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To cite this article: E Hidayat *et al* 2018 *IOP Conf. Ser.: Earth Environ. Sci.* **123** 012019

View the article online for updates and enhancements.

Modeling the Dynamic Interrelations between Mobility, Utility, and Land Asking Price

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Abstract. Limited and insufficient information about the dynamic interrelation among mobility, utility, and land price is the main reason to conduct this research. Several studies, with several approaches, and several variables have been conducted so far in order to model the land price. However, most of these models appear to generate primarily static land prices. Thus, a research is required to compare, design, and validate different models which calculate and/or compare the inter-relational changes of mobility, utility, and land price. The applied method is a combination of analysis of literature review, expert interview, and statistical analysis. The result is newly improved mathematical model which have been validated and is suitable for the case study location. This improved model consists of 12 appropriate variables. This model can be implemented in the Salatiga city as the case study location in order to arrange better land use planning to mitigate the uncontrolled urban growth.

Keywords: Modeling, Land asking price, Urban growth, Salatiga City

1. Introduction

Regarding the future interest, planning a city should consider sustainable development. The challenge is to linking economic activities, social issues, and environmental impacts. One way to achieve sustainable development is by using land use planning to control economic and social activities, so as a result, allocation of land should fit particular uses. Land use is very important as a benchmark for parceling mechanisms, also as a benchmark for zoning the urban environments. Zoning has a function to evaluate the environmental consequences, as well as to support the future decision making in order to mitigate the negative effects of urban development [1].

Urban development is influenced by population growth and rapid urbanization process. These cause urban sprawl which leads to unsustainable practices that cause ecological, social and environmental problems [2]. Furthermore, population growth triggers a rapid land use change particularly converting farmland into housing areas. The increase of population is equal to the increasing demand for housing. While, a high density of housing areas evokes new issues, like the probability of hazards, such as fire hazards, an increasing need of water, and the high impacts of houses on ecosystem function [3]. Moreover, high population density and the establishment of new settlements may entail serious problems in water supply, energy provision, and utilities [4]. Similar findings by Mohammady [5] show that the expansion of urban areas results in a lack of infrastructure, increase of environmental pollution, and limits urban services. Eventually, unplanned urban growth

will lead to hampering the sustainable development and lessen the socio-economic quality of the inhabitant itself.

Urban sprawl and population growth trigger dynamic socio-economic quality which leads to dynamic land and property price. The new population needs more space to live so that the demand for land and housing also rises. One example to provide additional housing option is establishing the road redevelopment program. The purpose of this program is to gentrify old neighborhoods which have low price become a new housing alternative for the new population. However, this program also gives impact on the transaction prices of nearby housing, because it pushes up property and rental prices near redevelopment sites [6]. Another research finding indicates the real estate price is connected to transportation facilities. Empirical results demonstrate that rail transit facilities can markedly elevate real estate prices [7]. In addition, cities with a larger scale of urban rail transit will achieve explosive growth in land value, and there will be a very large gap in land value between cities with different scale of urban rail [8].

From the environmental perspective, environmental quality affects the prices of land and real estate properties. For instance, a land on a location near to the industrial plant usually prone to noise and air pollution produced by industries [9], buyers usually tend to ignore these type of land and resulted in low land value. In addition, the availability of water which included as utility becomes a consideration. The property sale prices will increase or decrease in response to water quality. Then, a long-term water quality monitoring is needed to identify the effectiveness of alternative land development [10]. Furthermore, people also consider sanitation and sewerage as a part of flooding risks, and the absence or presence of sanitation and sewerage become influential factors in determining the market value [11].

Based on the previous paragraphs, road development and transportation facilities are factors relatively close to people's mobility. Meanwhile, water and electricity, as well as sanitation and sewerage, are factors related to utility. Furthermore, several researchers used a specific term such as land value, market value, property price, and real estate price. These terms, in general, are commonly purposed to explain the impact of mobility and utility. Hereafter, the terms used in this research is land asking price. Understanding the interrelation between mobility, utility, and land asking price is important. The presence or absence of mobility will influence the utility and land asking price. On the other hand, the presence or absence of utility will also influence the mobility and land asking price. Therefore, the reciprocal relation between mobility, utility, and land asking price is important to enhance the land use planning. The aim of this research is to provide alternative information to forecast the land asking price which has reciprocal relation with mobility and utility. The final results of this research are the instruments which can be used to determine the price of land objectively to manage the uncontrolled urban growth.

2. Data and Methods

2.1. Research Design

This research is a deductive research. Based on the existing theory, the author has hypotheses that mobility, utility, and land asking price have dynamic interrelationship. Table 1 shows the steps and procedures to answer the hypotheses in a consecutive way.

Principally, there are 2 data collection methods used in this research for gathering information, namely secondary data collection and primary data collection. Ensuring the accuracy and appropriateness of the data is needed to achieve a decent conclusion. Secondary data collections in this research are collected by studying the literature related to land valuation modeling or concerned field using the online procedure. In addition, the supplemental data is needed by visiting the related offices. The land market data is used as the land asking price whereas land asking price is set up by the seller with an additional fee for the property agent. In addition, Salatiga city has 23 sub-districts and each

sub-district is collected 3 land asking prices [12]. The total number of land asking price data is 69 data for a whole city. Primary data in this research are required in order to validate the step 1 in research design. The data is based on the expert opinion. The expert is a respondent who has graduated from university level and has experience more than 5 years in the related field.

Prior to data processing, the data are classified based on their purposes and types. Validation is required when there are peculiar data found. The researcher then is converting the data into the data type. For example, data for the statistic approach is converted into numeric data. If the data are not quantitative, then dummy method is applied.

a. For determining the Influence Variables, the existing models are compared. If a variable is accommodated by minimum 3 researchers, this variable will consider as the influence variable. Then validated using expert opinion.
b. The Most Suitable Variables is generated using statistical analysis method. The selected existing models are calculated using actual data from the case study location. The result is decided based on the comparison of statistical analysis test.
c. Construction of newly improved model is used statistical analysis that is the linear regression. Then, validated using several statistical tests.

Table 1. Research Design

Step	Purpose	Activities
1	The influence variables which is suitable for the case study location	The mobility and utility aspects are broken down to generate the influence variables towards land asking price. 9 existing models are compared. Then, validation using expert opinion
2	The most appropriate models	Selected existing models are compared to choose the most appropriate one in appraising land asking price in case study location. 3 existing models are calculated using multiple linear regression with the actual data from the case study location
3	The improved new models	Model A is developed using variables from step 1. New improved model (model B) is constructed with variables of model A and additional variables of the most appropriate existing model (step 2).

Source: Author, 2017

2.2. Case Study: The Salatiga City

Salatiga is one of the cities in the Central Java province of Indonesia. Compared to other cities in central java, Salatiga city is typically a small city because it only has area 56,78 km^2, meanwhile, the average size of the city in Central Java is about 1358 km^2. Salatiga consists of 13,75% agriculture land and 86,25% non-agriculture land. Salatiga city is divided into 4 districts (Kecamatan) and 23 sub-districts (Kelurahan). Total population in 2015 is 183.827 people [12]. Salatiga is located about 47 km south of Semarang, the capital city of Central Java Province. It is also located about 55 km from Surakarta, the culture and tourism city in Central Java. Therewith, Salatiga is located on the arterial road network connecting Semarang to Surakarta. Thus, Salatiga has very high traffic intensity. The public transportation in Salatiga according to Marsudi [13] follows the radial pattern. It means the CBD (central business district) as the central of the city. In general, people are moved from the housing area to the city center. It causes the accumulation of the private car and public transportation mainly passes the main roads, and leads to the bad use of the existing road network. Moreover, Salatiga is included in the emerging extended metropolitan region (EMR) Kedungsepur, which is going to be an activity center in Central Java. Therefore, Salatiga is a very strategic city to be developed.

The city of Salatiga was chosen as the case study location. It is comprised of 4 districts (Kecamatan) and each district has several sub-districts (Kelurahan). The total numbers of sub-districts are 23 for a whole city. As much as 3 samples of land asking price data are taken in each sub-district in order to represent the land asking price distribution in particular sub-district.

The land price which is used as the dependent variables is the land asking price/offer price instead of transaction/deal price. Land asking price is chosen due to the nature of the price itself. Land asking price is much reasonable because it is included in the real value type. Additionally, the seller usually set the land asking price by using comparative and cost method. Thus, land asking price can represent market price because transaction price/deal price is same as the land asking price or less than land asking price. Land asking prices in this research are taken from the property agent in Salatiga City. It means the price consists of expected price from the seller with an additional fee from the agent. In terms of mobility, the variables represent this aspect are variables related to people movement and accessibility facilities. In this research, the accessibility infrastructure and transportation facilities are also included as the mobility. While for the utility are variables that related to urban services or supporting infrastructure. Both mobility and utility in Salatiga city are elaborated.

3. Results and Discussion

3.1. Determining the Influence Variables

The mobility aspect and the utility aspect are extracted using the literature review method to determine the influence variables toward land asking price. 9 previous journal articles and master theses are selected. The previous study by Ai [14] or R1 which discussed the modeling of land value focusing on residential land. A similar topic of residential land value is also discussed by Lehner [15] or R2. Meanwhile, Chiarazzo et. al. [9] or R3 conducted a research which emphasized on the environmental aspect towards real estate price, while Bohman and Nilsson [16] or R4 conducted a research about the impact of commuter trains toward property value. Subsequently, Nazir, Othman, & Nawawi [17] or R5 was employed hedonic pricing model in determining housing value. Furthermore, Tutuko and Shen [18] or R6 studied the effects of land use zoning on housing development, while the impacts of living conditions on housing development were studied by Tao [19] or R7. Meanwhile, Sue and Wong [20] or R8 conducted a research focused on the political economy of housing price. The last, Topçu [21] or R9 elaborated the accessibility effects on urban land value. R (researcher) is term to help in comparison of existing models. From these 9 articles, each article has its own method and variables. However, these articles still have similarities and are relevant to the discussion about mobility aspect and utility aspect in the dynamic interrelations with the land asking price, property price or housing price. Variables generated from previous researches are classified into mobility aspect or utility aspect. Table 2 presents variables which influence the land and property price.

Table 2. Variables influence Land and Property Price

Variables	R1	R2	R3	R4	R5	R6	R7	R8	R9	Aspect
Distance/travel time to the CBD	X	X	X	X	X	-	-	-	X	Mobility
Access/Distance to bus stop / train station	X	X	X	X	X	-	-	X	X	
Distance to the nearest the main road/highway	X	X	-	X	X	X	-	-	-	
Access to Hospital/Health Center	X	-	-	-	-	X	-	-	-	Utility
Access to Nearest park/open space	-	-	-	-	X	X	X	-	X	
Access to nearest school	-	-	-	-	X	X	-	X	X	
The presence of good sanitation	-	-	-	-	-	X	X	-	X	
Availability of Electricity	-	-	-	-	-	X	X	-	-	
Availability of garbage disposal system	-	-	-	-	-	X	-	-	-	
Availability of Clean water system	-	-	-	-	-	X	X	-	-	

Source: Author, 2017

Table 2 shows some variables included in several studies. However, some of them are applied only by 1 or 2 researchers, variables of distance/travel time to central business district (CBD) for example, are applied by 6 researchers. Meanwhile, the availability of the garbage disposal system is used only by 1 researcher. Thus, on determining the influence variables, only variables included in minimum 3 studies will be considered as the influential variables. These variables will be used for testing the dynamic interrelation among mobility, utility, and land asking price.

Moreover, to make sure the suitability of variables generated by the literature review, validation needs to be done in order to find out the compatibility of the real condition of mobility and utility in the case study area. Interview method has been employed. In this research, the respondents are persons who have knowledge and experience in the related field in Salatiga City. A minimum requirement for the respondent is graduated from university level and has work experience more than 5 years in related field. The respondent is chosen based on the disposition of each intended organization and must fulfill the minimum requirements. Table 3 presents the summary of interview results. It is only showed the respondents opinion related to the validation of influential variables related to land price.

Table 3. Summary of Interview results for Influential Variables

Respondent	Opinion
Mr. Jadi Amali, Head of Sub-division for Urban Planning at Bappeda	New development of CBD area will increase the land price since the nearby property will be converted into a commercial area. Infrastructure has a strong influence in the property market.
Ms. Sri Kusrini Martuti, Head of General Affair Section at BPN	Method for determining land tax or property tax based on the regulation of Financial Minister number 150/PMK.03/2010 about classification and designation of object value. BPN as the regulator in maintaining the land administration does not have the responsibility to control the land value. The land value or property price depends on the market price BPN provides a land value map or zone land price (ZNT), which can be accessed at http://peta.bpn.go.id/. This zone land price is based on market price
Mr. Robert A, Lending Officer at Bank of Stated Owned Company	The valuation procedure is divided into 3 categories, namely, physical, tenure, and fair market value. The physical category consists of Land use, risk towards flood, high voltage electricity path, prone to landslides, land contour, and soil fertility (for agriculture land). The physical category also points of access to the road (road width), access to electricity, access to landline (telephone), clean water facility, school, market, gas station, access to mosque/church, and distance to the cemetery. Tenure category depends on the freehold, building use right, right to use only. Fair market value category uses the comparison method of nearby property.
Mr. Lodewyk Pattiwael, CEO at Rumah Salatiga (Property agents)	There are many factors in determining the land value. However, in general, land value depends on the supply and demand.

Source: Interview result, 2017

Based on the interview result, it can be seen that respondents from BPN and property agent do not declare specifically about variables which influence land value. Meanwhile, respondents from Bappeda and Bank analyst emphasize that infrastructure gives strong influence in determining the land market price or property price.

Variables generated from the mobility aspect consist of 3 variables, namely, Distance/travel time to the CBD, access/distance to bus stop, and distance to the nearest main road. Access or distance to the CBD is classified as mobility because in transportation theory, CBD is included in the trip attraction. People move from housing (generation) area to attractive area, whereas CBD always

attracts a lot of people. Studies about trip attraction to CBD/commercial area/shopping center have been done by many researchers, for example D'Andrea and Francoso [22] and Uddin, Hasan, Ahmed, Das, Uddin, & Hasan [23]. The variable of distance to bus stop and distance to the nearest main road are classified as mobility due to a close relationship with the accessibility. Meanwhile, the variables considered for analysis from utility aspect are 3 variables, namely access to nearest park/public space, and access to the nearest school, and the present of good sanitation. These variables are classified as utility because public space, school, and drainage system can be described as public services, the Government has responsibility to provide those utilities because support the people daily activities. The access to nearest public space and access to the nearest school are also attracting people. However, those variables are classified as utility instead of mobility because of public space and schools are attracting only a particular user for a particular time. In addition, Ortuzar and Willumsen [24] is stated that the commercial land use is the highest trip attraction. While, public space and school are areas included in the recreational and educational land use, so, much suitable included in the utility.

Therefore, the 6 final variables generated from the literature review and validated using expert opinion is used to construct the model A. However, on the one hand, the bus stop variable and main road variable in some existing studies are classified as transportation factor or accessibility aspect. These variables are not something new for land valuation. Similarly, school variable or public space variable in some existing researches are classified as infrastructure factor or environment aspect. These variables are not new things in determining the land or property price. On the other hand, these 6 final variables adopted from related literature and validated using interview methods are appropriate variables in the case study location, Salatiga city. In addition, these final variables representing mobility and utility are a new alternative for land valuation method in Salatiga for specifically, and in Indonesia for generally.

3.2. The most appropriate models

Some of the existing models are compared in order to understand the variable compatibility in the case study area, Salatiga City. The existing models are chosen based on the variety of variables employed in each model. The selected existing models are also chosen based on the similarity characteristic of mobility behavior. The chosen models are models which constructed using data from the Asian region. The proposed models are Singapore model by Lehner [15], Hankou-China model by Ai [14] and Labuan-Malaysia model by Nazir, Othman, and Nawawi [17]. Table 4 presents the statistical analysis of the existing models.

Table 4. Statistical Analysis of Existing Model

Existing Model	Rsquare (>0,5)	Multicollinearity (>0,1)	F-test (<0,05)	Durbin-watson (-2 until 2)
Singapore Model	0,267	Free	0,006	1,003
Hankou – China model	0,194	Free	0,058	1,004
Labuan – Malaysia model	0,647	free	0,0000	1,847

Source: Author, 2017

The Singapore model, the Hankou-China model, and the Labuan-Malaysia model have been validated using several statistical tests such as t-test, f-test, multicollinearity, R-Square, and durbin-watson test. The result indicates that the Labuan-Malaysia model is the most appropriate model. This model can be adapted and implemented in the case study location, Salatiga city. The Labuan-Malaysia model also provides the most accurate variables in forecasting the land asking price.

The most appropriate model which has the most suitable variables is Labuan-Malaysia model. This model has been validated using several statistical tests. This model provides the most accurate variables in forecasting the land asking price because this model has variables which are different from the other model such as distance to the nearest religious place. This variable is mostly related to culture instead of mobility or utility. In general, the characteristic of people who live in Salatiga city is religious people, thus, distance to the nearest religious place is a variable that is suitable for the Salatiga city culture. Another variable is the distance to nearest police station. This variable should be included in the safety aspects instead of in mobility or utility. The feel of safety belongs to everyone. People want to live safely, so, this variable also proofs that the Labuan-Malaysia model has the most appropriate variables.

3.3. The new improved models

The new models are mathematical models. These models consist of model A and model B. Model A is a model constructed with 6 variables based on the literature review and validated with interview method. Model B is a model constructed with 6 variable of model A and additional variables of Labuan – Malaysia model. Table 5 presents statistical analysis of new models.

Table 5. Statistical Analysis of New Models

Mathematical Model	Rsquare (>0,5)	Multicollinearity (>0,1)	F-test (<0,05)	Durbin-watson (-2 until 2)
Model A	0,225	Free	0,006	0,969
Model B	0,679	free	0,0000	1,636

The model A is constructed using statistical analysis and validated using several tests. The variables generated from the mobility aspect consist of 3 variables and 3 variables for utility. However, a variable from utility aspect namely the presence of good sanitation is ignored because all data have a same value. In term of statistical analysis, this variable cannot be calculated. It does not mean the presence of good sanitation does not influence the land asking price rather this variable cannot be applied only for this particular data. The mathematical model A is illustrated in the equation as follow.

$$Y = 2724367.976 - 793.228x1 - 55.731x2 - 122.434x3 - 116.133x4 - 103.439x5$$

Whereas:
Y = land asking price (rupiah/square meter), x1 = distance to CBD (meter), x2 = distance to nearest bus stop (meter), x3 = distance to main road (meter), x4 = distance to nearest green/public space (meter), x5 = distance to nearest school (meter)

Model B is constructed using statistical analysis and validated using several tests. Model B variables are an adaptation of model A variables and Labuan-Malaysia Model variables. Model A consist of 6 variables and 10 variables from Labuan-Malaysia model is added. However, 3 variables of both models are similar, namely the distance to a bus stop, access to nearest park/public space and access to nearest school. Thus, the same variables are removed, so that there are no redundant variables. In addition, a variable of good sanitation is also removed because the data are all the same. All location in the case study have a drainage/sanitation and the condition of this utility is also in good condition in flowing the rain water, so, all location in the case study have low risk to urban flood. However, for other case study or another area which have different conditions, the variable of good sanitation should be applied. Therefore, model B is comprised of 12 variables, adapting variables of model A and Labuan-Malaysia model. The mathematical model B is illustrated in the equation as follow.

$y =$ 3999524.155 + 673653.495$x1$ - 195790.872$x2$ + 249435.115$x3$ + 155582.405$x4$ – 2166410.369$x5$ – 423282.769$x6$ - 443791.287$x7$ + 463726.491$x8$ + 381131.834$x9$ + 324238.643$x10$ - 737.260$x11$ - 171.333$x12$

Whereas:

Y = Land asking price/offered price by the seller (rupiah), x1 = access to local market / commercial place (1 if under 500 meter; 0 if other), x2 = access to religious place (1 if under 500 meter; 0 if other), x3 = the land parcel location/hook position (1 if corner lot; 0 if other), x4 = road access (1 if more than 4 meter and paved; 0 if other), x5 = gap of sales price compare to zone land price/BPN map (1 if the gap under, 1 million rupiah; 0 if other), x6 = access to bus stop (1 if under 1000 meter; 0 if other), x7 = access to public space (1 if under 2000 meter; 0 if other), x8 = access to the nearest school (1 if under 1000 meter; 0 if other), x9 = access to nearest river (1 if under 1000 meter; 0 if other), x10 = access to police station (1 if under 1000 meter; 0 if other), x11 = distance to main road (meter), x12 = distance to cbd (meter).

After comparing the model A and model B using statistical test, it can be concluded that model B has better performance compare to model A. Model B has higher R-square and less negative variables. Therefore, model B is a newly improved model which fits the case study location, Salatiga city. Model B consist of 5 mobility variables and 2 utility variables also 5 supporting variables.

Finally, after calculating and comparing the model A and model B, the result is model B as the newly improved model. The variables of model B consists of mobility variables, utility variables, and supporting variables. Mobility variables are access to local market/commercial place, road access/width, access to bus stop, distance to the main road, and distance to CBD. Utility variables are access to public space and access to the nearest school. Moreover, supporting variables are access to the religious place, comparison of sales price and zone land price, the hook land parcel location, access to nearest river, and access to the police station. In addition, the variable of the presence of good sanitation is cannot be calculated because the data are all the same. This variable is not yet confirmed influence land asking price or not.

4. Conclusion

The main results of this research are instruments in a form of mathematical model which can be used to assess the land price objectively. The newly improved mathematical model can be used by the planner and transport engineer in order to arrange better land use planning. The model B can be used to anticipate the uncontrolled urban growth in Salatiga city. The new improved model can be used as an instrument in the preliminary land acquisition process to develop new collector road, planning the bus stop location. In addition, the mathematical model B also can be used by the land-appraiser. This model is useful to predict the land asking price for property investment. For the Government, the mathematical model can be used as an early prediction for land taxation particularly for the industry, and for planning appropriate distance of new public/green space to the industrial area, commercial area, etc.

5. Acknowledgments

6. References

[1]   Gerundo R and Grimaldi M 2011 The Measure of Land Consumption Caused by Urban Planning *Procedia Eng.* **21** 1152–1160
[2]   Du R 2016 Urban growth: Changes, management, and problems in large cities of Southeast China *Front. Archit. Res.* **5** 290–300

[3]   Vukomanovic J, Doumas S, Osterkamp W and Orr B 2013 Housing Density and Ecosystem Function: Comparing the~Impacts of Rural, Exurban, and Suburban Densities on Fire~Hazard, Water Availability, and House and Road Distance~Effects *Land* **2** 656–678

[4]   Afandiyev V, Eminov Z and Nagiyev S 2014 Economic and geographic factors affecting the development of Greater Baku *J. Urban Reg. Anal.* **6** 203

[5]   Mohammady S 2014 A Swarm Optimization Based Method for Urban Growth Modelling *Environ. Res. Eng. Manag.* **69**

[6]   Yau Y 2011 Does comprehensive redevelopment change the housing price gradient? A case study in Mongkok, Hong Kong *Urbani izziv* **22** 98–106

[7]   Zhang X, Liu X, Hang J, Yao D and Shi G 2016 Do Urban Rail Transit Facilities Affect Housing Prices? Evidence from China *Sustainability* **8** 380

[8]   Yang Y, Zhang P and Ni S 2014 Assessment of the Impacts of Urban Rail Transit on Metropolitan Regions Using System Dynamics Model *Transp. Res. Procedia* **4** 521–534

[9]   Chiarazzo V, Caggiani L, Marinelli M and Ottomanelli M 2014 A Neural Network based Model for Real Estate Price Estimation Considering Environmental Quality of Property Location *Transp. Res. Procedia* **3** 810–817

[10]   Chang H, Thiers P, Netusil N R, Yeakley J A, Rollwagen-Bollens G, Bollens S M and Singh S 2013 Relationships between environmental governance and water quality in growing metropolitan areas: a synthetic view through the coupled natural and human system lens *Hydrol. Earth Syst. Sci. Discuss.* **10** 7395–7424

[11]   Cupal M 2015 Flood Risk as a Price-setting Factor in the Market Value of Real Property *Procedia Econ. Financ.* **23** 658–664

[12]   BPS Kota Salatiga 2016 *Kota Salatiga dalam Angka*

[13]   Marsudi M 2006 *Analisis Kinerja Mobil Penumpang Umum (MPU) dan Sistem Jaringan Trayek di Kota Salatiga* (Magister Teknik Sipil)

[14]   Ai P 2005 Residential land value modelling

[15]   Lehner M 2011 *Modelling housing prices in Singapore applying spatial hedonic regression* (IVT, ETH Zürich)

[16]   Bohman H and Nilsson D 2016 The impact of regional commuter trains on property values: Price segments and income *J. Transp. Geogr.* **56** 102–109

[17]   Nazir N N M, Othman N and Nawawi A H 2015 Role of Green Infrastructure in Determining House Value in Labuan Using Hedonic Pricing Model *Procedia - Soc. Behav. Sci.* **170** 484–493

[18]   Tutuko P and Shen Z 2016 The Effect of Land Use Zonings on Housing Development: The Introduction of Cdl Approach in the Border Area of Surabaya and Sidoarjo Regency, Indonesia *Procedia-Social Behav. Sci.* **227** 107–114

[19]   Tao L W 2015 Living conditions—The key issue of housing development in Beijing Fengtai District *HBRC J.* **11** 136–142

[20]   Sue E D W and Wong W-K 2010 The political economy of housing prices: Hedonic pricing with regression discontinuity *J. Hous. Econ.* **19** 133–144

[21]   Topcu M and Kubat A S 2009 The analysis of urban features that affect land values in residential areas *Proceedings of the 7th International Space Syntax Symposium, Stockholm, Sweden* pp 8–11

[22]   D'Andrea A F and Francoso M T 2015 Application of Cluster Analysisin Trip Attraction Models of Campinas Metropolitan Region *Int. J. Eng. Technol.* **7** 377–381

[23]   Uddin M, Hasan M R, Ahmed I, Das P, Uddin M A and Hasan T 2012 A comprehensive study on trip attraction rates of shopping centers in dhanmondi area *Int. J. Civ. Environ. Eng.* **12** 12–16

[24]   de Dios Ortúzar J and Willumsen L G 2011 *Modelling Transport* (John Wiley & Sons, Ltd)