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THE INFLUENCE OF SPATIAL DESIGN MODIFICATION ON BATU PAHAT LOW-COST PROPERTY INVESTMENT VALUE

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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, property investment value

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1.0 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 *et al.*, 2003). Abbott *et al.* (2003) 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 *et al.*, 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 (Husna & Nurizan, 1987; Idrus & Ho, 2008; Abdul Mohit *et al.*, 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 (2001) investment in housing is a considerable source of wealth for many individuals [6]. 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 *et al.,* 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 & 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.* (2005) 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 (1927) and Henderson (1931), 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; Grudnitski, 2003; Boris *et al.*, 2005).

According to Boris *et al.* (2005) 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 (Des Rosiers, 2002; Plaut & Plaut, 2003).

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 *et al.,* 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; Johnston *et al.,* 2002; Fleishman & Odish, 2003; Grudnitski, 2003). 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 have 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 & 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 (2001) 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 (Etzion *et al.,* 2001).

Generally, as pointed out by Cole & 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 (Cole & Reeve, 2001).

Various studies investigated the effects of housing rehabilitation on property values (Simons *et al.,* 1998; 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 (1996).

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 & Niner, 1998; Cole & Reeve, 2001). In addition, 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

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 & Morgan) 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 (MPBH, 2013; 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 RM80000 “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 Saunders *et al.* (2015) 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.

3.0 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 RM 271.02 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 [28]. 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

		Unstandardized Coefficients		Standardized Coefficients		
Model		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 *RM 266.48* 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 Tables 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 6: 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 7: Final regression table

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-506124.385	146179.567		-3.462	.001	-798151.642	-214097.129					
	Sale Year (*age*)	266.483	73.205	.192	3.640	.001	120.239	412.727	.450	.414	.167	.755	1.324
	Gross Floor Area m^2	-1273.064	127.267	-1.460	-10.003	.000	-1527.309	-1018.819	.491	-.781	-.458	.098	10.167
	Plot Area m^2	1290.189	95.804	2.026	13.467	.000	1098.798	1481.580	.705	.860	.617	.093	10.800
	Floor area modified m^2	-704.783	225.111	-.176	-3.131	.003	-1154.493	-255.073	.015	-.364	-.143	.664	1.506
	Extra-Kitchen m^2	476.558	278.569	.086	1.711	.092	-79.947	1033.064	-.065	.209	.078	.827	1.209
	Extra-Bedroom m^2	482.459	512.550	.048	.941	.350	-541.477	1506.395	.085	.117	.043	.810	1.235
	Extra-Storage Utility m^2	-2940.754	802.617	-.193	-3.664	.001	-4544.166	-1337.342	-.077	-.416	-.168	.759	1.317
	Number of bedrooms	-2412.130	849.561	-.147	-2.839	.006	-4109.323	-714.937	-.397	-.334	-.130	.784	1.275

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

Table 8: 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 9: 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 were 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;

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

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.

4.0 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 *RM 266.48*, and contributes **19.5%** to the property value. This finding is contrary to the findings of Musili [29], 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.* [30], Boris [9] and Musili [29]. 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 [30] 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.* (2006) 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.* (2003) and Berezansky *et al.* (2010), 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.

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