The Need For Integrated Intermodal Facilities at Rangkasbitung Station

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Abstract. Rangkasbitung Station is a large class station that serves the departure of the Tanah Abang-Rangkasbitung (PP) Electric Rail Train and the Rangkasbitung-Merak (PP) Local Train. At this station, intermodal integration facilities are not yet available to support access that makes it easier for passengers to go to the next mode. This study aims to identify the suitability and needs of intermodal integration facilities with 6 indicators of intermodal infrastructure integration, and make recommendations for the development of intermodal integration facilities. This research used purposive sampling to determine the number of sources, then used the triangulation technique method to ensure the validity or correctness of the data obtained through observation, interviews, and documentation. Method Analytical Hierarchy Process (AHP) is used for ranking intermodal integration facilities which will be developed first at Rangkasbitung Station. The results of this study are the proposed development of intermodal integration facilities, namely the 1st rank for pedestrian facilities with a total value of 2.281, the 2nd rank for crossing facilities with a value of 1.388, and the 3rd rank for drop off facilities with a value of 0.327.

Keywords: Intermodal Integration, Facilities, Stations, Analytical Hierarchy Process (AHP).

1. Introduction

The operation of intermodal transportation involves two or more different modes as part of the entire transportation process, including information exchange, connectivity and coordination [1]. Intermodal integration facilitates accessibility and convenience for passengers to travel from one place to another in more than one mode [2]. The train station is a node that combines the railroad network with other modes of transportation. Railway stations play a very important role as a place for changing modes so that integrated infrastructure networks, integrated services, and integrated supporting facilities are needed. Rangkasbitung Station is only served by advanced modes of transportation, including rural transportation, damri, conventional and motorcycle taxis online. The station does not yet have an intermodal integration facility that facilitates

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the accessibility of passengers who will or have used the train mode. The available advanced modes of transportation still stop haphazardly around the station because drop off facilities are not yet available. The unavailability of pedestrian facilities and crossing facilities that directly connect the entrance and exit of the station with access across the road so that there is no contact between pedestrians and motorized vehicles which can reduce the safety and security of passengers. From these problems this study aims to identify the suitability of intermodal integration facilities with 6 indicators of intermodal integration infrastructure and examine the proposed needs for intermodal integration facilities developed at Rangkasbitung Station based on ranking with Analytical Hierarchy Process (AHP).

Fig. 1. The Rangkasbitung Station area where intermodal integration facilities are not yet available

2. Research Method

2.1 Intermodal Integration Facility

Integrated facilities can be realized by getting closer and building facilities that connect the two modes of transportation. Based on the book Faces of Passenger Intermodal Transportation, that there are 6 indicators of integration of intermodal infrastructure, including [3]:

1. Proximity is the level of performance when using the service transfer including distance between facilities, travel time and travel efficiency.
2. Connectivity is the degree to which facilities are connected to each other through well-designed pedestrian paths that allow pedestrians to pass through the area easily, safely and comfortably.
3. Convenience is the availability of easy access to information for pedestrians and users, including persons with disabilities.
4. Safety is the level of mobility to ensure the safety of its users. This includes the physical condition of the road space, fences, and activities that can hinder the movement of pedestrians to avoid conflicts between pedestrians and vehicles.
5. Security is the ability of a facility to protect its users from the threat of crime, such as the availability and quality of pedestrian lighting.

6. Attractiveness is the attractiveness of choice to use the facility, such as the availability of a canopy on the pedestrian walkway, as for the completeness of the road space (chairs, trash cans, etc.).

2.2 Technical Triangulation

Technical triangulation is defined as a data processing technique that combines various data collection techniques and existing data sources [4]. Triangulation techniques were used to re-check the correctness of data information by combining all collection techniques, namely data from 3 (three) sources through interviews, observation, and documentation so that the degree of trust can be valid in this research.

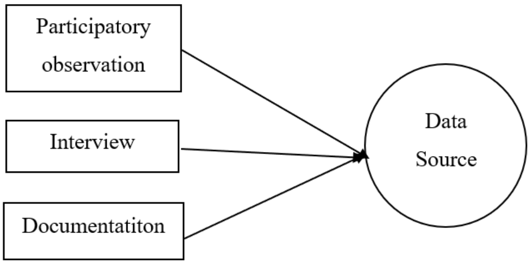

Fig. 2. Technical Triangulation
(Source: Sugiyono, 2022)

2.3 Metode Analytical Hierarchy Process (AHP)

Thomas L. Saaty developed the Analytical Hierarchy Process method (AHP), which describes problems with many complex hierarchical factors. The hierarchy is described as a representation of a complex problem in a structure with different levels, objectives being the first level, followed by criteria, sub-criteria, until the last alternative level. A complex problem can be divided into groups which are then arranged in a hierarchical format so that the problem appears more structured and systematic. The principles used in solving problems with the AHP method are as follows [5]:

1. Decomposition

This principle breaks the whole problem into structured and systematic parts in a hierarchy that are interrelated. The following is the AHP hierarchical structure:

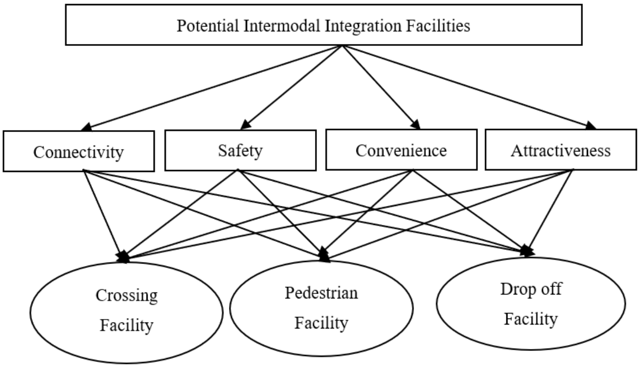

Fig. 3. Hierarchy Structure

Explanation of the hierarchical link above, as follows:

a. The purpose of this research is to determine the potential of intermodal integration facilities at Rangkasbitung Station with several criteria.
b. Create a pairwise comparison matrix that describes the relative contribution or influence of each element on the objectives, namely the criteria and alternatives determined.

2. Comparative Judgment

This concept considers the relative importance of the two components at a certain level compared to the level above it. A pairwise comparison matrix can be used to make this evaluation. Where is the preference level of various alternative criteria included. Scale 1 of the scale that shows the lowest level and scale 9 shows the highest level. The rating scale is shown in the following table:

Table 1. Interest Scale

Interest Intensity	Definition
1	Equally important than the others
3	A little more important than the others
5	Pretty important compared to the others
7	Very important compared to others
9	Absolute importance compared to others
2, 4, 6, 8	Elements are almost as important

(Source: Riadi, 2020)

3. Synthesis Of Priority

When determining the order of importance of the criteria and alternative elements, it can be determined to what extent these elements influence the decision objective. Opinions of experts and decision stakeholders regarding decision making, both through discussions and questionnaires in determining this priority.

4. Logical Consistency

Certain criteria can be used to classify entities and interests, as well as the relationships between them.

This study uses the AHP method to rank priorities for what proposed facilities should be developed for intermodal integration facilities at Rangkasbitung Station. The criteria used in the hierarchical chart are obtained from 6 indicators of integration of intermodal infrastructure, then selection is made during interviews with informants to select criteria that need to be improved in the development of intermodal integration facilities at Rangkasbitung Station. In determining the alternatives from the hierarchical chart, the author obtained from the results of the suggestions given by the informant during the interview. The following are the steps in the AHP method, as follows [6]:

1. Define the problem and determine the desired goals. Create a hierarchical structure starting with the main goal, then the criteria and alternatives.
   a. Create a pairwise comparison matrix that describes the relative contribution or influence of each element on the objectives, namely the criteria and alternatives determined. Here is the matrix table:

Table 2. Criteria Comparison Matrix

Criteria	K1	K2	K3	K4
K1	Q11	K12	K13	K14
K2	K21	K22	K23	K24
K3	K31	K32	K33	K34
K4	K41	K42	K43	K44

The following is an explanation of the criteria comparison matrix table, namely K1 is a connectivity criterion, K2 is a convenience criterion, K3 is a safety criterion, K4 is an attractiveness criterion. The four criteria are compared with each other and produce 16 criteria comparison matrices.

   b. To get the weight index by normalizing, namely row operations by dividing the value of K(n) by the total value of the matrix in one column and column operations. With the following formula:

$$With\ K(n) = \frac{Comparison\ Matrix}{Total\ Corresponding\ Column\ Matrix} \quad (1)$$

   c. Add up the value of each row of the normalized matrix and divide it by the number of elements in each row. The results of this division show the overall priority value of each element.

2. Determine consistency to find out how good the consistency of the criteria and alternatives that have been determined. Things to do as follows:
   a. Multiply each value of the first element, the value in the second column by the second priority relative, and so on.

b. Add up each row.
c. Countdown value and value maximum
d. ƛ = Average normalized matrix

$$ƛ\ \max = \sum_{i=1}^{n} e \left(\frac{K(n)}{Wi}\right) n \tag{2}$$

e. Consistency Index (CI)

$$CI = \left(\frac{(ƛmax - n)}{(n-1)}\right) \tag{3}$$

f. Table Ratio Index is the size of the random index consistency depending on the number of criteria or alternatives used or selected

Table 3. Ratio Index

Amount	RI
2	0,00
3	0,58
4	0,90
5	1,12
6	1,24
7	1,32
8	1,41
9	1,45
10	1,49

g. Consistency Ratio (CR)

$$CR = \frac{CI}{RI} \tag{4}$$

CR value ≤ 10% or 0.1 for consistent data standards is acceptable and if it exceeds 10% or 0.1 the data is inconsistent.

h. Arrange ranking results from AHP calculations.

3. RESULTS

3.1 Criteria Consistency Test

Consistency test or consistency ratio criteria was carried out to find out the level of consistency of the assessment results carried out by the three informants based on the chosen rating scale. The requirement for a CR value ≤ 10% or 0.1 for consistent data standards is acceptable and if it exceeds 10% or 0.1 the data is inconsistent.

Table 4. Criteria Consistency Test Results

Pairwise Comparison	Consistency Value	Information
Source 1	0,055	Consistency
Source 2	0,043	Consistency
Source 3	0,069	Consistency

Based on the assessment of the three informants, the results of the criteria consistency test are said to be consistent because they do not exceed the consistency ratio requirements and these criteria can be continued to the next calculation stage.

3.2 Criteria Weighting

The weighting of the criteria is the result of calculating the AHP analysis and also the result of the consistency test that was carried out. From these results an average calculation is carried out and gets priority from the criteria used as follows:

Table 5. Criteria Weighting Test Results

Indicator	Source 1	Source 2	Source 3	Mean	Rank
Connectedness	0,405	0,433	0,392	0,410	1
Convenience	0,219	0,220	0,230	0,223	3
Safety	0,332	0,314	0,324	0,323	2
attractiveness	0,044	0,044	0,055	0,048	4

From the results of the interviewees assessment of the criteria, it was found that the weighting of the criteria used in this study was that the connectivity criteria were the first priority criteria for developing intermodal integration, then supported by safety, convenience, and attractiveness criteria. These criteria must be mutually sustainable in order to create a good and integrated intermodal integration facility.

3.3 Alternative Consistency Test

An alternative consistency test or consistency ratio was carried out to find out the level of consistency of the assessment results carried out by the three informants based on the chosen rating scale. CR value ≤ 10% or 0.1 for consistent data standards is acceptable and if it exceeds 10% or 0.1 the data is inconsistent.

Table 6. Alternative Consistency Test Results

Pairwise Comparison	Alternative Connectivity 1,2,3	Alternative Facilities 1,2,3	Alternative Security 1,2,3	Alternative attractiveness 1,2,3	Information
Source 1	0,039	0,014	0,030	0,048	Consistency
Source 2	0,083	0,044	0,039	0,031	Consistency

Pairwise Comparison	Alternative Connectivity 1,2,3	Alternative Facilities 1,2,3	Alternative Security 1,2,3	Alternative attractiveness 1,2,3	Information
Source 3	0,044	0,083	0,014	0,083	Consistency

From the results of the consistency test calculations in table 5, based on the assessment of the three informants, consistent results were obtained because they did not exceed the consistency ratio requirements. And can proceed to the next stage.

3.4 Alternative Ranking

Alternative rankings are used to determine proposed intermodal integration facilities that must be developed at Rangkasbitung Station. From these proposals, priorities are generated based on the highest rank to the lowest rank. Following are the results of alternative rankings based on the assessment of the three informants:

Table 7. Alternative Rating Results

Alternative	Source 1	Source 2	Source 3	Mean	Rank
Crossing Facilities	1,367	1,376	1,422	1,388	2
Pedestrian Facilities	2,269	2,454	2,119	2,281	1
Facility Drop Off	0,363	0,323	0,296	0,327	3

Table 6 shows the results of the alternative comparison assessment of the three informants. Pedestrian facilities received the highest score of 2,281, then crossing facilities with a value of 1,388, and pedestrian facilities drop off with a value of 0.327.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

Based on the results of the analysis and discussion of intermodal integration facilities at Rangkasbitung Station. Based on the results of the analysis, it was concluded that the current condition is that there are still no intermodal integration facilities, including pedestrian facilities, crossing facilities, and transport facilities drop off at Rangkasbitung Station. From the results of the assessment of the three informants using the AHP method, it was found that the priority criteria that needed to be maximized were connectedness, convenience, safety, and attractiveness. From the ranking results using the AHP method, it was found that the first priority for developing intermodal integration facilities was pedestrian facilities with a value of 2.281, then pedestrian facilities crossing with a value of 1.388, and facilities drop off with a value of 0.327.

4.2 Suggestion

Based on the results of research related to the need for intermodal integration facilities at Rangkasbitung Station, it was suggested that carry out development and development according to the results of the proposal based on the ranking of this research carried out by regulators, operators and local governments who work together to fulfill intermodal integration facilities at Rangkasbitung Station in order to facilitate the movement of passengers who will or have used the train mode and continue their journey with the advanced mode. The intermodal integration facilities are pedestrian facilities, crossing facilities, and facilities drop off at Rangkasbitung station.

5. REFERENCE

[1] Y. Gusleni, "Integrasi Pelayanan Angkutan Umum Di Pelabuhan Tanjung Emas," *Jurnal Transportasi Antarmoda,* vol. 1, no. 16, pp. 51-64, 2018.

[2] H. Juniati, "Integrasi Pelabuhan Benoa Dan Trans Sarbagita Dalam Rangka Peningkatan Pelayanan Transportasi Perkotaan Di Denpasar Bali," *Jurnal Transportasi Multimoda,* vol. 2, no. 17, pp. 42-51, 2019.

[3] A. S. Zulfikri & Kuswati, Wajah Transportasi Antarmoda Penumpang, Jakarta: Badan Penelitian Dan Pengembangan Perhubungan Kementrian Perhubungan, 2015.

[4] Sugiyono, Metode Penelitian Kualitatif, Bandung: Alfabeta Bandung , 2022.

[5] M. Riadi, "Analytical Hierarchy Process," *Kajian Pustaka,* 2020.

[6] A. &. I. R. R. Muhardono, "Penerapan Metode AHP Dan Fuzzy Topsis Untuk Sistem Pendukung Keputusan Promosi Jabatan," *Jurnal Sistem Informasi Bisnis,* pp. 108-115, 2014.