



Paper 83

Selecting Potential Location to Integrate Shuttle Bus as Public Transportation in Jakarta Suburban Area Using Analytical Hierarchy Process (Study Case: JakLingko Indonesia)

Annisa Fitri Febrianti and Yos Sunitiyoso

ICMEM

The 7th International Conference on Management in Emerging Markets

Abstract – JakLingko Indonesia provided integration of public transportation in Jakarta and its tariff, would expand the business to cover public transportation integration in a sub-urban area. The aim of this research is to determine the prioritization of potential locations to integrate shuttle buses as public transportation in suburban areas based on stakeholders' preferences. AHP method is used to analyze the data to get the location prioritization. The data was obtained by using qualitative and quantitative data. To develop the AHP hierarchy structure, data was gathered from interviews with stakeholders, brainstorming, and literature review, then the questionnaire to know the preferences of the stakeholders. There are four criteria and ten sub-criteria obtained. The criteria are socio-demographic, financial, demand pattern, and distance. While the sub-criteria obtained are age, population, income, profit sharing, investment cost, activities, vehicle ownership, origin to destination, origin to the closest station, and commuting expenses. AHP hierarchy structure was tested with four alternative locations which are Bekasi City, Depok, Tangerang Regency, and Bogor Regency. The result of the calculation is Depok has the highest score among others.

Keywords – AHP, Decision Making, Integration, JakLingko Indonesia, Potential Location, Public Transportation

I. INTRODUCTION

JakLingko is a company that handles and provides integrated public transportation and its payment method in the Jakarta area. Nowadays, public transportation in Jakarta is used by most people in their daily life. The integration payment method aims to make the fare cheaper and covers all of society. The initiative required a combination of all public transportation in Jakarta such as MRT, LRT, KCI, TransJakarta, and MikroTrans. Reference [6] shows, that to increase the number of usages of public transportation, the service of public transportation should be designed to accommodate the level of service required by the customer so it will be attracted, potential users. Integrating public transportation and tariff is one of the services of public transportation which will provide for people's needs especially those who live in suburban areas.

The number of commute people in Jakarta is high and everyday people did mobilization. As in [2], the number of

commuting people in DKI Jakarta is 1,253,771 people from the surrounding city which are Bogor Regency, Bogor City, Depok, Tangerang Regency, Tangerang City, Tangerang Selatan, Bekasi Regency, and Bekasi City. The highest number of activities is from Depok with 296,488 people and Bekasi City with 277,234 people. Since the residents in the buffer zone are far from public transportation, the behavior of people is tended to use a private car which brings the traffic problem. Also, the private-public transportation shuttle bus is costly for some people. The availability and accessible public transportation facilities become a consideration in choosing a property. Moreover, the tariff and the convenience of public transportation is the important factors to determine the usage of public transport. The integrated tariff and public transportation will be made users efficient in time and cost. Reference [5] shows that the integrated public transportation model would save time and money for the users, and also increase the incomes of bus providers and private public transport operators. Most of the people who live in the BODETABEK area are working in Jakarta, and the numbers of workers have pointed out the importance of public transport in their daily commute. To increase the quality of mobility and accessibility of the BODETABEK area, the integration of public transportation is needed. Integration of public transportation will reduce the number of traffic jams and make add value to the area which is more accessible.

Most of the residents in the buffer zone of Jakarta are provided with a shuttle bus since the distance from the residence to the public transport is far, but the shuttle bus usually charges a high price. Looking at the current situation, the users have a limited choice to use public transportation. The need for public transportation is tended to be high since most Jakarta workers live in the buffer zone of Jakarta. As in [1], the number of Jakarta residents who live near transit terminals is only 44%, while the number of suburban residents is lower which is only 16%. Public transport which indeed supports seamless multi-destination travel will attract a higher volume of passengers. The location of the residents will be more attractive with the development of a strong public transportation corridor, especially with the integration of public transportation and tariff. Reference [4] shows that, the strong public transportation corridor will reduce the random travel patterns since the development of the housing will be concentrated along the corridors.

Currently, JakLingko integrating all public transportation and the tariffs in DKI Jakarta and the payment will become seamless. Reference [3] shows, that the passengers are allowed to use several public transportations by implementing an integration tariff system. The passengers could buy the ticket based on their preferences in choosing the public transportation modes. JakLingko application system provides several price ranges, from the economic route which provides cheaper prices, and the fastest route usually more expensive. The focus of this research is knowing and determining the potential location for JakLingko Indonesia to expand its business by integrating public transportation, especially shuttle buses to provide integrating public transportation journeys by capturing the buffer zone with most Jakarta workers living in an already facilitated by shuttle bus in each location. Also, knowing the stakeholders' preferences and their consideration in selecting the priority location to integrate the shuttle bus since they are the decision maker. The decision-making method selects the right potential location for JakLingko to expand the business is needed since it would give benefit both parties. JakLingko's purpose is to make the payment seamlessly and efficiently to users and provide all users' needs related to payment.

II. METHODOLOGY

The methodology used to formulate the decision of business expansion of the company is using Analytical Hierarchy Process (AHP) to support the prior analysis. Analytical Hierarchy Process could address the potential location to integrate shuttle buses as public transportation for JakLingko Indonesia to expand the business. AHP method would be more detailed, measurable, and scientific since most of the data is combining the input, opinion, and judgment from the stakeholders related. Moreover, the AHP method is usually used to make prioritization the alternative which required a complex decision maker and simplifies the decision. Therefore, alternative priorities can be determined.

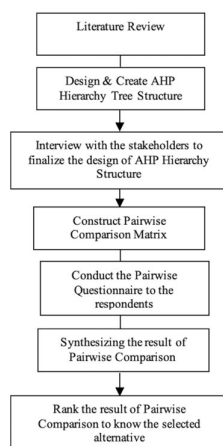


Fig. 1. Conceptual Framework of Decision-Making Process

Table 1 - Modification Scale of Intensity of Importance

Intensity of Importance	Definition	Explanation	Modification on Likert Scale
1	Equal Importance	Contribute equally to the objective	5 on Likert scale 4 if left criterion is moderate importance than the right criterion
3	Moderate Importance	One criterion over another is slightly favor	6 if right criterion is moderate importance than the left criterion 3 if left criterion is strong importance than the right criterion
5	Strong Importance	One criterion over another is strongly favor	7 if the right criterion is strong importance than the left criterion 2 if left criterion is very strong importance than the right criterion
7	Very Strong Importance	One criterion is favored very strongly over another	8 if right criterion is very strong importance than the right criterion 1 if left criterion is extreme importance than the right criterion
9	Extreme Importance	One criterion favoring one criterion over another is the highest possible order of affirmation	9 if right criterion is extreme importance than the right criterion

As in Fig. 1 is the framework of the decision-making process. The calculation of the AHP method can be done by determining the criteria and sub-criteria developed through the interview with the stakeholder, then questionnaire to the respondents to get the preferences from the respondents to know the priority judgment in pairwise comparison. The respondents in this research are the stakeholder from the company that has deeply understood the whole business in the company. Furthermore, the interviewees in this research as the decision maker which determine the continuity of the business expansion. The respondents are the director, head of the corporate strategy, and head of the business strategy and development. The interview and filling out the questionnaire have been done in an online session. Due to the online session in filling out the questionnaire, the pairwise comparison is using google form and the Likert Scale.

Since the pairwise comparison did in the online form and the Likert scale was divided into two criteria as a comparison, the even number on the scale is not used. The results of the pairwise comparison were calculated by the AHP calculation excel template from bpmmsg.com developed by Klaus D Geopel. The data analyzed was used to know the consistency and the weight of each criterion and sub-criteria. The quantitative data from the literature is normalized to be able to calculate using the AHP

method. Then, the results of the calculation were tested with the alternative location to get the place prioritization.

III. RESULTS

The data that has been collected from the brainstorming, interview, and literature review were used for determining the criteria and sub-criteria in the AHP structure model. As in table 2, the criteria that have been determined are socio-demographic, financial, demand pattern, and distance. In determining the sub-criteria, the authors get the sub-criteria that has similarities with each other. The sub-criteria determined are age, population, income, profit sharing, investment cost, activities, vehicle ownership, origin to destination, origin to the closest station, and commuting expenses.

As in Fig. 2, the criteria and sub-criteria were determined from interviews with the stakeholders, brainstorming, and literature review, then the AHP hierarchy structure was made. The alternative potential location was mapping and chosen from the route of the shuttle bus that has been operated around the Jabodetabek area. This is meant to make the partnership between stakeholders. The alternative locations are Bekasi City, Depok, Tangerang Regency, and Bogor Regency, which have a high number of people commuting.

Table 2 - Criteria and Sub-Criteria Description

Criteria	Sub Criteria	Description
Socio Demographic	Age	Usually, the productive age commutes more in their daily and affect the activity.
	Population	The population in an area, could determine the demand of public transport itself.
	Income	Determine the preferences of public transport used and knowing the people preferences whether using public transport or private transport.
Financial	Profit Sharing	The profit sharing between JakLingko and the business partner like operator and developer will be the consideration, since it is business to business partnership.
	Investment Cost	The investment cost needs to be considered since it needs some installation infrastructure in a shuttle bus.
	Activities	Know the journey pattern of each people and the transportation they used.
Demand Pattern	Vehicle Ownership	Knowing the proportion estimation between people who used private vehicles every day and used public transport as daily transportation
	Origin to Destination	Knowing the preferences of people to use public transport directly. Also, knowing the proportion in an area that used shuttle bus directly to their destination.
	Origin to Closest Station	Sizing the number of people who commute every day and do

Distance

Commuting Expenses

transit. Also, comparing people's preferences whether using shuttle bus direct to their destination or for transit.
Commuting Expenses in each area is considered to measure the ability and preferences of people in each area.

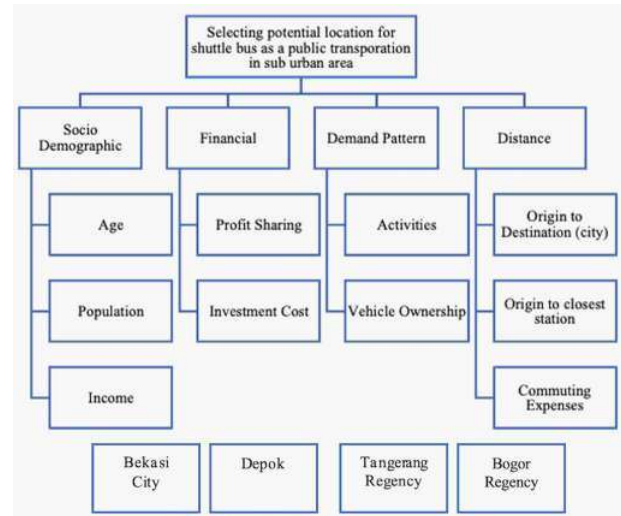


Fig2 AHP Structure for Select Potential Location

As in table 3, the result of the calculation has been collected. The interview that has been conducted to finalize the criteria and sub-criteria is continued with the pairwise comparison in each criterion and sub-criteria resulting in the weight of each criterion and sub-criteria to know the prioritization. Then, the global weight of each criterion will be gotten by calculating the local of each sub-criteria and multiplying the weight of the main criteria.

Table 3 - The Weight of The Main Criteria and Sub-Criteria

Object ive	Criteria	Local Weigh t	Sub Criteria	Local Weigh t	Global Weight	Rank
Select and determine the potential location for shuttle bus as a public transportation in sub urban area.	Socio Demographic	10,1%	Age	20,90 %	2,11%	10
			Population	41,10 %	4,15%	6
			Income	38,10 %	3,85%	7
	Financial	28,1%	Profit Sharing	12,8%	3,60%	8
			Investment Cost	87,20 %	24,5%	2
			Activities	90%	38,25%	1
	Demand Pattern	42,5%	Vehicle Ownership	10%	4,25%	5
			Origin to Destination	50,5%	9,70%	3
			Origin to Closest Station	32,7%	6,28%	4
	Distance	19,2%	Commuting Expenses	16,8%	3,23%	9

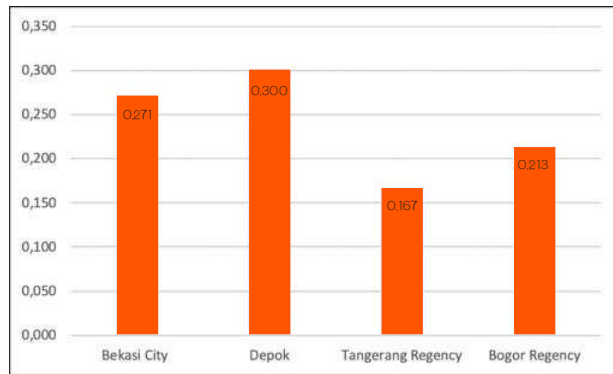


Fig 3. The Total Score of Alternative Location

As in table 3, the highest value gets from the calculation for the criteria is the demand pattern which has a local weight is 42,5%. The second criteria are financial with a local weight of 28,1%, followed by distance with 19,2%, and socio-demographic 10,1%. While the highest global weight of the sub-criteria is an activity with a total global weight of 38,25%, then the sub-criteria investment cost with a total global weight of 24,5%, followed by sub-criteria origin to destination with 9,7% and origin to the closest station with total global weight 6,28%.

The score of the alternative location getting from normalization data in each sub-criteria multiply by the global weight in each sub-criterion. As in Fig 3, Depok has the highest score as the priority alternative to selecting a potential location for a shuttle bus as a public transportation in a suburban area with a total score of 0,3. Then, Bekasi City with a total score of 0,271. Followed by Bogor Regency with a total score of 0,213 and Tangerang Regency with a total weight of 0,167.

IV. DISCUSSION

Analytical Hierarchy Process analysis can be used to determine and select the potential location for JakLingko Indonesia to expand the business of integrating public transport like shuttle buses. To continue the selection of potential locations and the possibility of changing the structure and sub-criteria in the AHP tree, JakLingko Indonesia management could execute some processes similar to the analysis process before. Currently, JakLingko Indonesia wants to cover all areas by integrating public transportation, including shuttle buses. AHP analysis could help the company to determine the priority alternative, in this case, selecting a potential location to be integrated with a shuttle bus as a public transportation and covered suburban area of Jakarta.

Of all the criteria, the highest value is the demand pattern and the lowest value is socio-demographic. In this case, the demand pattern means the journey pattern in each

user in daily mobilization, and socio-demographic is the characteristic of the population in an area. This result means that the most important criterion from the stakeholder to integrate shuttle buses is the journey pattern of each user in an area instead of the characteristic of the population in the area. The demand pattern criteria also could determine the demand for the integrating shuttle bus. From the data calculation, results obtained for the priority location to integrate shuttle buses as public transportation from sub-urban to Jakarta City is Depok.

V. CONCLUSION

AHP tree model used for analyzing the priority of potential location in integrating shuttle buses as public transportation is determined from the stakeholders' interview and literature review. The criteria and sub-criteria that developed from the interview and literature review consist of four criteria which are socio-demographic, financial, demand pattern, and distance. Each criterion also consists of sub-criteria to analyze the alternative. The sub-criteria socio-demographic consists of age, population, and income. The sub-criteria financial consist of profit sharing and investment cost. The criteria demand pattern consists of activities and vehicle ownership. The last criteria are distance which consists of origin to destination, origin to the closest station, and commuting expenses.

After getting the AHP tree structure model, the author created the questionnaire to get the preferences of each respondent about each criteria weight. The questionnaire form used the google form since it is convenient and more familiar to the respondents. After getting the results, the data were analyzed by the AHP calculation excel template from bpmmsg.com developed by Klaus D Geopel. The data analyzed was used to know the consistency and get the weight of each criterion and sub-criteria. Then, the criteria and sub-criteria are tested with the alternative location to know the priority of the potential location. The result of the priority is Depok, Bekasi City, Bogor Regency, and Tangerang Regency. Depok has the highest value to be the first prioritization location for integration, it is also similar to the number of activity data in which Depok has the highest number of activities among other areas. Besides that, there are criteria that become the consideration for the stakeholders in selecting the integrating area. The most considered criteria is the demand pattern, which means the journey pattern of the users in their daily commute.

ACKNOWLEDGMENT

The author is thankful, for having Mr. Yos Sunitiyoso as an advisor who is willing to guide the author from the beginning until finishing the research.

REFERENCES

1. Adriana, M. C., Samadhi, N., Wihanesta, R and Asokawati, A. "Integrating Public Transport Networks to Overcome Jakarta Traffic Congestion". 2018 <https://wri-indonesia.org/en/blog/integrating-public-transport-networks-overcome-jakarta-traffic-congestion> [Accessed: April 2022]
2. Central Bureau Survey. "Statistik Komuter Jabodetabek Hasil Survei Komuter Jabodetabek 2019". 2019. Subdirektorat Statistik Mobilitas Penduduk dan Tenaga Kerja.
3. Hulu, K.G.A and Kusuma, A. "Analysis of Tariff Integration Between MRT and Transjakarta. 2nd International Symposium on Transportation Studies in Developing Countries (ISTSDC 2019)". 2019.
4. Japan International Cooperation Agency (JICA). "Development Goals and Strategies". 2022. https://openjicareport.jica.go.jp/pdf/12079000_03.pdf [Accessed on March 2022]
5. Narain, K., Munshi, S., Shivangi., Swarup, T., Kumari, S., Engineer, S., Agarwal, P., Mathew, M., Gupta, M. "Management Solution for Improved Service Operation". 2019. Faculty of Management, CEPT University.
6. Susilo, Y. O and Joewono, T. B. "An Exploration of Public Transportation Users' Attitude and Preferences towards Various Policies in Indonesia: Some Preliminary Results" 2010. Journal of the Eastern Asia Society for Transportation Studies.