The Role of The Structural Factor in The Land Value Spatial Model : A Case Study of Surabaya City, Indonesia

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ABSTRACT

The instillation of GIS in the land property evaluation sector in Indonesia, is still at its early stage. The property taxation department has been using GIS in producing property taxation data since 1996, its main task being supplying computer-generated maps (Dirjen Cukai, 1998). Spatial analysis which is the strength of GIS remains to be practised. The land value spatial model is a model that assesses the value of land based on spatial treatments which have been identified as influencing the value of land. Generally there are 4 treatments influencing the value of land i.e. the structural factor, the neighbourhood factor, the location factor and the time factor. Spatial analysis is needed to produce maps from these treatments in order to churn out spatial data. The spatial analysis in need are reclassification, overlapping, length and distance measurement, neighbourhood and network analysis. Furthermore, statistical analysis is needed to form a spatial model. This study focuses on a sole factor that is the stuctural factor in influencing the value of land. The structural factor includes both physical and land usage treatments. The physical factor to be included in this study are the area, the front width, the direction and the shape. There are 148 land transaction lots used in shaping the spatial model. This working paper attempts to examine the level of influence of the physical treatments on the land value in the area studied.

***Keyword :** Spatial Model, Value of Land*

INTRODUCTION

There are many institutions which have interests in land-value estimation. Banking systems need such land-value information to determine credit values, the government needs them to levy property tax whereas investors need the information in any property transactions. Each of these institutions might have their own estimations depending upon their interests. Conflicting parameters and standards may be resulted in conflicting information on land values. Spatial factors is an alternative standard, which can be applied to reconcile the conflicting interests as it would produce relatively consistent estimation on land value. For that purpose, spatial analysis on land value needs some technological supports. Wyatt (1996) explains that technology usage in land value estimation will further improve the quality of such estimation. He has found out that Geographical Information Systems (GIS) have a very good potential to conduct spatial data analysis and to improve the probability to come to an objective land value. Value maps that are produced be the GIS can be used for various purposes such as optimum land-use planning, land taxation, land value management, and identification of areas that are feasible for development and investment in the future, all of which relate to the management and land value assessment. The main advantages of GIS are that of cartography, database management, and spatial analysis (Ruslan Rainis, 1998). Castle (1992) has studied and found out that there are 462 functions of using GIS in land value assessment. All of those functions can be shown in three dimension matrices. He believes that the GIS advantages can be extended and enhanced if it is combined with other software packages such as the Artificial Intelligence/Expert System. The main features of GIS will be used to build a model of spatial land value in the study area.

Table 1. shows some variables and models which have been identified by previous researchers, spatial

Researchers	Variables	Spatial Models
Hellman & Naroff (1978)	1. Median Value of property (MV) 2. Crimes against People (CP) 3. Crimes against property (CR) 4. Distance from CBD (DC) 5. Median Family Income (MI) 6. Total Crimes (TC)	1. MV=f(TC,MI,DC) 2. MV=f(CP,MI,DC) 3. MV=f(CR,MI,DC)
Farber (1986)	1. House Price (HP) 2. Sales Period (SP) 3. Area (AR) 4. Garden (GD) 5. No. of Rooms (NR) 6. Air Conditioning (AC) 7. Age of House (AH) 8. Average Price a block (AP)	HP=f(SP,AR,GD,NR,AC,AH,AP)

Dowall & Leaf (1991)	1. Estimated plot Price (EP) 2. Infrastructure (IS) 3. Registered Title (RT) 4. Tenure (TN) 5. Distance from CBD (DC)	EP=f(IS,RT,TN,DC)
Nelson (1993)	1. Price Land (PL) 2. Sale Month (SM) 3. Slope (SL) 4. Flood plain (FP) 5. Soil Quality (SQ) 6. Parcel Size (PS) 7. Downtown (DT) 8. Edge City (EC) 9. Urban Boundary (UB)	PL=f(SM,SL,FP,SQ,PS, DT, EC,UB)
Brondino & Silva (1998)	1. Market Value (MV) 2. Width (WD) 3. Area (AR) 4. Distance to CBD (DC) 5. Shape (SH) 6. Position (PS) 7. Fence (FC) 8. Sidewalk (SW) 9. Pavement (PV) 10. Building (BD) 11. Sewers (SR) 12. Power (PW) 13. Water (WT) 14. Slope (SL)	MV=f(WD,AR,DC,SH, PS,FC,SW,PV,BD,SR,P W,WT)

From the previous research, Hedonic Model is the model mostly used. The model of Hedonic is shown in equation 1.

$$P=f(S,N,L) \quad \text{.................................} \quad (eq.\ 1)$$

Where,

P = Property Value
S = Structure Treatments
N = Neighborhood Treatments
L = Location Treatments

RESEARCH FOCUS

From the three main factors of Hedonic model, this study is focused on how the structure factors determine the land value. The land structure treatment such as slope, contour, and width that determine land value is depended on land use. According to Ratcliff (1972), there are some classifications of land use, namely: agricultural, forestry, recreation, mining, water shed, transport, and urban land. Structure factor relates to the phisycal situation of particular lot of land. It means that each areas with different characteristics would have different structure factor. Mountaineous areas, for example, are characterized by its steep slope and its contrast elevations. Hence, the slope and contour will determine its land value. On the other hand, flat areas do not have steep slope nor high elevation. The study area (Sub-District of Gubeng, City of Surabaya) can be categorized as urban flat land. Therefore, variables that are used as structure factor in this study are: direction, landscape, scope, and front width. The equation of spatial model is shown in equation 2,

$$LV = f(LD, LI, LA, FW) \text{ .... (eq. 2)}$$

Where,

LV = Land Value
LD = Lot Direction
LI = Landscape Index
LA = Lot Area
FW = Front Width

Land value is calculated from the transaction price of land. Direction is included in the model as the area study is in tropical climate where sun ray at certain times is objectively considered. Landscape or shape is important factor to construct buildings; there are certain landscape which helps to plan the building and there are others which makes difficulties for planning. Scope or area coverage (Nelson, 1993) is considered as this constitutes structure factor which determines land advantage. Front width (Brondino et al, 1998) is also taken into account because in urban areas a particular lot with an appropriate front-width will potentially beneficial for economic activities.

CONTRUCTION OF SPATIAL DATA

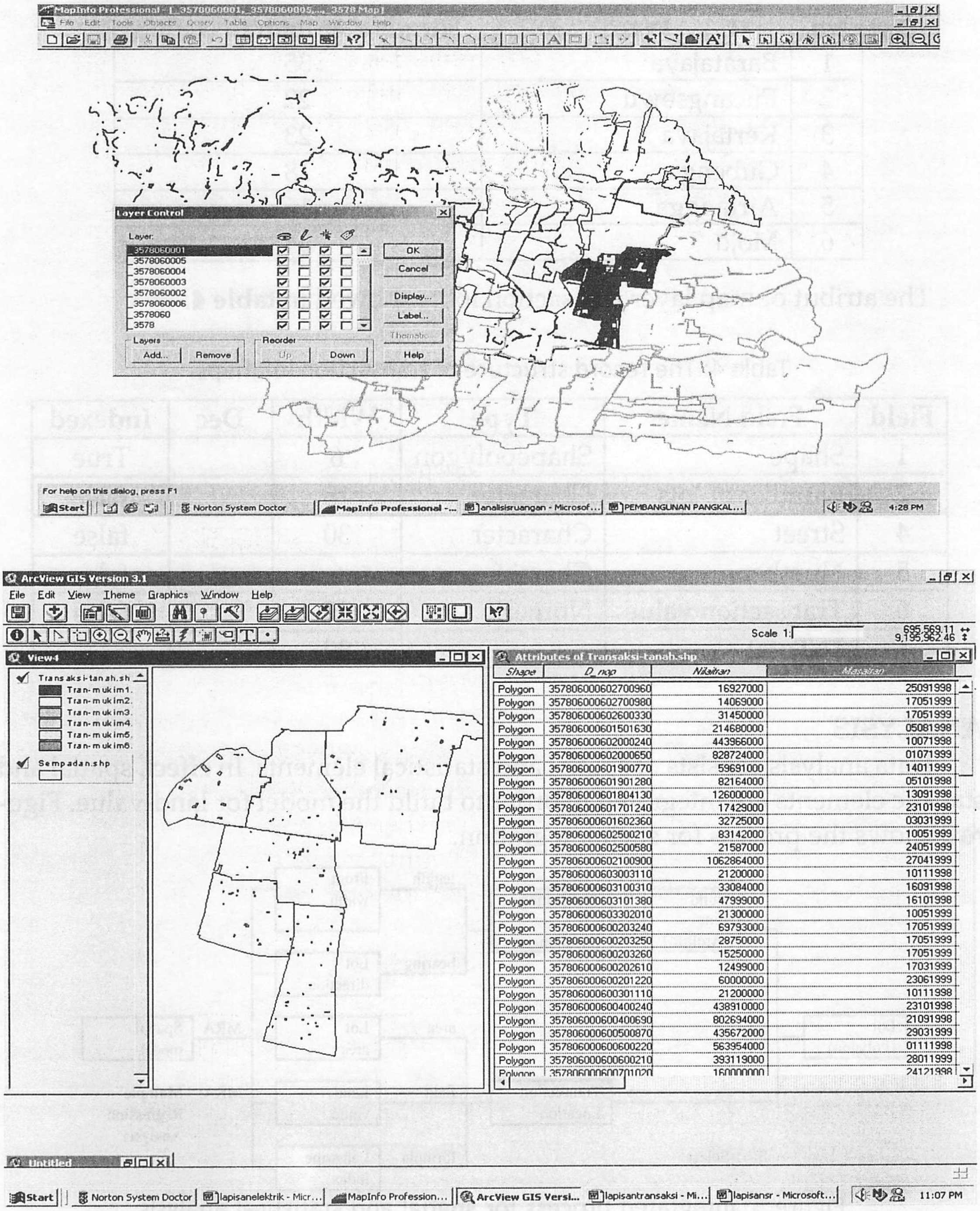
To construct spatial model for property value based on structure treatments, 2 layer maps are required, namely lot map and lot transaction map. Figure 1 shows the lot map and figure 2 shows the lot transaction map.

Study area is Sub-District (Kecamatan) of Gubeng. The layers in figure 1, consist of 6 wards (Kelurahan). The number of lots in each layers is shown in Table 2.

Table 2. Number of lots in Gubeng Sub-District.

No.	Layer	Ward	Number of lots
1	_3578060001	Baratajaya	4218
2	_3578060002	Pucangsewu	3092
3	_3578060003	Kertajaya	4361
4	_3578060004	Gubeng	2716
5	_3578060005	Airlangga	3963
6	_3578060006	Mojo	8267
7	_3578060	Ward boundary	6
8	_3578	Sub-District of Surabaya	31

Figure 1: Map of Surabaya City and lot of area study



The source of data on lots is the Directorate General of Taxation. They use MapInfo software to build the lot data. In this research, the data source is converted to ArcView by Universal Translator on the ground that ArcView has better facilities for spatial analysis. Map layer of lot transaction is shown in figure 3 using ArcView. Table 3 describes total transaction lot for each wards.

Table 3: Total number of transaction lot for each wards.

No.	Ward	Number of lot transaction
1	Baratajaya	35
2	Pucangsewu	22
3	Kertajaya	23
4	Gubeng	18
5	Airlangga	16
6	Mojo	34

The atribut of map layer transaction lot is showed in **table 4:**

Table 4: The record structure of transaction lot maps.

Field	Field Name	Type	Width	Dec	Indexed
1	Shape	Shapepolygon	6		True
2	Number of lots	Character	18		false
4	Street	Character	30		false
5	Number	Character	6		false
6	Transaction value	Numeric	30		false
	** Total **		90		

ANALYSIS

Data analysis consists of spatial and statistical elements. In effect, spatial and statistic elements are integrated in order to build the model for land-value. Figure 3 shows the process for such integration.

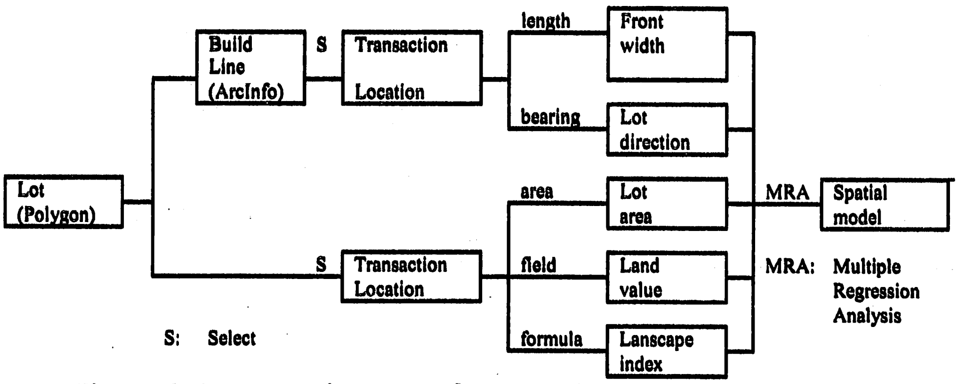


Figure 3: Integrated process for spatial and statistical analysis

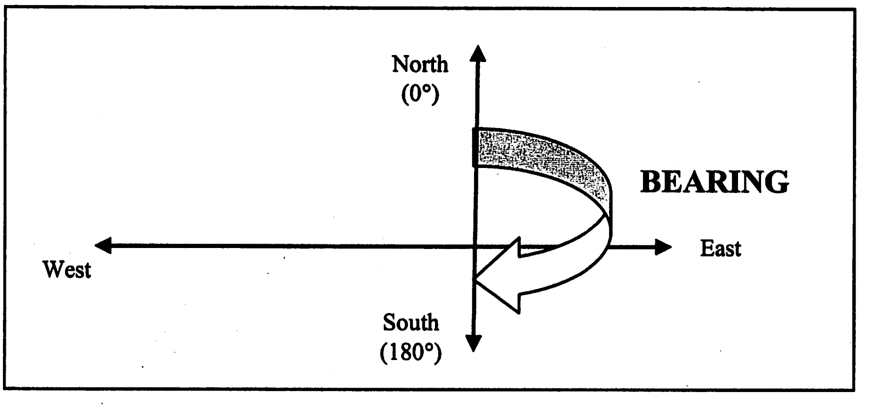
***Spatial Analysis* :**

1. Front Width

   The procedures to acquire front-width is carried out using ArcInfo software. Shapearc instruction is used to convert shape file to coverage file. Then clean instruction and build line is used to convert polygon into line. Next, with ArcView software, file coverage of lots in the study area which is categorized as line is activated. With the 'convert to shape' the file can be reconvert again into shape file. The line with lpoly = 1 is assigned, which means that there is no more line in the left or along particular road. The length of front-width can be found at the 'length' field and the 'attribute theme'.

2. Lot direction
The procedures to acquire lot direction are started by editing front-width for the corner lot. In effect, the editing is done by cutting the front-line which face secondary road. The task is to choose the line which face better road as the reference to determine the bearing line. Then, front-width map is processed with script to get the bearing. The resulted bearing of line is measured in degrees such that is depicted in Figure 4.

Figure 4: Bearing of line



The bearing of line is converted to horizon direction as shown in table 5,

Table 5: Conversion of line bearing to horizon

No	Direction	Bearing	Dummy value
1	East	46° - 135°	1
2	South	136° - 215°	0
3	West	216° - 315°	0
4	North	316° - 360° & 1° - 45°	0

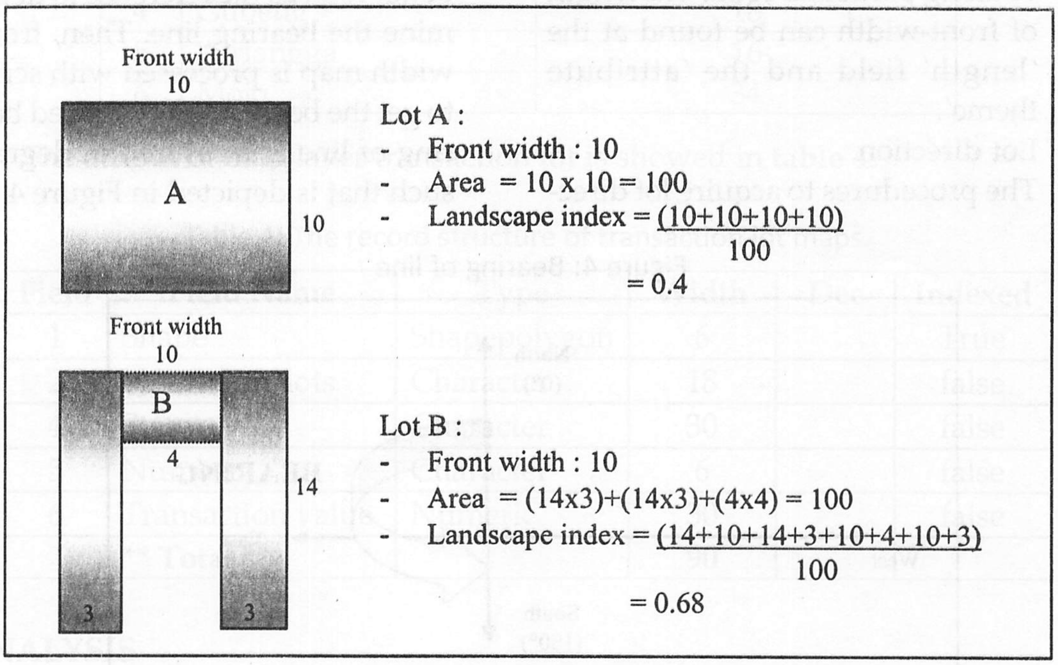
3. Area
The lot area is produced by activating land transaction map and choose measurement units in the view properties. Next, the extension X tools is activated to choose the Update area menu, perimeter, acres and length. The result of the polygon coverage can be found in the field area in the relevant attribute theme.

4. Land Value
The land value in transaction site of the study is acquired from the government agency, the transaction value in Indonesian rupiah is converted to Malaysian ringgit. The value field is added and the data is keyed in from the attribute theme.

5. Landscape Index
Landscape index is used to measure the lot density. The concept of

landscape index is derived from the ration between the number of polygon line and the polygon width. (Roy, 1998). In case of land lot, if the lot width is the same, the front-width is also the same. However, there is one possible deviance as depicted in Figure 5.

Figure 5 : The concept of landscape index



From figure 5, it can be interpreted that the higher ratio of landscape index the less shape value will be. The landscape index ratio is calculated by dividing the length of lot polyline with the area of lot polygon.

***Statistic Analysis*:**

Furthermore, the result of spatial analysis will be processed by statistical analysis. The statistical analysis use Multiple Regression Analysis (MRA). MRA is used in this model as the dependent variable is metric data whereas independent variables are combination of metric and non-metric data (Hair et. al, 1995). The purpose of regression analysis is to formulate spatial model, which will help to forecast the land value. The general equation of MRA is shown in equation 3,

$Y = a_0 + a_1 X_1 + a_2 X_2 + a_3 X_3 + ... + a_n X_n + e$ .... *(eq. 3)*

metric

metric & non metric

Where,

Y	= Land value
a_0	= Intercept
$a_1 ... a_n$	= Regression coefficients
$X_1 ... X_n$	= Spatial factor
n	= Number of factor
e	= Prediction error

To build the spatial model, there are 148 transaction locations in research area. The result of SPSS calculation is shown in equation 4.

$Y = -224608 + 1021.995\, X_1 - 4306\, X_2 + 326765.7\, X_3 - 4152.208\, X_4$ ... *(eq. 4)*

Where,

Y = Land value
X_1 = Lot area
X_2 = Front width
X_3 = Landscape Index
X_4 = Lot direction

Level of significance for each independent variable is showed in table 6,

Table 6 : Level of significance for each independent variable

Variables	t	Sig.
Lot Area	11.624	0.000
Front width	-1.596	0.113
Landscape Index	2.935	0.004
Lot directiion (horizon)	-0.170	0.866

These results show that area and landscape index are significant at a = 0.01. Front width and lot direction are not significant. The adjusted R square is 0.743. It shows that all of independent variables have influence the dependent variable for about 74 %. The result of F test is 107.499, significant at a = 0.000. It proves that the model is acceptable.

CONCLUSION

The resulted spatial model of land value in this study shows that significant variables in structure factor are the area wide and landscape of the lot. It also shows that area is the most reliable determinant of land value. Landscape index has the second highest significance as it determine the construction process of any buildings. Front width does not significant, but it constitute variable which has stronger influence than lot direction. This means that front width is more likely to be considered given the fact that any lots which has appropriate front width will be much easier for private as well as commercial buildings. The last variable is the dummy, sunrise direction, which turned out to be insignificant. Technological advance has enable one to get sunray without being precluded by lot direction. Overall, the model has contributed 74 % of the possible factors determining land value, and the rest (26%) is determined by other factors. With a sample of 148 land values from 25,753 lots in the study area, it is still too small to produce a model that can be used in forecasting. In order to create spatial model of land value which is useful in forecasting, there is a need to get a reasonably big samples to construct and test the model and it is suggested to add more variables such as neigborhood, location and time.

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