, and cash flow statement, were tabulated in excel in order to evaluate the financial performance of the companies.

The first analysis involves a randomness test to identify correlation between the level of sustainable strategy and the size of the property developer. All companies in the sample were assigned with two ranks, namely, the sustainable strategy rank as above and the ranking for the company size, i.e.: the company with highest assets value is ranked 1, follow by the second high asset value as 2.

The pair of rank were used to do Walk-Wolfwitz test, also known as a randomness run test to verify the randomness of the data.

Secondly, this paper examined the relationship between sustainable strategies and the financial performance. Ratios, growth rates and compound annual growth rate (CAGR) of companies' were derived from the financial data.

The property developers' characteristics of growth, profitability and leverage are studied in this paper, which includes: revenue growth rate, assets growth rate, liabilities growth rate, share price growth rate, market capitalisation growth rate, average return on equity, average return on assets and debt ratio.

The financial performance of green developers were compare with the preformance of conventional developers.

3. RESULTS AND DISCUSSION

Walk-Wolfwitz test's results as follow:
Run test for randomness with 31 runs,
p value = 0.12609

Conclusion: No real evident against randomness. Figure 1 indicates that there are big property companies that implemented sustainable strategies, there are also small companies which do so. The figure also suggests that a lot of big property companies do not rank as sustainable developers, at the same time many small companies also do not rank as sustainable. The random test concludes that the company size does not correlates to the level of strategies.

This concludes that the size of company do not correlate to the level of sustainable strategies.

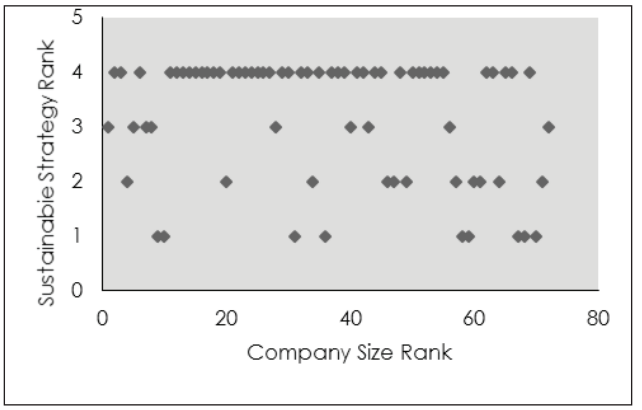

Figure 1: Sustainable strategy rank vs company size rank

The tables below compare the property developers' characteristics and performances between overall industry, conventional developers and green developers.

Table 3 shows the revenue growth for the industry, which recorded growth of 12% to 20% between 2011 to 2013. The green developers recorded higher growth than the conventional developers for all 3 years. In the year 2014, the market slowed down and recorded -7% growth for revenue, in which conventional developers made a 1% growth but the green developers suffered 14% dropped in revenue.

It is observed that the green developer's revenue growth is more sensitive than the industry as a whole. Overall green developers recorded CAGR at 11%, which is slightly better than CAGR 10% for conventional developers.

Table 3: Revenue growth

Revenues Growth	2014	2013	2012	2011	CAGR
Industry	-7%	20%	12%	19%	**11%**
Conventional Dev	1%	12%	10%	17%	**10%**
Green Dev	-14%	29%	14%	20%	**11%**

Total assets growth for the industry do not show any negative growth throughout the study period. The 0% growth in year 2012 was caused by the -7% growth from conventional developers and was neutralised by the positive 10% growth from the green developers.

The green developers enjoyed a straight 4 years of positive growth for total assets and marked 13% CAGR which is more than double compared to the conventional developers at 5% growth.

Table 4: Total assets growth

Total Assets Growth	2014	2013	2012	2011	CAGR
Industry	10%	10%	0%	13%	**8%**
Conventional Dev	12%	8%	-7%	7%	**5%**
Green Dev	9%	12%	10%	21%	**13%**

Both total assets and total liabilities will give impact to the financial health of a company. The total liabilities for the industry have CAGR at 6%. Throughout the study period, the conventional developers increased and decreased the liabilities and end up not accumulating more liabilities but the green developers recorded 14% growth in total liabiites, which is 1% higher than the total assets growth.

Further analysis on leverage will be illustrated in Table 5 – debt ratio.

Table 5: Total liabilities growth

Total Liabilities growth	2014	2013	2012	2011	CAGR
Industry	11%	13%	-12%	16%	**6%**
Conventional Dev	17%	12%	-28%	5%	**0%**
Green Dev	7%	13%	7%	30%	**14%**

Cumulative share price is not proportionate to market capitalisation. It is due to the fact that the number of outstanding shares are different for each company. Anyway, the cumulative share price give a good indicator on the market confidence towards the company, or type of company as a whole.

The industry cumulative share price has CAGR of 8% for 2011 to 2014, the conventional developers contribute to in the price increase as the CAGR is 11%. At the same time, the share price of green developer has CAGR of -1%, which means the cummulative share price in 2014 is lower than 2011.

In year 2014, both conventional and green developers suffered dipped of share price at 2% and 12%, total up a 4% dropped for the industry. For the same period, KLSE recorded a dip of 6%, hence property industry is considered to perform better in 2014. The CAGR for KLSE index for 2011 to 2014 is 4%, which show property industry was doing better than KLSE as a whole for the study period.

Looking at the breakdown, the conventioanl developers perfom better than KLSE but green developers perfom lower than KLSE.

Table 6: Share price growth

Share Price Growth	2014	2013	2012	2011	CAGR
Industry	-4%	27%	15%	-2%	**8%**
Conventional Dev	-2%	31%	16%	3%	**11%**
Green Dev	-12%	12%	13%	-15%	**-1%**

Market capitalisation is the product of share price and the number of share. It is the market value of the company. The industry has 3% CAGR, in which conventional developers recorded 9% and green developer recorded -3%. Similar to with the share price, the performance of green developers are not as favourable as conventional developers in term of market capitalisation.

Table 7: Market capitalisation growth

Market Cap growth	2014	2013	2012	2011	CAGR
Industry	-2%	7%	16%	-8%	**3%**
Conventional Dev	1%	25%	12%	0%	**9%**
Green Dev	-5%	-9%	20%	-16%	**-3%**

Both return on equity and return on assets measures the profitability of the company. Table 8 illustrates that the conventional developers recorded better performance from 2011 to 2013 and green developers has superior performance for year 2014. The performance of convertional developers are more stable compared to the green developers.

Table 8: Average retun on equity

Average Return on Equity	2014	2013	2012	2011	2010
Industry	8%	8%	8%	7%	4%
Conventional Dev	8%	8%	9%	7%	5%
Green Dev	9%	8%	7%	6%	2%

Table 9 shows the average return on assets, the conventional developers showed more superior performance than green developers for all 5 years.

Table 9: Average return on assets

Average Return on Assets	2014	2013	2012	2011	2010
Industry	6%	6%	6%	5%	3%
Conventional Dev	6%	6%	6%	5%	4%
Green Dev	5%	5%	5%	4%	3%

Debt ratio has formula of total liabilities divided by total assets. The higher the debt ratio means the more the company relies more on liabilities to operate. The industry debt ratio fluctuated from 36% to 38%. The conventional developers always has lower debt ratio but the green developers have debt ratio ranging from 41% to 44%.

Table 10: Debt ratio (TL/TA)

Debt Ratio	2014	2013	2012	2011	2010
Industry	38%	37%	37%	38%	36%
Conventional Dev	36%	35%	34%	36%	35%
Green Dev	44%	43%	44%	44%	41%

4. CONCLUSION

Many will possibly think larger developers will have higher intention to diversify and be green developers. The research showed that the size of the developers do not correlate with the level of sustainable strategy implemented. There are huge developers that do not have sustainable strategy and there are small developers which keen to promote themselves as green developers.

As for the company characteristics and performance, it is found that green developers are more sensitive in term of revenues. They tend to grow more when the market is growing but lose more business when the market is not good.

Regardless of the revenues fluctuation, the assets of green developers increase at a favourable 13% annually. Anyway, the growth of liabilities is faster than the growth of assets, which is at 14% annually. This leads to an increasing debt ratio from 41% in 2010 to 44% in 2014. The green developers should take note on the high debt ratio and keep it at a tolerable level.

From the share price and the market capitalisation growth perspectives, it is found that the market has more confident in conventional developers compared to green developers.

It is suggested a further study on the characteristics and performance of green developers rank 1 and rank 2 to be made in order to capture the differences between chracterictics and performance when different level of sustainable strategies are implemented. The insight will be an important reference for future strategy generation and policies design.

BIBLIOGRAPHY

Bueren, E. & Priemus, H. (2002). Institutional Barriers to Sustainable Construction. *Environment and Planning B: Planning and Design.* 29 (1) 75-86.

Leong, B. T., Ang, F. L., Fuey Lin, A., Chiew, S. K. (2015). Does It Pays to Be Green? A Study into the Financial Performance of Malaysia Green Developer. *The 19th Pacific Association of Quantity Surveyors Congress 2015. Yokohama.*

Newell, N. & Manaf, Z. (2008). The Significance of Sustainability Practices by the Malaysian Property Sector. *Local Economy.* 223 (3) 152-167.

Mokthsim, N., Salleh, K. O. (2014). Malaysia Efforts Toward Achieving A Sustainable Development. Issues, Challenges and Prospects. *Precedia – Social and Behavioral Sciences* 120, 299-307.

Pivo, G., & McNamara, P. (2008). Sustainable and Responsible Property Investing. *Sustainable Investing: The Art of Long Term Performance* 117-127

Razali, M. N., & Adnan, Y. M. (2015) Sustainable Property Development by Malaysian Property Companies. Property Management, 33(5), 451-477.

Rao, P. & Holt, D. (2005). Do Green Supply Chains Lead to Competitiveness and Economic Performance? *Int Journal of Operations & Production Management.* 25 (9) 898-916.

Stefan, A. & Paul, L. (2008). Does It Pay to Be Green? A Systematic Overview. *Academy of Management Perspectives.* 22 (4) 45-62.

Zainal Abidin N. (2010). Investigating The Awareness and Application of Sustainable Construction Concept by Malaysian Developers. *Habitat International* 34 (4) 421-246.

ENHANCEMENT OF USERS' REQUIREMENT ASSESSMENT FOR SUSTAINABILITY OF EXISTING PUBLIC OFFICE BUILDINGS USING LEAN THINKING APPROACH

David Martin*, **Adegbenga Adeyemi & Rozilah Kasim**

Department of Real Estate Management,
Faculty of Technology Management and Business,
Universiti Tun Hussein Onn Malaysia,
86400 Parit Raja Batu Pahat Johor, Malaysia

*Corresponding author
Email: martin@uthm.edu.my

Abstract

The improvement of existing buildings had been argued to be a major approach in attaining sustainability in the built environment, especially in developing countries. However, literature review shows that users' requirement is the basis of accomplishing sustainable improvement, but hardly achieved in purported improved buildings. The paper approached the sustainable improvement diagnosis technique of public office buildings through the enhancement of users' requirement assessment using the lean thinking concept. The research adopted the quantitative method, using diagnostic Post Occupancy Evaluation as data acquiring tool from a massive office complex in Nigeria, a developing country. Survey questionnaires related to the triple bottom line of sustainable development were distributed to all the 971 civil servants in the study area, from which 339 useable questionnaires were retrieved. The analyses were done using Analysis of Moments Structures (AMOS) regressions, while the findings established that muda is inherent in public office buildings, with highly significant inverse causal effects of -0.661 and -0.760 on job productivity and design features respectively; and strong effect sizes of 44% and 58% in explaining both their variances respectively. The study revealed that users are more concerned about facilities put in place within public office buildings, compared with spatial plan or structure. Urgent improvement is therefore required more in facilities for sustainability. The study concludes that lean thinking can enhance the assessment of users' requirement in existing public office building improvement diagnosis in Nigeria, a developing country. However, the approach can only be used as a supplement and not a replacement of the diagnosis technique, since the end-users are not able to provide the technical details of professional expertise and equipment needed in a typical improvement diagnosis technique.

Keywords: *User requirement, lean thinking, 'muda', sustainable improvement, public office buildings*

1. INTRODUCTION

The improvement of old buildings from existing built assets for sustainability is termed sustainable improvement (Mansfield, 2011), and it is an offshoot of Sustainable Development (SD), which was defined as the ability to meet the needs of the present users without compromising the ability of future generations to meet their needs (WCED, 1987). Jylha and Junnila (2014) noted that facility management in recent years had shifted to an end-user-driven mindset in which focus is on supporting end-users. This suggests a change in improvement philosophy, while knowledge of user requirement would enable proper decisions for improvement of office buildings (Israelson and Hansson, 2009). Schipper and Swets (2010) also suggested that a creative solution from intensive research is required to determine and address users' requirement. Studies have shown that purported sustainably improved buildings' performance have not adequately reflected end-users' requirement (Hansson, 2010). The main objective of this study therefore is examine whether the lean thinking approach can enhance the assessment of users' requirement in sustainable improvement diagnosis technique for public office buildings.

This paper evaluates sustainability of existing public office buildings through the improvement as against maintenance of their standards. In maintenance, the original standard at construction is restored, while in improvement, the original standard is upgraded. Hence when maintenance is carried out on a non-sustainable building, it can at best reinstates it to its original non-sustainable standard as depicted in Figure 1. The paper adopts the definition of improvement as a work carried out on existing buildings in an attempt to upgrade them to sustainable standards whilst retaining their current use (Marir and Watson, 1995), which is a condition superior to an earlier one.

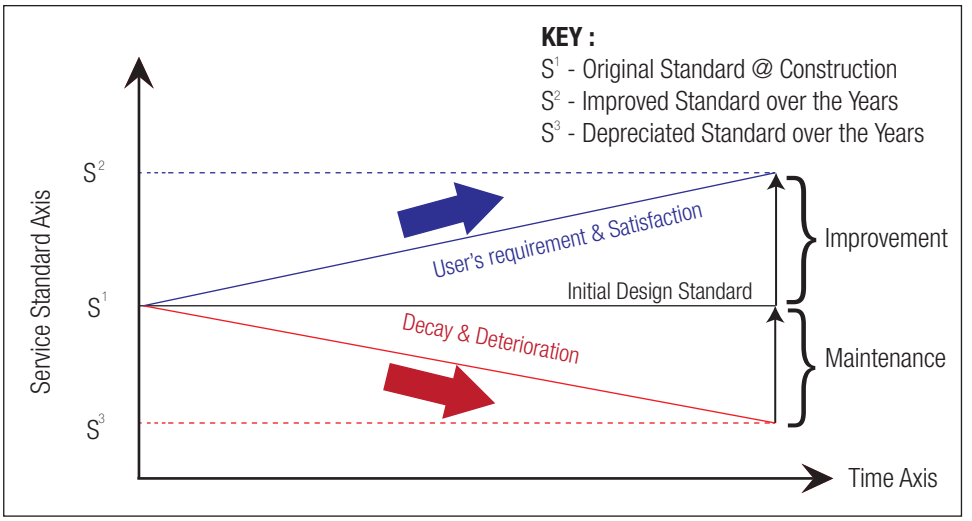

Figure 1: Building maintenance and improvement (Adeyemi, 2010)

2. LITERATURE REVIEW

2.1 Users' requirement and job productivity

Karna defines users' satisfaction as when the quality of a service meets or exceed expectations; otherwise, they are not satisfied. From this perception, an important attribute of users' requirement that could serve as a measure of performance is the reference to the user as a key determinant of quality (Rotimi, 2013). Therefore, improvement of quality needs to be directed towards ensuring that facilities fulfill the requirements and specifications assigned from users' perspective (Seo, 2007). The most important factor as a benchmark for a building improvement to meet sustainability objectives is the level of users' requirement incorporated in it (Birkeland, 2012). Black observed that world class systems incorporate intense end-user focus in which the end-user is an indispensable part of the process. Black gave an example of Boeing (aircraft manufacturer) who involves users' views in its production process in what is termed as aggressive listening (to end-users). Therefore, the built environment also needs to focus on end-users' satisfaction in order to generate world class facilities. Haynes argues that a sustainably improved office can have direct impact in increasing job productivity and it is a crucial factor in job satisfaction, staff recruitment and retention.

Eilam and Shamir (2005) reported that office building improvement provides opportunity for self-expression and self-enhancement, in which users are expected to support the change when it is perceived as agreeable with their self-concept. On the other hand, when the improvement is not concordant with users' self-concept, it will result in stress and lack of motivation and other forms of resistance. It can then be expected that this resistance will lead to poor ratings of the environment, low occupants' satisfaction and possibly reduced job productivity. Therefore, it can be assumed that users' requirement inclusion in the improvement design process as suggested by Speckelmeyer as well as the consideration and continuity of successfully adapted environmental features lead to successful environments in offices. A leading argument for economic sustainability is the belief that sustainable buildings are healthier and lead to job satisfaction, less employee absenteeism and higher levels of productivity thereby boosting the overall profitability of business occupiers (Wilkinson et. al., 2011) .

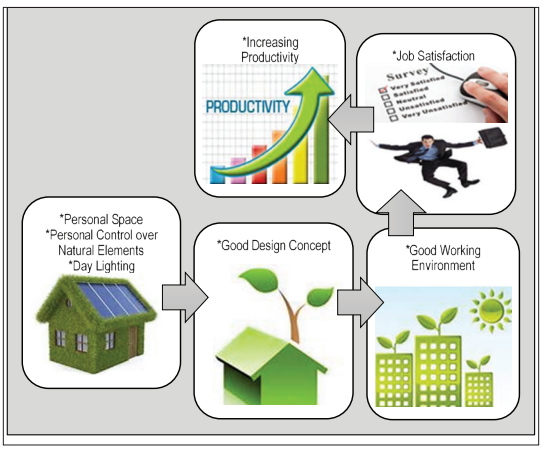

Figure 2: Users' satisfaction and job productivity (Adeyemi, 2016).

Figure 2 depicts literature impression of the relationship between users' requirement (which includes personal space, control over natural elements, etc.) satisfaction and job productivity in the office environment. Comfort is the absence of unpleasant sensations, which has positive effect on human well-being (Speckelmeyer, 1993), and is seen as a key determinant of users' requirement, since the building should not be perceived as an object separated from its users, thus end-users, their perception of the environment and their participation during the initial planning and design phases should play an important role in the process of sustainable improvement (Sinou and Kyvelou, 2006) and Rey also noted that the question of users' requirement plays a prominent role during the design stage of an improvement project. In order to achieve sustainability objectives, a coherent strategy and action plan is needed to address end-users' expectations and needs in existing buildings (Shika et.al., 2012).

The paper therefore suggests the enhancement of users' requirement assessment from end-users' perspective, since only them can best define their requirements (Jylha and Junnila, 2014). The paper equally promotes the role of the facilities manager in providing users' requirement details for sustainable improvement purpose, since they relate more with end-users (i.e. occupants) than other professionals in the built environment (Adeyemi, 2010).

2.2 Lean thinking concept

Lean thinking has the underlying philosophy that by identifying and eliminating 'muda' (i.e. Japanese word for waste), standard (hence performance) can be improved to meet users' requirement, and at reduced cost (Kempton, 2006). According to Averill, lean thinking is an improvement model that emphasizes on the ultimate elimination (or continuous minimization) of 'muda' and non-value-added activities in delivering high quality products to end-users at the lowest possible cost. It has its origin in the philosophy of achieving improvements in most economical ways with special focus on reducing 'muda' from end-users perspective (Womack and Jones, 2005). The concept of 'muda' became one of the most important concepts in quality improvement activities primarily originated by Taiichi Ohno's famous production philosophy from Toyota in the early 1950s. Ohno realized on his visit to Ford Motors in USA that there was too much muda everywhere, which he classified into 7 drivers, namely: Defect/Error, Inventory, Waiting/Delay, Motion, Transportation, Over-processing and Overproduction; this system later metamorphosed into what is now branded as lean thinking by Womack, Jones and Roos. Womack and Jones later added the 8th driver - Human talent, and introduced lean thinking principles as applicable beyond manufacturing environment into any field.

According to Nicholas and Soni, the two overarching philosophy of lean thinking for sustainability are elimination of 'muda' and continuous improvement (or kaizen in Japanese). Wang defined kaizen as a system of continuous improvement in quality, technology, and safety, while opined it as the effort for perfection which is never reached but creates the urge to make improvements, since there is no end to muda elimination. Kaizen works by utilizing everyone's knowledge to identify and implement improvements quickly and without significant cost (Askin and Goldberg, 2007).

Nicholas and Soni suggested that the concept of lean thinking applies to a vast range of operations and processes in widely differing industries, offices, health care, etc. with only

"tweaking of details". Thus, varying industries have since adopted the concept including the construction industry from where terms such as lean design and lean construction emerged. The substantial argument is that the concept had delivered large improvements in manufacturing, in particular the motor vehicle industry, and where already applied in construction. Lean thinking concept was initially used to measure only waste but Sharp and Jones extended the application to include the measurement inefficiency, which was adopted for this paper.

2.3 The variables

Schipper and Swets (2010) opined that 'muda' is universal and constant, appearing in every sector but that the definitions of the 'muda' drivers should be adapted to describe the situation to which it is applied. Schipper and Swets (2010) argued that as any new situation is approached for the application of lean thinking, the definitions of the drivers can be customized to fit the specific circumstances. Thus, the 'muda' drivers were adapted to suit office building (i.e. scope of the study) as depicted in Table 1, and used as independent variables. This was done through "tweaking of details". DeVellis (2012) noted that theory plays a vital role in the conceptualization of measurement variables.

Table 1: Concept of 'muda' adapted for office building

S/N	Muda drivers	Modified description
1	Waiting/Delay (WAT)	Delay, due to inadequate provisions for access to carry out maintenance activities, etc.
2	Overproduction (OPN)	Large accommodation space, too many corridors, etc. not appreciated by users.
3	Inventory (INV)	Storage facilities; and building materials kept for maintenance that are not necessary or have short life spans.
4	Motion (MOT)	Wasted human motion as related to workplace: ergonomic design negatively affecting productivity, quality & safety e.g. walking, reaching and twisting.
5	Over-processing (OPS)	Adding Design Features not needed by users, e.g. bath tubs in general convenience; irregular office shapes that reduces functional space; etc.
6	Transportation (TRN)	Distant location between complimentary offices and other ancillary rooms causing unnecessary movements for users.
7	Defect/Error (DEF)	Situation where one or more elements of a building do not perform their intended function; and failure in the function, performance, statutory or users' requirement of a building that manifests itself within the structure, fabric services or other facilities of the building.
8	Human talent (HMT)	Non-inclusion of end-users' input in design or improvement policy formulations. How could people be better involved in kaizen?

The paper also adapted the job productivity framework of Haynes', which suggests that the job productivity of the office occupier is influenced by comfort, office layout and distraction as shown in Table 2, while the study also adapted Arge's design features classifications as depicted in Table 3. The design features were adopted because they concisely captured all the building elements (Adeyemi, 2016). Both the job productivity and design feature variables were used as dependent variables in this study.

Table 2: Job productivity variables (Haynes, 2007)

S/No.	Variables	Items
1	Comfort (CFT)	Temperature (TEMP); natural lighting (DAYL); decor (OVRF); cleanliness (HYGN); security (SCTY).
2	Office layout (OFL)	Storage facilities (STRR); office shape (OFSH) and office size (OFSZ); office ergonomics (OFEG); circulation routes (PSSG).
3	Interaction (INT)	Social interaction (SINT); work interaction (WINT); aesthetically pleasing (AEST) i.e. modern attractiveness with regular upkeep; refreshment areas (RFSH); creative environment (CREN).
4	Distraction (DST)	Noise/concentration (NOIS); toilet sanitary condition (TOIS); downtime (DNTM); health due to IAQ (HLTH); electricity (ELEC).

Table 3: Design feature variables (Arge, 2005) in sustainable improvement

S/No.	Variables	Items
1	Spatial Plan (SPL)	Offices design (OFFD) and layout (OFLT); ancillary rooms' design (ARMD) and layout (ARML); and overall building design (BLGD).
2	Structure (STR)	Walls (WALL); floors (FLOR); windows (WIND); doors (DORR); ceiling (CEIL).
3	Facilities (FAC)	Water (WATR); electricity (ELTR); ICT facilities (ICTF); security (SECU); and other facilities such as Parking lot, fire-fighting equipment, safety measures, storage facilities, cooling devices, etc. (OFAC).

3. METHODOLOGY

The study examined the enhancement of users' requirement in sustainable improvement diagnosis technique of existing public office buildings using the lean thinking approach from users' perspective. The Federal Secretariat office complex, Bauchi, a massive public building in Nigeria was chosen for the study because of the urgent need for improvement in developing countries while the civil servants in the complex were the respondents as end-users. Eisenhardt (1989) argues that a study area tends to be more appropriate to confirm or challenge a theory or address a rare or unusual situation. Public office buildings in Nigeria were selected because they are a constant subject of discussion by eminent Nigerians and scholars alike both in the country and in publications and on the internet.

The subject property was selected because of the researcher's in-depth local knowledge of it (Yin, 2013) and for the followings reasons stated below:

(a) It was designed and constructed in 1989, when sustainability was not a consideration (Miller, and Buys, 2008);
(b) It has not undergone any major improvement work since its construction;
(c) It is a massive structure accommodating 26 different government parastatals with combined civil servants of 971, reflecting the *federal character* and *quota system* of the nation (Strzelecka, 2008);
(d) The building is still operational and not abandoned; and
(e) Easy access to the building for collection of data (Yin, 2013)

The Post-Occupancy Evaluation (POE) tool was adopted for acquiring data from occupants, and related to the sustainable development (SD) triple bottom line (TBL) components of the environment, economy and society (Zheng et.al., 2014). The paper focuses on the building superstructure i.e. that part of the building which is above the ground and serves the purpose of the building's intended use.

The study design adopted the quantitative method while the study technique involved the use of survey and direct observation approaches. The method involved the use of SPSS, AMOS, narrations and discussions to analyze data. The βeta coefficient, which indicates the unique contributions, causal effects and factor loadings of the variables; the R^2 or effect size, which explains the variances of the constructs; and the P-value, which indicates practical significance, were used as standards of measurement (Adams and Lawrence, 2015), to determine the significance of the 'lean thinking' approach with respect to the objective of the study.

The questionnaire was distributed to all 971 civil servants at the study area, while a total of 339 useable questionnaires were retrieved for analysis. This figure represents a response rate of 35%, which is above the required minimum of 29% for the subject population size (Bartlett et. al., 2001). The diagnostic POE tool adopted for the study was used to acquire data from occupants (as respondents) regarding the observed variables in Tables 1, 2 and 3 to determine muda and its effect on perceived job productivity and design features from end-users' perspective through questionnaires for enhance users' requirement in sustainable improvement diagnosis of public office buildings.

The study adopted Hassanain (2008) evaluation options to measure 'muda' using a 5-point Likert scale with options ranged from "strongly dissatisfied", "dissatisfied", "marginal", "satisfied" to "strongly satisfied"; each option was allotted a score from 1 to 5 respectively. In addition, Haynes evaluation options were adopted to measure the job productivity variables using a 5-point Likert

scale evaluation options ranging from "very negative", "negative", "marginal", "positive" to "very positive", while each option was allotted a score from 1 to 5 respectively to answer the question - *"In your opinion, what effect do the following elements have on your Perceived Job Productivity in your office environment?"*.

Furthermore the evaluation options Haynes (2007) was adopted for measuring the design feature variables based on a 5-point Likert scale of "very poor", "poor", "marginal", "good" or "very good", with each option allotted a score from 1 to 5 respectively. AMOS regression was subsequently conducted to estimate the causal effects of 'muda' (independent variable) on job productivity and design features (dependent variables), as well as the relationship between job productivity and design features. All estimates were given in standardized coefficients (i.e. estimates for each of the different variables were converted to the same scale by AMOS for ease of comparison).

4. RESULTS AND DISCUSSION

4.1 Establishment and ranking of muda

The AMOS regression analysis depicted in Table 4 reveals the unique contributions of the 'muda' variables from the strongest to the least based on their respective βeta coefficient estimates and effect sizes (R^2), which were used to rank the 'muda' drivers in order of prominence. The result confirms that 'muda' is inherent in public office buildings and substantiates the claims of Nicholas and Soni, Schipper and Swets (2010) and Samuel et. al., (2015), who opined that 'muda' is universal, appearing in every situation and can be determined through the customization of the definitions of the drivers to fit the specific circumstances after a careful analysis of the nature of the new environment, and adopted to describe the situation to which it is applied. The result also shows significant practical applications (i.e. the usefulness of the research findings in real life) through their P-values of <0.05 (Awang, 2015).

Table 4: Ranking of *muda* drivers based on βeta coefficient

Muda Driver	βeta Coef	R^2	P-value	Result	Ranking
Inventory (INV)	0.848	0.72	***	Significant	1
Defect (DEF)	0.796	0.63	***	Significant	2
Over processing (OPS)	0.782	0.61	***	Significant	3
Over production (OPN)	0.770	0.59	.004	Significant	4
Motion (MOT)	0.669	0.45	***	Significant	5
Transportation (TRN)	0.636	0.40	***	Significant	6
Human Talent (HMT)	0.523	0.27	***	Significant	7
Waiting (WAT)	0.472	0.22	.025	Significant	8

*** indicates highly significant at <0.001 (Awang, 2015)

4.2 Causal effects of 'muda'

The βeta coefficients of -0.661 and -0.760 depicted in Figure 3 shows the inverse causal effects of 'muda' on perceived job productivity and design features respectively, indicating that as 'muda' increases by 1 unit, it will inversely affect job productivity and design features by -0.661 and -0.760 units respectively.

The keys to the coding in the tables and proposed structural model are found in Tables 1, 2 and 3). The 'muda' effect size of 44% and 58% also explained the variances for perceived job productivity and design features respectively from users' perspective, which are very strong (Awang, 2015). The result also showed highly significant p-value and thus confirming their practical significance to everyday life, with P-value of <0.05 (Samuel et. al., 2015) as depicted in Table 5. These are consistent with Veitch et al.; Warr (2011) and De Been and Beijer (2014), who reported that satisfaction with the physical working environment are directly related to job productivity.

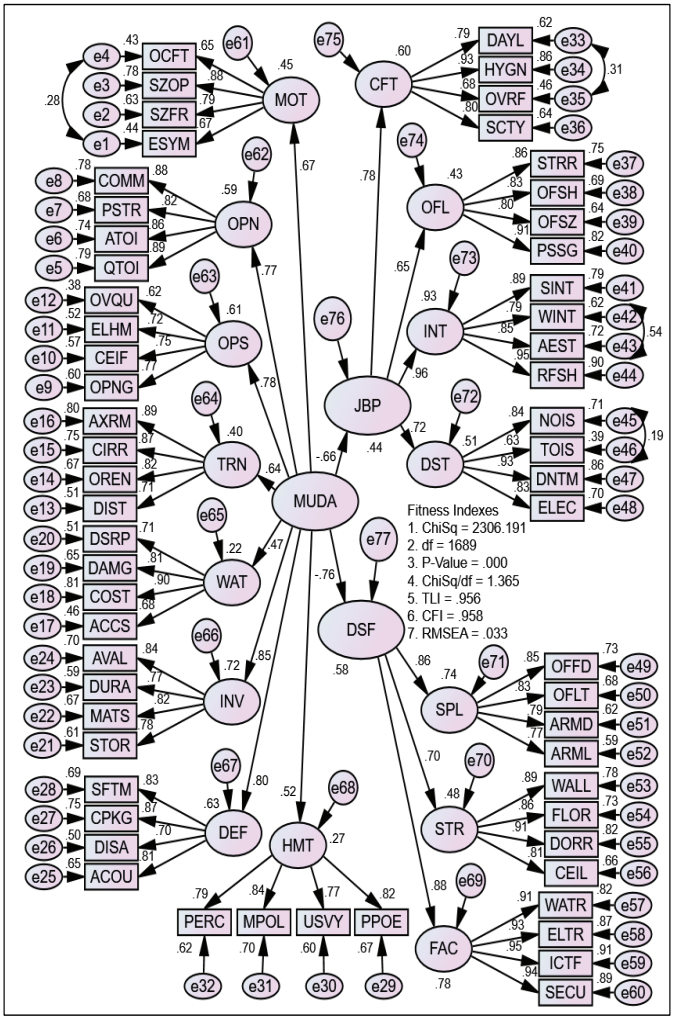

Figure 3: Proposed structural model

Table 5: Regression weights of proposed structural model

Path			Beta Estimate	S.E.	C.R.	P-Value	Result
JBP		MUDA	-.661	.162	5.944	***	Significant
DSF		MUDA	-.760	.265	6.397	***	Significant

*** indicates highly significant at <0.001 (Awang, 2015)

4.3 Design feature to eliminate 'muda'

The summary of respondents' perception of design features in the preliminary analysis (Table 6) revealed that spatial plan and structure were deemed "Good" with mean scores of ≥ 3.00, while facilities was deemed "Poor" with a mean score of < 3 (Haynes, 2008).

Table 6: Respondents' perception of design features

S/No.	Construct	Mean	Users' Perception	Ranking
1	Spatial Plan (SPL)	3.04	Good	1
2	Structure (STR)	3.00	Good	2
3	Facilities (FAC)	2.59	Poor	3

Furthermore the respondents suggested that urgent improvement is needed in public office building *facilities* (i.e. services and utilities provided), as compared to *spatial plan* (i.e. design and layout) and *structure* (i.e. building elements and finishing); 77% of the opinions were on need for *facilities*, while *spatial plan* and *structure* had 10% and 13% respectively (Figure 4). This suggests that the occupants are not as bothered about the design and layout (*spatial plan*) or building elements and finishes (*structure*), compared with services and utilities (*facilities*) put in place in public office buildings in order to eliminate or minimize perceived *muda*. Thus, more urgent improvement is required in *facilities* (i.e. services and utilities), which is consistent with Spring (2004), who opined that architects are often criticized for giving preference to aesthetic values rather than functional, thus creating 'muda' in the built environment.

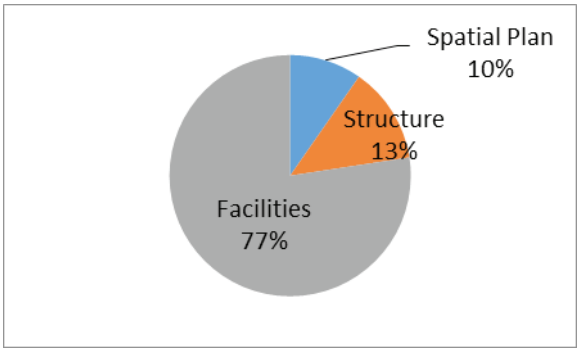

Figure 4: Users' requirement by design features

4.4 Relationship between design features and job productivity

Figure 5 showed a direct and moderate correlation of 0.48 (Awang, 2015) between design features and job productivity. This correlation implies that as design features are improved (particularly *facilities*), job productivity will equally improve, thus enhancing public office buildings performance and leading to increase in job productivity simultaneously.

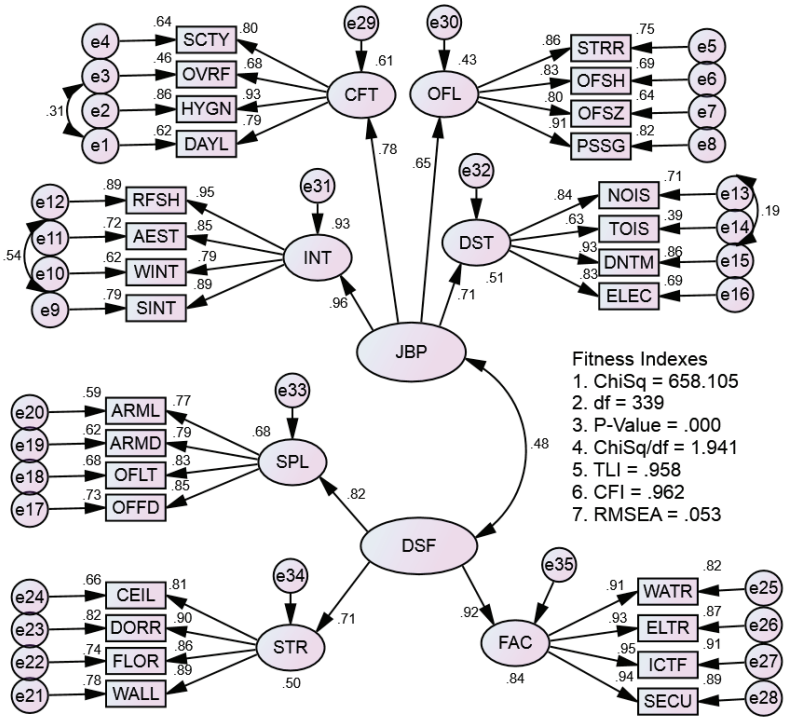

Figure 5: Correlation of job productivity and design features

Table 7: Regression weight of relationship between job productivity and design features

Path				**β**eta Coef	S.E.	C.R.	P-Value	Result
JBP		DSF		.484	.029	6.062	***	Significant

*** indicates highly significant at <0.001 (Awang, 2015)

Table 7 shows a highly significant P-value, suggesting that the result has practical significance to real life. This is consistent with Haynes (2007), Shika *et al.* (2012) and Birkeland (2012), who reported that a good office design had direct impact in increasing productivity and is a crucial factor in job satisfaction. Eilam & Shamir (2005) also reported that workers would be more satisfied with a recently improved work environment, hence increased productivity. This is also in agreement with Gohardani and Bjork, (2012) who opined that 'muda' and productivity are very important factors to consider in the pursuit of cost efficiency

5. CONCLUSION

The paper has shown that *lean thinking* can enhance users' requirement assessment in the sustainable improvement diagnosis technique of existing public office buildings, since it could provide additional information directly from the occupants with respect to 'muda' (i.e. waste and inefficiencies). However, the paper suggests that *lean thinking* cannot replace or substitute the typical diagnosis technique such as Tool for Office Building Upgrading Solutions (TOBUS) (Caccavelli & Gugerli, 2002). since it works only with inputs from the end-users who may not be able to provide technical and professional details required for other assessments, in particular for energy reduction, Green House Gases emissions and building elements condition, which may require sophisticated equipment to analyze. The paper promotes the multi-stakeholder and bottom-up policy formulation approaches to SD, in which end-users are involved as stakeholders.

Perceived 'muda' has significant influence on both perceived job productivity and design features which makes *lean thinking* an important consideration for enhanced assessment of users' requirement in the bid for sustainable improvement of public office buildings along the local TBL setting of environment, economic and social factors required for successful SD. The paper has shown that in meeting the needs of the people as defined in SD, the design feature of *Facilities* is a major user requirement, which can minimize (or eventually eliminate) 'muda' inherent in public office buildings, and guard against in future design of public office buildings. There is no doubt that there are a number of other factors and barriers that affect our ability to make existing buildings more sustainable. However, until the major issue of 'muda' is also addressed from end-users' perspective, the pace of SD in developing countries may remain slow.

BIBLIOGRAPHY

Adeyemi, A. (2010). Role of an Estate Surveyor and Valuer in National Development. International Journal of Environmental Science, 6(3), 120-128.

Adeyemi, A. (2016). Lean Thinking Approach to Sustainable Improvement for Public Office Buildings from Occupants' Perspective. Universiti Tun Hussein Onn Malaysia: Ph.D. Thesis.

Arge, K. (2005). Adaptable Office Buildings: Theory and Practice. Facilities, 23(3), 119-127.

Averill, D. (2011). Lean Sustainability: Creating Safe, Enduring and Profitable Operation. Boca Raton: CPC Press.

Askin, R. G. & Goldberg, J. B. (2007). Design and Analysis of Lean Production Systems. New York: John Wiley & Sons Inc.

Adams, K. A. & Lawrence, E. K. (2015). Research Methods, Statistics and Applications. Los Angeles: SAGE Publications Inc.

Awang, Z. (2015). SEM Made Simple. Selangor: MPWS Rich Publication.

Bartlett, J. E., Kotrlik, J. W. & Higgins, C. C. (2001). Organizational Research: Determining Appropriate Sample Size in Survey Research. Information Technology, Learning and Performance Journal, 19(1), 43-50.

Birkeland, J. (2012). Design Blindness in Sustainable Development: From Closed to Open Systems Design Thinking. Journal of Urban Design, 17(2), 163-187.

Black, J. (2008). Lean Production: Implementing a World-Class System. New York: Industrial Press, Inc.

Bond, A., Pope, J. & Morrison-Saunders, A. (2015). Introducing the Roots, Evolution and Effectiveness of Sustainability Assessment. In Morrison-Saunders, A., Pope, J. & Bond, A. (Eds.) Handbook of Sustainability Assessment. 3-19. Cheltenham: Edward Elgar Publishing Limited.

DeVellis, R. F. (2012). Scale Development: Theory and Applications. 3rd ed. Los Angeles: SAGE Publications.

De Been, I. & Beijer, M. (2014). The Influence of Office Type on Satisfaction and Perceived Productivity Support. Journal of Facilities Management, 12(2), 142–157.

Eilam, G. & Shamir, B. (2005). Organizational Change and Self-Concept Threats – A Theoretical Perspective and a Case Study. Applied Behavioral Science, 41(4), 399-421.

Emmanuel, A. J., Ibrahim, A. D. & Adogbo, K. J. (2014). An Assessment of Professionals' Perception of the Sustainability Performance of Infrastructure Projects in Nigeria. Journal of Construction Project Management and Innovation: Supplement 1, 4, 912-932.

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. Academy of Management Review, 14(4), 532–550.

Gohardani, N. & Bjork, F. (2012). Sustainable Refurbishment in Building Technology. Smart and Sustainable Built Environment, 1(3), 241–252.

Haynes, B. P. (2007). Job productivity: A Theoretical Framework. Journal of Corporate Real Estate, 9(2), 97–110.

Haynes, B. P. (2008). An Evaluation of the Impact of the Office Environment on Productivity. Facilities, 26(5/6), 178–195.

Hassanain, M. A. (2008). On the Performance Evaluation of Sustainable Student Housing Facilities. Journal of Facilities Management, 6(3), 212–225.

Israelson, N. & Hansson, B. (2009). Factors Influencing Flexibility in Buildings. Structural Survey, 27(2), 138-147.

Jylhä, T. & Junnila, S. (2013). Learning from Lean Management – Going Beyond Input-Output Thinking. Facilities, 31(11), 454–467.

Jylhä, T. & Junnila, S. (2014). The State of Value Creation in the Real-Estate Sector – Lessons from Lean Thinking. Property Management, 32(1), 28–47.

Karna, S. (2009). Concepts and Attributes of User Satisfaction on Construction. Helsinki University of Technology: Ph.D. Thesis.

Kempton, J. (2006). Can Lean Thinking Apply to the Repair and Refurbishment of Properties in the Registered Social Landlord Sector? Structural Survey, 24(3), 201-211.

Kim, Y. S., Oh, S. W., Cho, Y. K. & Seo, J. W. (2007). A PDA and Wireless Web-Integrated System for Quality Inspection and Defect Management of Apartment Housing Projects. Automation in Construction, 17(2), 163-179.

Mansfield, J. R. (2011). Sustainable Refurbishment: Some Practical Regulatory Hurdles. Structural Survey, 29(2), 120–132.

Marir, F. & Watson, I. (1995). Representing and Indexing Building Refurbishment Cases for Multiple Retrieval of Adaptable Pieces of Cases. Proc. of the First Int. Conf. on Case-Based Reasoning Research and Development - ICCBR-95. 55-66. Berlin Heidelberg: Springer.

Miller, E. & Buys, L. (2008). Retrofitting Commercial Office Buildings for Sustainability: Tenants' Perspectives. Journal of Property Investment & Finance, 26(6), 552–561.

Nicholas, J. & Soni, A. (2006). The Portal to Lean Production: Principles and Practices for Doing More with Less. Boca Raton: Auerbach Publication

Nicholas, J. & Soni, A. (2006). The Portal to Lean Production: Principles and Practices for Doing More with Less. Boca Raton: Auerbach Publication.

Nwokoro, I. & Onukwube, H. N. (2011). Sustainable or Green Construction in Lagos, Nigeria: Principles, Attributes and Framework. Journal of Sustainable Development, 4(4), 166–174.

Ohno, T. (1998). Toyota Production System: Beyond Large-Scale Production. New York NY: Productivity Press.

Oribuyaku, D. (2015). Code for a Sustainable Built Environment in Nigeria: A Proposed High-Level Vision of a Policy Framework. MPRA Paper No. 66197. Retrieved August 22, 2015, from https://mpra.ub.uni-muenchen.de/66197/.

Pemsel, S., Widén, K. & Hansson, B. (2010). Managing the Needs of End-users in the Design and Delivery of Construction Projects. Facilities, 28(1/2), 17-30.

Rey, E. (2004). Office Building Retrofitting Strategies: Multicriteria Approach of an Architectural and Technical Issue. Energy and Buildings, 36(4), 367–372.

Rotimi, F. E. (2013). An Evaluative Framework for Defects in New Residential Buildings: The New Zealand Case. Auckland University of Technology: Ph.D. Thesis.

Samuel, D., Found, P. & Williams, S. J. (2015). How did the Publication of the Book - The Machine that Changed the World change Management Thinking? Exploring 25 Years of Lean Literature. International Journal of Operations & Production Management, 35(10), 1386-1407.

Schipper, T. & Swets, M. (2010). Innovative Lean Development. New York: Productivity Press.

Schakib-ekbatan, K., Wagner, A. & Lussac, C. (2010). Occupant Satisfaction as an Indicator for the Socio-Cultural Dimension of Sustainable Office Buildings – Development of an Overall Building Index. Proc. of the Windsor 2010 Int. Conf. on Adapting to Change: New Thinking on Comfort. London. Network for Comfort and Energy Use in Buildings. 9–11.

Sinou, M. & Kyvelou, S. (2006). Present and Future of Building Performance Assessment Tools. Management of Environmental Quality: An International Journal, 17(5), 570–586.

Speckelmeyer, K. F. (1993), Office Relocation and Environmental Change: A Case Study. Environment and Behavior, 25(2), 181-204.

Spring, M. (2004). Beauty is but Skin Deep. Building, 269(24), 26-28.

Sharp, M. & Jones, K. (2012). Perceived Inefficiency in Social Housing Maintenance. Journal of Construction Innovation, 12(4), 414–428.

Shika, S. A., Sapri, M., Jibril, J. D., Sipan, I. & Abdullah, S. (2012). Developing Post Occupancy Evaluation Sustainability Assessment Framework for Retrofitting Commercial Office Buildings: A Proposal. Procedia - Social and Behavioral Sciences, 65, 644–649.

Strzelecka, E. (2008). Urban Development versus Sustainable Development in Poland. Management of Environmental Quality, 19(2), 243–252.

Warr, P. (2011). Work, Happiness and Unhappiness. Cambridge: Psychology Press.

Wang, J. X. (2011). Lean Manufacturing: Bottom-Line Based. Boca Raton: CRC Press.

World Commission on Environment and Development (WCED). (1987). Our Common Future: Report of the World Commission on Environment and Development. Washington D.C.: United Nations.

Womack, J. and Jones, D. (2005). Lean Solutions. London: Simon & Schuster.

Wilkinson, S. J., Reed, R. & Jailani, J.(2011). User Satisfaction in Sustainable Office Buildings: A Preliminary Study. In PRRES 2011: Proceedings of the 17th Pacific Rim Real Estate Society Annual Conference. Pacific Rim Real Estate Society.

Womack, J. P., Jones, D. T. & Roos, D. (1991). The Machine that Changed the World: The Story of Lean Production. New York: Maxwell Macmillan International.

Womack, J. P. & Jones, D. T. (1996). Lean Thinking: Banish Waste and Create Wealth in Your Organization. New York: Simon & Schuster. Veitch, J. C. (2008). Towards a User-Centered Theory of the Built Environment. Building Research & Information, 36(3), 231–240.

Yin, R. K. (2013). Case Study Research: Design and methods. 5th ed. Sage publications.

Zheng, H. W., Shen, G. Q. & Wang, H. (2014). A Review of Recent Studies on Sustainable Urban Renewal. Habitat International, 41, 272-279.

Caccavelli, D. & Gugerli, H. (2002). TOBUS - A European Diagnosis and Decision-Making Tool for Office Building Upgrading. Energy and Building, 34, 113–119.

MAKING SENSE OF STIGMATISED PROPERTY: A CROSS-PROFESSIONAL PERSPECTIVE

Rosli Said[a], **Rohayu Ab. Majid**[b] **& Chuah Teong Geng**[c]

[a&c]Department of Estate Management,
Faculty of Built Environment,
University of Malaya,
50603 Kuala Lumpur, Malaysia
Corresponding Author
Email[a]: rosli_alambina@um.edu.my

[b]Department of Estate Management,
Faculty of Architecture, Planning & Surveying,
Universiti Teknologi Mara,
40450 Shah Alam, Selangor, Malaysia.

ABSTRACT

Housing is the basic needs for a human and it creates a lot of investment opportunity for speculators. When a property is attached with stigma, its value will be affected. However, there are different impacts of stigma on the value of the property. The main aim of this research is to determine the impact of stigma on property price. Therefore, the opinion of estate agents, negotiators or auctioneers was obtained through questionnaires interview. The data were analysed using cross-tabulation analysis, normality test for data distribution, reliability analysis for constructed research survey and structural equation modelling (SEM) to obtain the result of the study. The relationship between types of stigma and its implications on property price were explored. The result shows that stigmas influenced the property price; while implications of stigma did not bring noticeable impacts.

Keywords: *Stigma, Stigmatised properties, Impact, Property value*

1. INTRODUCTION

Housing is the basic need for a human; it involves a series of transaction procedures and a huge amount of money. Therefore, property homebuyers will usually study the market and history of the property before proceeding with the transaction. By referring to Malpezzi (2002), housing market involves land use, development regulation and housing prices where the housing prices are affected by regulations and demand determinants. This was supported by Green and Hendershott (1996) who mentioned the house prices are reflected by the willingness of the amount paid by homebuyers, and by the number of properties supplied by the builders. In addition, the price of a house is the main consideration for a homebuyer to own house (Haron and Liew, 2013). In purchasing property, factors that affect the homebuyers' decision making are, among other, the location, physical perspective, safety, economic features and amenities. Additionally, characteristic of the property also influence the homebuyers' decision making.

However, when the property is located at an undesirable location, such as close to hazards, homebuyers' perception differs. This type of property will be characterised as stigmatised property. Stigmatised properties create a negative perception amongst the public. Such property may have a physical or nonphysical defect, where the latter includes emotional defect such as the occurrence of death or crime. The properties are also characterised as stigmatised property when the neighbourhood or surrounding area of the properties have an ongoing commission of a crime. According to Brown and Turlow (1996), places with violent crimes have issues of disclosure and loss of property value. Such implication also applies to the properties on contaminated land, or susceptible to natural disasters, or even if it is perceived as being inhabited by supernatural beings (i.e., haunted). However, different homebuyers have a different perspective on the features of the properties. For example, some homebuyers are willing to purchase the property that is near power transmission line, as the developers may offer it with extra lands. The study of Richard Roddewig (1996) found that there is no evidence to suggest that the market for stigmatised properties is lacking. Thus, such demand may increase the value of the property. However, the studies by Lynch and Rasmussen (2001), Hellman and Naroff (1979) and Linden and Rockoff (2008) proved that stigma has a significant impact on the house price. When the properties are characterised as stigmatised, the willingness of homebuyers to purchase them are affected, as reflected in the price of the property. In short, the homebuyers' perception has a significant impact on the price of stigmatised properties.

Therefore, the main aim of this research is to determine how the public perceptions on stigmatised properties influence their prices. In order to gain more insight into the issues related to stigmatised properties, this paper is organised as follows. First, relevant literature encompasses the concept of stigma is discussed. Then, follows the discussion on the impact of stigma on property price and the methodology used in assessing such implication. Thereafter, analysis and conclusion of the paper are presented and discussed.

2. LITERATURE REVIEW

2.1 Definition of Stigma

Stigma has many definitions. For example, Morgan (1994) in Perlin & Ben-Ezra (2005), refers stigma as property psychologically impacted by an event which occurred or was suspected to have occurred on the property, even being one that has no physical impact of any kind. Perlin and Ben-Ezra, 2005) further added that stigmatise properties can be created even without physical indications, where it can be of non-physical or emotion defects. Meanwhile, Sanders (1996) defined it as "an intangible psychological impact on value or marketability because of increased risk or future uncertainty". In addition, Said in the NST (2012) refers Stigmatise properties as "any negative public perception adversely affects a project's marketability and value".

Thus, stigmatised property can be concluded as a phenomenon when there were psychological impacts by bad circumstances and the value or reputation of the property was affected. This perception will influence the decision of the homebuyers when purchasing the property.

In real estate contents, stigma was categorised into various groups by different studies, as summarised in Table 1.

Table 1: Types of stigma

(Filarski, 2013)	(Wiltshaw, 1998)
• **Public stigma** Wide demographics know the existence of stigma. • **Criminal stigma** The neighbourhood of the properties has ongoing commission of crime. • **Murder or suicide stigma** Properties involved in murder or suicide cases. • **Debt stigma** Debtor moved out without the debt collectors noticing. • **Phenomena stigma** Properties that renowned as "haunting".	• **Certainty stigma** A known liability that is consider as permanent and comprehensive • **Uncertainty stigma** When the outcomes and probabilities of the occurance are uncertain. • **Risk stigma** Uncertain risk after the remedial is taken. • **Multicausal stigma** Several contributors are taken into account.
Dr Sr Rosli in (NST, 2012)	(Colangelo and Miller, 1995)
• **Physical stigma** A tangible physical asset defect. • **Non-physical stigma** An intangible physical asset defect. • **Physiological or emotional stigma** Neither physical nor environmental defects	• **Residual stigma** A permanent liability and continuing risk after the remedial took place, resulted from public perception. • **Proximity stigma** Negative impact towards the close proximity properties with other stigmatised causal.

In general, stigmatised properties include properties in contaminated area, natural hazard (such as flood and landslide) and neighbourhood with high crime rate. This includes properties involving death, abandoned for a prolonged time, incomplete construction or paranormal occurrence. As mentioned by Colangelo and Miller (1995), properties can be stigmatised due to their proximity to those factors. Stigma can be the defect that is tangible or intangible, and this is borne by the user or homebuyer. The common point for the different types of stigma is the impact towards property value.

2.2 Implication of Stigma

From the definitions studied in the previous subsection, it can be said when the property is characterised as stigmatised, there is an impact on the property in terms of its value, reputation and risk. As mentioned in NYT (2006), the stigmatised property will dissuade the potential homebuyers even if it is free from physical defects. Therefore, the stigmatised properties will command less than the market value (Wiltshaw, 1998; Roddewig, 1996 and Sanders, 1996). Declining market value is mainly due to the lack of demand in the market. Therefore, when the property is characterised as stigmatised, the demand for the property declined and hence, the market value of the property dropped.

In general, homebuyers refuse to purchase the property when additional cost of remedial is required for the properties' debt stigma, phenomena stigma or environmental stigma. Homebuyers feel insecure when they do not understand about the defects and afraid they have no adequate control over the property (Muldowney and Harrison, 1995). It is easy to understand that the effect of stigma rose from the risk perception, which concerned the homebuyers. The risk is an important issue in this aspect as it consists of remedial costs, time and uncertainty (NST, 2012). Every risk encountered or perceived by them will influence their decision whether it is from the environmental, safety or financial. When the homebuyers have a negative reaction towards the risk and stigma, the demand on the stigmatised property will reduce.

For environmental risk, it consists of health risk, remediation risk, media risk and regulatory risk (Richard Roddewig, 1996). Properties on contamination land are considered environmentally stigmatised. Homebuyers are afraid of the health hazard arise from the land. For instance, when the groundwater is below the contamination land, it has a high chance of being polluted. Therefore, the water supply to the residents might be harmful. In order to reduce the risk and value affected of the properties, owners are required to carry out the remedial work, such as site clearance. The remedial cost and any other additional costs are charged to the owner. On the other hand, properties with high exposure in media created public awareness on the pollution issues, which will affect the perceptions of the public and homebuyers. Therefore, the liability of the homebuyers and the owners on the particular land, such as the remedial work and taxes will be known; thus, expertise is required. The impact accrued from the environmental risk will discourage the home buyers.

However, research by Neustein and Bell (1998) offered a contradicting opinion; new generations of homebuyers are looking for the contaminated real estate. Researchers highlighted the perception as the main factor to shift the attitude and demand of the purchaser in the market and bring the impact on the property value or price (Neustein and Bell, 1998; Hurd, 2002 and Wiltshaw, 1998). The study of Muldowney and Harrison (1995) also mentioned when the public has negative opinions about the risk and future problems, the value of the properties will be affected. In addition, the homebuyers are not confident with the science has "caught up" with the common contamination problems and will lead them to question the future of the property. It is hard to determine the market value of the stigmatised properties and its future value when the property is repaired (Sanders, 1996). When the value of the property became uncertain, the desire of the home buyers towards that property will be less.

Properties situated in the neighbourhood that has an ongoing commission of crimes are characterised as crime stigma. According to Brown and Turlow III (1996), places with violent crimes are having the issues of disclosure and loss of property value. Additionally, the crime rate has a high impact on the individual's safety perception on a neighbourhood (Tita et. al., 2006). Thus, the value of property has a direct relationship with the individual's perception. Some homebuyers will not move into the neighbourhood with a bad reputation in terms of crimes and safety. People will reduce their desirability of ownership in the neighbourhood when the threat is a crime (Tita et al., 2006). As discussed by Cullen and Levitt (1999), residents prefer safer communities. The unlikelihood of the residents to enter a particular neighbourhood will affect the value of the properties. The influence on it is mainly due to the low mobility among the residents in a neighbourhood, reducing the housing supply on the market (Lynch and Rasmussen, 2001).

However, some homebuyers are willing to enter the affected neighbourhood. When the house has other characteristics, the homebuyer will change their desirability of ownership (Lynch and Rasmussen, 2001). For instance, location and accessibility of the house may be valued higher, despite with higher crime rate. Some homebuyers are willing to pay more in order to enter the particular neighbourhood. This contradicts the statement of Ihlanfeldt and Mayock (2010), where serious crimes will drive people out of the neighbourhood. Meanwhile, the willingness of the homebuyers to enter the crime neighbourhood also contradict to the assumption of the study by Linden and Rockoff (2008). This contradiction occurred because Linden and Rockoff (2008) did not consider the other characteristics of the properties that might change the ownership behaviour of the individuals. However, crime still has a significant impact on the market (Lynch and Rasmussen, 2001; Hellman and Naroff, 1979; and Linden and Rockoff, 2008).

Property's reputation could further affect its market value. Homebuyers will have difficulty in reselling their properties in the future even they are comfortable with the stigmatised property (Chapman and Ludlum, 2014). According to Ecker (2013), stigmatised properties are often harder to be rented and sold. This statement is supported by Larsen and Coleman (2010) who stated stigmatised properties usually sold or leased at a lower price or stayed in the market longer compared to other houses. In such cases, estate agents or sellers are facing problems to disclose the properties especially the properties that are thought to be "haunted". Meanwhile, in Malaysia, there is no law for a seller to disclose such information about the property's history (Star, 2012). Thus, homebuyers have to take the full responsibility for purchasing a stigmatised property in Malaysia.

On the other hand, Miller in NYT (2006) gave the opinion about the stigmatised property in the weaker market having more effect on its value. People are less pronounced with their opinions when the market is in recession, and thus, they affect less on the value. Correspondingly, an industry observer in the Star (2012) mentioned a haunted house that fetched a lower price compared to other properties in the market will be more attractive to the homebuyers who are not concerned about the paranormal phenomena. Some investors bought the haunted house and sold it for a large profit in the market. The marketability of stigmatised properties in the market varies on the beliefs of the home buyer.

Stigmatised property has a direct implication towards the property value or house price. As mentioned earlier, the homebuyers have a different opinion on the stigmatised properties (Neustein and Bell, 1998). In the articles of Star (2011) and Star (2012), the industry observers highlighted stigmatised properties provided an opportunity to the investors to make a huge profit. Some homebuyers purchased the stigmatised property in the weaker market with lower price and waited a longer time to market the property, lowering the chance for future tenants to hear about the rumour or the history of the properties (Alias et al., 2014). When the property is successfully transacted, investors will be able to earn larger profits (Star, 2011; Star, 2012). There are several studies about the changes in property values due to stigma, where most of the researchers have the opinion of stigmatised property fetching the lower property value. The list of the result and opinions of the previous researchers are shown in Table 2.

Table 2: The Result and Opinion of the Researchers about Implications of Stigma on the Property Value or House Price

Types of stigma	**Implication of the property value or house price**	**Author**
Electromagnetic Field	Decline in value: (i) Residential Property: 1% - 2% (ii) Industrial Property: 1% - 3% (iii) Commercial Property: 2% - 8% (iv) Other Type of Property: Agricultural land, 3%	Alias and Baharuddin (2005)
Crime stigma	(i) Increase of 10% in crime in the properties decreases $206 of property sales price (ii) Increase of 10% violent crime in neighbourhood decreases $145 of property sales price	Lynch and Rasmussen (2001)
Landslide property	(i) In the year 2009, - apartment sales price dropped to 26% - the terraced house remained unscathed with 1% increment (ii) In the year 2010, - Apartment sales price dropped to 4%	Star (2011)

Haunted house	The sales price of stigmatised property is 10% to 20% less than comparable properties.	Star (2012)
Death stigma	Capital appreciates for $22.5million in one year time	NYT (2006)
Crime stigma	Property value depreciates about $60 million	Linden and Rockoff (2008)
Crime stigma	Reduction in violent crime increases the house price by approximately 39%.	Tita et al. (2006)
Crime stigma	Property value increases with: (i) 1% crime rate reduction: $2.3 million (ii) 5% crime rate reduction: $11.489 million (iii) 10% crime rate reduction: $22.996 million	Hellman and Naroff (1979)

In short, individual's perception will affect the demand and market for the stigmatised properties. The perception of the individuals from the risk factors that come from stigma is treated as one of the many attributes of the sales price (Messer et al, 2006). However, there is no valid support to say there is no market for the stigmatised property (Roddewig, 1996). This fact is only true for certain types of stigmatised properties. Some people will go for the stigmatised property when the property has other attractive characteristics such as location and accessibility when compared to the bad reputation of the crime stigma. The summary of the implications of stigma is shown in Figure 1 and this becomes the theoretical framework of the study.

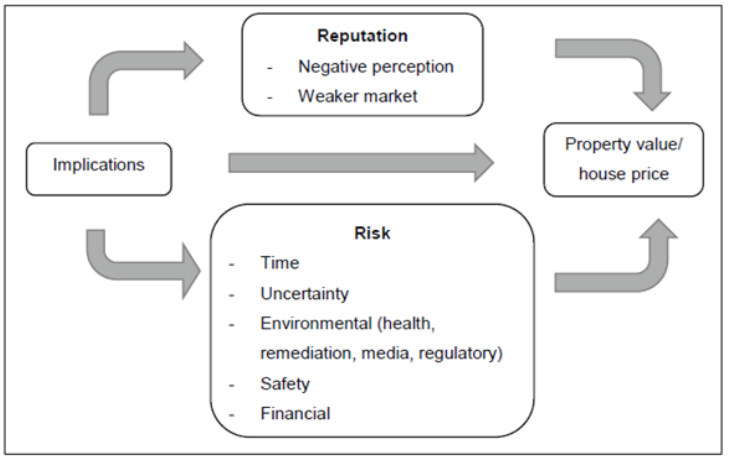

Figure 1: Summary of Implication of Stigma

3. METHODOLOGY

Quantitative method is used as the research approach for the study. The questionnaires were used as a mode of research survey and conducted to determine the opinions of the real estate real estate agents, negotiators and auctioneers. The questionnaire contained open-ended questions, checklists, and ranking scales. The brief description of types of questions by Phillips (2008) are:

- Open-ended: Respondent is allowed to answer without limit in ample blank spaces that have been provided.
- Checklist: Respondent is required to choose the suitable items that apply in the situation from a list of items that have been provided.
- Two-way: The answer is limited to a pair of alternatives responses.
- Ranking scales: Respondent is required to rank a list of items.

Snowball sampling technique is used for this research. This is conducted by approaching respondents who can fulfil all the criteria of the study. After obtaining the required data from the first respondent, the researcher will approach the other respondent who was suggested by the first respondent. The process is repeated until the desired number of the respondents is reached. Snowball sampling is usually adopted when the target group is small with unique characteristics and compiling the complete list of sampling units is considered not practical.

The sample size is limited to 50 people of respondents. The target group of respondents are estate agents, negotiators and auctioneers. The respondents must be registered with their respective professional bodies and active in Malaysia housing market. These parties must have been dealing with stigmatised properties. The surveys were conducted both face-to-face interview and online forms distribution. The geographical area of study is Klang Valley.

The method used in the analysis is Structural Equation Modelling (SEM). The method is commonly used to convert a theoretical framework into AMOS syntax (Awang, 2010). SEM is also known as a collection of tools used to analyse the connections between various concepts in cases whereby the connections can be either for expanding the general knowledge or for problem solving (Blunch, 2008). A confirmatory factor analysis is used in the study to determine the relationship between the types of stigma, implications brought by stigma and price changes of stigmatised property. According to Blunch (2008), under the three-indicator rule, a confirmatory factor model is identified when every factor has, at least, three indicators, no manifest variable is an indicator for more than one factor and the error terms are not correlated.

Latent variables are theoretical constructs that are unable to observe and measured directly in a research study. In order to measure all the variables in the study, the unobserved variable is linked to one that is observable (observed variables) (Byrne, 2010). Among latent variables, there are exogenous and endogenous variables. Referring to Byrne (2010), exogenous latent variables are synonymous with independent variables. Exogenous latent variables will bring impact on the values of other latent variables in the model. However, endogenous latent variables are synonymous with dependent variables, which will be influenced directly or indirectly by exogenous variables. Figure 2 shows a schematic diagram of the study.

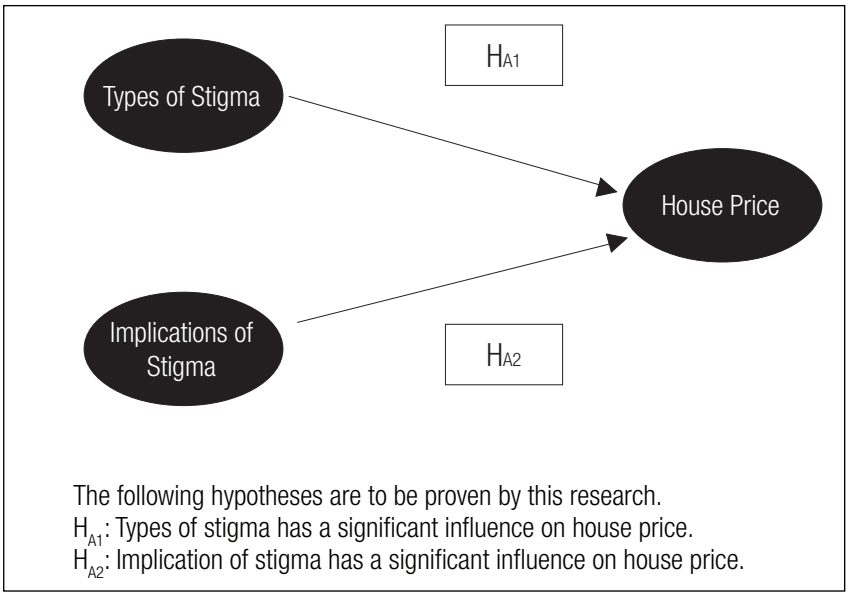

Figure 2: Schematic Diagram

The theoretical model of the study is developed using AMOS graphic as shown in Figure 3.

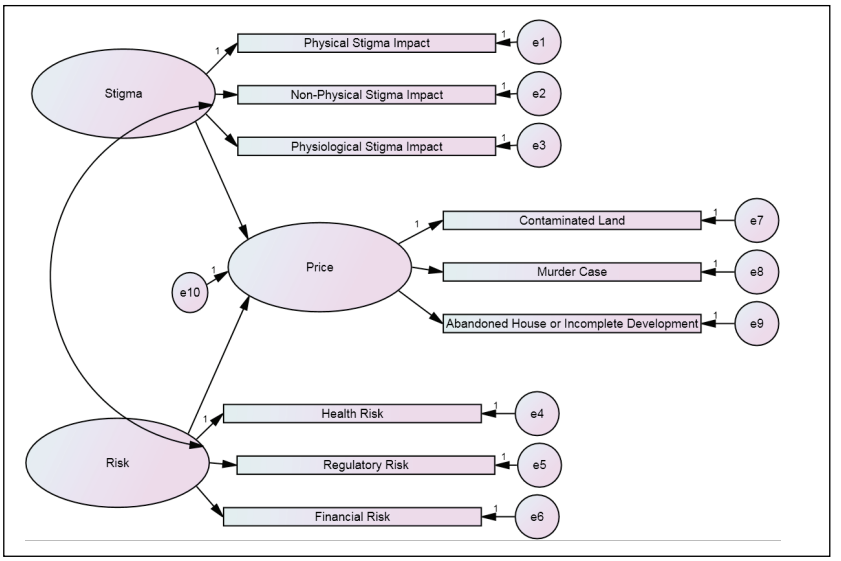

Figure 3: The Theoretical Model of This Study in AMOS Graphic
Source: AMOS 20.0 Output Viewer

As mentioned before, the aim of the research is to identify the relationship between types of stigma, implications of stigma and price changes of stigmatised properties. The relationships between variables are represented by parameters or path (Teo et al., 2013). These parameters include directional effects, variances, and covariance. The relationships between the variables are known as directional effects.

In the study, the directional arrows from stigma (latent variable) to non-physical stigma impact and physiological stigma impact (observed variable) are known as factor loading to be estimated. This is the same as the directional arrows from risk to regulatory risk, and financial risk; as well as changes in value due to the murder case and abandoned or incomplete construction or development. Physical stigma, health risk and contaminated land are factor loadings set at 1.0. The relationship between latent variables to another latent variables is known as path coefficient (Teo et al., 2013). The arrow from stigma to price indicates the path coefficient, which shows the relationship between exogenous variable to endogenous variable. In the study, the path coefficient is shown by stigma to price, the risk to price, stigma to risk and risk to stigma. The directional effect in this study is six-factor loadings between latent variables and observed variables and four path coefficients between latent variables. Therefore, ten parameters have been established in this study.

Path loading of independent latent variables set to 1.0 will be estimated by variance (Teo et al., 2013). In this study, indicator error (e1 to e9) that associated with the nine observed variables; errors-associated endogenous variables (stigma) and exogenous variables (risk and price) will be estimated by variance. On the other hand, covariance is known as non-directional associates among independent latent variables. In this study, a covariance exists as the hypothesis made earlier mentioned that stigma and risk factors are correlated. In short, for this study, 23 parameters (4 path coefficient, six-factor loadings, 12 variances and one covariance) were specified for the estimation.

3. RESULTS AND DISCUSSION

The results of the analysis are presented as follows:

Normality Test for Data Distribution

Skewness and kurtosis are the common methods used to identify the normality of data. The data distribution pattern can be represented in skewness and kurtosis statistics. According to Chua (2013), the value of skewness and kurtosis should be in the range of -1.96 to + 1.96 for a normally distributed data. The results are shown in Table 3.

Table 3: Normality Test for Types of Stigma, Types of Implications of Stigma and House Price

Variable		Skew	Kurtosis
Types of Stigma	Physiological Stigma	.000	-.500
	Non-Physical Stigma	.139	-.789
	Physical Stigma	-1.088	1.143
Types of Implications of Stigma	Financial Risk	-.579	-1.136
	Health Risk	.000	-1.750
	Regulatory Risk	-.328	-.336
House Price	AH	.515	-.635
	CL	.622	-1.042
	MC	.000	-1.550

Source: AMOS 20.0 Output Viewer

The results of the normality test show the data of types of stigma, types of the implication of stigma and house price are normally distributed since the skewness and kurtosis values are within ±1.96.

Reliability Analysis of Constructed Research Survey

The level of reliability of a questionnaire survey is determined by the result of the Cronbach's alpha value by using Cronbach's alpha internal consistency method. The acceptable range of alpha is 0.65 to 0.95 (Chua, 2013). In the study of Tavakol and Dennick (2011), a satisfactory alpha value is from .70 to .95. This had been mentioned Gefen et al. (2000) where the construct reliability should be above .70. A low alpha coefficient shows the items in the questionnaire survey have a low ability to measure the concept whereby high alpha value shows all the items are homogeneous or overlap to each other (Chua, 2013). The results are shown in Table 4.

Table 4: Reliability Test for Types of Stigma, Types of Implications of Stigma and House Price.

Item Tested		Cronbach's Alpha
Types of Stigma	Physical Stigma	.716
	Non-Physical Stigma	
	Physiological Stigma	
Types of Implications of Stigma	Health Risk	.871
	Regulatory Risk	
	Financial Risk	
House Price	Contaminated Land	.910
	Murder Case	
	Abandoned Houses or Incomplete Construction or development	

Source: SPSS 20.0 Output Viewer

The results show that the Cronbach's alpha reliability coefficients are below .95 which is .716 for types of stigma, .871 for types of the implication of stigma and .910 for house pricing. The reliability value is satisfactory. The implications of stigma are reduced to three variables namely health risk, regulatory risk, and financial risk; variables for house pricing is reduced to contaminated land, murder cases and abandoned houses or incomplete construction or development in order to obtain the ideal Cronbach's alpha reliability coefficient.

Structural Equation Model (SEM)

SEM is used to study the relationship between the types of stigma, implications brought by stigma and house pricing changes of the stigmatised property.

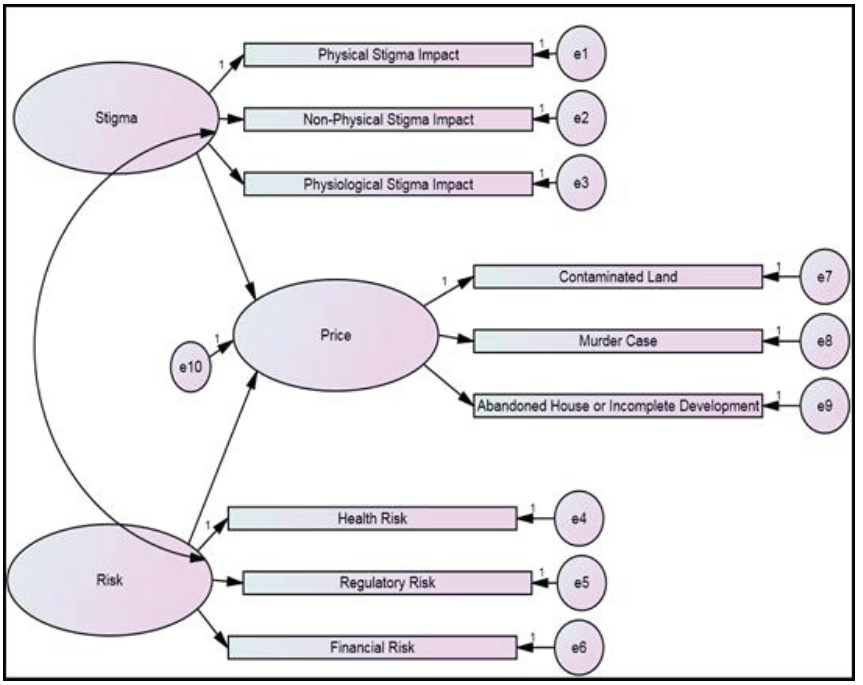

Figure 4: The Path Diagram presents the strength and magnitude of association among the variables in the Study

Source: AMOS 20.0 Output Viewer

Based on the figure above, the covariance between types of Stigma and types of implications that bring by stigma (Risk) is .14. The result of the errors and path coefficient are in Figure 4.

Table 5: Result of errors and path coefficient

Variables	Estimate
Stigma	.127
Risk	.559
e10	.714
e1	.433
e2	.095
e3	.219
e4	.241
e5	.182
e6	.202
e7	.397
e8	.390
e9	.003

Source: AMOS 20.0 Output Viewer

Variance estimated path loading of independent latent variables that have been set to 1.0. The estimation of variance for each variable is stated in Table 5. This shows the independent latent variables have a positive path loading.

The estimate of correlations determines the strength of the relationship between types of stigma and implications that brought by stigma.

Table 6: Result of Correlation

Variable	Path	Variable	Estimate
Stigma	<-->	Risk	.531

Source: AMOS 20.0 Output Viewer

Based on the result above, the value of correlation among types of stigma and types of implications brought by stigma is .531, which is at an average level.

The hypothesised links among the main variables in this research study namely Stigma, Risk and Price are tested.

H_{A1}: Types of stigma has a significant influence on house price.

Table 7: Path Analysis of SEM for Hypothesis 1

Variables	Path	Variable	Estimate	P
Price	<---	Stigma	1.214	.030

Source: AMOS 20.0 Output Viewer

The P-value for H_{A1} is .030, which is lower than .05. Hence the null hypothesis is rejected. Therefore, H_{A1} is supported. Types of stigma have a significant and direct influence the house price.

H_{A2}: Implication of stigma has a significant influence on house price.

Table 8: Path Analysis of SEM for Hypothesis 2

Variable	Path	Variable	Estimate	P
Price	<---	Risk	-.023	.917

Source: AMOS 20.0 Output Viewer

Since the P-value for H_{A2} is higher than .05, the null hypothesis is not rejected. Thus, H_{A2} is not supported. The types of implications that brought by stigma have no significant and direct influence on house price.

In summary, the result of the main variables in this study is shown in Table 9.

Table 9: Summary of the Result of Main Hypothesis in the Study

No	The Main Hypothesis Statement in the Study		Result
1	H_{A1}	Types of stigma have significant influence on house price.	Supported
2	H_{A2}	The implication of stigma has a significant influence on house price.	Not Supported

3. CONCLUSION

This research study aims to determine the perception of estate agents, negotiators and auctioneers on the influence of stigmatised property on its value. The information of stigmatised properties and perceptions of respondents were collected through a questionnaire survey.

The normality and reliability test were conducted before applying the structural equation modelling (SEM) in the analysis of the study. The purpose is to determine the eligibility of the data obtained to be analysed using SEM method. From the result of SEM, it was clearly shown that types of stigma bring significant influence to house pricing. For instance, when a property is characterised as physical stigma such as built on contaminated land, the price is reduced to an average of 19%.

On the other hand, types of implications that brought by the stigmas had no significant impact on its price. Thus, it sufficed to conclude that health risk, regulatory risk and financial risk will not affect the price of the properties. Homebuyers took more consideration on other types of factors such as physical attributes of the houses and design than the risk that brought by stigma.

BIBLIOGRAPHY

Alias, A., & Baharuddin, M. (2005). Valuers' Perceptions of the Value of Properties Located Proximate to Transmission Lines. Journal of Valuation and Property Services.2005, 5(1).

Alias, A., Hamsani, D., Chua, S., & Zaid, S. (2014). Psychologically Impacted Houses–Superstitions And Marketability Problems. Journal of Building Performance, 5(1).

Awang, Z. H. (2010). Research Methodology for Business & Social Science. Malaysia: Reka Cetak Sdn Bhd.

Blunch, N. J. (2008). Introduction to Structural Equation Modelling Using SPSS and AMOS. London: SAGE Publications Ltd.

Born, W., & Pyhrr, S. (1994). Real estate valuation: The effect of market and property cycles. Journal of Real Estate Research, 9(4), 455-485.

Brown, R. B., & Turlow III, T. H. (1996). Home homebuyers beware Statutes shield real estate brokers and sellers who do not disclose that property is psychologically tainted. Okla. L. Rev., 49, 625.

Byrne, B. M. (2010). Structural equation modelling with AMOS: basic concepts, applications, and programming. United States of America: Taylor and Francis Group, LLC.

Case, K. E., Fair, R. C., & Oster, S. M. (2012). Principles of Economics Prentice Hall.

Catherine, F. (2013). Stigmatised Property: Amityville Horror. Retrieved from http://propertyhealing.com/stigmatized-property-amityville-horror/

Chan, N. (2001). Stigma and its assessment methods. Pacific Rim Property Research Journal, 7(2), 126-140.

Chapman, D., & Ludlum, M. (2014). Teaching stigmatised property: You don't have a ghost of a chance.

Chua, Y. P. (2012). Mastering Research Methods. Malaysia: McGraw-Hill (Malaysia) Sdn. Bhd

Chua, Y. P. (2013). Mastering Research Statistics Malaysia Mc Graw Hill Education.

Colangelo, R. V., & Miller, R. D. (1995). Environmental site assessments and their impact on property value: The appraisal's role. APPRAISAL INSTITUTE, CHICAGO, IL 60610-0956(USA). 1995.

Cullen, J. B., & Levitt, S. D. (1999). Crime, urban flight, and the consequences for cities. Review of economics and statistics, 81(2), 159-169.

Ecker, S. (2013). Stigmatised Properties: Would You Live In A Home Where Someone Died Of Unnatural Causes? Retrieved from http://www.huffingtonpost.com/2013/03/27/stigmatized-properties-someone-died_n_2962468.html

Égert, B., & Mihaljek, D. (2007). Determinants of house prices in Central and Eastern Europe. Comparative economic studies, 49(3), 367-388.

Gans, J., King, S., Stonecash, R., & Mankiw, N. G. (2011). Principles of economics: Cengage Learning.

Gefen, D., Straub, D., & Boudreau, M.-C. (2000). Structural equation modelling and regression: Guidelines for research practice. Communications of the association for information systems, 4(1), 7.

Green, R., & Hendershott, P. H. (1996). Age, housing demand, and real house prices. Regional Science and Urban Economics, 26(5), 465-480.

Grether, D. M., & Mieszkowski, P. (1974). Determinants of real estate values. Journal of Urban Economics, 1(2), 127-145.

Haque, M. (2010). Sampling Methods In Social Research. Global Research Methodology Journal.

Haron, N. A., & Liew, C. (2013). Factors Influencing the Rise of House Price in Klang Valley. International Journal of Research in Engineering and Technology (IJRET), 2(10), 261-272.

Hellman, D. A., & Naroff, J. L. (1979). The impact of crime on urban residential property values. Urban Studies, 16(1), 105-112.

Hornby, A. (Ed.) (2010) Oxford Advanced Learner's Dictionary (8th ed.). Oxford: Oxford University Press.

Hox, J. J., & Boeije, H. R. (2005). Data collection, primary vs. secondary. Encyclopedia of social measurement, 1, 593-599.

Hurd, B. H. (2002). Valuing Superfund site cleanup: evidence of recovering stigmatised property values. Appraisal Journal, 70(4), 426-437.

Ihlanfeldt, K., & Mayock, T. (2010). Panel data estimates of the effects of different types of crime on housing prices. Regional Science and Urban Economics, 40(2), 161-172.

Jing, D. (2010). The effect of the real estate cycle on investment decisions - An empirical study of Stockholm office market by using DCF cyclical valuation models (Master Program in Real Estate Management), KTH School of Architecture and the Built Environment (36)

Kivela, J., Inbakaran, R., & Reece, J. (2000). Consumer research in the restaurant environment. Part 3: analysis, findings and conclusions. International Journal of Contemporary Hospitality Management, 12(1), 13-30.

Lin Lee, C. (2009). Housing price volatility and its determinants. International Journal of Housing Markets and Analysis, 2(3), 293-308.

Linden, L., & Rockoff, J. E. (2008). Estimates of the impact of crime risk on property values from Megan's laws. The American Economic Review, 1103-1127.

Lynch, A. K., & Rasmussen, D. W. (2001). Measuring the impact of crime on house prices. Applied Economics, 33(15), 1981-1989.

Majid, R. A., & Said, R. (2013). Impak Kitaran Harta Tanah Dalam Pasaran Perumahan. Journal of Design and Built Environment, 12(1).

Malpezzi, S. (1996). Housing prices, externalities, and regulation in US metropolitan areas. Journal of Housing Research, 7, 209-242.

Malpezzi, S. (2002). Urban regulation, the "new economy," and housing prices. Housing Policy Debate, 13(2), 323-349.

Messer, K. D., Schulze, W. D., Hackett, K. F., Cameron, T. A., & McClelland, G. H. (2006). Can stigma explain large property value losses? The psychology and economics of Superfund. Environmental and Resource Economics, 33(3), 299-324.

Millington, A. F. (2000). An Introduction To Property Valuation (5th ed.). London: Bell and Bain Ltd.

Morgan, R. M. (1994). The expansion of the duty to disclosure in real estate transactions: It's not just for sellers anymore. Florida Bar Journal, 31.

Mueller, G. R., & Laposa, P. (1994). Evaluating real estate markets using cycle analysis. Paper presented at the meeting of the American Real Estate Society, Santa Barbara, California.

Muldowney, T. J., & Harrison, K. W. (1995). Stigma Damages: Property Damage and the Fear of Risk. Def. Counsel J., 62, 525.

Neustein, R. A., & Bell, R. (1998). Diminishing diminution: A trend in environmental stigma. Environmental Claims Journal, 11(1), 47-59.

NST. (2012, July 20). Making sense of stigmatised properties, New Straits Times. Retrieved from http://www2.nst.com.my/nation/making-sense-of-stigmatised-properties-1.109915

NYT. (2006, April, 30). Some home homebuyers regret not asking: Anyone die here, New York Times. Retrieved from http://www.nytimes.com/2006/04/30/realestate/30cov.html?_r=1&adxnnl=1&pagewanted=2&adxnnlx=1431608548-OhnD2ioXVxws7yu23lXpgw&

Patricia Pulliam Phillips, C. A. S. (2008). Data collection: planning for and collecting all types of data. San Francisco: Wiley.

Perlin, A., & Ben-Ezra, M. (2005). Stigma Busters-Primer on Selling Haunted Houses and Other Stigmatized Property. Prob. & Prop., 19, 59.

Pyhrr, S., Roulac, S., & Born, W. (1999). Real estate cycles and their strategic implications for investors and portfolio managers in the global economy. Journal of Real Estate Research, 18(1), 7-68.

Research, A. I. o. C., Fund, D., & Dybvig, L. (1992). Contaminated Real Estate: Implications for real estate appraisers: Research and Development Fund, Appraisal Institute of Canada.

Roddewig, R.M. (1996). Stigma, environmental risk and property value: 10 critical inquiries. The Appraisal Journal.

Said, R., Adair, A., McGreal, S., & Majid, R. (2014). Inter-relationship between the housing market and housing finance system: evidence from Malaysia. International Journal of Strategic Property Management, 18(2), 138-150.

Sanders, M. V. (1996). Post-repair diminution in value from geotechnical problems. Appraisal Journal, 64, 59-66.

Star, T. (2011, 5 February). Is there hope for Bukit Antarabangsa property owners? The Star. Retrieved from http://www.thestar.com.my/Story/?file=/2011/2/5/business/7816803&sec=business

Star, T. (2012, June 30). Selling a haunted house The Star. Retrieved from http://www.thestar.com.my/story/?file=%2F2012%2F6%2F30%2Fbusiness%2F11552156

Taltavull de La Paz, P. (2003). Determinants of housing prices in Spanish cities. Journal of Property Investment & Finance, 21(2), 109-135.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. International Journal of medical education, 2, 53.

Tejvan. (2008). Understanding the housing market. From http://www.housingmarket.org.uk/housing/definition-of-the-housing-market/08/

Teo, T., Tsai, L. T., & Yang, C.-C. (2013). Applying Structural Equation Modeling (SEM) in Educational Research Application of Structural Equation Modeling in Educational Research and Practice (pp. 3-21): Springer.

Tewksbury, R. (2009). Qualitative versus quantitative methods: Understanding why qualitative methods are superior for criminology and criminal justice. Journal of Theoretical and Philosophical Criminology, 1(1), 38-58.

Tita, G. E., Petras, T. L., & Greenbaum, R. T. (2006). Crime and residential choice: a neighbourhood level analysis of the impact of crime on housing prices. Journal of Quantitative Criminology, 22(4), 299-317.

Weintraub, E. (2015). Location, Location, Location What Does Location, Location, Location Mean? , from http://homebuying.about.com/od/marketfactstrends/qt/013008_location.htm

Wiltshaw, D. (1998). Stigma, perception and the remediation of contaminated land. Journal of Property Research, 15(4), 285-303.

Zietz, J., Zietz, E. N., & Sirmans, G. S. (2008). Determinants of house prices: a quantile regression approach. The Journal of Real Estate Finance and Economics, 37(4), 317-333.

THE EFFECT OF SPATIAL DESIGN MODIFICATION ON BATU PAHAT LOW-COST RESIDENTIAL PROPERTY VALUE: A HEDONIC PRICE MODEL

Abdulazeez Umar Raji[a]*, **Christy Pathrose Gomez**[b], **Rameson Nallusamy**[c]

[a]Department of Real Estate and Facilities Management,
Universiti Tun Hussein Onn Malaysia,
86400, Batu Pahat, Johor, Malaysia

[b&c]Department of Construction Management,
Universiti Tun Hussein Onn Malaysia,
86400 Batu Pahat, Johor, Malaysia

*Corresponding author
Email: abdulazeezraji@hotmail.com

Abstract

Spatial modification of terrace house in Malaysia is initiated by homeowners to satisfy their needs. Modification is more prevalent within the low income group occupying low-cost housing units due to their nature of their family size. The aim of this research is to develop a valuation model for low-cost terrace house spatial modification. This study explores the effects of post-occupancy changes and spatial modification in low-cost terrace housing. Additionally, it is to establish whether spatial modification being carried-out by homeowners has any price premium associated with their property value. The data was analyzed quantitatively using regression analysis. Each sample unit (homeowner) was provided with a questionnaire to obtain information on spatial modifications and key building related characteristics. The regression was done using both enter and stepwise methods. The findings indicate that the critical factors influencing residential property value of spatially modified low-cost terrace housing are Sale year (age), Number of bedrooms, Plot area, Gross floor area, Modified area, Extra-kitchen, Extra-bedroom, Extra-storage. Whilst, a price (value) premium on their current investment of 19.3%, 4.7% and 8.4% can be attained by adding extra-kitchen, bedroom and kitchen respectively. The results show that the variables accounted for R square = 86.6% of the variance in regression. Hence, the hedonic house value model is proposed to help homeowners in spatial modification appraisal. The strong recommendation of the study is that homeowners of low-cost terrace housing should clearly consider spatial modifications by prioritizing value enhancement objectives aimed at enhancing opportunities for social mobility.

Keywords: *Low-cost housing, Spatial design modification, Hedonic price model, Residential property value*

1. INTRODUCTION

Modification of terrace house in Malaysia is increasing day-by-day to satisfy the needs of the homeowners. According to literature, the design concepts have not changed much ever since terrace housing flourished initially around the 1960s and 1970s; the period which witnessed frenzy in the development of terrace houses in Malaysia in order to meet the excessive demand for urban housing.

Throughout history, people have sought to alter their homes to suit their own personal needs. Most people change their living environment in some way for a number of reasons. However, some of the motivation behind such behavior is well understood to be particularly related to speculation and investments. For example, people upgrade a property to improve the resale value (Abbott, Edge and Conniff, 2003). Abbott et al. argue that there are other reasons behind such behavior. Some homeowners claim their motivation is to make their homes more "stylish". The way in which this is carried out depends on the individual's understanding of the concept of "stylish". Although this is likely to differ somewhat between people, there are likely to be social norms within particular social groups which to some extent define the term "stylish"(Abbott, Edge and Conniff, 2003).

Understandably, insufficient home space is more likely to be experienced by those in the lower segment of the Malaysian housing sector (i.e. low-cost housing), as evidenced by quite a number of past studies (Mohit, Ibrahim, and Rashid, 2010). The low-cost terrace housing (LCTH) built-up area ranges between 720- 750 square feet. Ideally, one would expect such shortcomings less likely to be experienced by residents in the upper segment of the housing in Malaysia, given the fact that the houses in that segment are much larger with a built-up area ranging from 850 square feet to 1200 square feet. However, it is evident that space inadequacy in homes has also been experienced by those in the upper housing segment (Saruwono, 2007). It is argued that insufficient home space appears to affect a much larger population of dwellers in Malaysian urban housing schemes.

According to Reed, investment in housing is a considerable source of wealth for many individuals. The actual level of such investment is reflected by both the price initially paid for the property, and investment in post-occupancy changes and modifications, such as additional rooms, shaded patios, balconies added by homeowners (Etzion and Pearlmutter, 2001). Generally, it is premised that the investment of property owners in the maintenance and modification of their apartments and houses tackles a range of issues, from poor stock conditions to inferior housing design. As a result, investment programs ranging from large-scale demolition, rebuilding and remodeling of properties (primarily initiated by the federal or local governments and social organizations, in order to improve the quality of life of a target group, mainly low-income population), to small- scale, usually individual or neighborhood grass-root initiatives, such as replacing windows, renewing roofs, installing central heating (Cole and Reeve, 2001).

This paper is aimed at establishing whether housing modification being carried-out by homeowners has any price premium associated with property value using the hedonic price method, as this can further indicate the extent to which the current practice of post-occupancy changes and spatial modifications in Malaysian low cost terrace housing has a positive impact on the community. It is noted by Boris et al. that homeowners modify for two major reasons; either to enhance property value or improve performance of utility to accommodate changing occupational needs. In summary, due to the obvious relatively larger extent of changing needs experienced by low-cost owners and their inherent desire for social mobility, hence the need to address the returns to be gained through spatial modification of their homes is crucial.

1.2 HEDONIC PRICE METHOD

Since the inception of real estate appraisal with the pioneering studies of Zangerle and Henderson, research focus on the effects of environmental and building factors such as landscape views, vegetation, noise, air pollution, building patterns on property values has been increasing significantly (Johnston et al., 2002).

According to Boris et al. in most empirical studies, the Hedonic Price Model is used to identify and measure the effect of environmental valuables and building characteristics on property values (Boris et al., 2005). The modeling approach assumes that the monetary value of a dwelling unit depends on the attributes a particular house or apartment may possess. For instance, the market price of a dwelling may reflect its physical attributes and environmental characteristics such as the number of rooms, age, location (Rosiers, 2002).

Hedonic Price Method may be defined as a method for estimating the implicit prices of the characteristics that differentiate closely-related products in a product class (Borgatti, Everett, and Freeman, 1999). In applied appraisal studies, the Hedonic Price Method (HPM) is commonly used in conjunction with the sales comparison approach (SCA), which is one of the principal approaches accepted in real estate valuation or appraisal, especially for residential properties. According to the underlying assumptions of this method, the marginal price effect of environmental amenities is attributed either to an individual's willingness to pay for a particular attribute such as a sea-view or proximity to a recreation area or reduce traffic noise and attractive view (Irwin, 2002). In summary, the above mentioned studies used the HPM to investigate the extent to which neighborhood amenities have been directly capitalized into the property values via either proximity or view effects.

The advantages of using hedonic price method are enormous: the hedonic method is probably the most efficient method for making use of available data; the imputation variant of the hedonic regression method is analogous to the matched model methodology that is widely used in order to construct price indices; the method`s main strength is that it can be used to estimate values based on actual choices and is versatile, which can be adopted to consider several possible interactions between market goods and environmental quality. Also if the list of available property characteristics is sufficiently detailed, hedonic methods can in principle adjust for both sample mix changes and quality of the individual properties.

1.3 LOW-COST HOUSING INVESTMENT AND MODIFICATIONS

Hedonic price studies has its theoretical base in Lancaster's (1978) utility model. Lancaster views housing as not only market goods *per se*. Rather it can be viewed as a collection of attributes that satisfy various general consumption objectives, such as shelter, comfort, aesthetics and accessibility (Maclennan and Yong, 1996). As a result, housing is not only a one-off purchased asset, but also an asset worthy of maintaining and renovation.

According to Reed investment in housing is a considerable source of wealth for many individuals. In addition, the actual level of such investment is reflected by both the price initially paid for the property, and investment in post-occupancy changes and modifications, such as additional rooms, shaded patios, balconies, added by the present homeowner and previous ones .

Generally, as pointed out by Cole and Reeve (2001), the investment of property owners in the maintenance and modification of their apartments and houses tackles a range of issues, from poor stock conditions to inferior housing design. As a result, investment programs range from large-scale demolition, rebuilding and remodeling of properties (by homeowners in order to improve the quality of life mainly among low-income population), on a small-scale such as replacing windows, renewing roofs, installing central heating .

Various studies investigated the effects of housing rehabilitation on property values (Ding et.al., 2000). These studies indicate that residential investment in new construction and rehabilitation has, in general, a positive effect on property values, specifically in low-income neighborhoods. However, as Groves and Niner (1998) found out, residential properties in owner-occupied inner city areas, which had undergone housing renovation, quickly deteriorate again, and property prices drop. These findings are in line with results of another study conducted in the city of Chicago by McMillen.

Housing deterioration often stems from neighborhood social and environmental factors, such as crime, the concentration of low-income population groups, poor environmental design and a lack of open spaces. These linkages point out limited longitudinal benefits of physical improvements of housing stock through renovation investment. However, by addressing relevant social and environmental improvements in the neighborhood might encourage the residents to invest in the repair, maintenance and improvement of housing (Groves and Niner, 1998). Etzion et.al. (2001) attribute post-occupancy housing changes and modifications to the inadequacy of the original design, and poor performance of buildings under location-specific climatic conditions. Acknowledging however that micro environmental externalities may also affect the household's motivation either to initiate such changes or to refrain from them.

The above studies refer to general causes of dweller-initiated housing modifications and their socio-economic consequences. However, in Malaysia there seems to be lack of empirical studies that offer any model explaining the linkages between housing values and post-occupancy housing changes using hedonic price model in residential property market.

2.0 RESEARCH METHOD

The sequence in which the study was carried out for achieving the outlined desired objectives is presented in this section. Quantitative technique was used as an approach for systematic empirical investigation of the social phenomenon (Nor, 2009). The study was based on the 1,360 LCTH populations in Batu Pahat, Johor, Malaysia. Data on the listing of low-cost housing estates and units were obtained from the website of Majlis Perbandaran Batu Pahat (Batu Pahat Municipal Council). The number of the units corresponds to the actual number of low income earners that are in record at Batu Pahat. There are 1, 360 low-cost housing units under the Majlis Perbandaraan Batu Pahat (see Table 1). The sample for 1, 360 low-cost housing (LCTH) units in Batu Pahat is 306 units (Krejcie and Morgan, 1970) and 306 questionnaires were distributed to get a substantial pool of data. Ministry of Housing determines the actual low income groups to be allocated the low cost housing units (MPBH, 2013).

Table 1: LCH under the Municipal Council in Batu Pahat and their respective prices (Ubale, 2013).

S/no	Estate	LCH Units	Percentage	Type	Price (RM)
1.	Bandar Baru	476	35.00	1 storey	25, 000.00
2.	Putera Indah	608	44.70	1 storey	25, 000.00
3.	Harmoni	25	1.83	1 storey	25, 000.00
4.	Bintang Emas	10	0.73	1 storey	25, 000.00
5.	Mulia/Raja	17	1.25	1 storey	25, 000.00
6.	Bestari	53	3.89	1 storey	25, 000.00
7.	Siswa Jaya	10	0.73	2 storey	28, 000.00
8.	Rengit Indah	28	2.05	2 storey	28, 000.00
9.	Ria 2	12	0.88	2 storey	28, 000.00
10.	PanchorRiang	4	0.29	2 storey	28, 000.00
11.	Permai	7	0.51	2 storey	28, 000.00
12.	Rengit Ria	7	0.51	2 storey	28, 000.00
13.	Damai II	46	3.38	2 storey	30, 000.00
14.	Permai, Besar	4	0.29	2 storey	35, 000.00
15.	Permai Besar 2	5	0.36	2 storey	80, 000.00
16.	Mulia Jaya	5	0.36	2 storey	30, 000.00
17.	Gaya I	14	1.02	2 storey	30, 000.00
18.	Gaya II	20	1.47	2 storey	50, 000.00
19.	Manis 5	9	0.66	2 storey	28, 000.00
	TOTAL	1, 360 Units	99.91%	SAMPLE : 306 Units	

However, in Malaysia, the policy postulates that for every housing development project proposed by a developer, 40% must be low cost housing and there is no single housing estate for only low income earners. All housing estates consists of the two broad categories of low cost houses, and medium and high cost houses (MPBP, 2013). The low cost houses are of three categories with respective prices of RM30000 “2 storey low cost terraces”; RM50,000 “2 storey low cost terrace” and RM80,000 “2 storey low cost terrace” (Jabatan Penilaian dan Perkhidmatan Harta, 2012).

Random sampling was employed in administering questionnaires to target respondents. Structured Questionnaires using Likert scale response technique were used as the design for the research instrument, wherein 306 questionnaires were distributed in the municipality of Batu Pahat. 250 (82%) questionnaires were returned while 56 (18%) questionnaires were not returned. Based on Krejcie and Morgan for a population of 1500, sample size of 306 is adequate with 5% margin of error and 95% level of confidence. Ordinal scale of measurement was used. Regression analysis was carried out to determine the link between housing modification and residential property value for low-cost terrace housing in the study area. Both ENTER and STEPWISE method was employed to establish the hedonic price model for modified housing appraisal. A reliability test was run on the set data for residents of LCH Batu Pahat Malaysia. The Cronbach`s Alpha value of 0.815 shows that the data is statistically reliable.

3. RESEARCH RESULTS AND DISCUSSION

Hence, to verify the assumption that terrace housing spatial modifications have a premium price on the residential property value, the hedonic price method using regression analysis was employed. Regression analysis was conducted using both the ENTER method and the STEPWISE method. The Regression analysis was carried-out in two phases. In the first phase all the nine variables namely Number of bedrooms, Extra-Bedroom (m^2), Gross Floor Area (m^2), Extra-Storage Utility (m^2), Extra-Kitchen (m^2), Cost of modification (RM), Sale Year (age), Floor Area Modified (m^2), Plot Area (m^2), were regressed against dependent variable, Unit Price. The model summary analysis of first regression is presented in Table 2 and Table 3.

Table 2: Model Summary for first regression

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.931(a)	.866	.847	2699.70656

A. ***Predictors***: (Constant), Number of bedrooms, Extra-Bedroom m^2, Gross Floor Area m^2, Extra-Storage Utility m^2, Extra-Kitchen m^2, Cost of modification (RM), Sale Year (age), Floor Area Modified m^2,
Plot Area m^2.

B. ***Dependent Variable:*** Unit Price (RM)

Table 3: Model summary for first regression result

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1.	(Constant)	-514827.114	151645.722		-3.395	.001
	Sale Year (*age*)	271.024	76.127	.195	3.560	.001
	Cost of modification (*RM*)	.016	.065	.013	.241	.811
	Gross Floor Area (m^2)	-1271.296	128.425	-1.458	-9.899	.000
	Plot Area (m^2)	1286.345	97.831	2.020	13.149	.000
	Floor area modified (m^2)	-723.432	239.670	-.181	-3.018	.004
	Extra-Kitchen (m^2)	466.923	283.486	.084	1.647	.105
	Extra-Bedroom (m^2)	469.732	519.068	.047	.905	.369
	Extra-Storage Utility (m^2)	-2935.626	808.872	-.192	-3.629	.001
	Number of bedrooms	-2386.035	862.730	-.145	-2.766	.007

A. **Dependent Variable:** *Unit Price*

B coefficients

B coefficient tells how much the dependent variable (house price) changes in response to a one unit change in independent variable. For example increase in age of property increases the house value by RM271.02 Malaysian Ringgit refer to Table 3.

Beta coefficients

Beta coefficient measures the percentage of variation in house price (*value*) associated with the percentage change in an independent variable with all other factors held constant (Nzau, 2004). In other words Beta coefficients indicate the relative importance of each variable in explaining variations in the dependent variable. Based on the regression results in Table 4.11, the variable Extra-kitchen explains 8.4% of variations in house price (value) whilst the variable sale year (age) explains 19.5% of the variations in house price value. On the other hand, the variable Extra-bedroom explains 4.7% of the variations in the house price value whilst, the variable cost of modification explains only 1.3% of the variations in the house price value.

Coefficient of determination (R square or R^2) or Percentage of variance

This is the percentage variation in house price that can be explained by combined influence of all independent variables in the regression equation. From the regression results our models R^2 is 0.866, meaning the combined influence of seven (9) variables explain 86.6 of all house price variations. Adjusted R square is R^2 adjusted to account for number of independent variables. Adjusted R^2 is usually regarded as a better measure of combined influence of the independent variables on the dependent variable. The R^2 range is $0 < R^2 < 1$. Therefore, the models adjusted R^2 is 0.847.

T-Statistic

The t statistic helps in determining the relative importance of each independent variable in the regression equation. When t- value is large one can be confident that an independent variable is significant in predicting the dependent variable (Nzau, 2004). As a guide regarding useful predictors, look for t- values below -2 and above +2. From the results in Table 4.11, the variables cost of modification, was found to be insignificant predictors of house value as indicated by t- values. The cost of modification (1) independent variables was therefore eliminated at this stage. The remaining nine (8) variables namely, sale year (age), number of bedrooms, plot area, gross floor area, modified area, extra-kitchen, extra-bedroom and extra-storage utility, were subjected to the final regression analysis and results tabulated in Table 4.

Table 4: Model summary for final regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.931[a]	.866	.849	2679.76205	.866	51.644	8	64	.000

A. **Predictors:** (Constant), Number of bedrooms, Extra-Bedroom m^2, Gross Floor Area m^2, Extra-Storage Utility m^2, Extra-Kitchen m^2, Sale Year (*age*), Floor area modified m^2, Plot Area m^2

Table 5: Final regression results

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t-values	Sig.
1	(Constant)	-506124.385	146179.567		-3.462	.001
	Sale Year (*age*)	266.483	73.205	.192	3.640	.001
	Gross Floor Area m^2	-1273.064	127.267	-1.460	-10.003	.000
	Plot Area m^2	1290.189	95.804	2.026	13.467	.000
	Floor area modified m^2	-704.783	225.111	-.176	-3.131	.003
	Extra-Kitchen m^2	476.558	278.569	.086	1.711	.092
	Extra-Bedroom m2	482.459	512.550	.048	.941	.350
	Extra-Storage Utility m^2	-2940.754	802.617	-.193	-3.664	.001
	Number of bedrooms	-2412.130	849.561	-.147	-2.839	.006

A. **Dependent Variable:** ***Unit Price (RM)***

The results from Table 5 above show that all eight independent variables are significant predictors of the house price as indicated by their t-values. Their combined influence on the dependent variable house price has not increased from previous 86.6% whilst the adjusted R^2 has increased from of 84.7% to 84.9%. This adjusted R^2 accounts for the number of independent variable is usually regarded as a better measure of the combined influence of the independent variables. The Standard error of the estimate (SEE) has improved from the previous 2699.70 to current 2679.76. The standard error of estimate (SEE) measures the amount of deviation between actual and predicted house values. The test of measure is that the lower the SEE, the more reliable is the derived model.

Table 6: Enter method

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t-values	Sig.
1.	(Constant)	-506124.385	146179.567		-3.462	.001
	Sale Year (*age*)	266.483	73.205	.192	3.640	.001
	Gross Floor Area m^2	-1273.064	127.267	-1.460	-10.003	.000
	Plot Area m^2	1290.189	95.804	2.026	13.467	.000
	Floor area modified m^2	-704.783	225.111	-.176	-3.131	.003
	Extra-Kitchen m^2	476.558	278.569	.086	1.711	.092
	Extra-Bedroom *m2*	482.459	512.550	.048	.941	.350
	Extra-Storage Utility m^2	-2940.754	802.617	-.193	-3.664	.001
	Number of bedrooms	-2412.130	849.561	-.147	-2.839	.006

A. **Dependent Variable:** ***Unit Price (RM)***

Based on the regression analysis, using the unstandardized B coefficients in Table 6 above, it is possible to explain how each of the eight independent variables contributes to house value. From the result, a B coefficient of 266.48 for sale year (age) indicates that any additional year in the age of the house then the value increases by RM266.48 Malaysian ringgit, whilst B coefficient of 1273.06 indicates that if the gross floor area increases by one square meter, the value of the house decreases by RM1,273.06. Interestingly, a B coefficient of 1290.18 indicates that if the plot area increases by one square meter, the value of the house increases by RM1,290.18. On the other hand, a B coefficient of 476.55 indicates that if kitchen area is extended by one square meter, the value of the house increases by RM476.55, whilst a B coefficient of 482.45 indicates that, if a bedroom area is extended by one square meter, the value of the house increases by RM482.45. In addition, a B coefficient of 2940.75 indicates that a house with storage or extra storage facilities increases the value of the house by RM2,940.75 whilst, a B coefficient of 2412.13 indicates that a house with more number of bedrooms increases the value of the house by RM2,412.13.

The next step is the use STEPWISE regression method to explain how the critical house value influencing variables, namely: sale year (age), number of bedrooms, plot area, gross floor area, modified area, extra-kitchen, extra-bedroom and extra-storage utility were entered in the regression equation. STEPWISE method also shows the percentage contribution of each variable to the coefficient of determination R^2 or adjusted R of the total model. The STEPWISE regression output is shown in Table 5 and Table 6.

The variable Plot area (m^2) was the first to enter the regression equation. The results above show Plot area as the most critical factor for spatial modification in enhancing the house value. The results of the final regression analysis show that the 8 independent variables, namely; sale year (age), number of bedrooms, plot area, gross floor area, modified area, extra-kitchen, extra-bedroom and extra-storage utility are the critical house value influencing variables.

3.1 Strength of the model

Coefficient of determination (R^2), measures the percentage variation in the dependent variable being explained by the changes in the independent variables. Analysis in table 2 above shows that the coefficient of determination (R^2) equals 0.866, that is, sale year (age), number of bedrooms, plot area, gross floor area, modified area, extra-kitchen, extra-bedroom and extra-storage utility, explain 86.6 percent of house sales price leaving only 13.4 percent unexplained. The P-value of 0.000 (Less than 0.05) implies that the model of house sales price is significant at the 5 percent significance level.

Table 7: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.967E9	8	3.709E8	51.644	.000[a]
	Residual	4.596E8	64	7181124.621		
	Total	3.427E9	72			

a. **Predictors**: (Constant), Number of bedrooms, Extra-Bedroom m^2, Gross Floor Area, Extra-Storage Utility, Extra-Kitchen m^2, Sale Year, Floor area modified, Plot Area

b. **Dependent Variable**: *Unit Price* (RM)

From Table 6 above, the ANOVA findings (P-value of 0.00) shows that there is correlation between the predictors variables sale year (age), number of bedrooms, plot area, gross floor area, modified area, extra-kitchen, extra-bedroom and extra-storage utility in response to variable (house sales price).

Table 8: Final regression table

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-12049.492	5070.587		-2.376	.020
	Plot Area m^2	448.850	53.608	.705	8.373	.000
2	(Constant)	584.947	3771.130		.155	.877
	Plot Area m^2	1376.623	110.436	2.162	12.465	.000
	Gross Floor Area	-1347.916	151.201	-1.546	-8.915	.000
3	(Constant)	-584658.714	154789.357		-3.777	.000
	Plot Area m^2	1303.092	103.085	2.046	12.641	.000
	Gross Floor Area	-1300.881	139.161	-1.492	-9.348	.000
	Sale Year	294.695	77.923	.212	3.782	.000
4	(Constant)	-465640.406	153884.655		-3.026	.003
	Plot Area m^2	1248.483	100.369	1.961	12.439	.000
	Gross Floor Area	-1232.049	135.160	-1.413	-9.116	.000
	Sale Year	237.837	77.168	.171	3.082	.003
	Number of bedrooms	-2482.451	894.800	-.151	-2.774	.007
5	(Constant)	-408115.770	151587.408		-2.692	.009
	Plot Area m^2	1252.381	97.482	1.967	12.847	.000
	Gross Floor Area	-1229.371	131.257	-1.410	-9.366	.000
	Sale Year	212.651	75.761	.153	2.807	.007
	Number of bedrooms	-2733.781	876.017	-.166	-3.121	.003
	Extra-Storage Utility	-1730.743	765.702	-.113	-2.260	.027
6	(Constant)	-479081.816	144190.727		-3.323	.001
	Plot Area m^2	1258.637	91.607	1.977	13.740	.000
	Gross Floor Area	-1239.455	123.358	-1.422	-10.048	.000
	Sale Year	257.077	72.564	.185	3.543	.001
	Number of bedrooms	-2832.572	823.619	-.172	-3.439	.001
	Extra-Storage Utility	-2883.226	807.208	-.189	-3.572	.001
	Floor area modified	-676.704	215.002	-.169	-3.147	.002

Table 9: Stepwise

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-12049.492	5070.587		-2.376	.020
	Plot Area m^2	448.850	53.608	.705	8.373	.000
2	(Constant)	584.947	3771.130		.155	.877
	Plot Area m^2	1376.623	110.436	2.162	12.465	.000
	Gross Floor Area	-1347.916	151.201	-1.546	-8.915	.000
3	(Constant)	-584658.714	154789.357		-3.777	.000
	Plot Area m^2	1303.092	103.085	2.046	12.641	.000
	Gross Floor Area	-1300.881	139.161	-1.492	-9.348	.000
	Sale Year	294.695	77.923	.212	3.782	.000
4	(Constant)	-465640.406	153884.655		-3.026	.003
	Plot Area m^2	1248.483	100.369	1.961	12.439	.000
	Gross Floor Area	-1232.049	135.160	-1.413	-9.116	.000
	Sale Year	237.837	77.168	.171	3.082	.003
	Number of bedrooms	-2482.451	894.800	-.151	-2.774	.007
5	(Constant)	-408115.770	151587.408		-2.692	.009
	Plot Area m^2	1252.381	97.482	1.967	12.847	.000
	Gross Floor Area	-1229.371	131.257	-1.410	-9.366	.000
	Sale Year	212.651	75.761	.153	2.807	.007
	Number of bedrooms	-2733.781	876.017	-.166	-3.121	.003
	Extra-Storage Utility	-1730.743	765.702	-.113	-2.260	.027
6	(Constant)	-479081.816	144190.727		-3.323	.001
	Plot Area m^2	1258.637	91.607	1.977	13.740	.000
	Gross Floor Area	-1239.455	123.358	-1.422	-10.048	.000
	Sale Year	257.077	72.564	.185	3.543	.001
	Number of bedrooms	-2832.572	823.619	-.172	-3.439	.001
	Extra-Storage Utility	-2883.226	807.208	-.189	-3.572	.001
	Floor area modified	-676.704	215.002	-.169	-3.147	.002
A. **Dependent Variable:** *Unit Price* (RM)						

Table 10: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.705(a)	.497	.490	4927.83441
2	.874(b)	.764	.758	3396.29556
3	.897(c)	.805	.796	3113.33480
4	.908(d)	.825	.814	2972.43016
5	.915(e)	.837	.825	2886.49639
6	.926(f)	.858	.845	2711.87415

a. Predictors: (Constant), Plot Area

b. Predictors: (Constant), Plot Area, Gross Floor Area

c. Predictors: (Constant), Plot Area, Gross Floor Area, Sale Year

d. Predictors: (Constant), Plot Area, Gross Floor Area, Sale Year, Number of bedrooms

e. Predictors: (Constant), Plot Area, Gross Floor Area, Sale Year, Number of bedrooms, Extra-Storage Utility

f. Predictors: (Constant), Plot Area, Gross Floor Area, Sale Year, Number of bedrooms, Extra-Storage Utility, Floor area modified

g. Dependent Variable: Unit Price

Model 1 (Plot Area) plot area was the first to enter the regression equation. The results in Table 8 shows plot area as the most critical factor in determining the house value. Individually, plot area had an R^2 of 0.497. This means that based on this model the LCTH if built with the variable plot area alone, can account for 49.7% of the total house value variations.

Model 2 (Gross Floor Area) Gross Floor Area (GFA) was the second variable to enter the equation. This is the second most critical factor in explaining house value variations. The R^2 in this model is 0.764, indicating that the two variables account for 76.4% of the house value variations.

Model 3 (Sale Year) Sale year (age) was the third variable to enter the equation. This is the third most important factor in explaining house value variations. The R^2 in this model is 0.805, indicating that the three variables account for 80.5% of the house value variations.

Model 4 (Number of Bedrooms) Number of bedrooms was the fourth variable to enter the equation. This is the fourth most important factor in explaining house value variations. The entry of number of bedroom in this model increased R^2 to 0.825, indicating that the four variables account for 82.5% of the house value variations.

Model 5 (Extra Storage Utility) Extra storage utility was the fifth variable to enter the equation. This is the fifth most important factor in explaining house value variations. The entry of extra-storage utility in this model increased R^2 to 0.837, indicating that the five variables account for 83.7% of the house value variations.

Model 6 (Floor Area Modified) Floor area modified was the sixth variable to enter the equation. This is the sixth most important factor in explaining house value variations. The entry of floor area modified in this model increased R^2 by 0.858, indicating that the six variables account for 85.8% of the house value variations.

Among the six models, model 6 is adopted as the appropriate regression model since the R^2 is the highest and it has the lowest standard error of the estimate (SEE). It can be seen that the results in model 6 (refer to Table 8 and Table 9) are similar to the final regression results obtained using the ENTER method. Hence, the variables namely; sale year (age), number of bedrooms, plot area, gross floor area, modified area, extra-kitchen, extra-bedroom and extra-storage are the critical house value influencing variables as shown by both the ENTER and STEPWISE regression methods. The 8 factors together account for 86.6% of the total house value variations. There was however other factors affecting house value, which account for 13.4% of house variations. Using STEPWISE regression analysis, one other factor which is cost of modification measure was found to be insignificant in explaining house value variations and hence it was excluded from the final model.

The hedonic model for LC housing modification

The critical factors were found to be (1) Sale year (age), (2) Number of bedrooms, (3) Plot area, (4) Gross floor area, (5) Modified area, (6) Extra-kitchen, (7) Extra-bedroom (8) Extra-storage. However, using the Unstandardized B Coefficients (see final regression results in Table 6 and model 6 adopted) house value model becomes;

$$Y = \alpha + \beta_1 AGE_i + \beta_2 N\_BEDROOM_i + \beta_3 PLOT_i + \beta_4 GFA_i + \beta_5 MOD\_AREA_i + \beta_6 EX\_KITCHEN_i + \beta_7 EX\_BEDROOM_i + \beta_8 EX\_STORAGE_i$$

Where;
Y = House value; α = Regression constant; β_1 = Sale year (*age*); β_2 = Number of bedrooms β_3 = Plot area (m^2); β_4 = Gross floor area (m^2); β_5 = Modified area (m^2); β_6 = Extra-kitchen (m^2) β_7 = Extra-bedroom (m^2); β_8 = Extra-storage (m^2)

The model above can be used by homeowners carrying out spatial modification and post-occupancy changes to determine the percentage increase in the premium price of their respective homes by modifying a particular space. Interestingly from model 6 (refer to Table 9 above), based on the value of unstandardized B coefficients, modification of *Extra storage utility*, *increase in number of bedrooms* and *total floor area increment* appear to increase the value of house considerably.

4. CONCLUSION

Proposed hedonic house value model: From the regression analysis of the data, using the unstandardized B coefficients in **Table 8** a B coefficient of 266.48 for sale year (age) indicates that any additional year in the age of the house increases the value by RM266.48, and contributes **19.5%** to the property value. This finding is contrary to the findings of Musili, where property value decreases as the building age increases. On the other hand, B coefficient of 1273.06 indicates that if the gross floor area increases by one square meter, the value of the house decreases by RM1,273.06, this is similar to the findings of Portnov et al., Boris and Musili. Interestingly, a B coefficient of 476.55 indicates that if a low-cost terrace house has a kitchen extension area extended by one square meter, the value of the house increases by RM476.55, thereby contributing **8.4%** increase to the original property value based on the *Beta* coefficient whilst, a B coefficient of 482.45 indicate that, if a bedroom area is extended by one square meter, the value of the house increases by RM482.45 and contribute **4.7%** to the property value. In addition, a B coefficient of 2940.75 indicates that a house with storage or extra storage facilities increases the value of the

house by RM2,940.75 and contributes **19.3%** to the property value. This is similar to findings of Portnov where he argues that storage and private gardens increase the property value.

Interestingly, based on the STEPWISE regression result **model 6** was adopted due its low estimate of standard error. Plot Area, Gross Floor Area, Sale Year, Number of bedrooms, Extra-Storage Utility, Floor area modified are the most significant variables for spatial modification towards enhancing residential property value of low cost terrace housing with R^2 of 85.8%. Therefore, the hedonic house value model for households to appraise their homes with respect to spatial modification in low-cost terrace housing is as follows:

$$Y = \alpha + \beta_1 AGEi + \beta_2 N\_BEDROOMi + \beta_3 PLOTi + \beta_4 GFAi + \beta_5 MOD\_AREAi + \beta_6 EX\_KITCHENi + \beta_7 EX\_BEDROOMi + \beta_8 EX\_STORAGEi$$

Hence, based on this study modification of achieving extra-kitchen, increasing size of bedroom and kitchen increases the value of low-cost terrace house by 19.3%, 4.7% and 8.4% respectively.

4.1 Implications of the findings

Homeowners of low-cost terrace housing should find this research valuable as it is adding new knowledge and statistical evidence to housing and property investment research subject. This research should also influence households in low-cost terrace housing design to consider housing spatial modification for either value enhancement objective or improving housing utility.

This research should be particularly relevant to the property owners, as noted by Portnov et al. that property owners can be motivated by a value enhancement objective. In particular, they may choose to modify their current properties, expecting future price premium on their current investment. Similarly, with reference to the findings of Odish et al. and Berezzansky et al., household may choose to carry out post-occupancy modifications to their apartments and houses in order to improve housing utility, and prevent functional and economic obsolesce of their dwellings. In this case, in addition to gaining personal utility, a homeowner may also be motivated by economic considerations such as homeowner may expect to rent the upgraded house at better terms to potential tenants and in return anticipating higher price premium.

Even though this study did not put into consideration the neighborhood attributes or environmental factors, the housing characteristics and neighborhood issues may influence the spatial modification efforts of homeowners both directly and indirectly. Since, in an environmentally disadvantageous or physically deteriorated neighborhood any value gain can hardly be expected, such a neighborhood will naturally become a disincentive for spatial modification decisions making. As a result, there will be little accumulation of upgrading and modifications of houses and apartments located in such neighborhoods.

BIBLIOGRAPHY

Abbott, L., Edge, M. & Conniff, A. (2003). Housing Modification and Implication for Future Housing Provision: A Socio-Psychological Investigation. In ENHR/IAPS Conference. Stockholm, Sweden

Abdul Mohit, M., Ibrahim, M. & Rashid, Y. R. (2010). Assessment of residential satisfaction in newly designed public low-cost housing in Kuala Lumpur, Malaysia. Habitat International, 34, 18-27.

Berezansky, B., Portnov, B. A., & Barzilai, B. (2010). Objective vs. perceived air pollution as a factor of housing pricing: a case study of the greater Haifa metropolitan area. Journal of Real Estate Literature, 18(1), 99-122.

Boris, P. A., Yakov, O., & Larissa, F. (2005). Factors affecting housing modifications and housing pricing: A case study of four residential neighborhoods in Haifa, Israel. Journal of Real Estate Research, 27(4), 371-407.

Borgatti, S. P., Everett, M. G. & Freeman, L. C. (1999). UCINET 6.0 Version 1.00. Natick: Analytic Technologies.

Cole, I., & Reeve, K. (2001). Housing and Physical Environment Domain: A Review of the Evidence Base. Center for Regional Economic and Social Research, Sheffield Hallam University, Sheffield.

Des Rosiers, F., (2002). Power lines, visual encumbrance and house values: a micro-spatial approach to impact measurement. Journal of Real estate research, 23(3), 275-302.

Ding, C., Simons, R., & Baku, E. (2000). The effect of residential investment on nearby property values: evidence from Cleveland, Ohio. Journal of Real Estate Research, 19(1), 23-48.

Etzion, Y., Portnov, B. A., Erell, E., Meir, I., & Pearlmutter, D. (2001). An open GIS framework for recording and analysing post-occupancy changes in residential buildings—a climate-related case studies. Building and Environment, 36(10), 1075-1090.

Groves, R. & Niner, P. (1998). A Good Investment? The Impact of Urban Renewal on an Inner City Housing Market, West Sussex: Policy Press.

Idrus, N. & Ho, C. S. (2008). Affordable and quality housing through the low cost housing provision in Malaysia. Paper presented at the Seminar of Sustainable Development and Governance, Toyohashi University of Technology.

Irwin, E. G. (2002). The effects of open space on residential property values. Land economics, 78(4), 465-480.

Johnston, R. J., Swallow, S. K., & Bauer, D. M. (2002). Spatial factors and stated preference values for public goods: considerations for rural land use. Land Economics, 78(4), 481-500.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. Educ psychol meas.

Maclennan, D. & Yong, T. (1996). Economic Perspective on the Structure of Local Housing Systems, Housing Studies, 11(3), 387–400.

Musili, K. J. (2010). Real estate valuation based on hedonic price model (Doctoral dissertation). University of Nairobi Kenya.

MPBH (2013) http://www.mpbp.gov.my/penerbitan

Nor, M. A. (2009). Statistical methods in Research. Published by Prentice Hall. Pearson Malaysia Sdn Bhd. Lot 2, Jalan 215 off Jalan Templer 46050 Petaling Jaya, Selangor, Malaysia. Fax: 03-77853435. ISBN: 978-983-3927-95-1

Nzau, B. M. (2004). Modelling the influence of urban sub-centres on spatial and temporal urban land value patterns: Case study of Nairobi, Kenya. ITC.

Ubale, M.Y (2013). Comparative study between Malaysian and Nigerian formal low cost housing policy issues. (Master Thesis Universiti Tun Hussein Onn Malaysia).

Portnov, B. A., Fleishman, L., & Odish, Y. (2006). Changes and Modifications in Residential Neighborhoods as a Factor of Housing Pricing: Jerusalem and Haifa as Case Studies. Journal of Real Estate Literature, 14(3).

Saruwono, M. (2007). An analysis of plans of modified houses in an urbanized housing area of Malaysia. Unpublished PhD, The University of Sheffield.

ASSESSMENT OF SUSTAINABLE HOUSING AFFORDABILITY IN MALAYSIA BASED ON PEOPLE'S PERCEPTION USING COPRAS METHOD

Rosli Said[a*], **Rohayu Ab. Majid**[b], **Amir Saufi Nozin**[c]

[a & c]Centre for Sustainable Urban Planning and Real Estate,
Faculty of Built Environment,
University of Malaya,
50603 Kuala Lumpur, Malaysia

[b]Centre of Studies for Estate Management,
Faculty of Architecture, Planning & Surveying,
Universiti Teknologi Mara,
40450 Shah Alam, Selangor, Malaysia

*Corresponding author
Email: rosli_alambina@um.edu.my

Abstract

Rapid urbanisation and economic development in Malaysia since the late 1980s has resulted in a significant expansion of housing development in urban areas. The Malaysian housing sector has thrived owing to growing market and active supply-demand dynamics. However, the increase in housing price has aroused greater public concern about the future direction of the housing sector in this country. Cheap and low-quality houses have often been associated with affordable housing. Nevertheless, this may not be true if sustainability is taken into account. In dealing with sustainable housing affordability, the criteria relating to social, economic and environment are necessary to be considered in determining the best alternative for the sustainable area. This research was conducted in Klang Valley, Malaysia using COPRAS method. The results indicate that area with high utility degree is the best area that conforms to the sustainable housing affordability criteria and vice versa. The research has contributed to a new knowledge because it is the first paper in Malaysia to address such issues using COPRAS framework.

Keywords: *Sustainability, COPRAS, MCDM, Housing, Affordability*

1. INTRODUCTION

The government of Malaysia aspires to accommodate the population in quality and affordable housing as stipulated in the National Housing Policy. Malaysia has extensive laws covering property development in which its focus revolves around fulfilling the need and requirements for sustainable development through physical, economic, social as well as environmental (Othman, K. N., and Alias, A., 2011). The sustainable housing can be represented as being analogous to ecologically sustainable development which in many cases reduces to smaller concept around environmental performance, water treatment or energy efficiency (Pullen et. al., 2010).

The idea of sustainability is relatively acceptable in Malaysia but opened to the critical solution. Abidin (2010) believes that Malaysian property developers are now beginning to embrace the concept of sustainability as part of their marketing campaign and strategic product differentiation as compared to their competitors. Realising the need to balance up the relationship between economic development, social integration and environmental protection, the government has taken a multitude of initiatives to minimise the impact of economic growth on the environment Abidin, Z.N. (2010).

Although sustainable housing affordability generates much interest among researchers in other countries, none of the local studies has focused on sustainable housing affordability. Thus, the main objective of this paper is to establish a set of criteria for sustainable housing affordability which will be used to identify the best area that can sustain its housing affordability. The study employs one of the Multi-Criteria Decision Making (MCDM) techniques namely the multi-attribute Complex Proportional Assessment (COPRAS) method. In order to gain more insight into the sustainable housing affordability, this paper is organised as follows. First, relevant literature encompasses the concept of sustainability, sustainable housing affordability and factors influencing them are discussed. Then, follows the discussion on the criteria of sustainable housing affordability and the tools used in assessing sustainability. Thereafter, analysis and conclusion of the paper are presented and discussed.

1.1 The Concept of Sustainability

The term sustainability is vague and open to different interpretations. There is no single definition can describe the very word of sustainability. Beck and Cummings (1996) argue that debate on what constitutes sustainability will only retard progress in making the concept of sustainability operational, Beck and et. al (1996). Perhaps this uniqueness that makes this term so much interesting. The lack of authoritative definition allows it to embody broad concepts which in turn, bestow upon it the ability of being flexible. In other words, it can be adopted locally to suit the local context and any situation.

Sustainability in the most direct definition is the observation of balancing between the three fundamentals; economic development, social equity and environmental protection (Drexhage & et.al, 2010). Figure 1 illustrates the integrated nature of the concept of sustainability which brings together the impact of economic, social and environment. In a wider aspect, sustainability can also include social attributes (health and equity), human values (freedom tolerance and respect for nature) and ecological (climate, air quality and land-use efficiency) (Kates et. al. (2005);Islam, N. (1996); Van Vliet, W. (1996). White (2013) on the other hand used a tag cloud system to identify the most recurrent word used to define sustainability. A tag cloud or word cloud is visually representing a particular part of the text for the purpose of making analytical comparisons. White (2013) found that the most common words which define sustainability are the environment, social and economic, life, system and nature.

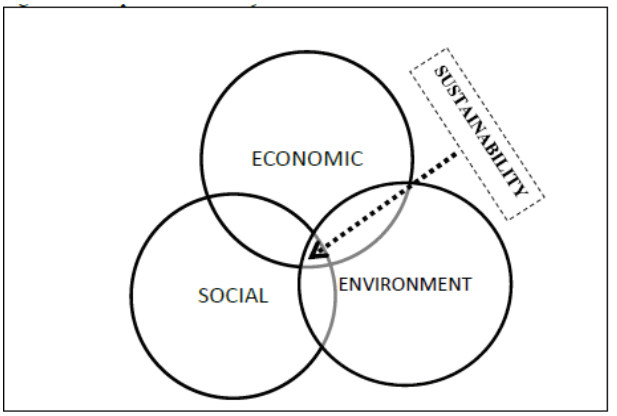

Figure 1: Concept of Sustainability

In addition, Kibert (2004) defines the sustainable building as facilities which are the outcome of sustainable construction for the sole objective of enhancing health, improve resources efficiency and limiting the detrimental effect of the built environment on the ecological system. On the other side of the coin, Hardi and Zidan (1997) define sustainability in a more philosophical nature where it revolves around the idea of being a persistence of particular necessary and desired attributes of people, communities and organization surrounding the eco-system over an indefinite period. This idea expresses the interrelationship between people and its surrounding.

1.2 Sustainable Housing Affordability

Medineckiene et al. (2010) highlight the need for a sustainability method that would incorporate the concept of sustainability into decision-making as more and more people in this world are still living in an inadequate shelter. The subject matter should consider the current situation of economic, social and built environment. Maliene and Malys (2009) put forward the notion of sustainable housing as those that are well available, high quality, economical, ecological, aesthetical, design, comfortable, and cosy. Sustainable housing should also consider the short and long-term costs of running a home or in another word; it is not only affordable but also cost-efficient with good energy, waste, and water management.

Mulliner and Maliene (2011) introduce the premise of 'sustainable housing affordability' in which they establish an initial system of criteria that somehow represents the core concept of sustainable housing affordability. Mulliner and Maliene (2011) argue that housing affordability shall not be considered in isolation with other criteria namely location, social, environment and economic sustainability of the housing. Mulliner and Maliene (2011) further suggested that affordable housing is not merely about cheap homes, but it must take into consideration a lot of other factors.

Mulliner et al. (2013) further enforced that housing which is not well connected to jobs, high-quality services and infrastructure has contributed to low demand and resulted in abandonment. Therefore, sustainability should deal with the major backbone of housing design and a fundamental dimension of housing quality. The pre-requisite for sustainable housing affordability is not limited to physical attributes, but also stresses the importance of community involvement and the challenge of getting the 'right mix'.

Choguill (2007) proposes a set of policies for the housing sector to be sustainable in each of the chosen areas. It includes involvement of the community, affordable and quality of construction material, development of building standards, housing finance and the regulation of land matter; all of which are supposed to support sustainable housing. Iman (2006) suggests the same view where a sustainable housing must be environmentally appropriate, financially viable, socially acceptable and technically feasible. Payne and Raiborn (2001) interestingly pointed out that the term 'environmentally appropriate' refers to a human or its inherent value.

1.3 Criteria for Sustainable Housing Affordability

Many researchers have ventured into the discussion on what makes housing sustainable and affordable. Karuppannan and Sivam (2009) particularly listed down a myriad of indicators to achieve sustainable development and affordable housing. They found that there were many instances where elements of affordability are aligned with sustainability domain which is common to both affordability and sustainability domains. Therefore, it is theoretically possible to sustain affordable housing.

The measures to implement environment sustainability in affordable housing go against the primary objective of providing cheap houses (Yates, J. 2008). Since the cost to implement sustainability can be very high, it will eventually be absorbed as housing cost. Moreover, sustainability has received limited attention in valuation profession (Warren-Myers, G., 2013) and as a result, the investors hesitate to invest in sustainable housing. Therefore, less investment reduces innovators' incentive to implement the concept of sustainability. On the contrary, MacKillop (2012) was of the opinion that sustainable housing can significantly impact affordability by minimizing or reducing the overall use of energy and water consumption.

Pullen et al. (2010) develop a framework to determine the criteria for sustainable housing affordability. Pullen et al. (2010) establish a set of criteria consist of nine distinct elements and sub-elements that clearly describe the core elements. The core elements include efficiency (energy, water), construction (materials, methods), procurement (government, private, public-private partnership), affordability (purchase or rent), desirability, dwelling sizes, appropriate density (low, medium, high), adaptability and social acceptability. On the same token, Mcalpine & Birnie (2007) introduce a 2-tier system of sustainability consist of a headline and strategic indicators to monitor the quantifiable sustainability themes. The indicators include, among others, the quality of housing, environment quality, land use, household and commercial waste and local transportation.

This paper applies a combination of literature review and semi-structured interviews that were verified by questionnaire surveys to determine their relative importance. However, it is not ideal to implement the same concept as implemented in other countries due to different culture, preferences and attitude of the Malaysians. Using Mulliner and Maliene (2011) work as a base, this paper adds, removes and adjusts the criteria to suit the local context. The final list of positive factors tailors to Malaysian context was developed (Table 1). Nevertheless, the impact of such indicators on housing sustainability can be difficult to assess as suggested by Dahl, A. L. (2012). Therefore, the indicators set in Table 1 are used to justify the best area that suits sustainable housing affordability as a result of the impact of such indicators.

Table 1: Selected Criteria for Sustainable Housing Affordability in Malaysia

Sustainable Housing Affordability Indicators		Sources
F1	House Price	(Burke et al., 2007; Mulliner & Maliene, 2011)
F2	House Quality	(Department of the Environment Heritage and Local Government, 2007; Mulliner & Maliene, 2011; The Ministry of Urban Wellbeing Housing and Local Government, 2013)
F3	House Type	(Hurtubia et al., 2010)
F4	House Finishes	(Fierro et al., 2009)
F5	House Design	(Fierro et al., 2009)
F6	Interior Features	(Hurtubia et al., 2010)
F7	Position of the House in Layout Plan	(Hurtubia et al., 2010)
F8	Size of Built-up Area	(Fierro et al., 2009)
F9	Size of Land Area	(Fierro et al., 2009)
F10	Built-up Area	(Fierro et al., 2009)
F11	Age of the House	(Fierro et al., 2009)
F12	Topography	(Fierro et al., 2009)
F13	Property Interest	(Lu, 2002; Saunders, 1990)
F14	Near to Commercial Area	(Mulliner & Maliene, 2011; Samuels, 2004)
F15	Near to Hospitals	(Mulliner & Maliene, 2011; Zhu et al.,2006)
F16	Near to Post Office	Own research
F17	Near to Entertainment	(Isalou et al., 2014; Mulliner & Maliene, 2011; Yusuf & Resosurdarmo, 2009
F18	Near to Transportation	(Australian Conservation Foundation, 2008; Mulliner & Maliene, 2011)
F19	Near to Place of Worship	Own research
F20	Near to Education	(Clark et al., 2006; Mulliner & Maliene, 2011; Samuels, 2004)
F21	Near to Workplace	(King, 2008; Mulliner & Maliene, 2011)
F22	Environment Quality	(Cowan & Hill, 2005; Zhu et al., 2006)
F23	Security	(Hipp, 2010; Samuels, 2004)
F24	Traffic Congestion	(Brownstone & Golob, 2009; Shen et al., 2011)
F25	Density	(Brownstone & Golob, 2009; Samuels, 2004)
F26	View	(Zhu et al., 2006)
F27	Exterior Condition	Own research

F28	Availability of Waste Management	(Hardi & Zidan, 1997; Joseph, 2006; Mulliner & Maliene, 2011)
F29	Safety Level	(Hipp, 2010; Samuels, 2004)
F30	Theme or Concept	Own research
F31	Availability of Child Care	(Mulliner & Maliene, 2011)
F32	Electrical Supply	(Elliot & Stratford, 2009; Maliene & Malys, 2009; Mulliner & Maliene, 2011)

1.4 Measuring Sustainable Housing Affordability

Assessing sustainability can be a daunting task. Very few researchers have embarked on the quest to assess the progress and effectiveness of sustainability application. Authors such as Pullen et al. (2010), describe the development and assess affordability and sustainability in residential developments where it stressed the need for a more integrated system-based approach that reflects a clearer need for social sustainability. Furthermore, Medineckiene et al. (2010_a) turn the spotlight on the importance of a process of addressing sustainability to integrate the concept of sustainability into decision-making procedure. Mulliner and Maliene (2011) push the boundary by proposing a set of criteria that represents sustainable housing affordability. A multi-criteria decision making (MCDM) technique is then used to assess and rank the said criteria. Several researchers focus on the strengths and weaknesses of diverse criteria or factors in assessing sustainable housing affordability (Hak, et al, 2012; , Hardi, P., & Zidan, T. 1997; Mori and Christodoulou, 2012).

2. METHODOLOGY

The geographical area of study is the Klang Valley because this region constitutes almost half of the total amount of residential construction stocks in the country [42]. Questionnaires were distributed to residents within six of the most demanded areas namely Petaling Jaya ($\mathbf{q}_1$), Kuala Lumpur ($\mathbf{q}_2$), Klang ($\mathbf{q}_3$), Shah Alam ($\mathbf{q}_4$), Putrajaya ($\mathbf{q}_5$) and other area within the same region ($\mathbf{q}_6$). The purpose of the questionnaires is to verify and elicit respondents' opinion on what factors constitute sustainable housing affordability. All the 1000 distributed questionnaires were returned from valid respondents of which 179 from Petaling Jaya, Kuala Lumpur (189), Klang (213), Shah Alam (190), Putrajaya (201) and others (28).

The total of 32 criteria or factors is considered to be relevant in assessing sustainable housing affordability as listed in Table 1. Respondents distinguish each factor based on its relative importance towards sustainable housing affordability. Responses are ranked on a five-point Likert Scale. Likert scale was used because of its simplicity in expressing the respondent level of agreement. The established ranks are then evaluated using the COPRAS method which is one of the MCDM techniques.

2.1 Complex Proportional Assessment (COPRAS) and Multi-Criteria Decision Making (MCDM)

Most existing literature focuses on house price rather than holistic measures of the condition, locational attributes and neighbourhood characteristic Bogdon & Can, A. (1997). A Complex Proportional Assessment (COPRAS) method applies to the varieties of research in built environment. COPRAS is used as a tool to assess sustainable housing affordability based on factors or criteria systems as discussed before. The method is suitable for cases where data are expressed in interval forms (Popovic et. al 2012) and used to determine the priority and the utility degree of alternatives (Zavadskas & Kaklauskas, 1996); [Zavadskas et. al, 2008). Ustinovichius et al. (2007) characterize COPRAS and its variations (COPRAS-G, COPRAS-F) as a method to account for direct and proportional significance and the weightage of another alternative on a system of factors

COPRAS is one of the many MCDM techniques. More examples of MCDM techniques include, among others, SAW, ELECTRE, AHP and TOPSIS, which serve a distinct purpose. For example, AHP is suitable when preferences for several criteria and alternative cannot be quantified (Eldrandaly and AbdelAziz, N. 2009). MCDM is particularly useful in making a highly complex decision by applying weigh or priorities (Aruldoss et.al, 2013) involving a careful selection of resources to ensure the accuracy of criteria, alternatives or factors (Haarstrick and Lazarevska, 2009). Due to its effectiveness and simple process, MCDM has gained wide acceptance throughout different sectors such as information technology, construction industry and sports (Dey et. al., 2011; Zhu et. al., 2006; Zolfani, et. al., (2008). There is also a plenty of MCDM application relating to built environment (Table 2). COPRAS seems to be well recognised and widely used in assessing sustainability issues in built environment.

Table 2: The use of MCDM technique in built-environment

Author	Related Research	Method Used
Medineckiene (2016)	-Focuses on multi-criteria selection of a dwelling house - taking into account the ecological aspects and impact on the environment, economic and social conditions.	COPRAS, SAW, MEW, AHP
Zolfani et al (2008)	-Focuses on quality control managers with a set of criteria namely knowledge of product and raw material, experience and educational background, administrative orientation, behavioral flexibility, risk evaluation ability, payment and teamwork	AHP, COPRAS-G
Bender et.al . (2000)	- Focuses on the perception of environmental quality in residential areas - Using different environmental quality factors	AHP
Kaklaukas et.al (2007a) Kaklaukas et.al (2008b)	- Focuses on construction factors, among others, economic, quality, technical, technological and comfort.	COPRAS
Mulliner & Maliene (2011)	- Focuses on housing affordability in different locations using a set of criteria according to their relative importance to sustainable housing affordability.	COPRAS

The advantages of COPRAS as compared to other types of MCDM techniques can be summarised as follow (Mulliner & Maliene, 2011):

- The simplicity of design and calculation.
- High adaptability.
- The complete aggregate of ranking.
- Measuring both quantitative and qualitative in a single test.
- Flexibility to account for both positive and negative (maximising and minimising) evaluation criteria.
- Estimation of alternative degrees of utility in considering the better or worse alternative.

2.2 Evaluation of Sustainable Housing Affordability by Utilizing COPRAS Method

The data were analysed using COPRAS method involving five main steps (Kaklauskas et. al, 2005), [Kaklauskas et.al. (2007_a); Kaklauskas et.al. (2007_b); Dey et. al., 2011); Mulliner et. al 2013).

1. A selection of various factors and the normalisation of the decision-making matrix. As mentioned, the purpose of this paper is to assess sustainable housing affordability in a number of alternative areas to create a ranking of alternatives. Thus, COPRAS with the ability to handle both positive and negative factors come in handy. The following formula is used by taking the overall mean score to allow direct comparison between all factors:

$$m_{pq} = \frac{\bar{\omega}_{pq}}{\sum_{q=1}^{n} x_{pq}} x_{pq}$$

Where x_{pq} is the value of the ***p***-th criterion of the ***q***-th options, and $\bar{\omega}_p$ is the weight of the ***p***-th criterion.

Table 3 shows the overall mean score for each factor and derive the overall score and relative weight, $\bar{\omega}$.

Table 3: Overall mean score and the weight of each factor

Factors	Mean Score (overall)	Weight, m
House Price	4.2747	3.3755
House Quality	4.1847	3.3044
House Type	3.8889	3.0709
House Finishes	3.8443	3.0356
House Design	3.8345	3.0279
Interior Features	3.7409	2.9540
Position of the House in Layout Plan	3.8271	3.0221
Size of Built-up Area	3.9264	3.1005
Size of Land Area	3.8937	3.0746
Built-up Area	3.9372	3.1090
Age of the House	3.9027	3.0818

Topography	3.8343	3.0277
Property Interest	4.0255	3.1787
Near to Commercial Area	3.9000	3.0796
Near to Hospitals	3.9869	3.1482
Near to Post Office	3.7755	2.9813
Near to Entertainment	3.6168	2.8560
Near to Transportation	4.0728	3.2161
Near to Place of Worship	4.0132	3.1690
Near to Education	4.0353	3.1865
Near to Workplace	4.0335	3.1850
Environmental Quality	4.1628	3.2871
Security	4.0728	3.2161
Traffic Congestion	4.0325	3.1843
Density	3.8576	3.0461
View	3.8564	3.0452
Exterior Condition	3.9798	3.1426
Availability of Waste Management	4.0152	3.1706
Safety Level	4.2571	3.3616
Theme or Concept	3.6620	2.8917
Availability of Child Care	3.8632	3.0506
Electrical Supply	4.3306	3.4196
Total	**126.6389**	**100.0000**

Table 4 indicates the mean score for each option and derives the individual mean score of each factor, which is essential for the next step.

Table 4: The weight and mean score for each factor

Factors, p	**Weight, w**	**Mean score for each option, *q***					
		q_1	q_2	q_3	q_4	q_5	q_6
House Price	3.3755	4.3128	4.4392	4.4645	4.2312	3.9391	4.1429
House Quality	3.3044	4.1404	4.3545	4.3128	4.1183	4.0000	4.1071
House Type	3.0709	3.9326	3.9312	3.8768	3.8011	3.8990	3.9286
House Finishes	3.0356	3.8427	3.8511	3.9194	3.7849	3.8030	3.9286
House Design	3.0279	4.1006	3.7447	3.8768	3.7204	3.7337	3.8929
Interior Features	2.9540	3.8764	3.6684	3.8483	3.6432	3.6583	3.7857
Position of the House in Layout Plan	3.0221	3.8202	3.8889	3.8571	3.7634	3.7828	3.9643

Size of Built-up Area	3.1005	3.8436	3.9894	4.0095	3.8656	3.8442	4.3929
Size of Land Area	3.0746	3.7640	3.8936	4.0190	3.9247	3.8030	4.2222
Built-up Area	3.1090	3.8268	3.9677	4.0758	3.9135	3.8384	4.2500
Age of the House	3.0818	3.8827	3.8763	4.0332	3.8750	3.8291	3.9286
Topography	3.0277	3.7472	3.7419	3.9858	3.8352	3.7990	4.1071
Property Interest	3.1787	3.8409	4.0688	4.2180	4.0440	3.9082	4.1481
Near to Commercial Area	3.0796	3.8827	4.1111	3.9336	3.7935	3.7839	3.8571
Near to Hospitals	3.1482	3.8324	4.2646	3.9479	3.9838	3.9347	3.7857
Near to Post Office	2.9813	3.6089	3.8984	3.8294	3.7135	3.8442	3.5357
Near to Entertainment	2.8560	3.4407	3.6402	3.6967	3.5568	3.7035	3.7500
Near to Transportation	3.2161	3.9777	4.3968	3.9479	4.1027	3.9391	4.1786
Near to Place of Worship	3.1690	4.1404	4.0423	3.8294	4.0811	4.0153	3.9286
Near to Education	3.1865	3.9218	4.0317	3.9479	4.1189	4.1357	4.1786
Near to Workplace	3.1850	4.0447	4.1217	3.9905	4.1250	3.8872	4.1071
Environmental Quality	3.2871	4.1742	4.2751	4.1564	4.2120	4.0000	4.2143
Security	3.2161	4.1173	4.3651	4.0190	4.0055	3.8794	4.0357
Traffic Congestion	3.1843	3.9492	4.2116	4.0865	3.9946	3.9095	4.0714
Density	3.0461	3.8436	3.9418	3.8152	3.8207	3.8492	4.0000
View	3.0452	3.8045	3.9101	3.8810	3.7880	3.8744	3.9643
Exterior Condition	3.1426	3.9330	4.0529	3.9716	3.9891	3.9548	3.9643
Availability of Waste Management	3.1706	3.8764	4.1852	4.0237	4.0870	3.8939	4.0714

Safety Level	3.3616	4.2416	4.5397	4.2180	4.2717	4.0251	4.2963
Theme or Concept	2.8917	3.6927	3.7143	3.6682	3.5297	3.6884	3.7500
Availability of Child Care	3.0506	3.7978	3.9048	3.8048	3.8152	4.0101	3.7143
Electrical Supply	3.4196	4.2753	4.5319	4.3839	4.3135	4.1357	4.4286
Total	**100.0000**						

2. Summation of weighted normalizes decision-making matrix by calculating the sums of both positive and negative alternatives (Table 5). The sums of S_{+q} of attributes values which provide larger values are preferable (optimization direction is maximising) as compared to other options. The sums of S_{-q} of attributes values which constitute smaller values are preferable (optimization direction is minimising) as compared to other options. For example, the lower the negative (minimising) values for the house price, the better the sustainable housing affordability is. Likewise, the higher the positive (maximising), the better it indicates. The formula to calculate the sums are as follows:

$$S_q^+ = \sum_{e_p = +} m_{pq}$$

$$S_q^- = \sum_{e_p = -} m_{pq}$$

Table 5 represents the normalised decision matrix for the six chosen areas in the Klang Valley region namely Petaling Jaya ($\mathbf{q_1}$), Kuala Lumpur ($\mathbf{q_2}$), Klang ($\mathbf{q_3}$), Shah Alam ($\mathbf{q_4}$), Putrajaya ($\mathbf{q_5}$) and other ($\mathbf{q_6}$). Other ($\mathbf{q_6}$) refers to the area within the Klang Valley region which does not fall under the five main areas (q_1- q_5).

Table 5: Normalized decision matrix

Factors, p	**e**	**Options, q**					
		$\mathbf{q_1}$	$\mathbf{q_2}$	$\mathbf{q_3}$	$\mathbf{q_4}$	$\mathbf{q_5}$	$\mathbf{q_6}$
House Price	-	0.570	0.587	0.590	0.559	0.521	0.548
House Quality	+	0.547	0.575	0.569	0.544	0.528	0.542
House Type	+	0.517	0.517	0.509	0.499	0.512	0.516
House Finishes	+	0.504	0.505	0.514	0.497	0.499	0.516
House Design	+	0.538	0.492	0.509	0.488	0.490	0.511
Interior Features	+	0.509	0.482	0.506	0.479	0.481	0.497
Position House in Layout Plan	+	0.500	0.509	0.505	0.493	0.495	0.519

Size of Built-up Area	+	0.498	0.517	0.519	0.501	0.498	0.569
Size of Land Area	+	0.490	0.507	0.523	0.511	0.495	0.549
Built-up Area	+	0.498	0.517	0.531	0.510	0.500	0.553
Age of the House	-	0.511	0.510	0.531	0.510	0.504	0.517
Topography	-	0.489	0.488	0.520	0.500	0.495	0.536
Property Interest	-	0.504	0.534	0.553	0.531	0.513	0.544
Near to Commercial Area	+	0.512	0.542	0.519	0.500	0.499	0.508
Near to Hospitals	+	0.508	0.565	0.523	0.528	0.522	0.502
Near to Post Office	+	0.480	0.518	0.509	0.494	0.511	0.470
Near to Entertainment	+	0.451	0.477	0.485	0.466	0.485	0.492
Near to Transportation	+	0.521	0.576	0.517	0.538	0.516	0.548
Near to Place of Worship	+	0.546	0.533	0.505	0.538	0.529	0.518
Near to Education	+	0.514	0.528	0.517	0.539	0.542	0.547
Near to Workplace	+	0.531	0.541	0.524	0.541	0.510	0.539
Environmental Quality	+	0.548	0.561	0.546	0.553	0.525	0.553
Security	+	0.542	0.575	0.529	0.527	0.511	0.531
Traffic Congestion	-	0.519	0.554	0.537	0.525	0.514	0.535
Density	-	0.503	0.516	0.499	0.500	0.504	0.524
View	+	0.499	0.513	0.509	0.497	0.508	0.520
Exterior Condition	+	0.518	0.534	0.523	0.525	0.521	0.522
Availability Waste Management	+	0.509	0.550	0.529	0.537	0.511	0.535
Safety Level	-	0.557	0.596	0.554	0.561	0.529	0.564
Theme or Concept	+	0.484	0.487	0.481	0.463	0.484	0.492
Available of Child Care	+	0.503	0.517	0.504	0.505	0.531	0.492
Electric Supply	+	0.561	0.594	0.575	0.566	0.543	0.581

3. The relative significance $\boldsymbol{H_q}$ of each option, based on positive (+) and negative (-), are calculated using the formula below:

$$H_q = S_q^+ + \frac{S_{min}^- \sum_{q=1}^{n} s_q^-}{S_q^- \sum_{q=1}^{n} \frac{S_{min}^-}{S_q^-}} = S_q^+ + \frac{\sum_{q=1}^{n} S_q^-}{S_q^- \sum_{q=1}^{n} \frac{1}{S_q^-}}$$

Where the minimum values S_q^- are cancelled, the higher value corresponds to a more sustainable housing affordability.

4. In this stage, prioritisation is determined by the largest H_q. H_{max} is the optimal value and the best among alternatives. Options are ranked from highest to lowest of relative significance H_q. (Table 7)

5. The degree of utility is determined by comparing each option by the one option with H_{max}. The area with the highest degree of utility ($ǔ_q$ = 100%) represents an area that most satisfies sustainable housing affordability. Other options will show utility values ranging from 0%-100% indicators of the worst to best-case scenario. The degree of utility $ǔ_q$ of the options O_q is calculated by the following formula:

3. RESULTS AND DISCUSSION

3.1 Demographic

Distribution of respondents was divided almost equally between the six regions. Each area represents circa 20% share of total respondents (+-2%) and only 3% respondents are from 'others' (Figure 2).

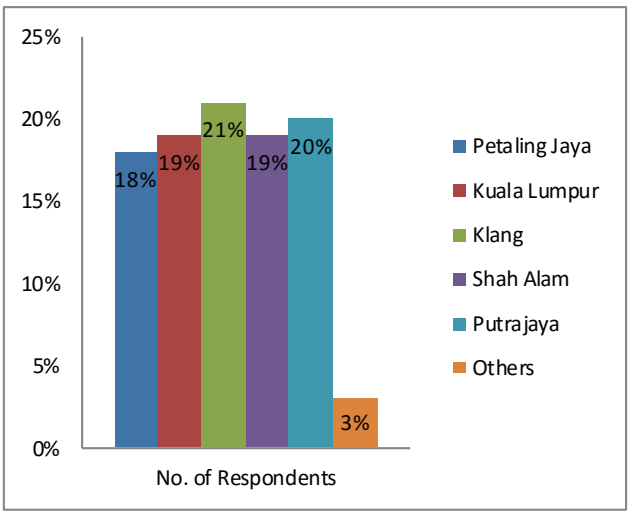

Figure 2: Distribution of respondents according to area

Table 6 accounts for a demographic analysis of the respondents according to employment sector, marital status and sex. There are 425 (42.5%) government and 575 (57.5%) private sector employees. The total of 436 respondents (43.6%) are single, and 549 (54.9%) are married while only 15 (1.5%) respondents are divorced. The distribution of male-female is almost equal to 49.6% (496 respondents) and 50.4% (504 respondents) respectively.

Table 6: Demographic Analysis

Categories		**Percentage (%)**
Employment Sector	Government	42.5
	Private	57.5
Marital Status	Single	43.6
	Married	54.9
	Divorced	1.5
Sex	Male	49.6
	Female	50.4

3.2 COPRAS

The step-by-step procedure in COPRAS assessment (Section 2.2) produces the following results (Table 7).

Table 7: Selected Sustainable Housing Affordability Areas

Criteria p	$\mathbf{q_1}$	$\mathbf{q_2}$	$\mathbf{q_3}$	$\mathbf{q_4}$	$\mathbf{q_5}$	$\mathbf{q_6}$
S_q^+	12.83	13.23	12.98	12.84	12.75	13.12
S_q^-	3.65	3.78	3.78	3.69	3.58	3.77
$\boldsymbol{H_q}$	16.59	16.86	16.61	16.57	16.59	16.77
Priority	4	1	3	6	5	2
$\check{U}_q$(%)	98.38%	100.00%	98.51%	98.25%	98.36%	99.46%

Table 7 shows that the location that best describes the most sustainable housing affordability is Kuala Lumpur ($\mathbf{q_2}$) as reflected in utility degree of 100%. The second best factor is 'others' ($\mathbf{q_6}$) with utility degree of 99.46%. However, for the purpose of this paper, 'others' ($\mathbf{q_6}$) has to be omitted because the area does not represent any specific location as discussed in Section 3.2. The next best in ranking is Klang ($\mathbf{q_3}$) with utility degree of 98.51% followed by Petaling Jaya ($\mathbf{q_1}$) at 98.38%. Shah Alam ($\mathbf{q_4}$) is the lowest in ranking as reflected in utility degree of 98.25% that is slightly lower than Putrajaya ($\mathbf{q_5}$) with utility degree of 98.36%.

Amongst the six areas, Kuala Lumpur ($\mathbf{q_2}$) may not have cheaper house price as compared to other areas. Most population concerns on house price as well as other factors such as density, traffic level and safety level. Surprisingly, the respondents are willing to discount all these factors in favour of housing quality and very high accessibility.

Putrajaya (q_5) may have been the country's first intelligent city with sustainable planning, but the results suggest that the area is not popular among the house-buyers. This could be due to Putrajaya (q_5), being as the federal administrative centre of the federal government of Malaysia, caters specific group of respondents, especially the government servants.

With encouragement through various government-backed subsidy and loan programmes, government servants are more dominant in the housing sector. Looking at the respondents' demographic, there are an equal number of private and public sector employees which prevents the result from being skewed towards one particular direction. However, Putrajaya did score very high in some factors such as high accessibility, low density, and the availability of childcare.

According to Table 7, Shah Alam ($\mathbf{q_4}$) has the lowest utility degree, thus, the worst performing area in relation to the predetermined factors of sustainable housing affordability. Shah Alam ($\mathbf{q_4}$) scored particularly worst in building-related factors such as housing type, finishes, design, interior features and position of the house in layout plan. However, Shah Alam ($\mathbf{q_4}$) scored better than other areas such as Kuala Lumpur ($\mathbf{q_2}$) and Klang ($\mathbf{q_3}$) in terms of traffic congestion.

Each of the six areas above has almost equal utility degrees. Evidence shows that the difference between the best option ($\mathbf{q_2}$) to the worst option ($\mathbf{q_4}$) is minuscule of 1.75%. This could be translated in layman terms as being the advantages and disadvantages of both areas are almost equal and often interchangeable to one another, other factors offset thus the cycle continues. Great improvement can be made by focusing on a smaller area, i.e. by zoning, precinct or section within the larger area. For example, Shah Alam ($\mathbf{q_4}$) consists of many sections and narrowing down the focus may produce a different outcome. Nevertheless, COPRAS method has substantially demonstrated its effectiveness in providing the utility degree of options and due to its flexibility could be applied to any region and place and the weight can be adjusted to suit any context.

4. CONCLUSION

With the overall rising of house price and cost of living, purchasers are compelled to find alternatives or options among the many few choices left. Over times, the decision-making process is long and perilous with nothing else to base upon other than price and household income. It is a time alternative to being put out there to understand better and discriminate the market according to what being most important to individual and society. This paper adequately explicates the necessity to shift our emphasis from the traditional price-income-cost genre towards sustainability-quality-affordability value. Sustainable housing affordability can be used as the main driver of green growth of Malaysian housing development.

Housing is one aspect of life but unfortunately, cannot be controlled by an individual. The government, the private sector, as well as potential owners must make a distinction between cheap housing and sustainable housing affordability as this issue will get even more complicated as we delve deeper into the topic. The bottom line is, with cooperation between these parties, we could arrive at what makes a house sustainable outside the limitation of simply housing cost. The government in local authority can use the same methodology in the proper planning of urban dwellings. Private developers, on the other hand, may use the result to find an alternative area to be developed as well as what can be improved in future housing developments to increase its appeal to a larger masses. This would prove beneficial to gain the upper hand against competing rivals. The results and method presented could also be used by the public in determining and deciding the best area to buy future houses according to their preferences.

BIBLIOGRAPHY

Aruldoss, M., Lakshmi, T. M., & Venkatesan, V. P. (2013). A survey on multi criteria decision making methods and its applications. *American Journal of Information Systems, 1*(1), 31-43.

Abidin, Z.N. (2010). Investigating the awareness and application of sustainable construction concept by Malaysian developers. Habitat International, 34, 421-426.

Beck, M. B., & Cummings, R. (1996). Wastewater Infrastructure: Challenges for the Sustainable City in the New Millennium. *Habitat International, 20,* 405-420.

Bogdon, A. S., & Can, A. (1997). Indicators of local housing affordability: Comparative and spatial approaches. *Real Estate Economics, 25*(1), 43-80. doi: 10.1111/1540-6229.00707

Choguill, C. L. (2007). The search for policies to support sustainable housing. *Habitat International, 31*, 143-149.

Dahl, A. L. (2012). Achievements and gaps in indicators for sustainability. *Ecological Indicators, 17,* 14-19.

Dey, P. K., Ghosh, D. N., & Mondal, A. C. (2011). A MCDM approach for evaluating bowlers performance in IPL. *Journal of Emerging Trends in Computing and Information Sciences, 2*(11), 563-573.

Drexhage, J., & Murphy, D. (2010). Sustainable Development: From Brundtland to Rio 2012.

Eldrandaly, K., Ahmed, A. H., & AbdelAziz, N. (2009). *An expert system for choosing the suitable MCDM for solving a spatial decision problem.* Paper presented at the 9th International Conference on Production Engineering, Design and Control, Egypt.

Haarstrick, A., & Lazarevska, A. (2009). *Multi Criteria Decision Making (MCDM)- A Conceptual Approach to Optimal Landfill Monitoring* Paper presented at the 3rd International Workshop "Hydro-Pysico-Mechanics of Landfills", Braunschweig, Germany.

Hak, T., Kovanda, J., & Weinzettel, J. (2012). A method to assess the relevance of sustainability indicators: application to the indicator set of the Czech Republic's Sustainable Development Strategy. *Ecological Indicators, 17,* 46-57.

Hardi, P., & Zidan, T. (1997). *Assessing sustainable development: Principles in practice.* Canada: International Institute for Sustainable Development.

Iman, A. H. M. (2006). *Property Demand and Supply*. Skudai: UTM Publisher.

Islam, N. (1996). Sustainability Issues in Urban Housing in a Low-income Country: Bangladesh. *Habitat International, 20,* 377-288.

Kaklauskas, A., Zavadskas, E. K., Banaitis, A., & Satkauskas, G. (2007$_a$). Defining the utility and market value of a real estate: a multiple criteria approach. *International Journal of Strategic Property Management, 11(2),* 107-120.

Kaklauskas, A., Zavadskas, E. K., & Raslanas, S. (2005). Multivariant design and multiple criteria analysis of building refurbishments. *Energy and Buildings, 37,* 361–372.

Kaklauskas, A., Zavadskasb, E. K., & Trinkunasa, V. (2007_b). A multiple criteria decision support on-line system for construction. *Engineering Applications of Artificial Intelligence,* 163-175.

Karuppannan, S. & Sivam, A. (2009). Sustainable Development and Housing Affordability. Institute of Sustainable Systems and Technologies. University of South Australia, Australia.

Kates, R. W., Parris, T. M., & Leiserowitz, A. A. (2005). What is Sustainable Development? Goals, Indicators, Values and Practice. *Environment: Science and Policy for Sustainable Development, 47***,** 8-21.

Kibert, C. J. (2004). Green building: An overview of progress. *Journal of Land Use & Environmental Law, 19*(2), 491-502.

MacKillop, F. (2012). Sustainable as a basis of affordable? Understanding the affordability 'crisis' in Australian housing. *Australian Planner, 50*(1), 2-12.

Maliene, V., & Malys, N. (2009). High quality housing- A key issue in delivering sustainable communities. *Journal of Building and Environment, 44,* 426-430.

Mcalpine, P., & Birnie, A. (2007). Is there a correct way of establishing sustainability indicators? The case of sustainability indicator development on the Island of Guernsey. *Local Environment: The International Journal of Justice and Sustainability, 10*(3), 243-257.

Medineckiene, M., Turskis, Z., & Zavadskas, E. K. (2010_a). Sustainable construction taking into account the building impact on the environment. *Journal of Environmental Engineering and Landscape Management, 18*(2), 118-127. doi: http://dx.doi.org/10.3846/jeelm.2010.14

Medineckienė, M., Turskis, Z., Zavadskas, E. K., & Tamošaitienė, J. (2010_b). *Multi-Criteria Selection Of The One Flat Dwelling House, Taking Into Account The Construction Impact On Environment* Paper presented at the The 10th International Conference, Vilnius, Lithuania.

Mori, K., & Christodoulou, A. (2012). Review of sustainability indices and indicators: Towards a new City Sustainability Index (CSI). *Environmental Impact Assessment Review, 32*, 94-106.

Mulliner, E., & Maliene, V. (2011). Criteria for sustainable housing affordability. *Journal of Environmental Engineering, 3*, 966-973.

Mulliner, E., Smallbone, K., & Maliene, V. (2013). An assessment of sustainable housing affordability using a multiple criteria decision making method. *Omega-International Journal of Management Science, 41*(2), 270-279. doi: 10.1016/j.omega.2012.05.002

Othman, K. N., & Alias, A. (2011). *The effects of property laws and regulations towards sustainable property development in Malaysia: A preliminary review.* Paper presented at the International Conference on Project and Facilities Management, Kuala Lumpur.

Payne, D., & Raiborn, C. (2001). Sustainable development: the ethics support the economics. *Journal of Business Ethics, 32*(2), 157-168.

Popović, G., Stanujkić, D., & Stojanović, S. (2012). Investment projects selection by applying copras method and imprecise data. *Serbian Journal of Management, 7*(2), 2570269.

Pullen, S., Arman, M., Zillante, G., Zuo, J., Chileshe, N., & Wilson, L. (2010). Developing an Assessment Framework for Affordable and Sustainable Housing. *Australasian Journal of Construction Economics and Building, 10*(1/2), 48-64.

Pullen, S., Arman, M., Zillante, G., Zuo, J., Chileshe, N. & Wilson, L. (2010). Developing an Assessment Framework for Affordable and Sustainable Housing. Australasian. Journal of Construction Economics and Building, 10 (1/2) 48-64.

Ustinovichius, Zavadskas, E. K., & Podvezko, V. (2007). Application of a quantitative multiple criteria decision making (MCDM-1) approach to the analysis of investments in construction. *Control and Cybernetics, 36*(1), 251-268.

Van Vliet, W. (1996). Sustainable Development, Global Restructuring and Immigrant Housing. *Habitat International, 20,* 349-358.

Warren-Myers, G. (2013). Real estate valuation and valuing sustainability: a case study of Australia. *Pacific Rim Property Research Journal, 19*(1), 81-100.

White, M. A. (2013). Sustainability: I know it when i see it. *Ecological Economics, 86*, 213-217.

Yates, J. (2008). Australia's housing affordability crisis. *Australian Economic Review, 41*(2), 200-214. doi: 10.1111/j.1467-8462.2008.00502.x

Zavadskas, E. K., & Kaklauskas, A. (1996). *Multiple criteria evaluation of buildings*. Vilnius, Lithuania.

Zavadskas, E. K., Kaklauskas, A., Turskis, Z. & Tamosaintinei, J. (2008). Multi-Attribute Decision-Making Model by Applying Grey Numbers. *Institute of Mathematics and Informatics, 20*(2), 305-320.

Zhu, X., Liu, S., & Yeow, M.C. (2006). Accessibility analysis for housing development in Singapore with GIS and multi-criteria analysis methods. *Applied GIS, 2*(2), 13.11-13.12.

Zolfani, S. H., Rezaeiniya, N., Aghdaie, M. H., & Zavadskas, E. K. (2008). Quality Control Manager Selection Based On AHP- COPRAS-G Methods: A Case In Iran. *Ekonomska istraživanja, 25*(1).

ANNOUNCEMENT

Do You Have A Paper You Would Like To Share With Other Real Estate Professionals?

The Journal of Valuation and Property Services (JVPS) is a major publication by the Valuation and Property Services Department (JPPH), Ministry of Finance Malaysia. JVPS is an international journal that provides a forum for critical appraisals of fundamental issues affecting the real estate industry. It is specially intended for real estate professionals to keep abreast with developments in the real estate industry as well as the real estate profession.
The Publication Board of this journal invites original papers from real estate professionals on any of the following areas:-

- Areas of major interest and practical relevance to the real estate profession;
- New techniques, applications, theories as well as related concept relevant to the real estate profession;
- Policy issues and regulations and their impact on the real estate market.

The journal focuses on Asia, with particular emphasis on Malaysia, but papers that promote cross-national learning on the real estate industry worldwide are welcomed. Each issue will also present practice notes relevant to the practice of valuation and property services written by senior professionals.
Further details on the journal are available from:-

The Editor
Journal of Valuation and Property Services (JVPS)
National Institute of Valuation (INSPEN)
Persiaran INSPEN
43000 Kajang
Selangor Darul Ehsan
Malaysia

Telephone : +603-8911 8888
Telefax : +603-8925 0640
Email : research@inspen.gov.my
Website : http://www.inspen.gov.my

NOTES TO CONTRIBUTORS

Editorial Policy and Submission Guidelines

1. Submission

Contributors can submit their papers before the 31st July of each year to :-

The Editor
Journal of Valuation and Property Services (JVPS)
National Institute of Valuation (INSPEN)
Persiaran INSPEN
43000 Kajang
Selangor Darul Ehsan
Malaysia
Telephone : +603-8911 8888
Telefax : +603-8925 0640
Email : research@inspen.gov.my

A prospective contributor may submit a summary of a proposed paper to the Editor for preliminary consideration as to it suitability for publication in the journal. The receipt of each paper submitted will be acknowledged. The Editor reserves the right to accept, modify or decline any paper.

2. Reviewing Process

All papers will be reviewed by one or more referees. Contributors will be informed about the acceptance (or otherwise) of their papers after the comments of referees have been received. The entire reviewing process will be conducted in complete confidentiality. For this purpose, the name, address and affiliation of the contributor should not be on the first page of the paper, but only on the accompanying letter.

3. Style

Papers should be the original, unpublished work of the contributors. They should not be under consideration for publication elsewhere. Papers should be written in a clear and simple style, and should have a carefully considered structure. Contributors are encouraged to adopt the most effective way of communicating their information to the reader. Illustrations may be used to elucidate the issues raised.

4. Language

Language used in all papers submitted shall be in English.

5. Contents

Papers should preferably be in the range of 4,000 to 6,000 words, excluding illustrations. A brief (maxima 60 words) profile of the contributor should accompany each article.

All manuscripts for publishing are to be typed in Arial font size 11 with 1.15-spacing on a A4 size document with normal margin of 1 inch on each side. The pages should be numbered consecutively.

a) First Page

The full title of the paper must be shown on the first page of the manuscript. Also to be included on the first page is an abstract of not more than 300 words and up to 5 keywords to facilitate indexing. The abstract should summaries the objectives, main finding and conclusions of the paper.

b) References

Only references that are cited in the text should be included in the reference list. The Harvard reference system is adopted in the Journal. References within the text will be shown in bracket, by quoting first, the author's name followed by a comma and year of publication all in round brackets, e.g. (Agus, 1994).

References should appear at the end of the article, arranged in alphabetical order by the first author's surname as follows:-

For books: surname, initials, (year) "title", publisher, place of publication.
For journal: surname, initials, (year) "title", journal, volume, number, pages.

Example:-

Book: Lim, K.K.(1990), *Valuation Methods*, Pelandok, Kuala Lumpur.
Journal: Zaharudin A. (1994), "The New Economic Policy and the Integrated Housing Model", *Ilmu Alam*, Vol. 2 No. 7, pp 23-35.

c) Illustrations

Illustrations such as diagrams, tables, graphs, photos and similar materials should be part of the text.

Table of values used to generate graphs must be included to ensure accurate representation. All illustrations should be identified correctly in the order in which they are referred to in the text, e.g. "Figure or Table 1., etc".

Acknowledgements, footnotes and endnotes (if necessary) are to be listed at the end of the article.

6. Editorial Scope

The editor reserves the right to edit /format the manuscript to maintain a consistent style.

7. Copyrights

Contributors shall undertake to ensure that articles submitted for publication do not infringe any copyright law. Relevant acknowledgements should be included in tables, figures or wherever necessary.

All contributions become the legal copyright of the publisher unless otherwise agreed. This covers the exclusive rights to reproduce and distribute the article, including reprints, photographic reproduction, microfilm or any reproduction of a similar nature and translation.

8. Disclaimer

Although the Valuation and Property Services Department (JPPH) is the publisher of the Journal of Valuation and Property Services (JVPS), the views presented in the Journal are entirely those of the contributors and do not reflect the official stand of the department. JPPH does not hold itself responsible for the accuracy of any article published. The role of the publisher is merely to provide a platform for discussion and exchange of ideas.

9. Honorarium

Every article published in the Journal of Valuation and Property Services shall be paid an honorarium of an amount approved by Treasury of Malaysia.