



Developing Mobile Application for Residential Property Business in Transit-Oriented Development Areas

Mohammed Ali Berawi^{1*}, Nyoman Suwartha¹, Maulindira Elrizqi¹, Gunawan Saroji²,
Mustika Sari²

¹*Department of Civil Engineering, Faculty of Engineering, Universitas Indonesia, Kampus UI Depok, Depok 16424, Indonesia*

²*Center for Sustainable Infrastructure Development, Faculty of Engineering, Universitas Indonesia, Kampus UI Depok, Depok 16424, Indonesia*

Abstract. Transit-oriented development (TOD) areas are being constructed in Indonesia, particularly in Jakarta, since the issuance of the Regulation of Minister of Agrarian Affairs and Spatial Planning in 2017. This development has led to an increasing supply of apartment units in Jakarta, but this is contrary to the declining residential property sales, which was at the worst level in 2019. Therefore, this study aims to determine the factors that influence consumer preferences in buying residential properties in the TOD area, which serves as the basis for planning residential apartments in the next TOD area development. This study adopts both quantitative and qualitative methods through desk study and benchmarking, as well as questionnaire surveys and fuzzy logic to achieve its objectives. The results obtained here showed that the order of priority factors for consumers intending to buy property is financial, property type, and demographic factors. Consumers intending to rent property prioritize property type, financial, and demographic factors. Moreover, the higher one's income means the lower one's interest in living in the TOD area. Another objective of this research is to harness many mobile internet users in Indonesia, reaching 53% of the total population, to develop a mobile phone-based application that serves as the platform for sale and purchase transactions of residential properties in the TOD area. The proposed application has six features: My Preferences, which provides recommendations for suitable apartment units according to user preferences; Search My Apartment; My Store; Mortgage Simulation; Payment Gateway; and Profile Settings.

Keywords: Customer preferences; Fuzzy rules; Residential property; TOD

1. Introduction

Development of the transit-oriented development (TOD) area is rife in Indonesia, especially in Jakarta, after the issuance of guidelines for developing TOD areas by the Ministry of Agrarian Affairs and Spatial Planning in 2017 (Berawi, et al., 2019c). The rise in the development of TOD areas has resulted in an increased supply of apartment units in Jakarta, which is relatively high, especially in 2019 that has increased by 20,234 units (Colliers, 2019). However, this is contrary to the level of sales that decreased by 5.78% from the previous quarter (Bank Indonesia, 2019). To encourage the level of residential property sales in the TOD area, it is necessary to determine in advance consumer preferences and behavior so that the developments are carried out on target.

*Corresponding author's email: maberawi@eng.ui.ac.id, Tel.: +62-21-7270029, Fax. +62-21-7270028
doi: [10.14716/ijtech.v11i7.4481](https://doi.org/10.14716/ijtech.v11i7.4481)

Consumer preferences are individual attitudes towards a series of objects, which are usually reflected in the decision-making process, based on whether individuals favor an object or not (Abdullah et al., 2011). As consumers often optimize their satisfaction from consuming goods to meeting their daily needs given their income (Krugman and Wells, 2006), their preferences to product selections are triggered by many factors, such as material substance, product brand, ease of instruction for product usage, as well as legality and recognition by state regulations (Voicu, 2013). Therefore, companies need to involve their potential customers' preferences in their product or service development (Chia and Harun, 2016).

Furthermore, concerning the development of TOD that aims to increase the ridership of public transportation (Berawi, et al., 2020b; Saroji et al., 2020), the government needs to determine the preferences of potential consumers for the properties in the TOD area. Consumer preferences in purchasing property, particularly residential properties, are influenced by various factors, such as location (Kauko, 2007), property feature (Manganelli, 2015), environment (Zhang and Xu, 2017), finance (Xiao and Tan, 2007), demography (Haddad et al., 2011), and many more.

The distance between the property and the city center, schools, business centers, and social facilities is a significant consideration for consumers in purchasing a property; hence location is vital (Hei and Dastane, 2017). Besides, proximity to public transit will increase land and property values (Berawi et al., 2020a). On the contrary, property features assessed from the building designs also play a significant influence. Moreover, the environmental factors, including the area's condition and security level around the property, have never been ruled out in determining property purchases (Zhang and Xu, 2017). In addition, customers consider their ability to pay (Anastasia, 2015), related to the price, payment, and repayment methods. Lastly, demographic factors, such as marital and family status, are essential because the more family members, the more living space will be needed.

Customer preferences are often expressed in a vague colloquial way at purchase time. Various fuzzy methods can be considered to develop new and more accurate ways to understand customers' product choices based on this kind of information (Barajas and Agard, 2011). Many studies have been conducted using fuzzy techniques regarding customer's behaviors and preferences. There are two methods to determine and revise the priority of customer demands (Chen et al., 2004): first, to classify the customers' demands using natural language processing techniques to obtain their expectations and second, to determine the revised priority of the customers' demands using a fuzzy logic inference. Kwong et al. (2007) developed a methodology to determine the significance of engineering characteristics and their influence using the fuzzy technique, while Földesi et al. (2007) used fuzzy numbers to represent customer assessments to classify the relationship between customer satisfaction and attribute-level performance and identify whether or not some of those attributes have a non-linear relationship with satisfaction.

In the development of the TOD area, good communication and information exchange must be established so that all stakeholders can contribute and work together effectively and appropriately. With the fact that 53% of Indonesians are internet users (Siswoko, 2019), there is an opportunity to develop an online platform that unites all stakeholders to ensure the sustainability of property businesses in the TOD area. Previous studies regarding the development of mobile phone applications in the transportation sector, particularly in transportation data collection, route planning, traffic safety, ride-sharing, etc., have been extensively conducted in several countries (Siuhi and Mwakalonge, 2016). The utilization of information and communication technology (ICT) in the property business process has also been widely researched (Najib Razali et al., 2014). However, the

development of a mobile application for property transactions, particularly those located in the TOD areas, have not been studied yet.

This study focuses on developing a mobile phone-based information system using fuzzy rules that considers the perspective of prospective consumers for residential properties in the TOD area, providing property unit recommendations for the consumers and facilitates them in the transaction process.

2. Methods

This study adopted a three-stage research approach by combining qualitative and quantitative methods: literature review, benchmarking studies, questionnaire survey, and fuzzy logic to achieve its research objectives, which include (1) determining the influential factors for consumers in purchasing residential property and (2) developing a mobile application for residential property business in TOD areas.

2.1. Literature Review and Benchmarking Study

This stage includes desk study activities to get insight into the existing conditions of the residential property market development in Indonesia and identify factors that influence the customers in purchasing and/or renting residential properties, especially in the TOD area. Furthermore, these factors will become independent variables in this study, representing the influential factors of location, property feature, finance, and demography. The number of family members occupying the property unit represents the property attribute determined by the cultural components (Jabareen, 2005). On the contrary, the customer's income per month represents the significance of property buyers' financial considerations, while marital status represents the demographic factor (Zeng, 2013). These variables are all adopted from the results of research conducted in fellow developing countries, as shown in Table 1.

Table 1 Research variables

No.	Variables	References
<i>Dependent Variable</i>		
1.	Customer Preference:	
	a. Asking Prices	(Voicu, 2013)
	b. Type of Property (1-bedroom, 2-bedroom, or 3-bedroom)	(Chia and Harun, 2016) (Berawi et al., 2019b)
	c. Distance to Station	
<i>Independent Variables</i>		
1.	Number of family members occupying the property unit:	
	a. 1 person	
	b. 2 persons	(Tan and Cheah, 2013)
	c. 3 persons	
	d. 4 persons	
	e. 5 persons	
2.	Customer's income per month:	
	a. < Rp10.000.000	(Hei and Dastane, 2017)
	b. Rp10.000.000 – Rp15.000.000	(Kamal and Pramanik, 2015)
	c. Rp15.000.000 – Rp20.000.000	
	d. >Rp20.000.000	
3.	Customer's marital status:	
	a. Married	(Koeri, 2016)
	b. Single	

A questionnaire was then composed based on these variables. The questionnaire used in this study was closed-ended multiple-choice questions that require respondents to identify answers from an existing list, based on the predefined variables above. The questionnaire surveys were distributed online and filled in by 125 respondents, with Jakarta province and its surrounding residents having a regular monthly income as the criteria. Determination of criteria for the questionnaire respondents was following the case discussed in this study. The apartment unit prices listed in the questionnaire were based on the type of variations and the distance of their proximity to the transit station, which took five TOD MRT Jakarta points (Lebak Bulus, Fatmawati, Istora-Senayan, ASEAN, and Dukuh Atas) as the case studies.

2.2. Fuzzy Rules

After the required data was obtained, it was processed to determine consumer preferences in buying and/or renting apartments, using fuzzy rules as the data analysis technique that include complimentary (NOT), contains (AND), and compound (OR) operators. These fuzzy rules will become machine learning (ML) for the application in determining the appropriate apartment recommendations based on the application users' preferences. The fuzzy rules in this study were obtained from all survey responses, which will later be processed using the Orange application, an open-source data visualization system, ML, and data mining system used to analyze and interpret data visually and interactively. It can also represent data, make models, evaluate models, and compare available models to get a model with the highest accuracy level (Demšar et al., 2004). In this study, Orange helped build the ML model according to visualization standards.

Following the process of fuzzy rules, the data were also processed using Information Gain to find out the relationship between dependent and independent variables (Berawi et al., 2019a). Information Gain is one of the decision tree's attributes that shows a measure built on a parametric model, connecting the connected variables and the independent variables (Tangirala, 2020). The higher the value of the information generated, the more the variable is for classification. The variables with the highest Information Gain are those selected to be separated.

2.3. Mobile Application Development

The next stage is a benchmarking study to obtain the features needed by mobile phone applications engaged in property transactions. Several stages create this application, starting with the requirement analysis that produces a flowchart and UML (Unified Modeling Language) used for the application. The second stage is the specification aiming to produce the tools needed to develop the application. It was followed by the design stage that develops the application's design and workflow based on the results of the requirement analysis done previously. Prototyping was done in the fourth stage, where the programming process is carried out based on the mockup design results from the previous stage. Lastly, the testing phase was conducted to ensure the application is running as expected.

3. Results and Discussion

A rail-based mass transit station is ideally located in the center of the TOD area. It is surrounded by a mix-used property development of high-density commercial properties, retail, offices, and public open spaces, hence creating a pedestrian-friendly environment. TOD area is generally located within a radius of about 600 meters from the transit stop support walkable TOD (Mu and de Jong, 2012), considering that pedestrians' comfortable walking distance is about 600 meters 10 min on foot.

Consumer preferences in purchasing residential property in TOD areas are crucial in TOD development. Furthermore, the utilization of ICT to support the residential property's purchasing activities in the TOD area is necessary. A Decision Support System (DES) type was developed in this research in the form of a mobile phone application for buying and selling property located in the TOD area to provide apartment unit recommendations to users based on their capabilities and demographics.

3.1. Relationship between Variables

Out of 125 respondents who completed the questionnaire, 84% are civil servants, 8% work in Jakarta's state-owned enterprises, 2% are private-sector employees, and the remaining 6% have other professions (police officers, medical doctors, etc.). The distributed questionnaire contained questions about the respondents' interest in living in a residential property located in a TOD area. The results show that the higher the income, the lower the interest in staying in the TOD area (Table 2). Hence, the government and property developers should provide affordable apartment solutions for people with middle and low income.

Table 2 Percentage of respondents willing to stay in the TOD area based on their income

No.	Income per month	Percentage of respondents with an interest to stay in the TOD area
1.	<Rp10,000,000	83.34%
2.	Rp10,000,000–Rp15,000,000	80%
3.	Rp15,000,000–Rp20,000,000	75%
4.	>Rp20,000,000	64.83%

Furthermore, the Information Gain value is calculated to determine the relationship between independent variables and a dependent variable using the open-source Orange application that presents a visual programming front-end for data analysis and visualization; wherein, the higher the Information Gain value obtained, the higher the relationship between the independent variables and the dependent variable (Table 3).

Table 3 Information gain value of the apartments for sale and rent

Variable	Information Gain of apartment for sell	Information Gain of apartment for rent
Income per month	0.590	0.601
Number of family members	0.544	0.652
Marital status	0.478	0.545

The monthly income has the highest correlation with consumer preferences for sold apartments, with an Information Gain value of 0.590. This was followed by the number of family members occupying the property unit with an Information Gain value of 0.544. Meanwhile, marital status has the lowest relationship with consumer preferences in purchasing residential property in the TOD area, with an Information Gain value of only 0.478.

Meanwhile, there is a slight difference in the rented apartment. The variable with the highest relationship is the number of family members occupying the property unit with an Information Gain value of 0.652, followed by the monthly income with an Information Gain value of 0.601. Furthermore, marital status is the least variable that affects consumer preferences in renting a property, with an Information Gain value of 0.545.

It can be concluded that the most influential variable in consumer preferences in purchasing residential property in the TOD area is the financial factor, measured by the amount of income/month; followed by the property type factor, based on the number of family members occupying the property unit, and demographic factor, based on the marital status. On the contrary, the most influential variable in consumer preferences in renting residential property in the TOD area is the property type factor seen from the number of family members occupying the property unit; then followed by the financial factor, measured by the amount of income/month; and lastly, demographic factor. The finding of factors influencing preferences in purchasing property is in line with the previous studies (Opoku and Abdul-Muhmin, 2010; Khaled et al., 2012) while influencing preferences in renting the property are on the contrary to the results of a study in Thailand conducted by Koeri (2016), stating that demographic, property type and price are the top three factors.

3.2. Fuzzy Rules

Fuzzy rules were formulated to determine the system's operation based on the results of the questionnaire survey, providing analyzed data on the relationship between the variables. The accuracy measurement tool, classification accuracy (CA), was used to decide the best fuzzy rules. In contrast, the Orange application was used to determine the accuracy and error of the ML models so that the model with the highest CA value can be obtained.

The formation of these fuzzy rules utilized several other decision-making models selected based on the highest accuracy value. There are five different decision-making models: kNN, Decision Tree, SVM, Naïve Bayes, and Logistic Regression, in the Orange application. These five models aimed to interpret the data to determine customer preferences for residential property units in TOD based on their monthly income, marriage status, and the number of family members. The level of accuracy produced by the five models is shown in Table 4.

Table 4 Classification accuracy calculation result

Method	Classification Accuracy (CA)
kNN	0.21
Decision Tree	0.27
SVM	0.26
Naïve Bayes	0.23
Logistic Regression	0.15

ML is a scientific technique where computers learn how to solve a problem through experiences without being explicitly programmed. There are five different ML models tested in this study, including kNN, Decision Tree, SVM, Naïve Bayes, and Logistic Regression. The first one, kNN or K-nearest neighbors, is a non-parametric method, the easiest to use for classification and regression. The basic logic behind kNN is exploring the neighborhood, assuming the data to be similar, and then obtaining the output. Second, Decision Tree is a tree-based algorithm widely used to solve classification and regression problems, with an inverted framed tree that branches from a homogeneous probability distributed root node to a very heterogeneous leaf node in order to obtain the output. Third, SVM or Support Vector Machine is a type of ML technique used for classification and regression with two main variants to support linear and non-linear problems. Forth, Naïve Bayes is a prime generative probability model used for classification problems, particularly text classifications. And the last one is Logistic Regression, a classification algorithm that uses a logistic function to frame a binary output model. The output of the logistic regression will be a probability ($0 \leq x \leq 1$). The model that came up with the highest CA value for both situations (apartments for sale and apartments for rent) is the Decision Tree, with an accuracy level

of 27%. The fuzzy rules for sale recommendations of apartment units in the TOD area are shown in Table 5.

Table 5 Fuzzy rule for sale recommendation of apartment unit in the TOD area

No.		Income (Rp)		Marital Status		No. of family members.		Recommendation
1.	IF	<10 M	AND	Yes	AND	2	THEN	(300-400m 1BD)
2.	IF	<10 M	AND	Yes	AND	3	THEN	(300-400m 1BD)
3.	IF	<10 M	AND	Yes	AND	4	THEN	(400-500m 1BD)
4.	IF	<10 M	AND	Yes	AND	5	THEN	(300-400m 1BD)
5.	IF	<10 M	AND	No	AND	1	THEN	(300-400m 1BD)
6.	IF	10-15 M	AND	Yes	AND	2	THEN	(300-400m 2BD)
7.	IF	10-15 M	AND	Yes	AND	3	THEN	(000-100m 2BD)
8.	IF	10-15 M	AND	Yes	AND	4	THEN	(300-400m 2BD)
9.	IF	10-15 M	AND	Yes	AND	5	THEN	(300-400m 2BD)
10.	IF	10-15 M	AND	No	AND	1	THEN	(300-400m 2BD)
11.	IF	15-20 M	AND	Yes	AND	2	THEN	(400-500m 2BD)
12.	IF	15-20 M	AND	Yes	AND	3	THEN	(000-100m 2BD)
13.	IF	15-20 M	AND	Yes	AND	4	THEN	(100-200m 2BD)
14.	IF	15-20 M	AND	Yes	AND	5	THEN	(900-1000m 2BD)
15.	IF	15-20 M	AND	No	AND	1	THEN	(000-100m 2BD)
16.	IF	>20 M	AND	Yes	AND	2	THEN	(200-300m 2BD)
17.	IF	>20 M	AND	Yes	AND	3	THEN	(900-1000m 2BD)
18.	IF	>20 M	AND	Yes	AND	4	THEN	(000-100m 3BD)
19.	IF	>20 M	AND	Yes	AND	5	THEN	(900-1000m 3BD)
20.	IF	>20 M	AND	No	AND	1	THEN	(200-300m 2BD)

BD : Number of Bedroom

Based on the fuzzy rules and the decision tree for the recommended apartment for sale above, an example of the cases is illustrated as follows: if a married application user has a monthly income below Rp10,000,000 and has one child (the number of user families is 3), based on fuzzy rules and decision tree, the application will recommend 1-bedroom apartment units located within a radius of 300-400 meters from the transit station. Table 6 below shows fuzzy rules recommending rented apartments in the TOD area.

Table 6 Fuzzy Rule for rent recommendation of apartment unit in TOD area

No.		Marital Status		No. of family members		Income (Rp)		Rrecommendation
1.	IF	Yes	AND	2	AND	<10 M	THEN	(000-100m 1BD)
2.	IF	Yes	AND	2	AND	10-15 M	THEN	(700-800m 2BD)
3.	IF	Yes	AND	2	AND	15-20 M	THEN	(300-400m 2BD)
4.	IF	Yes	AND	2	AND	>20 M	THEN	(100-200m 2BD)
5.	IF	Yes	AND	3	AND	<10 M	THEN	(000-100m 1BD)
6.	IF	Yes	AND	3	AND	10-15 M	THEN	(000-100m 2BD)
7.	IF	Yes	AND	3	AND	15-20 M	THEN	(100-200m 2BD)
8.	IF	Yes	AND	3	AND	>20 M	THEN	(000-100m 2BD)
9.	IF	Yes	AND	4	AND	<10 M	THEN	(300-400m 2BD)
10.	IF	Yes	AND	4	AND	10-15 M	THEN	(400-500m 2BD)
11.	IF	Yes	AND	4	AND	15-20 M	THEN	(100-200m 2BD)
12.	IF	Yes	AND	4	AND	>20 M	THEN	(000-100m 3BD)
13.	IF	Yes	AND	5	AND	<10 M	THEN	(300-400m 2BD)
14.	IF	Yes	AND	5	AND	10-15 M	THEN	(700-800m 2BD)
15.	IF	Yes	AND	5	AND	15-20 M	THEN	(400-500m 3BD)
16.	IF	Yes	AND	5	AND	>20 M	THEN	(200-300m 3BD)
17.	IF	No	AND	1	AND	<10 M	THEN	(000-100m 1BD)
18.	IF	No	AND	1	AND	10-15 M	THEN	(000-100m 2BD)
19.	IF	No	AND	1	AND	15-20 M	THEN	(300-400m 1BD)
20.	IF	No	AND	1	AND	>20 M	THEN	(000-100m 2BD)

BD, number of bedroom

Based on the figure above showing the fuzzy rules for the recommendation of apartments for rent, one of the cases can be illustrated as follows:

If an application user is married with 1 child (the number of family members is 3) and has a monthly income of Rp10,000,000–Rp15,000,000, the application based on fuzzy rules and decision tree will recommend apartment units Type B, with the specifications of the apartment unit having two bedrooms within a radius of 0–100 meters from the transit station as the center of the TOD area.

Nevertheless, several apartment types might not be included in the recommendation list based on the fuzzy logic calculations. This is a natural thing, since it could be new information that there are indeed several places/radiuses in the TOD area that are not suitable for residential development because customer preferences were not considered. For example, Table 5 has no one-bedroom apartment within a radius of 0–100 meters on the recommendation list for sell apartments. It shows that based on community preferences, it is not suitable to build an apartment/residential property within a radius of 0–100 meters from the transit station.

3.3. Mobile Application

After the ML model's recommendation system was formulated, the mobile application was developed through several stages; first, analyzing the feature requirements and second, breaking down all of these features into flowcharts and UML. Based on a benchmarking study to several similar applications that provide services that leverage the business process of property sectors in national or international regions, there are six features deemed necessary in assisting users in determining as well as marketing their TOD apartment units (Table 7). The first feature is recommending each user the right apartment unit according to their financial and demographic abilities. The second stage specified Android Studio, Java programming language, Firebase toolset, Midtrans payment service, and Heroku as the tools needed for the application development. The user interface was then designed using these tools, followed by the prototyping stage producing a mobile application mockup. The prototype was tested to improve its usability.

Table 7 Features contained in the TOD apartment sales mobile application

No.	Features	Function
1.	My preferences	Provides apartment recommendation units to the user based on economic condition and user demographics.
2.	Search My Apartment (for buying and renting)	A search engine for both sale and rented apartment units in the TOD area by utilizing Google maps powered by data on the train line and existing TOD area.
3.	My Store	Helps promote users' advertisement of apartment units for sale or rent
4.	Payment Gateway	Facilitates communication between sellers and buyers, and also facilitate buyers in paying booking fees and TOD fees.
5.	Mortgage Simulation	Provides an overview of the user regarding the estimated installments to be paid, information on the bank, and apartment mortgage services.
Profile Setting		
	Change password	Keep user's account safe by changing their passwords anytime and everywhere.
6.	Change my preferences	user update "My Preferences" questions and answers, e those answers are very dynamic and can change by time.
	Feedback and rate	A place for the user to give suggestions and critics to further improve this application.

4. Conclusions

The results of this study show that there are three main factors influencing consumers in buying or renting residential property in the TOD area: financial factors (property prices and consumers' income), property type concerning the number of people or family members occupying the property, and consumer demographics. For customers intending to buy residential properties, the order of influential factors is finance, property types, and demographics. For consumers intending to rent an apartment, the order of influential factors is property type, followed by financial and demographics factors.

Considering the high number of mobile phone users in Indonesia, a mobile phone-based application developed to serve residential property transactions for purchasing and renting, particularly in the TOD development area, is an opportunity to leverage the property business process. The mobile application proposed in this study has six main features: My Preferences, Search My Apartment, My Store, & Payment Gateway, Mortgage Simulation, and Profile Settings.

Acknowledgements

This research was supported by a research grant from the Ministry of Research and Technology/National Research and Innovation Agency, Republic of Indonesia, Contract No. NKB-2661/UN2.RST/HKP.05.00/2020.

References

- Abdullah, F., Abdurahman, A.Z.A., Hamali, J., 2011. Managing Customer Preference for the Foodservice Industry. *International Journal of Innovation, Management and Technology*, Volume 2(6), pp. 525–533
- Anastasia, N., 2015. The Rational and Irrational Factors Underlying Property Buying Behavior. *Journal of Economics and Behavioral Studies*, Volume 7(2), pp. 183–191
- Bank Indonesia, 2019. Residential Property Development Q3 2019. Divisi Statistik Sektor Rill, Departemen Statistik, Bank Indonesia. Available Online at <https://www.bi.go.id/en/publikasi/survei/harga-properti-primer/Pages/SHPR-Tw.III-2019.aspx>, Accessed on July 28, 2020
- Barajas, M., Agard, B., 2011. Selection of Products based on Customer Preferences Applying Fuzzy Logic. *International Journal for Interactive Design and Manufacturing*, Volume 5(4), pp. 235–242
- Berawi, M.A., Aprianti, L., Saroji, G., Sari, M., Miraj, P., Kim, A.A., 2020a. Land Value Capture Modeling in Residential Area using Big Data Approach Method. *Engineering Journal*, Volume 24(4), pp. 249–259
- Berawi, M.A., Leviakangas, P., Muhammad, F., Sari, M., Gunawan., Yatmo, Y.A., Suryanegara, M., 2019a. Optimizing Search and Rescue Personnel Allocation in Disaster Emergency Response using Fuzzy Logic. *International Journal of Technology*, Volume 10(7), pp. 1416–1426
- Berawi, M.A., Saroji, G., Iskandar, F.A., Ibrahim, B.E., Miraj, P., Sari, M., 2020b. Optimizing Land Use Allocation of Transit-Oriented Development (TOD) to Generate Maximum Ridership. *Sustainability*, Volume 12(9), pp. 3798–3818
- Berawi, M.A., Suwartha, N., Salsabila, F., Gunawan., Miraj, P., Woodhead, R., 2019b. Land Value Capture Modeling in Commercial and Office Areas using a Big Data Approach. *International Journal of Technology*, Volume 10(6), pp. 1150–1156
- Berawi, M.A., Wicaksono, P.L., Gunawan., Miraj, P., Rahman, H.A., 2019c. Life Cycle Cost Analysis of the Transit-Oriented Development Concept in Indonesia. *International*

- Journal of Technology*, Volume 10(6), pp. 1184–1193
- Chen, C.Y., Chen, L.C., Lin, L., 2004. Methods for Processing and Prioritizing Customer Demands in Variant Product Design. *IIE Transactions*, Volume 36(3), pp. 203–219
- Chia, J., Harun, A., Mohd Kassim, A.W., Martin, D., Kepal, N., 2016. Understanding Factors that Influence House Purchase Intention Among Consumers in Kota Kinabalu: An Application of Buyer Behavior Model Theory. *Journal of Technology Management and Business*, Volume 3(2), pp. 1–257
- Colliers, 2019. *Property Market Report | Q1 2019 Jakarta Apartment*. Available Online at <https://www2.colliers.com/en-id/research/colliers-quarterly-property-market-report-q1-2019-jakarta-apartment>, Accessed on July 29, 2020
- Demšar, J., Zupan, B., Leban, G., Curk, T., 2004. Orange: From Experimental Machine Learning to Interactive Data Mining. *Lecture Notes in Computer Science*, Volume 3202, pp. 537–539
- Földesi, P., Kóczy, L.T., Botzheim, J., 2007. Fuzzy Extension for Kano's Model using Bacterial Evolutionary Algorithm. In: ISCI'07: 3rd International Symposium on Computational Intelligence and Intelligent Informatics, pp. 147–151
- Haddad, M., Judeh, M., Haddad, S., 2011. Factors Affecting Buying Behavior of an Apartment an Empirical Investigation in Amman, Jordan. *Research Journal of Applied Sciences, Engineering and Technology*, Volume 3(3), pp. 234–239
- Hei, C.P., Dastane, O., 2017. Buying a Dream Home - Considerations of Residential Property Consumers in Malaysia. *Singaporean Journal of Business Economics and Management Studies*, Volume 5(9), pp. 19–35
- Jabareen, Y., 2005. Culture and Housing Preferences in a Developing City. *Environment and Behavior*, Volume 37(1), pp. 134–146
- Kamal, M., Pramanik, S.A., 2015. Customers' Intention towards Purchasing Apartment in Dhaka City, Bangladesh: Offering an Alternative Buying Intention Model. *Australian Journal of Business Science Design & Literature*, Volume 08(35), pp. 24–32
- Kauko, T., 2007. An Analysis of Housing Location Attributes in the Inner City of Budapest, Hungary, using Expert Judgements. *International Journal of Strategic Property Management*, Volume 11(4), pp. 209–225
- Khaled, M.C., Sultana, T., Biswas, S.K., Karan, R., 2012. Real Estate Industry in Chittagong (Bangladesh): A Survey on Customer Perception and Expectation. *Developing Country Studies*, Volume 2(2), pp. 38–45
- Koeri, R., 2016. *A Study of Factors Influencing Customer Choice Decision in Renting Apartment in Bangkok*. Master of Business Administration, Graduate Program, Bangkok University, Bangkok, Thailand. Available Online at <https://pdfs.semanticscholar.org/7841/a64e4024a0299b7dfd2ed4b3e5651785cb5b.pdf>
- Krugman, P., Wells, R., 2006. Consumer Preferences and Consumer Choice. In: *Economics*, pp. 253–280
- Kwong, C.K., Chen, Y., Bai, H., Chan, D.S.K., 2007. A Methodology of Determining Aggregated Importance of Engineering Characteristics in QFD. *Computers & Industrial Engineering*. Volume 53(4), pp. 667–679
- Manganelli, B., 2015. *Real Estate Investing: Market Analysis, Valuation Techniques, and Risk Management*. Springer
- Mu, R., de Jong, M., 2012. Establishing the Conditions for Effective Transit-Oriented Development in China: The Case of Dalian. *Journal of Transport Geography*. Volume 24, pp. 234–249
- Najib Razali, M., Abdul Rahman, R., Mohd Adnan, Y., Mohd. Yassin, A., 2014. The Impact of

- Information and Communication Technology on Retail Property in Malaysia. *Property Management*, Volume 32(3), pp. 193–212
- Opoku, R.A., Abdul-Muhmin, A.G., 2010. Housing Preferences and Attribute Importance Among Low-Income Consumers in Saudi Arabia. *Habitat International*, Volume 34(2), pp. 219–227
- Saroji, G., Berawi, M.A., Sumabrata, J., Ibrahim, B.E., Miraj, P., 2020. Creating Added Value for Urban Transit in Developing Country: A Case Study of Transit-Oriented Development Project. *Engineering Journal*, Volume 24(4), pp. 33–47
- Siswoko., 2019. Dinamika Data Aplikasi Informatika 2019 (*Dynamics of Informatics Application Data 2019*). *Hilos Tensados*, Volume 1, pp. 1–476
- Siuhi, S., Mwakalongo, J., 2016. Opportunities and Challenges of Smart Mobile Applications in Transportation. *Journal of Traffic and Transportation Engineering (English Edition)*, Volume 3(6), pp. 582–592
- Tan, T.H., Cheah, Y.Y., 2013. Locational, Neighborhood, Structural and Socio-Cultural Attributes of Housing in Homeownership Decisions. *Journal of Chemical Information and Modeling*, Volume 53(9), pp. 1689–1699
- Tangirala, S., 2020. Evaluating the Impact of GINI Index and Information Gain on Classification using Decision Tree Classifier Algorithm. *International Journal of Advanced Computer Science and Applications*, Volume 11(2), pp. 612–619
- Voicu, M.C., 2013. Characteristics of the Consumer Preferences Research Process. *Global Economic Observer*, Volume 1(1), pp. 126–134
- Xiao, Q., Tan, G.K.R., 2007. Signal Extraction with Kalman Filter: A Study of the Hong Kong Property Price Bubbles. *Urban Studies*, Volume 4(4), pp. 865–888
- Zeng, R., 2013. *Attributes Influencing Home Buyers' Purchase Decisions : A Quantitative Study of the Wuhan Residential Housing Market*. Master's Thesis, Southern cross University, Lismore, NSW
- Zhang, M., Xu, T., 2017. Uncovering the Potential for Value Capture from Rail Transit Services. *Journal of Urban Planning and Development*, Volume 143(3)