Eco. Env. & Cons. 26 (2) : 2020; pp. (747-755)
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ISSN 0971–765X

The influence of Paratransit on urban land patterns: "Becak Masin" in Padangsidimpuan City, Indonesia

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(Received 18 November, 2019; accepted 31 December, 2019)

ABSTRACT

Paratransit is an urban informal public transportation which is very responsive and fill the vulnerability of conventional public transportation services. This transportation operates in urban areas which are conventional transportation operational areas or non-conventional transportation service areas. This study aims to investigate the effect of services and characteristics of paratransit on the triggering aspects of changes in urban land patterns. The investigation was carried out with the perception data of becak masin users in the city of Padangsidimpuan. The perception of 300 users is processed using the SEM-PLS (structural equation modeling - partial least square) method. The findings show that service and characteristics of becak masin have a strong and positive effect on the use of temporal space and increasing city accessibility. Three services of becak masin that have a profound effect on changes in land use at several points in urban areas, negotiation costs for payment, able to carry goods and transportation are always available in public areas. Two characteristics of becak masin that have a profound effect on changes in the use of temporal space and increasing urban accessibility, namely, feeder transportation to reach conventional of public transportation and small transportation makes this transportation can operate in various classes of roads thereby creating new accessibility.

Key words: *Paratransit, Urban land, SEM-PLS*

Introduction

Developing counties have many types of paratransit compared to developed countries (Cervero, 2000; Cervero and Golub, 2007). Paratransit continues to growup reciprocal to the needs of urban residents. Paratransit is a very responsive urban public transport (Nguyen-Hoang and Yeung, 2010). Present paratransit is strengthening its responsiveness by involving IT in supply in transportation needs of urban residents. Information systems-based paratransit such as Gojek and Grab which operate in Southeast Asia. Developed countries like America also change jetney into robo-taxi (Cervero, 2017). This fact proves significantly that paratransit is very needed urban residents (Finn, 2012).

Urban land is a paratransit operational space. The operation creates a network of origin / destintion pathways that connect urban spatial (Eboli *et al.*, 2012; Tsai *et al.*, 2012; Yang and Gakenheimer, 2007). Urban land is also needed to support transportation operations area such as parking lots, waiting for passengers and a nother activities (Harding *et al.*, 2013). The relationship directly and indirectly affect the pattern of urban land use. The change in urban land use does not occur all

at once, but changes and develops dynamically and reciprocal with the increase in urban resident (Black, 2018; Buchori *et al.,* 2017).

The study of paratransit began in 1974 (Lave and Mathias, 2009), has been carried out for approximately 45 years. Paratransit research is among carried out on the supply, demand, constraints, advantages, to reducing the use of paratransit. This decade paratransit research analyzed many of the links between paratransit to population travel, services, urban accessibility, costs, disability and the environment. Research on the influence of paratransit on urban land which is a space for movement is very minimal, mostly only concerning land use. Land use is still general, while the linkages and their effects need to be investigated in depth for the planning and design of urban transportation, especially urban public transport (Peng and Lu, 2007; Yang and Gakenheimer, 2007). Research on changes in urban land uses has been carried out and resulting in several variable findings that can affect land patterns.

This gap needs to be studied to analyze the effect of paratransit on variables that affect urban land patterns. In this study, it will show whether paratransit has a positive effect on these variables. The operational findings of the becak masin provide information on the services and characteristics needed by urban residents and gaves for the government the consideration on the development of urban areas.

Padangsidimpuan City is a small city in North Sumatra province that has two types of urban public transportation. The conventional transportation of this city is angkot (urban transportation) and the paratransit is becak masin. Angkot is a mini-bus that has a special route based on the Decree of the Mayor of Padangsidimpuan. Angkot has 17 routes, with details of 5 routes not operating. Urban areas that are not served by angkot reach 27.7% and there are still many potential routes that have not been served (Lubis and Buchori, 2016). Becak masin is driven by an old Vespa. The size of this mode is small and simple. All urban locations can be reached by this transportation. The mode capacity can accommodate two passengers and goods (Lubis, 2015). This year began to emerge information-based motorbike transportation similar to a Gojek or Grap but did not use a special application and did not yet have a legal entity.

Fig. 1. Public Transportation of Padangsidimpuan City

Materials and Methods

Paratransit Services and Characteristics

Paratransit is an urban passenger transportation provided by non-government. This transportation is very different from conventional transportation (angkot, BRT and railroad and so on). This paratransit can operate in conventional transport lines and road other classes such as arterial, collective and local roads (Cervero and Golub, 2007). Paratransit is a responsive demand transport, with operational patterns, (a) Many-to-one, raising passengers from any place to one place, (b) Many-to-few, raising passengers from any place to a certain place (downtown, markets, hospitals, schools and so on) and (c) Many-to-many, raising passengers from any place and dropping passengers at any place (Lave and Mathias, 2009).

Some previous studies describe some typical paratransit services, namely, (a) baggage services, passengers are free to carry luggage and get help from operator (Grieco *et al.,* 1995), (b) direct service (door to door), passengers are delivered directly to the final place (Cervero and Golub, 2007; Lubis, 2015), (c) negotiation services, transportation costs are relatively elastic depending on negotiations with transport operators (Cervero and Golub, 2007; Hoang and Yeung, 2010; Lubis, 2015), (d) fast service, the required travel time is relatively faster than conventional transportation (Cervero and Golub, 2007; Lubis, 2015; Valenzuela *et al.,* 2005), (e) explores urban area, the ability to explore urban areas and remote areas of urban (Finn, 2012; Lubis, 2015), (f) availability services, transportation is always available especially in the urban public areas (Finn, 2012; Guillen and Ishida, 2004; Lubis, 2015), (g) non-route services, transportation does not have a fixed route (Cervero, 2000; Finn, 2012; Lubis, 2015), (h) operational services, non-stop transportation operations for 24 hours (Lubis, 2015).

The results of previous studies indicate that the characteristics of paratransit in its operations are, (a)

luxury transportation, public transportation services intended for residents of the weak economy of the city (Al-Hasan *et al.,* 2015; Cervero and Golub, 2007; Joshi, 2014), (b) transportation small mode, the dimensions of transportation are smaller than conventional transport (Cervero, 2000; Cervero and Golub, 2007; Hoang and Yeung, 2010; Lubis, 2015), (c) low operator resources, low operator education and expertise or new arrivals from villages (Cervero, 2000; Cervero and Golub, 2007), (d) fillers of conventional transportation scarcity, paratransit is a substitute for conventional transportation for underserved areas (Cervero and Golub, 2007; Finn, 2012; Grieco *et al.,* 1995), (e) feeder transportation, transport operating in residential areas as feeder to obtain conventional transportation (Cervero, 2000; Finn, 2012; Guillen and Ishida, 2004; Valenzuela *et al.,* 2005).

Development of Urban Land

The city is a collection of places to live, work, and other activities. The increase in the population of the city has resulted in an increase in the need for land for shelter and activities. City development is not something that is static because it has a causal relationship with the lives of the people who live in it (Roorda and Ruiz, 2008). The development of the city is reciprocal dynamic, the interaction of urban residents with the surrounding environment and the development of urban facilities and infrastructure. The city's land development expands horizontally and vertically and can be observed based on the physical and administrative consequences of the spatial (Morency *et al.,* 2011; Roorda *et al.,* 2010; Roorda and Ruiz, 2008).

Several studies suggest that changes in urban land use are influenced by variables, (a) number of population, increasing urban population resulting in increased urban land use (Bento *et al.,* 2005; Linard *et al.,* 2013; Naess, 2004), (b) urban population mobility, increasing number of urban population travel with various travel destinations will result in urban land expansion (Bento *et al.,* 2005; Roorda and Ruiz, 2008; Wunas and Natalia, 2011), (c) temporal space use, the effect of temporal and continuous use of space affects the surrounding space (Aljoufie *et al.,* 2013; Eboli *et al.,* 2012; Harding *et al.,* 2013), (d) construction of facilities and infrastructure, development urban facilities and infrastructures require relatively extensive land and have an impact on the surrounding land (Naess, 2004; Won and Kim, 2017), (e) the changes economic value of land, land that is traversed by the transportation network or affordable by public transport will have an impact on the increase in economic value of a land (Eboli *et al.,* 2012; Ilnytskyi *et al.,* 2016), (f) urban accessibility, the increasing number of accessibility can be increasing travel urban residents go to any place, results in greater opportunities for changes in urban land use (Eboli *et al.,* 2012; Linard *et al.,* 2013; Tsai *et al.,* 2012).

SEM-PLS (Structural Equation Modeling - Partial Least Square)

SEM-PLS is a multivariate analysis method technique. Multivariate analysis is an applied science that continues to develop and has many conveniences. The method is a combination of several statistical analyzes such as path analysis, factor analysis, regression analysis which is operated at once and in more detail. Researchers are challenged to conduct research with increasingly complex and more detailed models of the variables studied (Hair *et al.,* 2014). Multivariate analysis can analyze several variables in testing the relationship of one or more hypotheses. Tests carried out simultaneously to produce a new finding or recommendation that can be used in decision making (Hair *et al.,* 2014). Causal relationships between variables are shown by three phenomena, namely, (1) Having a covariant value, the value of the independent variable and the value of the dependent variable, (2) Changing the value of the independent variable earlier than the value of the dependent variable, (3) Dynamic changes of other variables at the same observation cause changes in the quality of validation (Hair et al, 2014).

SEM-PLS processing has two evaluations before analyzing the results of processing namely, (a) evaluating the outer model, filtering indicators with certain rules to get valid, reliable and significant indicators, (b) evaluating the inner model, namely evaluating the path between constructs so that it is obtained significant path. This stage is done if the outer model evaluation is complete. After the evaluation, an analysis of the final evaluation results was continued (Ghozali, 2006; Hair *et al.,* 2014). The evaluation process in the SmartPLS software is known as Algorithm (coefficient of loading, path, R^2, f^2) and Bootstraping (significance of indicators and constructs), while predictive relevance analysis uses Blinkfolding (Q^2 and q^2).

Research Method

This research is exploratory testing of variables and indicators of becak masin and variables that affect urban land patterns. The research data is the perception of becak masin users with a total of 300 respondents. This perception data were collected through the filling of closed questionnaires distributed proportionally in the three sub-districts of Padangsidimpuan. Processing data using multivariate analysis, with SEM-PLS (structural equation modeling - partial least square) method. Data processing using Microsoft Office Excel 2007 and Smart PLS v.3.2.8 Professional paid software. The rule of thumb used in this study refers to the type of predictive exploratory research. The rule of thumb used is, (1) minimum loading coefficient of 0.4, (2) mini-

Table 1. Variables and Indicators of Urban and Land Patterns

Latent Variable	Code	Indicator Reflective/Formative Model	Code
Service of Becak Masin	LBM	• Baggage services	L01
		• Direct service	L02
		• Negotiation services	L03
		• Fast service	L04
		• Explores urban area	L05
		• Availablility services	L06
		• Non-route services	L07
		• Operational services	L08
Characteristics of Becak Masin	KBM	• Luxury transportation	K01
		• Transportation small mode	K02
		• Low operator resources	K03
		• Fillers of conventional transportation scarcity	K04
		• Feeder transportation	K05
City Population	SK01	• Development and population density require shelter and land to work	S01
		• Becak masin is the right choice for travel in city	S02
Mobility of City	SK02	• Residents' travel activities increase urban land use	S03
		• Becak masin became a pioneer to make path to be the highway	S04
Temporal Space	SK03	• Becak masin use space and land in temporary operations such as parking, bases, repairs and so on	S05
		• The establishment of the building is temporary as a supporter of becak masin travel and operational activities, for example, stalls and transit places	S06
Facilities and Infrastructure	SK04	• The construction of public buildings uses vacant land and is in suburban areas and requires land and space	S07
		• Becak masin play a role in the process of building public buildings	S08
Land Value	SK05	• Empty areas that are touched by the public transport network will increase the economic value of land so that land conversion will be faster	S09
		• Becak masin is the first reference for transportation that touches empty land	S10
Accesibility	SK06	• The increased accessibility of cities causes the distribution of travel to increase and spread	S11
		• Becak masin is a pioneer in finding roads/shortcuts in the city	S12

mum reliability test of 0.7, (3) and a maximum collinearity test of 5.0. Significance used is the 95% confidence level, with t-value ≥ 1.96 and p-value ≤ 0.005 (Ghozali and Latan, 2015; Santosa, 2018; Sholihin and Ratmana, 2013).

The research diagram needed for the logical process of testing and describing the stages of testing. The test diagram model is illustrated in Figure 2 below.

Figure 2, shows that in the testing process this influence uses 20 hypotheses with details of 8 hypotheses/direct influence and 12 hypotheses/indirect effects.

Variables and indicators taken from previous studies are explained in Table 2 below. The table explains the use of variable codes and indicators that will be used in the effect test model.

Results and Discussion

The results of this test produce a structural model that has been validated by the convergent test, discriminant test, reliability test, collinearity test, and significance test, as shown in Figure 3.

Service of Becak Masin

Base on previous research all indicator of The becak

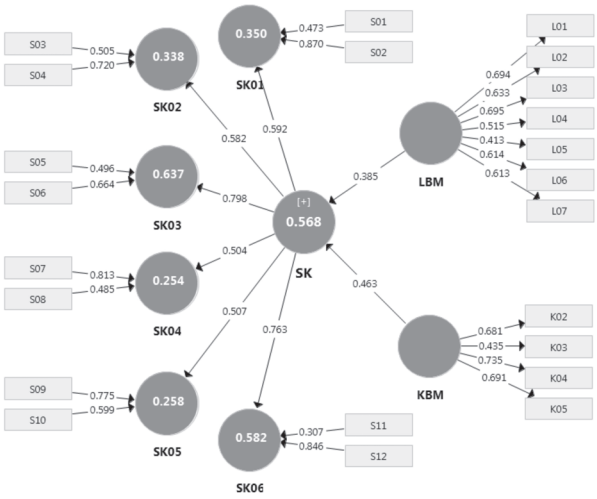

Fig. 3. Testing Model Results

Table 2. Hypothesis/Influence of Research Model Pathways

Construct Path	Path / Hypothesis		Significance		Influence
	h value	comment	t value	p value	(%)
KBM —> SK	0,463	strong	10,279	0,000	31,72%
LBM —> SK	0,385	strong	8,299	0,000	25,08%
SK —> SK01	0,592	strong	11,684	0,000	35,03%
SK —> SK02	0,582	strong	11,476	0,000	33,83%
SK —> SK03	0,798	strong	37,816	0,000	63,65%
SK —> SK04	0,504	strong	8,196	0,000	25,43%
SK —> SK05	0,507	strong	8,556	0,000	25,75%
SK —> SK06	0,763	strong	23,335	0,000	58,22%

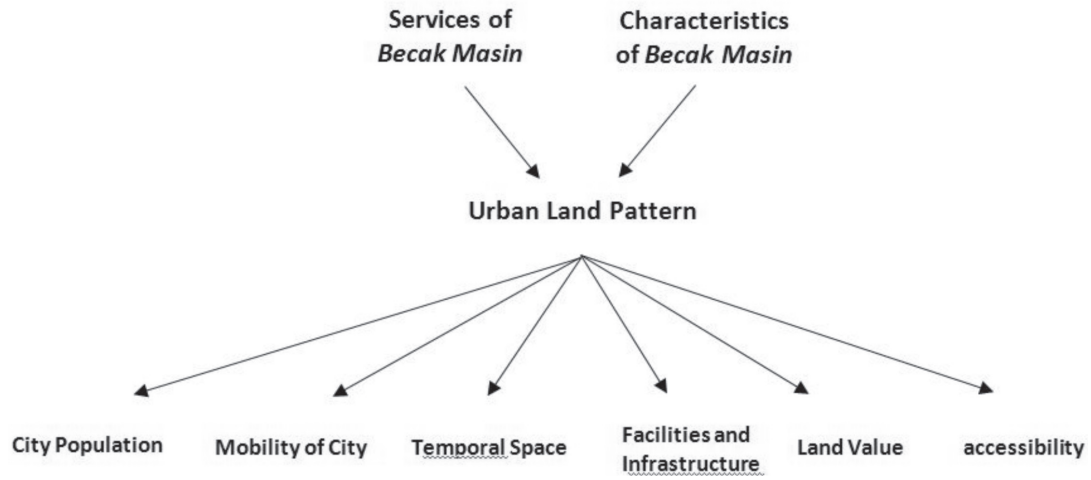

Fig. 2. Hypothesis Model of the Effect of *Becak Masin* on Urban Land Patterns

masin service has been proven to be valid in Padangsidimpuan city, but the analysis results found that the 24-hour operational becak masin service is not valid and not significant. The reason is the number of personal vehicles such as motorbikes already owned by each household, the population and type of work in this city are still relatively low. Research that says L08 (24-hour paratransit operations) is due to the ownership of private vehicles is still low (Lubis, 2015). The most popular services for the city population are becak masin that can deliver directly to the final destination, can transport luggage and the costs can be negotiated. This finding is proven by the results of the outer model evaluation which shows the highest loading coefficient and a highly significant value compared to the others. These results corroborate the findings which state that female traders in the city of Accra, Ghana chose paratransit. The reason for choosing paratransit is because conventional transportation cannot carry baggage and not directly to the market location to unload luggage (Grieco *et al.,* 1995).

Characteristic of Becak Masin

Becak masin is not the transportation of choice or luxury transportation in the city of Padangsidimpuan, because all social layers of the population have used it. This is evident in the results of the questionnaire respondents said 99.7% had used it. The results of the evaluation of the outer model of the becak masin states that the loading coefficient of K01 (luxury transportation for low-income residents) is negative and the probability value does not meet the basic conditions so that K01 is considered invalid. Not reliable and insignificant. This finding contradicts the findings which state that paratransit is a luxury transportation of low-income population that occurs in the cities of Brazil and Ahmedabad India (Golub, 2003; Joshi, 2014; Kumar *et al.,* 2016). Mainly are used in areas not served by angkot or to get angkot services. The user always uses the becak masin because his house is located in an alley that can only be entered into a becak. This is evidenced by the results of the outer evaluation of the characteristics of the with the biggest positive coefficient and compared to the others. This characteristic finding supports the results of research which says that paratransit is a new paradigm about public transportation because it can answer various types of urban population needs that are not served by conventional public transport (Cervero and Golub, 2007; Finn, 2012).

Urban Land use Pattern

Factors affecting urban land patterns based on the results of previous studies are proven. This fact is often found along with the development of the city that extends towards the city limits. The most common factor is the construction of urban infrastructure in agricultural land or vacant land resulting in the development of the function changes around. This fact is proven by the results of evaluating temporal space use variables that show positive and significant path coefficients. This corroborates the results of research which states that infrastructure development in Saudi Arabia exerts changes in land use during the development process and influences the surrounding land (Aljoufie *et al.,* 2011). The fact that the shortest operational route of the is followed by private transportation so that it becomes a collector's road is the accessibility of the city. This evidence is supported by the results of the evaluation of variables increasing city accessibility that show positive and significant construct path coeffi-

Table 4. Effects of Determinant (f^2) and Effects Predictive Relevance (q^2)

Construct	Effects of Determinant			
	LBM		KBM	
SK03	0.054	moderate/positive	0.010	small/positive
SK06	-0.040	moderate/negative	0.055	moderate/positive

Construct	Effects Predictive Relevance			
	LBM		KBM	
SK03	0.025	moderate/positive	0.005	small/positive
SK06	-0.015	small/negative	0.019	small/positive

cients. This finding supports the finding that the relationship between the interaction of the travel demand of the population with the characteristics of land use results in a space in the form of accessibility to a place that is mostly done by the population (Tsai *et al.,* 2012).

Relationship analysis or hypotheses which are the objectives of this study (Figure 3) all produce positive path relationships with significant results (Table 2).

In general, the characteristics of becak masin have a strong positive influence on urban land patterns. This data is proven by the number of trips that city residents use for this transportation due to the advantages of its characteristics that are not owned by angkot, which are small modes that can enter small roads/alleys, angkot vacancy fillers and feeders to be able to use angkot services. This evidence supports the finding that paratransit is a feeder, a conventional transportation gap filler and has many advantages (Cervero and Golub, 2007; Finn, 2012).

Table 4 provides information that services (LBM) and Characteristics (KBM) have the strongest effect on variables SK03 (temporal land use) and SK06 (paratransit increases urban accessibility). LBM has a moderate effect on SK03 and SK06 but SK06 is negative or not in the same direction. The effects on SK03 and SK06 are the same both based on their regression effect and predictive relevance. This evidence clarifies the influence of LBM that is focused or more dominant on temporal land use caused by the process of activities such as the construction of roads and public buildings, the process of transportation activities (passenger interaction with transportation) and the effect of activities around the land (Aljoufie *et al.,* 2011; Tsai *et al.,* 2012).

KBM provides the same positive effect based on regression and predictive relevance on SK03 and SK06. These results explain the characteristics of the becak very important in the process of land change caused by processes or activities that are temporary such as the construction process or transportation activities during the daytime. The characteristics of the becak masin also play an important role in increasing the accessibility of the city, namely, the mode of small becak masin, filling the scarcity of conventional transportation and being a feeder transportation to get conventional public transportation services.

Conclusion

LBM (becak service) and KBM (characteristic of becak masin) have a big influence on urban land patterns. The becak masin service has a strong and positive effect on the use of temporal space. Cost negotiation services, being able to carry luggage and are available in public areas have an impact on changes in land use at several points in urban areas. The characteristics have a strong and positive influence on the use of temporal space and accessibility. Substitute characteristics, angkot feeders, and small transports give the effect of becak masin creating new accessibility.

Acknowledgments

The researcher would like to thank the respondents either residents or operators of the becak masin who gave their perception as users and drivers of the drivers. The survey team and interview team have contributed.

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