LOCATION ANALYSIS FOR THE SHOP HOUSE VALUATION IN KOTA KINABALU USING GIS-MRA

Oliver Valentine Eboy
School of Science Social, Universiti Malaysia Sabah,
Locked Bag No. 2073, 88999 Kota Kinabalu, Sabah, Malaysia.
Email: oliver@ums.edu.my

Abstract

The location of the shop houses is one of the most important factors that affecting its rental value. In the past studies, MRA has been used as an attribute analysis for property valuation problem since 1920s. Characterized by its "correlation" and "prediction" features, this technique provides statistical reasoning capabilities. However, although the statistical functions provides models that are capable of producing relatively accurate and consistent regression estimates, the technique does not possess distance measuring capability. This capability is felt necessary because the incidences of property values are locationally distributed. GIS fills in this gap. With a proper framework, both GIS and MRA can be combined as a new tool of spatial reasoning in property valuation analyses. This paper first described the influence of location factors on rental values in which the information is then measured and quantified using distance analysis that could portray how far the location factor affects the shop houses rental value. The outcome of this will then be analysed using MRA to show the relationship between all the location factors and rental value of shop houses. The results revealed that using GIS is possible to improve the variable of location factor in MRA and subsequently produce a better rental model.

Keywords: *Location, Shop House, Rental Value, Multiple Regression Analysis (MRA), Geographic Information System (GIS).*

Introduction

The value of property is based on the assessment of 'value factors' that are considered relevant to the value of the subject property. With regard to commercial property, the 'value factors' may include locational influences, physical attributes, legal factors and planning and economic factors (Wyatt et. al. 2003).

According to Wyatt et al. (2003) and Gallimore (1996) locational influences is the primary influence on value such as accessibility, proximity to Central Business District (CBD), neighbourhood or important nodes such as bus stations and car parks need to be considered.

Using the combination of GIS and MRA provides an opportunity to investigate locational influences on value more objectively. The MRA had contributed a lot in property valuation to determine the value of property using the 'value factors' as its variables. Although most researchers manage to show the effectiveness of using MRA in property valuation but it still lacks geographical value factors.

Although the use of GIS is commonly but concentrate mainly in describing and displaying spatial influence on property value rather than analysis. This research attempts to explicitly measure the locational influence at the intra-urban level. Therefore, this paper will show the

integration of GIS with MRA, to provide a more accurate result for decision-making in property valuation.

Why GIS-MRA techniques?

As stated by many researchers (Shenkel, 1971; Ashton, 1972; Dalgiesh and Buchart, 1998), MRA is an effective method to calculate the rental or price of the property. By using MRA, the cost, time and human resource will be reduce significantly when doing property valuation is done especially in mass appraisal.

GIS in the other hand, is a 'computer system for capturing, managing, integrating, manipulating, analysing and displaying data which is spatially referenced to the Earth' (McDonnell and Kemp, 1995). GIS has the capability to relate layers of data for the same points in space, combining, analysing, and finally, mapping out the results. Spatial information uses location, within a coordinate system, as its reference base.

Therefore, by integrating MRA technique and GIS capabilities, it is possible to produce a model that have both spatial and aspatial characteristics. Some previous works in property (Curry, et. al., 1990; Rosiers & Theriault's, 1991; Hamid and Vui, 2006; Oliver, 2006) have shown some examples of spatial analyses, incorporating GIS and MRA.

In Rosiers & Theriault's (1991) study, the ability of GIS-MRA technique had been explored to provide an analytical framework for information of a thematic, aspatial nature (e.g. property prices) which can be link with geographic support that allows spatial analysis of various phenomena.

Curry, et. al.'s (1990) study showed that the use of GIS has enhanced the understanding of the spatial pattern of the effects of the location factors (e.g. distance from a defined point in town, existence of bank, in or outside town) on property values.

Hamid and Vui., (2006) study produced a much more extended version of GIS-MRA in which the model capable to generate surface value analysis using extensive GIS interpolation techniques such as (Inverse Distance Weighting) IDW and Kriging integrate with MRA model.

Influence of location factor to the shop house value

Location is an important factor in determining the values of properties. The influence may be in terms of accessibility to shopping complex, parks, petrol station, public facilities and work place; road traffic, noise and business; neighbourhood amenities; safety issues such as level of crime and security; to mention a few (Kahn, 1963; Gallimore et al, 1996; Rozana, 2004).

However, for commercial property, the location factor may be differ to that of residential. As mention by Wyatt et al. (2003), location factor that influence commercial property are accessibility to the market place, proximity to suppliers of raw materials and important nodes such as railway stations, car parks and open spaces. For example, easy access to parks significantly influences residential property but not commercial property. Parking spaces greatly influence the value of commercial property but rarely for residential property.

Area of study

The area of study is located in Kota Kinabalu, Sabah. However, the place chosen as case study for this paper is the city of Kota Kinabalu. The type of property used for this study is the ground floor shop houses.

Measuring locational variable for shop houses

The identification of locational influence factor is needed for this study and is obtained through review of the literatures and interviews.

From the area of study, the author has outlined 23 of the locational factors that may influence the shop house. The identified influence factors are listed in Table 1.

Therefore, this distance, is indicated using GIS tool, in which the term for this approach is called neighbourhood analysis.

Neighbourhood analysis

One of the neighbourhood analysis used in this study is the Buffer analysis. The attribute data for the location factors is coded using "Dummy" or variable's indicator that depicts the impact of location on the properties.

Table 1: List of Location Factors Identified in The Study Area.

LOCATION FACTORS	
BANK	SURROUNDING VIEW
EDUCATION CENTRE	LIBRARY
LODGING	CINEMA
HOTEL	PUBLIC HALL
ROAD1 (MAIN/SECONDARY)	OFFICE CENTRE
ROAD2 (1 OR 2 WAY)	BUS/TAXI STAND
RECREATION PARK	POLICE STATION
HEALTH CENTRE	PETROL STATION
POST OFFICE	GARBAGE SITE
SHOPPING COMPLEX	PUBLIC TOILET
TOURISM CENTRE	ACCESSIBILITY
MARKET	

Based on the research carried out by Ibrahim (1995), Low (2005) and Shirley (2008), the suggested walking distances suitable for the influence of the locational factors listed above to the shop houses' rental value are as follows (Table 2).

Figure 1 show the result of one of the neighbourhood analysis to identify the buffer for a particular location. The buffer area (pink color) represents the radius distance of the bank's influence and the highlighted (yellow color) represents the

Table 2: Suggested Distance for Buffer Analysis to The Locational Factors

Locational Factor	Distance Suggestion (meter)
Garbage Site	50
Bank, Hotel, Lodging,Office Centre, Education Centre, Post Office, Cinema, Recreation Park, Tourism Centre, Public Toilet, Library, Market, Health Centre, Public Hall, Police Station, Petrol Station	150
Shopping Complex	200
Bus/Taxi Stand	300

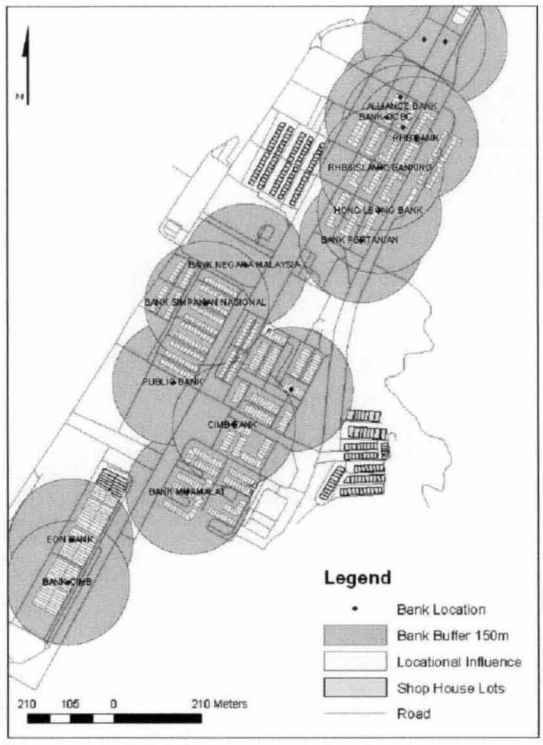

Figure 1: Buffer Analysis showing the impact of location of Banks on the commercial properties.

shop house's property that receives the impact of the banks. Therefore, if the surrounding of the shop house has more locational factor (e.g. post office, shopping complex) then it will receive a higher rental value.

The coded attribute of the locational influence data (1 and 0) will then be added with other non-locational influence to be analysed in order to develop the rental model for each locality. Code '1' means the locational factor give influence while code '0' means the locational factor does not give influence to the shop house.

Construction of Multiple Regression Analysis (MRA) model

In order to account for the variation in shop houses rental in the study area, the MRA regression model needs to be constructed. The MRA is based on the linear model using enter regression technique, in which rental values are regressed against physical and location characteristics of the properties.

This paper construct the MRA model based on 163 data samples taken in the year 2007. The construction of the model is based on the formula as follow:

$$RV = B_0 + B_1X_1 + B_2X_2 ..... B_nX_n$$

Where RV is the estimated rental value for each shop house which is calculated as the sum of B_0, constant, physical characteristics and location characteristics variables (B_1X_1 ..... B_nX_n). Not all location characteristics in the model were based on GIS buffer analysis, some are determined based on site observation from the authors in the area of study. Table 3 shows which variable that uses GIS buffer analysis and site observation.

Once the construction of the model is completed, hence, an output of the MRA model with GIS inclusion is produced.

Results

The MRA models with GIS inclusion are then tested to see the variation of the rental value through coefficient of determination (R2), accuracy of the variable (F test) and whether the model is best overall (Significant F).

The summary output of the model in Table 4 shows the R square (R2) of 0.392 indicates that 39% of the model variation determine the rental value of the shop houses. Theoritically, the higher the R2, the better the model. However, based on Mchaney dan Croan (1998), the R2 value 0.38 is still acceptable and reliable.

Next, the measurement of the significant F from the Analysis Of Variance (ANOVA) in Table 5 is to identify whether the model as a whole is significant. The model has the value of 0.000 shows that it is significant in 99% confidence level. So the model is highly significant and can be accepted. Further test, the F test, was conducted to measure the contribution of each independent variable, measuring the overall goodness fit or correctness of the model when all the variables are considered simultaneously. The test reveals that the model has F value with significance level of 99%. This shows the accuracy of the model can be accepted. Hence, the model passes the entire test and we can rely on the coefficient (B) of the model.

Finally, the variables which are most significant can be determined from the model's coefficient (B) in Table 6. In this study, only the variables that have Sig. t below 0.01 (in bold text) will be taken into account as significant. The model shows that the Bus/Taxi Stand variable gives the most significant influence with 0.001 and based on the coefficients B, it increases the rental value by RM1325.211 to the shop house. This means that the Bus/Taxi Stand provide major positive influence towards shop houses' rental value as this maybe because most of the people use public transports to the city. This is followed by Public Hall and Cinema and both gives significant influence of 0.007. Based on the coefficients B, Public Hall variable increase the rental value by RM1889.579 to the shop house and it also provide positive influence

Table 3: The Methods Use in Determining The Location of The Shop House for The Mra Model

GIS Buffer Analysis		Site Observation
Garbage Site Tourism Centre Petrol Station Health Centre Bank Market Police Station Office Centre Post Office Bus/Taxi Stand	Education Centre Public Toilet Shopping Complex Library Cinema Petrol Station Public Hall Hotel Recreation Park	Accessibility Surrounding View Road1 (Main/Secondary) Road2 (1 or 2 Way)

Table 4: Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.626	.392	.291	1230.62941642

Table 5: Analysis of Variance (ANOVA)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	135706560.933	23	5900285.258	3.896	.000
Residual	210508377.718	139	1514448.761		
Total	346214938.650	162			

towards shop houses' rental value. The Cinema variable however, decreases the shop house rental value by RM-892.684. This maybe occurs because the big cinema building is blocking the front part of the effected property from the main road and this in turn have deterred the chances of potential tenant to promote their products effectively.

Therefore, by using this model, the shop house's rental value can be predicted. Based on the residual statistics in Table 7, the predicted rental value of the shop house in the study area is ranging between RM1682 to RM6627. This is slightly different than the current rental value which is ranging between RM1000 to RM8150. A visual map of the prediction rental value of the shop houses can then be produced as shown in Figure 2.

Conclusions

The study shows that addition of GIS into the MRA model can improve the rental value prediction. Eventhough GIS can provide a good MRA model, but the right type of GIS analysis must be chosen to produce a better result. The result in the model clearly shows that some locational factor affects the shop house rental value based on its existence in the neighbourhood area.

As the R2 in the MRA model garners only 39% of the variations in determining the rental value, the accuracy can be increase if other variables can be included such as rental duration aggreement, family connection, unidentified location factors (e.g. feng shui), building physical characteristics and also depends on the sincerity of the respondents in giving the information for this study and thus improve the MRA model.

Therefore, this study only shows the useful of GIS analysis in fascilitate the variable specification for the shop house's rental value and explores the possibility of improving the variable of locational dummy in MRA model.

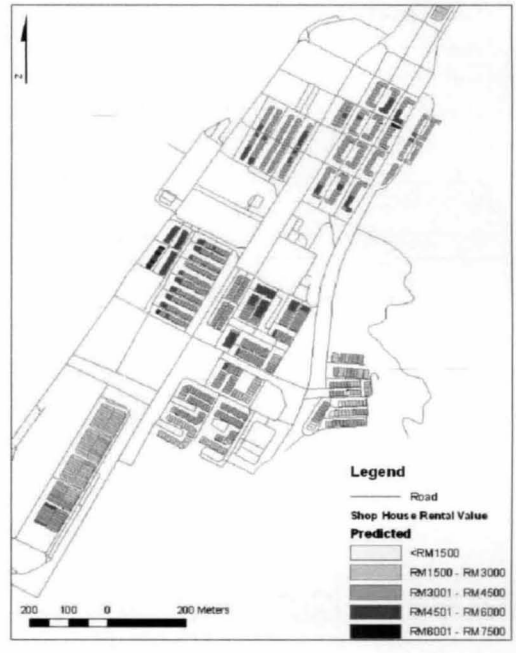

Figure 2: Prediction for all of the shop house's rental value using GIS-MRA in Kota Kinabalu City

Table 6: Coefficient B of The Model

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	2809.690	895.684		3.137	.002
Lodging	406.836	505.091	.113	.805	.422
Hotel	348.184	591.541	.048	.589	.557
Shop Complex	311.288	294.775	.101	1.056	.293
Office Centre	-583.336	381.733	-.116	-1.528	.129
Bank	-245.725	341.715	-.069	-.719	.473
Bus/Taxi Stand	**1325.211**	**397.829**	**.305**	**3.331**	**.001**
Education Centre	-832.071	433.693	-.241	-1.919	.057
Post Office	-637.724	828.188	-.059	-.770	.443
Cinema	-892.684	326.659	-.234	-2.733	.007
Recreation Park	-632.296	642.484	-.104	-.984	.327
Tourism Centre	-195.486	541.042	-.044	-.361	.718
Public Toilet	524.216	387.768	.166	1.352	.179
Library	26.178	894.007	.002	.029	.977
Market	1343.742	614.570	.258	2.186	.030
Health Centre	1152.435	613.379	.198	1.879	.062
Public Hall	**1889.579**	**695.941**	**.263**	**2.715**	**.007**
Garbage Site	-275.585	1065.188	-.025	-.259	.796
Police Station	414.891	596.852	.087	.695	.488
Petrol Station	229.758	345.585	.061	.665	.507
Surrounding View	602.536	374.139	.154	1.610	.110
Accessibility	149.863	467.011	.025	.321	.749
Road1	1736.380	790.897	.242	2.195	.030
Road2	-585.940	502.065	-.129	-1.167	.245

Table 7: Residual Statistics of The Model

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1831.7171631	6626.7988281	4100.6134969	915.25669655	163
Residual	-2626.79907227	3639.10009766	.00000000	1139.92737942	163
Std. Predicted Value	-2.479	2.760	.000	1.000	163
Std. Residual	-2.135	2.957	.000	.926	163

Acknowledgement

Financial support of this research under agreement No. FRG0014-SS-1/2006 from higher education ministry is gratefully acknowledged.

Bibliographies / References

Ashton, Peter (1972). *"The Use Of Multiple Regression Analysis In the Valuation Of Real Estate"*. The Real Estate Appraisers, m.s. 12 – 16.

Buang bin alias (2000). *"Analysis Of Factors That Contribute To The Accumulation Of Uncollected Rates In Local Authorities In Malaysia"*. Universiti Teknologi Malaysia. Phd Thesis.

Castle, Gilbert H., (1998). *"GIS In Real Estate: Integrating, Analyzing, And Presenting Locational Information."* The Appraisal Institute of USA & Adams Business Media/GIS World, United States of Amerika. 1-15

Curry, N. et. al., (1990). *"Using A Computer-Assisted Mass Appraisal-Geographic Information System (CAMA-GIS) Link To Develop A Multiregional Market Model"*. Property Tax Journal, 9(1): 103-114.

Dalgiesh, Robert and Buchart, Lawrence (1998). *"Regression Modelling In Calgary – A Practical Approach"*. Assessment Journal. Vol 5, Issue 4.

Gallimore, P., Fletcher, M. and Carter, M. (1996). *"Modeling The Influence Of Location On Value"*. Journal of Property Valuation and Investment.

Gujarati, D.N. (1995). "Basic Econometrics". Third Edition. Singapore: McGraw-Hill International Edition.

Hamid, Abd. and Vui, Chin Chui. (2006), *Using GIS-MRA Generated LOVE Surface For Computing Adjustment Factors In The Prediction Of Residential Property Values,* Proceedings of the International Real Estate Research Symposium (IRERS) 11-13 April 2006, PWTC Kuala Lumpur, Malaysia.

Ibrahim @ Atan b. Sipan (1995). *"Improving Mass Appraisal Valuation Using Geographic Information System"*. The Surveyor, Institution Surveyor Malaysia.

Ismail Omar (1997). *"Penilaian Harta Tanah."* Dewan Bahasa Dan Pustaka, Kuala Lumpur.

Kahn, Sanders A., (1963). *"Real Estate Appraisal And Investment"* The Ronalds Press.

Kau, J.B. and Sirmans, C.F. (1985). *"Real Estate."* Mc Graw Hill Incorporation, New York. 220-221

Lawrence, David (1972). *"Modern Methods Of Valuation Of Land, Houses & Building, 6th Edition."* The Gazette Limited, London.

Low Tze Yang (2005). *"Menganalisis Kesan Faktor Lokasi Terhadap Nilai Sewa Harta Tanah Perdagangan Dengan Menggunakan Integrasi MRA Dan GIS"*. Universiti Teknologi Malaysia. Bachelor of Science thesis. Unpublished.

McDonnell, R.A. and Kemp, K.K. (1995) *"International GIS Dictionary."* Chichester: John Wiley & Sons, Inc.

McHaney, R. and Croan, T.P. (1998) *"Computer Simulation Success. On Ohe Use Of The End-User Computing Satisfaction Instrument."* Atlanta: A Comment Decision Sciences. Vol. 29 No. 2.

Oliver V. Eboy (2006), *"Determining The Influence Of Location Shop House's Rental Value Using Spatial Statistics Techniques",* Proceedings of the International Real Estate Research Symposium (IRERS) 11-13 April 2006, PWTC Kuala Lumpur, Malaysia.

Ratcliff, Richard U., (1961). *"Real Estate Analysis."* Mc Graw Hill Incorporation, New York.

Rosiers, F.D. & Theriault, M., (1991). *"Integrating Geographic Information Systems To Hedonic Price Modelling: An Application To The Quebec Region."* Property Tax Journal, 11(1): 29-57.

Rozana Zakaria (2004). *"Kesan Letakan Dan Ciri-Ciri Pemandangan Terhadap Nilai Sewa Harta Tanah Komersial. Kajian Kes: Rumah Kedai Dalam Kawasan Terpilih Di Johor Bahru."* Universiti Teknologi Malaysia. Bachelor of Science thesis.

Shirley Kung (2008). *"Menganalisis Kesan Faktor Lokasi Terhadap Nilai Sewa Harta Tanah Komersial Dengan Menggunakan Pengintegrasian GIS Dan MRA"* Universiti Malaysia Sabah. Bachelor of Social Science thesis. Unpublished.

Shenkel, William M. (1971). *"The New Valuation System".* The Real Estate Appraiser, Vol.37, hlm. 31-34.

Thrall, Grant Ian (2002), "Business Geography And New Real Estate Market Analysis," Oxford University Press.

The Government Centre For Information Systems, CCTA (1994). *"Geographic Information and Geographic Information System Standards."* HMSO, London.

Wyatt, P., and Ralphs, M., (2003). "*GIS In Land And Property Management,"* Spon Press.