

# Potential Users of River Transport Integrated with the South Sumatera Light Rail Transit (LRT) after Improvements to the Facilities in Accordance with Public Perception

Edi Kadarsa<sup>1,\*</sup>, Reini Silvia Ilmiaty<sup>1</sup>, Apriansyah Putra<sup>2</sup>

<sup>1</sup>Department of Civil Engineering, Sriwijaya University, Indonesia

<sup>2</sup>Department of Information System, Sriwijaya University, Indonesia

Received August 28, 2022; Revised December 19, 2022; Accepted January 9, 2023

## Cite This Paper in the Following Citation Styles

(a): [1] Edi Kadarsa, Reini Silvia Ilmiaty, Apriansyah Putra, "Potential Users of River Transport Integrated with the South Sumatera Light Rail Transit (LRT) after Improvements to the Facilities in Accordance with Public Perception," *Civil Engineering and Architecture*, Vol. 11, No. 2, pp. 863 - 872, 2023. DOI: 10.13189/cea.2023.110224.

(b): Edi Kadarsa, Reini Silvia Ilmiaty, Apriansyah Putra (2023). *Potential Users of River Transport Integrated with the South Sumatera Light Rail Transit (LRT) after Improvements to the Facilities in Accordance with Public Perception*. *Civil Engineering and Architecture*, 11(2), 863 - 872. DOI: 10.13189/cea.2023.110224.

Copyright©2023 by authors, all rights reserved. Authors agree that this article remains permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

**Abstract** The Palembang City, one of the cities in Indonesia with a high population density, is crossed by the Musi River and its networks that flow through 10 sub districts and 30 villages. The shipping lanes of the Musi River within Palembang City and its suburbs can be navigated by huge ships all year round and are means of transportation that is free from congestion, environmentally friendly and energy efficient. Since 2018, river transport in Palembang is connected with the South Sumatera light rail transit (LRT), namely in the Ampera area. The LRT is a convenient and strategic transportation, because it passes through office, business center, entertainment and sports facilities. In addition, this rail-based transportation is connected with Trans Musi and air transportation. Both of these transportations have affordable and competitive fares comparable to other transportation. However, until now these two transportations are still equally struggling to attract customers. Therefore, this study aimed to determine public perception of transportation connected to the LRT and what they want for the integration between these two modes. Then, the public perceptions were visualized into images or computer simulation. The images or simulation was then re-run by the community to see whether it is what

they want or whether it still needs revision or addition. The survey also investigated whether there is an increase in users if the perception is realized. It shows that the most desired supporting facility for the integration between the river transport and the LRT is pedestrian lanes or sidewalks. Furthermore, a more realistic explanation tool will help people to imagine the activities that will be carried out in the future; thus, they are more convinced to choose to use it or not.

**Keywords** User Perception, River Transport, LRT, Integration, Public Transport

---

## 1. Introduction

The city of Palembang has miles of river networks running from inland areas to the high seas. The main river is Musi River that splits the city and can be passed by huge ships, both passenger and cargo ships, all year round. There are 10 sub districts or 30 villages located relatively close rivers. Residents in these villages are likely to utilize river transportation [1].



**Figure 1.** Study Location in 16 Ilir

In addition to river transport, there is a rail-based public transportation that serves the mobility of the population of the city of Palembang, namely the LRT (light rail transit). These LRT tracks run across strategic areas of the city of Palembang, including office area, commercial business, and even airport. The LRT mode has several advantages, such as traffic jam-free, safe and comfortable with a relatively affordable price. There are two river piers adjacent to the LRT station that could be a profitable infrastructure for both modes when integrated as shown by figure 1. However, both types of modes are struggling to attract users; in fact, the operating costs of the LRT are greater than the monthly income [2].

Several previous studies show that competent integrated service facilities are one of the considerations for someone to use public transportation and transit to continue the journey using other modes to the final destination [3][4]. This study investigated potential users of river transport that continue their travel using the LRT or vice versa. A survey and analysis were conducted to identify sub-optimal integrated service facilities and improve their service in accordance with people's preferences. Then, another survey and analysis were conducted to observe if there is a change in the number of users of the two transports who transit after the service facilities are repaired. The survey for respondents was conducted with the help of 2D and 3D pictures to help respondents understand and visualize the new form of service facilities after remodeling. With a better understanding, it is expected that respondents would pick a transport with more careful consideration than without visual aid (simulation) or with simpler aids.

Studies on river transport, LRT and service facility for integration have been previously undertaken. Among others are:

Calthorpe [3] stated a mixed-use community within an average 2000-foot walking distance of a transit stop and core commercial area. TOD mixes residential, retail, open space, and public uses in a walkable environment, making it convenient for residents and employees to travel by transit, bicycle, or foot. Prima and Prayogi [4] reviewed pedestrian behavior in a Transit Oriented Development area. People behavior may be influenced by physical or non-physical factors of the pedestrian lane. Different behaviors would result in different responses toward a pedestrian lane. Arliansyah [5] conducted a study on origin-destination mobility of people living in urban villages that are relatively close to the river. The study was conducted on 30 villages to obtain a travel origin-destination matrix. Mode selection analysis was performed to determine what percentage of the population uses river transportation. Kadarsa [6] studied Musi River shipping lane capacity. The results showed that barges and jukungs can sail through Musi River shipping lane safely. Wahiputra et al. [7] conducted a review on LRT feeder. A public transport survey was conducted at all LRT stations to see the presence of public transport as a feeder for the LRT. The results showed that additional feeders are needed in some stations to serve population mobility in some villages. Febriansyah et al. [8] conducted a study to observe tourism mobility in the area surrounding Musi River and its networks. This study investigated transportation before and after river transportation. Kadarsa [9] assessed the potential of TOD around the South Sumatra LRT station. A regression analysis was conducted to determine the relation between building condition and production and attraction. This study pointed out that in order for TOD to be successful, supporting facilities such as pedestrian paths, bicycle paths, parks etc.

are needed. Zakwan et al. [10] studied an information system for pedestrians in the integrated station using video recording to see the movement of pedestrian flow. The results showed that on weekdays, travel delay was slightly better than on holidays. This was because during weekdays, the pedestrians were more familiar with the pedestrian lane (most of them commuted from home to work to work). While on holidays, more pedestrians were relatively new to the pedestrian lane in the integrated station. Kadam et al. [11] conducted a study to develop a multimodal integration planning around the metro station to reduce the use of private vehicles and boost metro users. One of the considerations is the movement of pedestrians which must be improved by providing adequate pedestrian infrastructures in the station area such as sidewalks, pedestrian bridges and fences. Vale [12] proposed a station area typology based on three components, namely land use, transport planning and walking paths that can be used as a tool for developing station area into a balanced transit-oriented development area. This research also studied several articles that discussed data collection through interviews. In general all articles discuss almost the same thing, the success or failure of the interview depends on interviewer role, the role of the respondent and techniques in interviews. Interview techniques include appearance, how to ask and how to take notes [13][14].

Previous studies have shown that river transportation has existed until today in Palembang City. In some piers, river transport is still a transport of choice for many people at certain times in the day. Similar to river transport, LRT can only move on the available road network, thus, these two modes must be intermodal with other modes to arrive at their final destination. One of the important intermodal integration facilities is pedestrian path, which connects river piers to LRT stations. This study adopts many methods that have been utilized by previous researchers, especially interviews with respondents to collect data. However, there has not been a study that examines instruments to explain the infrastructure improvements to be carried out in order to provide a clearer picture to respondents before they answered or made decisions

## 2. Materials and Methods

Broadly speaking, this study examined the potential of

river transport users who continue their journey using the LRT or vice versa. Furthermore, surveys and analysis were conducted to identify suboptimal integration service facilities to be improved according to community preferences. Then, surveys and analysis were again performed to determine whether the number of users of both transports who make transit improves after improvements were implemented. Surveys of respondents were conducted with the help of 2D and 3D images to help them grasp or imagine new forms of service facilities after renovation. It is hoped that with a better understanding, respondents can make an informed choice of transport than if no instrument in the form of images (simulations) or simpler instruments are provided.

The study began with studying the movement of origin and destination of people who live on the banks of the river in Palembang City which carries the intermodal potential with the LRT. The survey was conducted on passengers of river transport at Pasar 16 and Ampera Pier located in 16 Ilir Village. As many data samples as possible were collected, namely all respondents we met and who were willing to be interviewed, the survey was conducted during the COVID-19 pandemic, causing a low number of river transport passengers. From the origin and destination information, movement intensity and mode used were obtained.

Subsequently, a survey was conducted to determine the perceptions of the people living on the banks of the river regarding integration facilities between river transportation and LRT through interview and stated preference data. The number of data samples was determined using Slovin's Equation and a sample of 100 respondents was obtained. Forum Discussion Groups (FGD) or interviews with expert informants were conducted to validate data from community surveys and at the same time collect data for the development of river transportation and LRT, especially in intermodal integration service facilities, including river transportation schedules. A user perception survey was performed again using instruments in the form of pictures or simulations that depict service facilities for integration after being remodeled following people's wishes to assess whether there has been a change in the public's interest in using these two public transports. The survey results with simulations (3D images), 2D images and without images were compared to determine the best survey results. Figure 2 following is the research flow chart:

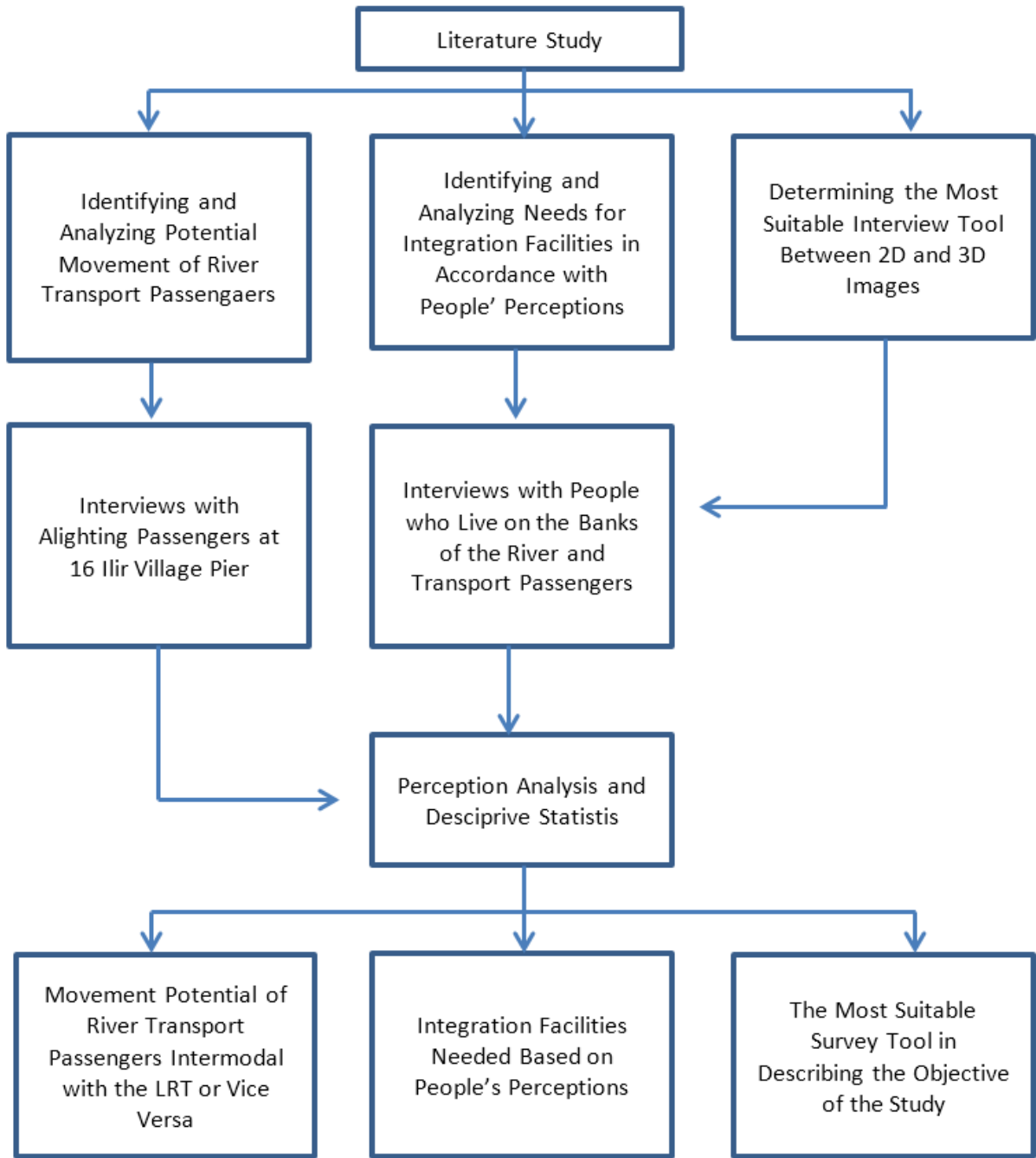


Figure 2. The Research Flow Chart

### 3. Results and Discussion

#### 3.1. The Potential of Users of River Transport Continuing Travel Using the LRT

The survey was conducted with a number of respondents in the city of Palembang that got on and off at 16 Ilir Dock and Ampera Dock to observe users who are likely to continue their travel using the LRT. The results are presented in the Figure 3.

From Figure 3, we can see that the common destination for river transport users that stop at 16 Ilir and Ampera Dock is 16 Ilir Village with 138 respondents out of 184 (75%). Out of the remaining 46 (25%) respondents who

continue, only 30 respondents are likely to continue using the LRT. Based on the travel destination, the movement that is most likely to use the LRT is the movement from the origin zone to the destination zone that passes the LRT line. Meanwhile, passengers whose next destination is not passed by the LRT line were considered to have no potential. Therefore, the potential movement using LRT was 16.5%.

Extra-zonal movement passengers, namely movement from outside the city of Palembang using river transportation where passengers get on or off at 16 Ilir and Ampera Dock are likely to continue traveling by LRT is shown in Figure 4.

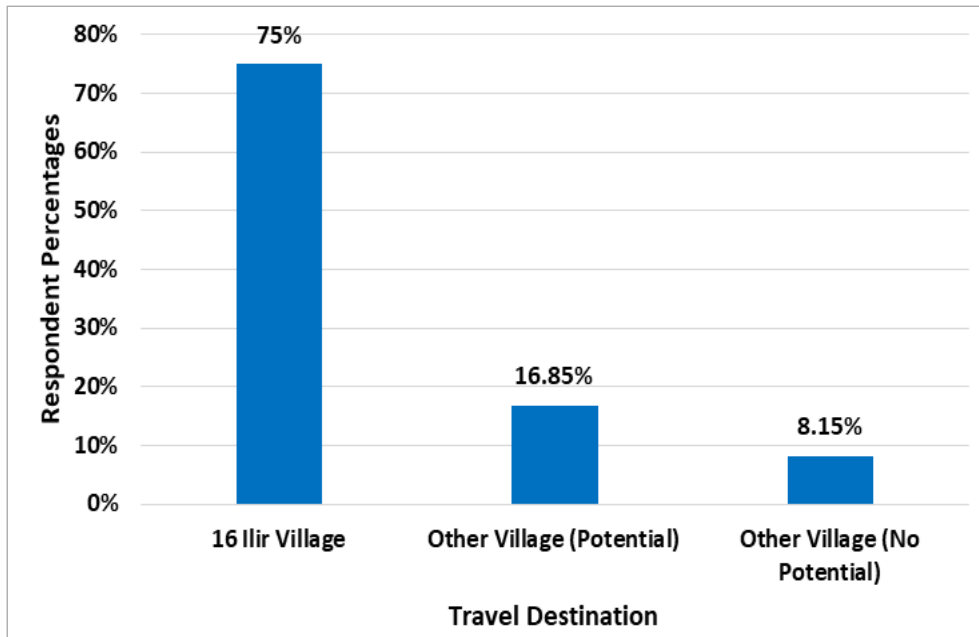


Figure 3. Percentage of city passengers that get off at 16 Ilir Dock and are likely to continue with the LRT

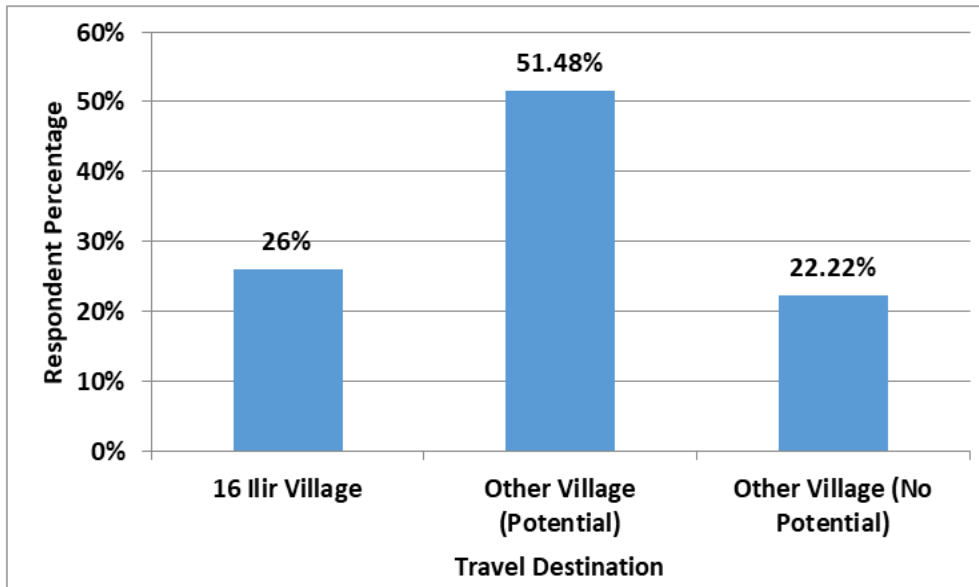


Figure 4. Percentage of Out-of-Town Passengers That Get Off at 16 Ilir Dock and are Likely to Continue with the LRT

Figure 4 shows river transport users from outside the city that get off at 16 Ilir and Ampera Dock of 36 respondents. From all these respondents, there were 10 (26%) respondents with 16 Ilir Village as their final destination. The remaining respondents who continued the trip were 26 people and only 18 (51.5%) respondents had the potential of using the LRT. This percentage is relatively high because respondents consider LRT to be a modern and unique public transportation. Some respondents did not continue their trip using the LRT because their destinations were not passed by the LRT route.

3.1.1. Departure Time at 16 Ilir Dock

Based on the observation, departure hours from 16 Ilir and Ampera Dock are shown in Figure 5 below.

Figure 5 below shows the number of passengers departing from 16 Ilir and Ampera Dock. The most common departure hour is between 16.00 and 16.30 with 73 respondents. It was followed by 10.00-10.30, 15.00-15.30 and 17.00-17.30 with 42-44 respondents. Starting hours include hours during which people go to work and children go to school. Furthermore, 10.00 - 10.30 is the time when people go shopping for their daily needs and socializing. 15.00 - 15.30 and 17.00 - 17.30 with 42-44 passengers departing. After 15.00 usually people start coming home from work.

3.1.2. Arrival Time at 16 Ilir Dock

Figure 6 below shows busy hours of river transport passenger arrival at 16 Ilir and Ampera Dock.

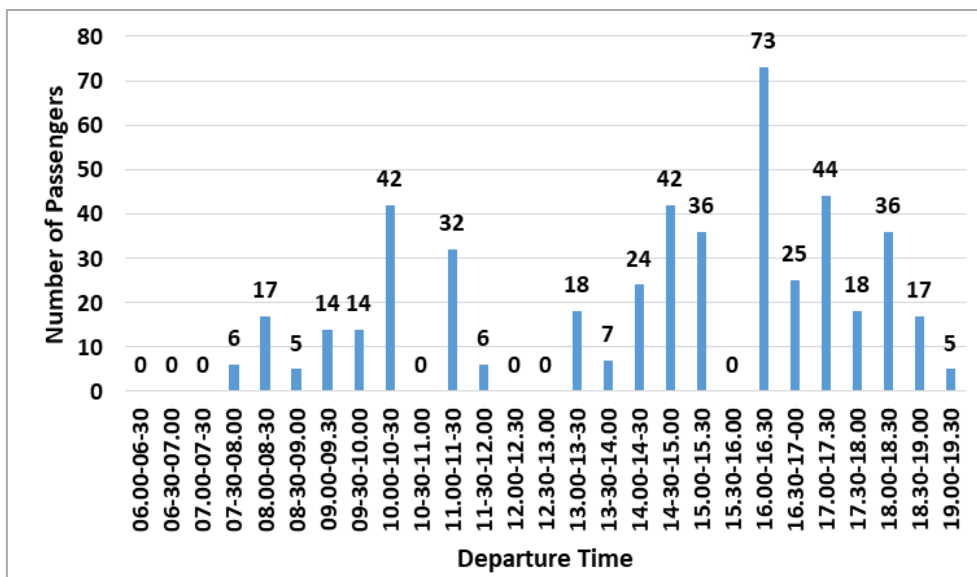


Figure 5. Number of passengers departing from 16 Ilir and Ampera Dock

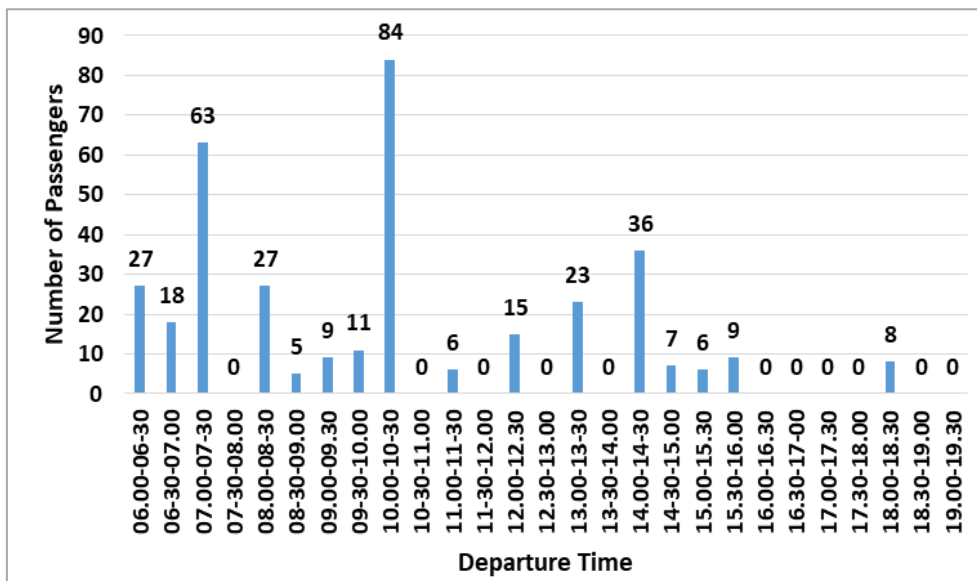


Figure 6. Number of passengers arriving at 16 Ilir and Ampera Dock

As seen in Figure 6, the majority of passengers arrive at 10.00-10.30 with 84 respondents, then, at 07.00-07.30 with 63 respondents and at 14.00-14.30 with 33 respondents. Generally, at that time, many people do business around 16 Ilir Village which is a business and commercial center. Then, between 07.00 and 07.30, around 63 people, adults and children, go to work and school.

This information on the arrival and departure times of ships at the docks in 16 Ilir Village can be used to adjust the LRT schedule or supply feeder so that passenger waiting times can be minimized.

Wahitpura et al. (2017) conducted the same study at the same location. The results showed the same trend for the number of passengers arriving and departing at the pier in 16 Ilir Village [7]. It is just that there were more passengers at the time of the study. According to information, people carry out their daily activities around Pasar 16 and Ampera Pier. In 2019, before the pandemic, the number of boarding and alighting passengers was estimated to be 2 to 3 times higher than when this survey was conducted.

### 3.2. Supporting Infrastructure Facilities between River Transportation and the LRT

#### 3.2.1. Community Perception on Pedestrian Lanes

The survey results show that the majority of respondents expressed that warm climate or rain makes the atmosphere uncomfortable to walk from the dock to 16 Ilir Village or vice versa. The majority of respondents strongly agree that the pedestrian lane from the dock to the LRT route is repaired and improved. The need for a pedestrian lane safe from traffic accidents and protecting people from rain and sunrays is important information obtained from the interview with river transport users.

#### 3.2.2. The Potential of Users of River Transport Connected with the LRT after Facility Repair

An interview was conducted with respondents at 16 Ilir and Ampera Dock and people who live on the banks of the river in Palembang City regarding their willingness to continue their trip using the LRT. The results show that very few respondents were willing to use the LRT, with 4.75% for within-city movement origin and 6.10% for external movement origin. The availability of a variety of public transportation that can park near the dock at a cheaper rate is the main cause of their lack of interest in using the LRT mode.

After what needs to be rectified is identified, namely protection from rain, heat and traffic accidents, 2D and 3D images (simulation) are drawn up to determine if there is a difference in the number of respondents who are willing to switch to river and intermodal modes with LRT. The survey was conducted 2 times with different respondents, but with the same location and time of the survey. The first survey was carried out with the help of 2D images and the second survey used colored 3D images. The purpose of using 2 different tools was to determine whether the better picture received by respondents regarding the improvement plan will increase their willingness to switch to using the LRT.

#### 3.2.3. Perception Survey with 2D Images

There were 2 forms of drawings made to help respondents understand the improvements being made, namely, the access layout in the 16 Ilir area and the pedestrian path from the pier to the LRT station. The analysis of interview results shows that even with the pedestrian lanes repaired, the increase in willingness to continue traveling using the LRT is very slim, namely 9% for internal (within the city) movements and 11% for external (Out-of-Town) as seen in Figures 7 and 8 below.

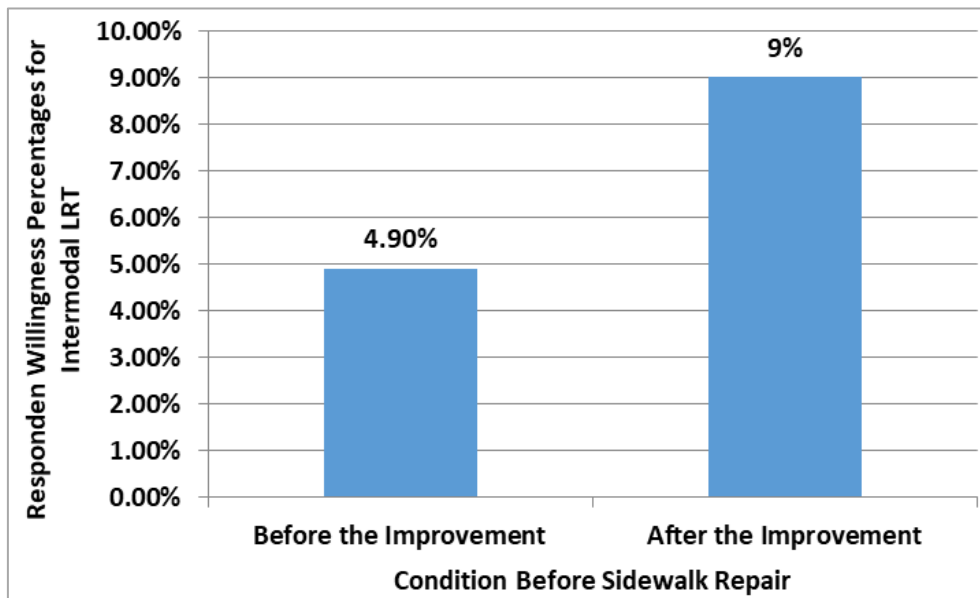


Figure 7. City Respondent's Perception Before and After the Improvement

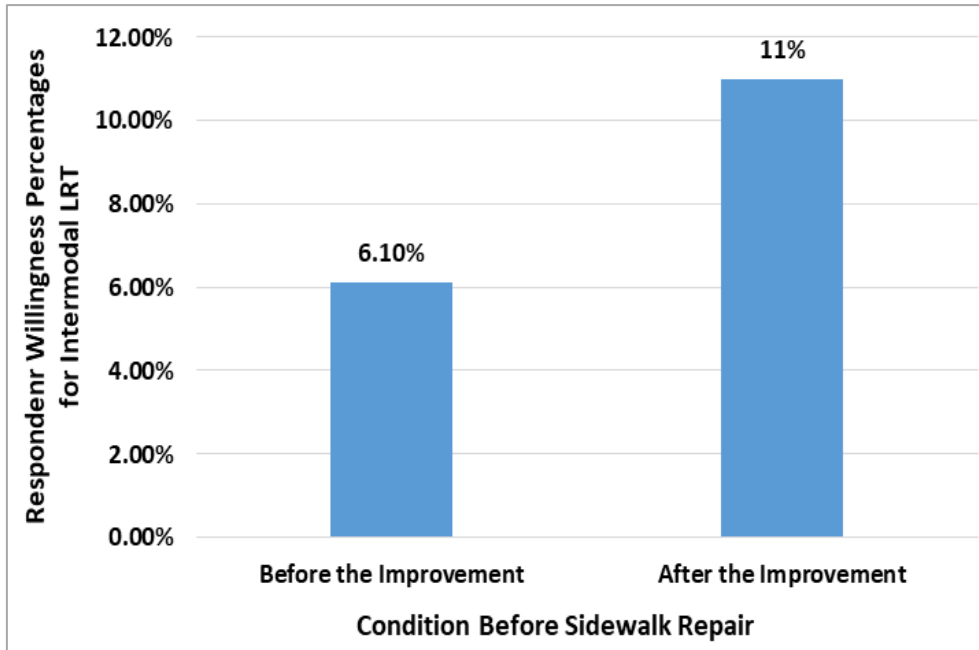


Figure 8. Out-of-Town Respondent’s Perception Before and After the Improvement

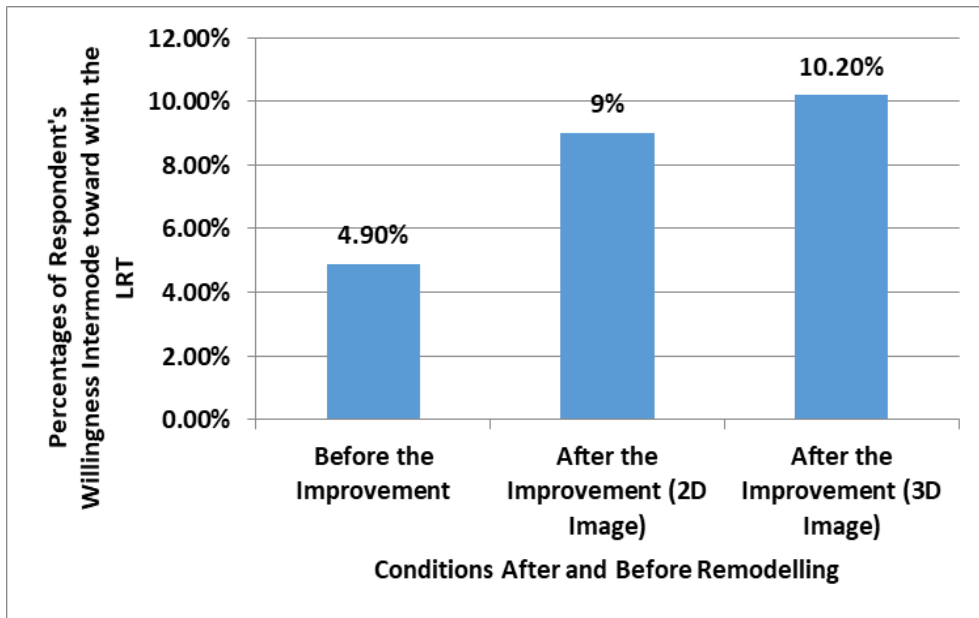


Figure 9. City Respondent’s Perception Before and After the Improvement

The low increase is particularly caused by LRT ticket prices for one way trip that are still considered quite expensive by prospective passengers and competition from other public transportation. Several other factors that make the LRT less attractive compared to other transportations include:

- Long waiting time for LRT compared to other public transportation
- Inconvenience when carrying a lot of stuff up and down the LRT station

- There are other door-to-door transportations that are relatively cheap, namely online transport services.

3.2.4. Perception survey with colored 3D image simulation

Furthermore, a survey was conducted using 3D images which were intended to help respondents imagine better repaired pedestrian paths. Figure 9 shows the results of a survey conducted for respondents in the city and Figure 10 for respondents out of town.



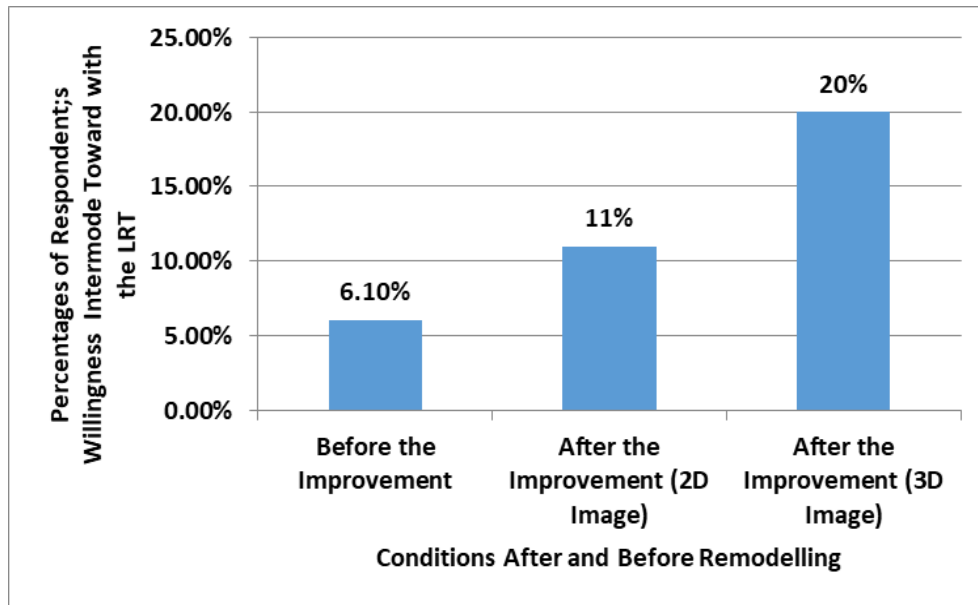


Figure 10. Out-of-Town Respondent's Perception Before and After the Improvement

Even after being shown the 3D images, the increase in the percentage of respondents from within the city that are willing to switch to or use the LRT lane is still relatively slim, with 1.2% from 9% to 10.20%. During the interviews, the respondents stated that they have been through sidewalks that are in good condition, so they were not that enthusiastic when shown the 3D images of pedestrian lane to be constructed. They have visualized pretty clearly the new pedestrian lane from the surveyor's explanation and when shown previous 2D drawings. They already have prior experience with good pedestrian lanes.

In contrast with the respondents from the city, respondents from outside the city seem to show a more significant increase in the percentage of willingness to switch to the LRT as the follow-up transport. The percentage increased by about 9%, from 11% to 20%. These respondents became more enthusiastic when they were shown the 3D images of the repaired pedestrian lane. According to some of them, the pedestrian lane as shown in the 3D images seems very comfortable to use compared to the black-and-white 2D images. Convenient and safe pedestrian lanes connecting to the LRT would be a new and pleasant experience. Many of the out-of-town respondents live in remote areas that have not been touched by development, so they were quite enthusiastic about the sidewalks specially designed for pedestrian comfort and safety.

#### 4. Conclusions

The results of the study showed that integration support facilities between river transport and the LRT whose services are due for improvement are pedestrian path or sidewalk. The ideal pedestrian path is that that is protected from rain and sunlight as well as safe from potential

vehicle accidents. If the pedestrian path is repaired in accordance with the expectations of the community, there will be an increase in river transport users who are willing to switch from other modes of transport to the LRT to continue their trips. The survey showed that the percentage of people who are willing to continue their trips if the path is repaired rose to 9% for inner-city respondents when 2D images were incorporated in the perception survey and 10.2% if 3D images were used. Meanwhile, for out-of-town respondents, 11% of them were willing to use the LRT after seeing the 2D images and 20% with 3D images. This shows that aids in the form of pictures or simulations showing a clearer representation of the planned improvement help influence one's choice of modes.

#### Acknowledgments

This study was funded by Public Service Agency DIPA Budget of Sriwijaya University Fiscal Year 2021.

#### REFERENCES

- [1] K. Nurhan, "Jelajah Musi", Kompas Press, Jakarta, 2010.
- [2] Sudirmansyah, J. Arliansyah, E. Kadarsa, "Income Generating Study on The South Sumatera LRT Operational", International Journal of Innovative Science and Research Technology, Vol. 5, No. 7, pp. 556-68, 2020, DOI: 10.38124/IJISRT20JUL446
- [3] P. Calthorpe, "Transit-Oriented Development Design Guidelines", Calthorpe Associates in Association with Minter & Associates, USA.
- [4] T.P. Prima, L. Prayogi, "Kajian Perilaku Pejalan kaki Pada

- Kawasan Transit Oriented Development (TOD)”, *Jurnal Arsitektur ZONASI*, Vol. 3, No. 1, pp. 1-10, 2020, doi.org/10.17509/jaz.v3i1.22842
- [5] J Arliansyah, “Analysis of Feeder Needs to Support the Implementation of LRT in Palembang”, *International Journal of Sustainable Transportation Technology*, Vol. 2, pp. 39-46, 2019, DOI:10.31427/ijstt.2019.2.2.
- [6] E Kadarsa, “Model Simulasi Arus Lalu Lintas Sungai untuk Menentukan Kapasitas Alur Pelayaran”, Disertasi, Program Studi Doktor Teknik Sipil, Institut Teknologi Bandung, 2017,
- [7] M.R. Wahiputra, J. Arliansyah, “Analisa Pemilihan Moda Transportasi Masyarakat Kota Palembang yang Bermukim di Bantaran Sungai Musi, Skripsi. Program Studi Teknik Sipil, Universitas Sriwijaya, 2017.
- [8] Febriansyah, “Perencanaan Kapal Wisata (Cruise) Kota Palembang”, Tesis, Magister Teknik Sipil, Universitas Sriwijaya, 2021
- [9] E Kadarsa, “Analysis Of Potential Transit Oriented Development Area Around Light Rail Station In Indonesia”, *International Journal of Scientific & Technology Research*, Vol. 9, No. 3, pp. 7170-7176, 2020, ISSN 2277-8616
- [10] R.M. Zakwan, W.J. Khai, N.B. Hamid,U.N. Ibrahim, “Level of Service For Pedestrian Towards The Performance of Passenger Information in Integrated Rail Transit Station: Sustainable Criteria For Station Design”, *International Journal of New Technology and Research (IJNTR)*, Vol.2, Issue 4, pp. 127-129, 2016, DOI: 10.31871/IJNTR
- [11] S. Kadam, P. Shrivastava, A.R. Kambekar, “Multimodal Integration and Strategic Planning for the Proposed Dahisar Metro Station, Proceedings of Sustainable Infrastructure Development & Management (SIDM), pp. 1-12, 2019, URL: <http://vnit.ac.in/>
- [12] D. Vale, “Transit-Oriented Development, Integration of Land Use and Transport, and Pedestrian Accessibility: Combining Node-Place Model with Pedestrian Shed Ratio to Evaluate”, *Journal of Transport Geography*, Vol/ 45, pp. 70-80, 2015, ISSN: 0966-6923
- [13] N. Fox, “Using Interviews in a Research Project”, *The NIHR RDS for the East Midlands / Yorkshire & the Humber* 2009
- [14] K.R. Soegijono,” Wawancara sebagai Salah Satu Metode Pengumpulan Data”, *Media Litbangkes* Vol. III, No. 01, 1993