JPPIPA 9(12) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Development of Makassar City's Service Model and Transportation for Goods and Passengers

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Received: August 28, 2023
Revised: November 27, 2023
Accepted: December 20, 2023
Published: December 31, 2023

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DOI: 10.29303/jppipa.v9i12.4928

Abstract: A well-thought-out, well-integrated operator of freight and passenger transportation with a wide clientele that can benefit both the service users and the overall framework of the transportation system. In this study, Makassar City's freight and passenger transportation services are modeled as urban transportation. In order to develop an integrated service model, this kind of research uses qualitative data that is then theoretically examined. According to the study's findings, using the Tallo River as a transportation route will improve the performance of goods and passenger transportation services while reducing road load. According to research, this model can affect how much traffic there is on the road, how quickly services are provided, how much it costs, and how each place the transportation system travels through develops.

Keywords: Congestion; Growth of transportation systems; Integration; Products and passengers; Urban transportation

Introduction

The increased economic expansion activities in Indonesia's major cities have led to issues with the transportation of products and people. Transportation of goods and people is challenging due to an imbalanced distribution system, an unbalanced supply-demand relationship, and other factors. The road is prone to congestion since there is an excessive disparity between the number of passing cars and the road's capacity. In order for activities related to movement to attract and encourage interactions, such as the movement of people or goods throughout the city, the dynamics of growth in the movement system as a whole affects spatial interaction, changing how retail logistics outlets emerge as a generator of movement in an area (S. K. Aksa et al., 2019). Overall, the distribution of land uses connected to industry and agriculture (production), warehouses (collectors), marketplaces, and settlements (consumers) determines how commodities are transported. Geographical disparities between urban and rural areas will be lessened by the frequency of freight and passenger transport services (Wang et al., 2023). Increased growth is frequently regarded as being hampered by operational, political, technological, and infrastructure fragmentation and lack of integration, as well as by the interaction of modes and investments (Mircetic et al., 2017).

On some road networks, space is at a premium for moving goods, particularly for large capacity freight. Limited movement area has an impact on how efficiently and effectively items are transported, which can be done by land, air, river, or sea. Long travel times and high prices are becoming increasingly important issues. In a similar vein, public transportation serves as a facility for many community events related to urban mobility. Public transportation use in cities is lower than private vehicle use, showing a continued reliance on private vehicles and a dearth of public transit options. A sound transportation strategy is necessary since a region's requirement for transportation always grows as it develops.

How to Cite:
Aksa, K., Aksa, N. S., Raga, P., & Pairunan, T. (2023). Development of Makassar City's Service Model and Transportation for Goods and Passengers. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 12001–12009. https://doi.org/10.29303/jppipa.v9i12.4928

Land and pricing, traffic accessibility, market demand, agglomeration benefits, and governmental policies all have an impact on how the logistics industry develops (M. He et al., 2018). From the perspective of urban planning, the logistics subsystem is undergoing a process known as "fragmentation" in relation to the quantity and frequency of delivery operations, which are controlled by distance factors (the logistics chain) and distribution accessibility (Hesse et al., 2004). The spatial distribution of retail activity patterns and the design of the road system show how movement toward retail services is inefficient and how movement differs from accessibility of land uses (Omer et al., 2016). Due to challenges with efficiency, the environment, and congestion in urban logistics management, urban logistics operations are currently highly essential. Logistics management seeks to provide an efficient flow of commodities (on time, quantity, and location) in an industrial or commercial setting (Widodo et al., 2016).

As a metropolis and provincial capital, it serves as a hub for local, regional, and national growth and development. The load of spatial functions has an effect on how transportation is implemented. Even if the building of the road infrastructure network is slower than the growth of cars, Makassar City experiences a reasonable amount of congestion since the growth of road vehicles is about 8% each year. With 1.5 million people living in Makassar, there are around 2.1 million vehicles and 1.6 million motorcycles on the road in total. This demonstrates that there is a distinction between the general populace and uncontrolled automobiles that cause new social issues (https://harian.fajar.co.id).

The effects of changes in urban morphology occur in both the freight and passenger transport systems at the same time since they typically share a physical transportation network. However, factors like excessive resource allocation for transportation, irrational transportation infrastructure, and others can make land use conflicts between cities and transportation worse (Z. He et al., 2022). The increasing number of cars brought on by the growing need for development both inside and outside of Makassar City is one of the reasons traffic congestion has not been reduced despite efforts to regulate transportation in the city. Another crucial aspect is freight transit, which is used extensively both inside and outside of cities. Makassar's urban transportation issues have been made worse by the positioning and design of industrial areas, both inside and outside the city, as well as ports, airports, and freight transport crossings, particularly on several main road sections with speeds of less than 10 km/hour at peak times, particularly on time to travel to and from work. Therefore, smoother access to the city will be made possible if a particular road is diverted and extended for goods movement (Ricardianto et al., 2022). The growth of an area's potential is made possible by the river transportation system, which connects cities and other regional boundaries, as stated by Rahmad (2014).

At the moment, Makassar City's pattern of shipping and importing commodities is determined by seller and business wants. In Makassar City, transportation of commodities is necessary both from the port and along the network of arterial roads from Maros to Gowa/Takalar. Inadequate urban circumstances, changes in traffic behavior from one situation to another, and lengthy or unpredictable travel times are further issues. The layout of road networks and modes of transportation are influenced by factors such as city spatial organization, land use, topographical conditions, population distribution, and economic potential. The movement of transportation to meet the needs of goods is based exclusively on business functions because the location of the logistics business differs between cities. The 14 sub-districts of Makassar City are dispersed throughout the hinterland, far from the city core, and have highly different land use characteristics. In Makassar City's border region, residential land usage started to shift away from the city limits.

It is expected that network systems and activities in all areas of Makassar City will be integrated in line with urban development to facilitate the mobility of goods and passenger transport easily and quickly and provide low-cost efficiency., easy, safe, and has a high carrying capacity in accordance with its use in anticipating the level of traffic jams in the city of Makassar.

Method

Descriptive techniques, together with qualitative and quantitative analysis, were used in the method's design. Design data and information will be gathered through observations, interviews, and documentation to gather facts from existing phenomena and seek out actual information in relation to the development of an urban transportation system for the transport of goods and passengers in order to lessen the burden of road traffic in Makassar City. Based on the scope of the research, a Research Process Flow is prepared as in Figure 1. It can be seen how the analysis process of the potential of transportation media can be developed as an alternative transportation media in an effective and efficient urban transportation system.

A literature review pertinent to this research was conducted, and field surveys were conducted in several areas, the calculation of traffic flow on specific road sections, particularly on road sections that form continuous road transport crossings, is then done by Traffic Counting. Utilizing both descriptive and

quantitative methods, thorough analysis and evaluation were performed. Users of transportation services, operators, government and private stakeholders, and other parties who have an impact or influence on the development of the urban transportation system are highlighted as the population in this study. Users of transportation services, i.e., the community, operators, i.e., transportation service providers, local government officials acting as regulators and policy makers, as well as other parties like stakeholders from goods supply companies, transporters, and the community at large, made up the respondents and informants.

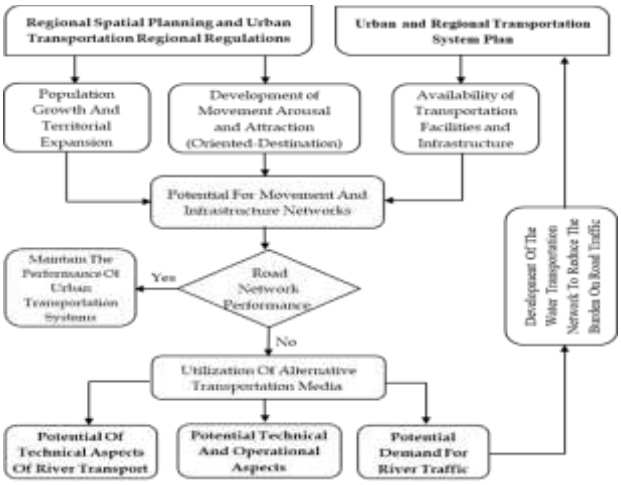

Figure 1. Study framework

With reference to population movement patterns and characteristics, mapping analysis techniques, quantitative analysis (statistical methods), and qualitative assessment analysis are used to be able to identify problems related to service patterns and the development of freight and passenger transport in order to provide solutions to traffic problems in Makassar City. As demonstrated below, movement patterns of people and freight are calculated using the average approach and the gravity equation (Tamin, 2003).

Table 1. The Origin-Destination Matrix

	1	2	……	13	Oi	Oj	Fi
1					O1	O1,n	fi = 1
2		Tij = $\frac{t_{ij}\ E_i\ +\ E_j}{2}$			O2	O2,n	fi = 2
……					.....	.....	……
13					O13	O13,n	fi = 13
Dj	D1	D2	……	D13	ΣOi		
Dn	D1;n	D2;n	……	D13;n		ΣOn	
fj	fj = 1	fj = 2	……	fj = 13			F

Information: T^{ij} is the amount of future movement from zone i to zone j. t^{ij} is the current amount of movement from zone i to zone j. $E^i.E_j$ is Zones i and j's growth rate.

Traffic characteristics, which may be estimated using the formula: are closely related to road loading studies to assess road network performance.

$$DS = Q/C \quad (1)$$

Information: Q is the amount of traffic flow per hour and C is the capacity per hour, and Degree of Saturation (DS).

Result and Discussion

If transportation access is increased, Tamin (2003) the cycle of transportation space usage gets more fascinating and develops. Similarly, Jiang et al. (1999) claim that choosing a mode of transportation for commodities depending on volume weight, trip distance, and time can help to lessen issues like traffic congestion, pollution, and accidents. The geographic distribution of the spatial layout, the capacity, and the location of the transportation facilities are all combined to create traffic volume and flow patterns. The newly constructed spatial arrangement will have a reciprocal or opposite effect on traffic volume and flow on the transportation network, necessitating more transportation infrastructure.

Table 2. Predicted Traffic Volume on Makassar City's Major Roads in 2022

Street Name	Vehicle Units							Passenger Car Unit
	Bicycle	Motor cycle	Car/Jeep	Bus	Pickup	Truck	Total	(SMP)
Jl.Perintis Kemerdekaan (Daya-Bandara)	495	35,797	23,474	12,693	3,579	7,856	83,398	67,714
Jl.Sultan Alaudin (Malengkeri)	15,897	96,006	22,135	14,069	2,776	9,006	143,992	92,059
Jl.Perintis Kemerdekaan (Tello-Daya)	1,315	147,930	37,643	38,240	3,315	4,140	231,268	142,803
Jl.Ir.Sutami	1,094	34,047	19,785	6,529	5,096	12,392	77,849	64,675
Tol Reformasi	-	-	4,755	6,977	1,825	5,020	18,578	23,678
Jl.Panampu	22,374	30,576	3,013	10,618	1,972	3,016	49,195	41,481
Jl.Urip Sumoharjo	3,224	101,668	34,125	39,783	3,077	1,928	180,580	122,695
Jl.A.Pangerang Pettarani	7,401	170,403	53,375	16,542	7,132	6,623	254,076	149,873
Jl.Sultan Alaudin (AP Pettarani-A.Tonro)	13,516	81,578	13,553	36,969	1,794	1,291	135,184	93,936
Jl.Metro Tanjung Bunga	1,647	26,074	15,013	661	1,200	433	43,382	26,662
Jl.Tamangapa	2,357	41,840	10,367	10,429	1,384	1,374	65,394	40,934

Source: Data Processing, Balitbang (2015)

Based on the findings of the traffic count and the data acquired, it is possible to estimate that 1,264,319 cars cross numerous major highways per day. Vehicles with two wheels account for the majority of daily traffic (731,872 units), followed by private four-wheeled vehicles (232,872 units). According to Makupiola et al. (2022), during peak hours on national roads, the average speed on Jalan Urip Sumoharjo is 41.00 km/h, while on Jalan Perintis Independen, it is 39.00 km/h. The service levels on Jalan Urip Sumoharjo are 0.82 (D), 0.72 (C), 0.90 (E), and 0.85 (D). Table 2 displays the approximate amount of traffic on Makassar City's major thoroughfares.

2,730,533 individuals per day could travel inside the Mamminasata Region in 2022. The expansion of cities and towns and the level of economic activity each year will have an impact on this sum. There will be numerous transportation issues if the number of journeys and the supply of reliable urban transit are not equal.

Table 3. Estimated Potential Movements for 2022

Subdistrict/ District	Attractive Movement Oriented (O^i)	Generation/Day Destination (T^d)
Mariso	70,983	95,832
Mamajang	76,541	103,151
Tamalate	203,910	272,782
Rappocini	188,113	252,192
Makassar	106,139	142,786
Ujung Pandang	37,129	49,888
Wajo	45,102	60,643
Bontoala	82,987	112,543
Ujung Tanah	63,950	86,732
Tallo	176,600	239,451
Panakukang	172,846	234,361
Manggala	130,918	177,525
Biringkanaya	170,313	230,926
Tamalanrea	121,013	157,727
Kab. Maros	312,033	141,031
Kab. Gowa	528,409	256,296
Kab. Takalar	243,590	116,710
Amount	1,760,152	2,730,573

Source: Data processing, Balitbang (2015)

The sub-districts of Tamalate, Rappocini, Tallo, Panakkukang, and Biringkanaya have the most travel habits. Part of Makassar City, this sub-district has seen an increase in the intensity of development, particularly in housing and settlements as well as urban amenities. In other words, the area around Makassar City has experienced economic expansion, which has boosted the mobility of residents who rely on private vehicles (S. K. Aksa et al., 2019). The capacity for movement of people in Makassar City and the Mamminasata Aglomaresi Area (Gowa, Maros, and Takalar), as shown in table 3, suggests that this region may have a higher trip distribution pattern than other sub-districts. Other than that, suburban activity patterns are not directly impacted by socioeconomic characteristics, movement time, or socioeconomic activities. On the other hand, suburban activity patterns are directly impacted by transportation and mobility networks, according to Muumin et al. (2020).

Makassar City experiences a somewhat convoluted distribution of goods as a result of its position as a major commercial and industrial hub. This includes transporting items to and from Makassar City, as well as loading things onto vehicles to be driven around the city. the movement of goods within and outside of the city. Makassar City adjusts the form of transportation utilized to move commodities based on affordability, the nature of the goods being moved, and the travel time. The following table lists the different types of transportation based on load weight.

Table 4. Estimated Type of Mode of Transport

Type of Mode of Transport	Total Weight of Cargo (Kg)	Total Fleet
Outboard motor (container crate)	>12000	196
Tronton	>12000	29
Truck	4001 - 9000	8.797
Pick Up	2000 - 4000	15.446
	Amount	24.467

Source: Data processing, Dishub (2012)

Light trucks are typically used to deliver cargo directly from points outside Makassar City to the Makassar City region. Small to medium trucks and large trucks are typically used to transfer commodities from outside Makassar City to the Makassar City region. On the basis of the findings, it was discovered that there is always a relationship between movement or travel and the distribution of land usage and space travel in a given area. The Maros-Makassar border crossing is where most deliveries to Makassar City are made, and here is also where most deliveries out of the city are made.

Therefore, the type of land use and the level of activity (intensity) within it are two factors that affect generation and attraction. Services and trade are the main activities in Makassar City, which serves as an industrial and storage hub for the entire province of South Sulawesi. According to changes in land use in Makassar City, the fastest-growing residential zones are located in the districts of Tamalanrea, Biringkanaya, Panakukang, Rappocini, Tamalate, and Manggala. In the meantime, Makassar City's industrial and warehousing zones in the Tamalanrea District and the Soekarno-Hatta Port region in the Wajo District serve as the main hubs for the transit of products.

Makassar City's service centers with predominately social (education, health, and worship) and economic (offices and trade, tourist and hotels, restaurants) purposes are influenced by these centers of attraction. The hinterland regions of Makassar City, including Takalar Regency and its environs, Gowa Regency, and Maros Regency, contributed to the growth of the movement. As can be seen in the accompanying diagram, the movement of commodities in Makassar City for various agricultural and fishery products often follows a regional movement pattern, namely movements that lead to the city core, industrial area, and warehousing of Makassar City (KIMA), as shown in the following figure 2.

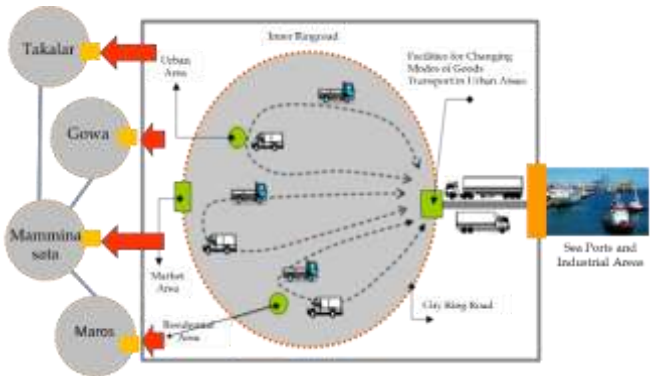

Figure 2. Patterns of logistics transportation in Makassar City (K. Aksa, 2023)

A multimodal alternative, such as the development of water transportation in Makassar City using the Tallo River as an urban transportation system that is integrated with the sea and Gowa Regency has a width of between 30 and 150 meters, is required for the development of goods and passenger transportation services. Because it branches all the way to Makassar City, passing by the Governor's Office, the Unhas campus, the UMI campus, the Unibos campus, and local bridges, the Tallo River has the potential to be transformed into a distinctive mode of transit. The potential for the growth of passenger and freight transportation as a substitute to lessen the need for private vehicles to cross the major roads in Makassar City, particularly on the high traffic-intensity Perintis Kemerdekaan road section, Urip Sumoharjo, AP. Pettarani, and Jalan Sultan Alauddin.

If the population of Makassar City and its surroundings moves in a pattern that is similar to that of centralized passenger transport services moving to the Central Market (Wajo District) or at the Port, then residents on the Tallo River route may have opportunities to switch modes three to four times. This is especially true for residents who live close to Ir. Sutami (the Tallo River bridge), who may switch modes with the intention of going to Antang. Therefore, if the network is faster, the trip is shorter overall, and the trip takes longer, the VCR can be reduced. However, the average delay of the road network will rise if alternate solutions to issues are not implemented (Ricardianto et al., 2022). According to Ansusanto et al. (2015), the reason for the notable decline in traffic volume in the road network is the ever shorter distance between residential areas and city centers.

Therefore, it is hoped that the Tallo River and Canal will be developed as a transportation medium, which will reduce traffic volume, level of traffic jams, and burden on the road network by about 30–35% pcu/hour. Additionally, the average vehicle speed (based on evening conditions) can increase from 20–25 km/h to 30–40 km/h, as shown in the following table 5.

Table 5. Predictions of Changes in Road Performance When Commodities Are Transported Over the Tallo River

Description	Assumed Reduction in Truck Operations				
	20%	25%	30%	34.20%	40%
% Reduction in Traffic Volume (smp/hour)	19.60	24.50	29.40	33.52	3.20
DS Forecast	0.51	0.48	0.45	0.42	0.38
DS actual	1.18	1.18	1.18	1.18	1.18
Forecast Speed (km/hour)	33.00	34.38	35.75	36.91	38.50
Actual Speed – km/hour (No changes)	27.50	27.50	27.50	27.50	27.50

Source: Data Processing (Balitbang, 2015)

The ability of the Tallo watershed as a transportation route is related to the three sites when goods-transporting vehicles enter the Makassar City border. the connection connecting Mandai from Maros to Tamalate in Makassar, Sungguminasa from Gowa to Tamalate in Makassar, and Samata from Gowa to Antang in Makassar. According to predictions, there will be vehicles carrying up to 161,629 tons of cargo via the Maros-Makassar border and between 94,580 and 14,095 tons with US trucks 2 and 3. A total of 270,304 tonnes of commodities are thought to have been moved via the border region.

When compared to building new roads, expanding the capacity of existing roads, managing traffic, and the construction of toll roads, the development of an alternative river transportation system can help to lessen

or unravel traffic in terms of congestion during peak hours. The Tallo River is situated in the center of Makassar City, which is connected to numerous activities in order to save travel time and distance without using the main highway. If Makassar City decides to use the Tallo River for water transportation, a dock will be built to support it, allowing for the transfer of passenger loading as well as the collecting and distribution of commodities packaged in containers. Minerals can, however, also be transported quickly via rivers and connected to the Tallo River's tributaries, including the Pampang River. The Transit Oriented Development (TOD) system can be used to make public transportation the primary means of mobility. As a transfer mode for river transportation services to activity places, this will enable private vehicles, public transit, and two-wheeled vehicles to travel through the transfer node with a vehicle parking system without utilizing the main road (Fahma, 2014). Ports and other transportation hubs need to be created because of the region's potential. To achieve this, more facilities must be made available for use as trade entry and exit points and as a mode of transit to promote regional growth (Djaenuddin et al., 2022).

Table 6. Estimation of the Daily Goods Transport Volume in the Makassar-Gowa and Makassar-Maros City Border Regions in 2022

Outlet	Truk 2 As	Truk 3 As	Goods Volume (tons)
Gowa-Makassar (Tamalate)	7.787	96	94.580
Gowa-Makassar (Samata)	956	219	14.095
Maros-Makassar	13.305	164	161.629
Amount	22.048	479	270.304

Source: Data Processing, Balitbang (2015)

There are two ways that freight travels between Makassar City outlets: from/to KIMA to locations outside Mamminasata, and from/to districts to locations inside or outside Mamminasata. The Tallo River's development has the potential to significantly slow down continuous transportation, particularly for mining supplies. Due to a regional law that forbids freight transportation from working during the day, transport companies suffer significant financial losses as a result. On the other side, large cargo loads harm the roads that are traveled, particularly on local roads that are not designated as roadways for the transportation of products.

Based on the identification, it is clear that trucks hauling goods cross the Makassar City outlet region on their way from or to KIMA to locations outside the Mamminasata area, and they also cross the regency area on their way to locations inside or outside the Mamminasata area. The Tallo River's development has the potential to significantly slow down continuous transportation, particularly for mining supplies. Due to a regional law that forbids freight transportation from working during the day, transport companies suffer significant financial losses as a result. When it granted money for the maintenance of neighborhood roads that did not fit the definition of freight routes, the Regional Government of Mamminasata likewise encountered this issue. The average level of main road service in Makassar City is 0.52 and the expected daily population movement is 5000 trips, with a similarity of 20% during peak hours, as shown in table 7.

The road that connects Takalar and Gowa Regencies via Barombong Beach, the Moncongloe-Daya-Kapasa roads that are connected, and other roads with a higher value than 1:25, which is the ratio used to compare arterial, collector, and local roads, all became collector roads Parangloe-Patalassang-Moncongloe-Kariango-Maccopa, the main thoroughfare Jalan AP Pettarani is on the same level as the Jalan Ir Sutami Elevated Toll route, allowing for a reduction in the number of vehicles traveling on the route while still allowing access to the toll road leading to the port and Makassar Industrial Area. To lessen the amount of freight moving on the highway, logistics transportation nodes are not currently connected to other forms of transportation. The high costs and complexity of distribution channels often lead to poorly functioning logistics systems and chains, which in turn causes variances in food prices and inflation. As a result, ensuring the timely delivery of logistical products is essential (Prasidi et al., 2020).

Table 7. Predicted V/C Ratio, Mamminasata Congestion Ratio

`	Road Type	Wide (m)	Co (smp/jam)	Peak Hour Volume Direction			V/C
				1	2	3	
Rod P. Kemerdekaan (Makassar – Maros)	4/2 UD	14	5800	4542	4879	9411	1.62
Road Sultan Alauddin (Makassar - Gowa)	4/2 UD	14	5800	7959	7964	15599	2.08
Axis road Gowa Takalar (Gowa - Takalar)	2/2	7	2900	1648	1842	3296	1.14

Source: Data Processing, Balitbang (2015)

The development of distribution centers and goods connections will eliminate the concentration of building materials on the main road network, which affects road performance with a consolidated system in the region.

The river transportation system is expected to be affected by the transportation of goods across the city. clustering in emerging regions. As seen in figure 3, the creation of the distribution and collecting facility is anticipated to direct supplies away from the Mamminasata agglomeration center and toward the Tallo river channel.

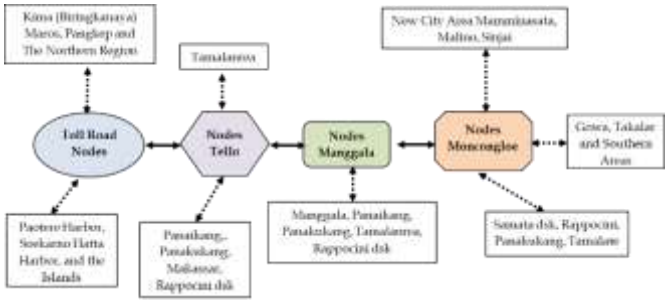

Figure 3. Shows the Tallo River's Pattern of goods and passenger transportation

To coordinate and integrate the current locations for loading and unloading passengers. Similar findings were found in Abidin's (2016) research, which suggests that river regeneration has a lot of potential for development as a substitute for existing urban land transportation. The placement of the node (pier) for passenger transportation is depicted in the following as illustrated in Figure 3.

Figure 3. Pattern of load transfer services for passenger and goods transportation (Ridwan, 2017)

Therefore, it is essential to model based on their functions by differentiating the specialization of operators that are independent of the subject of transportation and have a broad reach, which can benefit service recipients and the entire structure of the transportation system (Cieplińska, 2019). Transportation managers need to upgrade track movement node infrastructure in order to boost service frequency and expedite the transfer of products and people (Mandaku, 2022). In riverside locales, circulation models are used to enhance river transportation and create distinctive circulation patterns, preserving traditional local knowledge and enhancing the places' potential as tourist destinations in the future (Hamidah et al., 2014). As tourism icons, rivers and canals can be developed to draw visitors and enhance the standard of living for locals (Ma'rruf et al., 2015). However, river docks and canals can be used to carry local goods over the river, especially those that are going toward the city. They may also act as feeders, carrying goods and/or visiting important hubs to collect cargo that will be removed, according to Puriningsih et al. (2018).

This is because freight and passenger transportation operators that operate in an integrated manner in the metropolitan area. By merging two means of transportation, this can also be accomplished in the creation of a service model for the transportation of products and people in Makassar City.

Conclusion

The study and discussion above lead to the conclusion that travel potential has an annual impact on the development of regions/cities and economic activity in the Mamminasata Region. Due to the intensity of growth, particularly in the areas of housing, settlements, and urban facilities, people's transportation dependence on private automobiles has increased in a number of Makassar City sub-districts. Thus, this causes transportation issues in the form of traffic congestion at specific times, particularly on major roadways. Makassar thus receives items from both inside and outside of the nation due to its status as a commercial and industrial hub. Transfer of commodities is modified according to cost, the nature of the goods being transported, and the travel time. By building a service model for developing river transportation in Makassar City that is connected to and integrated with different activities, reducing distance and time without having to pass through the main highway, the development of transportation services for both goods and passengers can aid in the alleviation of congestion and decrease traffic. Road performance is anticipated to be impacted by the freight and passenger transport business paradigm in Makassar City. The Tallo River channel will receive commodities that would otherwise travel to Mamminasata's downtown if a distribution center and goods connection were built. With a service pattern that is consistent with their functions, this will govern the transportation of goods and passengers in metropolitan areas, which will be advantageous to service receivers and the overall design of the transportation system. In the meantime, Siswono et al. (2021) advise that small

boats, such as speedboats, jukung boats, katinting boats, and jolloro boats, be permitted to travel through Makassar City's canals. These boats are well-suited to the water's depth and are particularly useful in the city's marketplaces and densely populated residential areas.

Acknowledgements
The author expresses gratitude to all those who contributed to the completion of the project, whether directly or indirectly (internally or externally), beginning with the process of gathering field data to obtain and obtain primary and secondary data regarding the article. This. We sincerely hope for your assistance and cooperation in order to provide support for ideas and materials in order to correctly complete this article, which is anticipated to be extremely helpful in the advancement of knowledge.

Author Contributions
Kamran Aksa as the first author took the initiative to compile and create a concept for publishing scientific work from the beginning to the completion of the publishing process. Nur Syam Aksa as the second author assisted in the process of data analysis results and providing images and maps. Paulus Raga and Teguh Pairunan played a role in data completeness by reviewing the writing to provide corrections.

Funding
This research received no external funding.

Conflicts of Interest
The authors state that there are no conflicts of interest with the publication of this research, and they collaborate to point out any shortcomings.

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