

## **The Development of Infrastructure and Service Networks for Island Transportation in Makassar City**

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**Abstract:** The expansion of the Sangkarang Islands District and the tourism potential of small islands in Makassar City require a reliable transportation system to support the movement from/to small islands. This study aims to analyze (1) the availability and suitability of small islands transportation infrastructure and service networks, (2) small island community movement patterns, and (3) formulating directions for the development of small islands transportation infrastructure and service networks in Makassar City. This research is a descriptive study with quantitative and qualitative approaches. The data collection method is in the form of field observations such as interviews using a questionnaire and also using secondary data. The analytical method used for the availability and suitability of the archipelago transportation infrastructure and services network is a qualitative descriptive analysis. For the movement pattern, it was analyzed with Origin-Destination Matrix (ODM). Meanwhile, to formulate directions for the development of the infrastructure and service networks, an analysis of external and internal factors is used. The results showed that the availability and suitability of the archipelago transportation infrastructure and services network were still low, especially the mode and route shift nodes. On holidays, the highest movement generation was on Kodingareng Island as many as 261 people/day, BarrangLompo Island with 186 people/day, and Samalona Island is much as 160 people/day, meanwhile, the movement to the center of Makassar City as much as 607 per day. The development priority strategy is the W-O strategy, namely the development of modal transfer facilities at the crossing nodes of small islands; improve the performance of mass transportation services that are integrated with the crossing nodes of small islands; land acquisition at the Fort Rotterdam and KayuBangkoa nodes; and planning of crossing nodes for long-term use.

**Keywords:** Transportation, infrastructure, services, node, Sangkarang

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### **I. Introduction**

Makassar City is located on the west coast of South Sulawesi which is a crossroads crossing from north to south and from west to east, not only has a land area (99.2%) but also has an archipelago area (0.8%) of the total. Makassar City has an area of 175.77 km<sup>2</sup>. Based on the data, Makassar City has 11 small islands namely Lanyukang Island, Langkai Island, Lumu-Lumu Island, Bonetambung Island, KodingarengLompo Island, KodingarengKeke Island, BarrangLompo Island, BarrangCaddi, Samalona Island, Kayangan Island, Lae-lae Island, and Lae-lae Kecil Island (Department of Marine, Fisheries, Agriculture and Livestock of Makassar City, 2014)<sup>[1]</sup>.

The development growth of the archipelago region is still far behind compared to the development of the mainland area of Makassar city. The socio-economic life of the island community is still a problem and is currently receiving the attention of the city government. High poverty rates, low school-age participation, and low community access to health and education services are conditions experienced by island communities today. The accessibility and connectivity of small islands to Makassar City are one of the causes of socio-economic problems for small island communities. The availability of adequate and smooth transportation services provides social and economic benefits, including providing educational services and health services to various areas that are scattered because already available transportation service network that is evenly distributed in the regions and can stabilize the price of goods (Adisasmita, 2011)<sup>a</sup>[2].

The development of archipelagic areas requires a concept which has the main objective of realizing a balance between land and water areas (sea) between regions and islands, especially in terms of growth rates, social justice, as well as enabling balanced development and trade between regions (islands); and the realization

of a balance between regions also means that the economic unity of the mainland islands and waters becomes strong (Narua, 2011)<sup>[3]</sup>.

The expansion of the Sangkarang Islands District from the Ujung Tanah District is one of the strategies of the Makassar City government in the context of equitable development and facilitating access to services to the community as well as efficiency and effectiveness in government, education, health, and social administration. The area of Sangkarang Subdistrict is 1.54 km<sup>2</sup> (0.87%) of the city area, which consists of 4 (four) villages, namely Barrang Caddi, Barrang Lompo, and Kodingareng Villages (BAPPEDA Makassar City, 2016)<sup>[4]</sup>. The population in the archipelago in 2016 reached 12,505 people (Central Bureau of Statistics, Makassar City, 2016)<sup>[5]</sup>.

The development rate of development on these islands has not shown any significant progress and the orientation of community economic activities are still focused on fishing activities. Even though the potential to develop these islands into tourist objects is very large because they are relatively close to the center of Makassar City and the island's environment is quite attractive with a stretch of white sand and quite interesting underwater panoramas, there are 5 (five) islands that present beauty, underwater which is rich in biodiversity as an attractive point for tourists. These issues encourage the development of an archipelagic transportation system in Makassar City.

The network of transportation infrastructure and services to support the movement to and from small islands is still very limited, especially port infrastructure and docks (Djamaluddin, 2010)<sup>[6]</sup>. To reach small islands from Makassar City, there are 4 (four) crossing nodes, namely the Kayu Bangkoa crossing pier, the Fort Rotterdam crossing pier, the Paradise island crossing dock, and the Paotere port. These nodes only provide docks without being equipped with adequate knot facilities. In terms of service, regular transportation only serves the central route of Makassar City to Barrang Lompo Island, Barrang Caddi Island, and Kodingareng Lompo Island, with a service frequency of one trip per day. Meanwhile, to reach other islands you have to use a charter boat. This condition causes the mobility and connectivity of small islands to the city center of Makassar is still very low. This research aims to analyze the condition of the transportation infrastructure and services network for the Makassar city islands and formulate directions for its development so as to realize the implementation of an effective and efficient archipelagic transportation system in supporting and drive the dynamics of development, increase the mobility of people, goods and services.

## **II. Material and Method**

### **Research Location and Design**

This research was conducted in January-May 2016, in Makassar City at the crossing node of small islands and 3 small islands, namely Kodingareng Lompo Island, Barrang Lompo Island, and Samalona Island. The selection of the 3 (three) islands is based on criteria, namely (1) the island with the largest population, (2) tourism potential, and (3) direction of government policies related to public services. This research is a quantitative descriptive research approach, with survey research methods.

### **Population and Sample**

The population in this study was divided into 2 (two), namely (1) small island households in Makassar City, and (2) movers at the crossing nodes. The population of small islands and movement actors at the crossing nodes were used to analyze the origin of the movement.

### **Data collection technique**

The sampling technique used in this study is probability and non-probability sampling. Small island household population uses probability sampling techniques. The population in this study has a known exact number so that the sampling uses the Slovin formula. The total household population is 1,303 households so that the total sample size in this study is 116 households consisting of 61 households Kodingareng Lompo Island, 52 households Barrang Lompo Island and 3 households Samalona Island.

The sampling technique for the movers at the crossing nodes is carried out by using a non-probability sampling technique with the accidental sampling method, namely sampling by choosing who happens to be there is found at the research location.

Primary data collection techniques are carried out by means of field surveys, questionnaires, and interviews. Field surveys were conducted to collect physical data on crossing nodes. The questionnaire was used to find out information on the origin and destination of the movements of small islands. There are 2 (two) types of questionnaires, namely (1) a household survey questionnaire to find out information on the characteristics and movement patterns of small island residents, and (2) an origin-destination survey questionnaire to find out information on the origin and destination of movement actors at the crossing nodes of small islands.

Secondary data is in the form of urban road networks, shipping lanes, land use, urban transport routes, population, potential islands, and related documents such as the spatial plan for the City of Makassar and the Zoning Plan for Coastal Areas and Small Islands in Makassar City.

### **Data Analysis Techniques**

The analytical methods used for the availability and suitability of the archipelago transportation infrastructure and services network are qualitative description analysis and Process Hierarchy Analysis (AHP). Movement patterns were analyzed using Origin-Destination Matrix (ODM) analysis, and analysis of external and internal factors to formulate directions for the development of infrastructure and service networks.

### **III. The Results**

Makassar City is a city located on the coast with great appeal and potential, consisting of 14 districts with an area of 17,577 hectares. The entire length of the coastline of Makassar City is 52.8 km which consists of a coastline of 36.1 km of coastal areas, and 16.7 km of coastlines of islands and Gusung. In the sea area of Makassar City, there are 11 islands, 2 Gusung, and about 26 Taka scattered. The farthest island is Lanyukang Island, 40 km from Makassar City, while the closest is Lae-Lae Island, 2 km from Makassar City.

Not all small islands in Makassar City have regular transportation with a fixed schedule. Islands that have regular transportation are KodingarengLompo Island, BarrangLompo Island, and BarrangCaddi Island. This ferry has a motor power of 110-125 PK with a schedule of only once a day, anchoring at the KayuBangkoadock. For Lae-lae and Kayangan Islands, transportation facilities are available at any time. Meanwhile, Samalona Island, Bonetambung Island, Langkai Island, Lanyukang Island, and Lumu-Lumu Island can be reached by using a chartered motor boat.

KodingarengLompo Island is 15 km from Makassar City, with an area of 14 hectares and a population of 4,170 people. In 2015, it is the island with the highest population. KodingarengLompo Island is served by regular transportation with a regular fleet of 4 (four) units at a rate of IDR 15,000 per trip. BarrangLompo is 13 km from Makassar City, with an area of 19 hectares and a population of 3,563 people in 2015. BarrangLompo Island has better public facilities than other islands; there are education, health, and village office facilities. This island is served by regular transportation with the number of ships is 3 units at a rate of IDR 10,000 per trip. Samalona Island has a panoramic view of white sand, snorkeling spots, and fishing, making it one of the most popular places for Makassar City people to enjoy white sand or swim. This island is 7 km from Makassar City, with an area of 2 hectares and a population of 82 people in 2015. There is no regular transportation available on this island; to access it you must charter a 40 PK motorboat with a capacity of 10 people with a rental fee of IDR 400,000 - IDR 500,000 round trip.

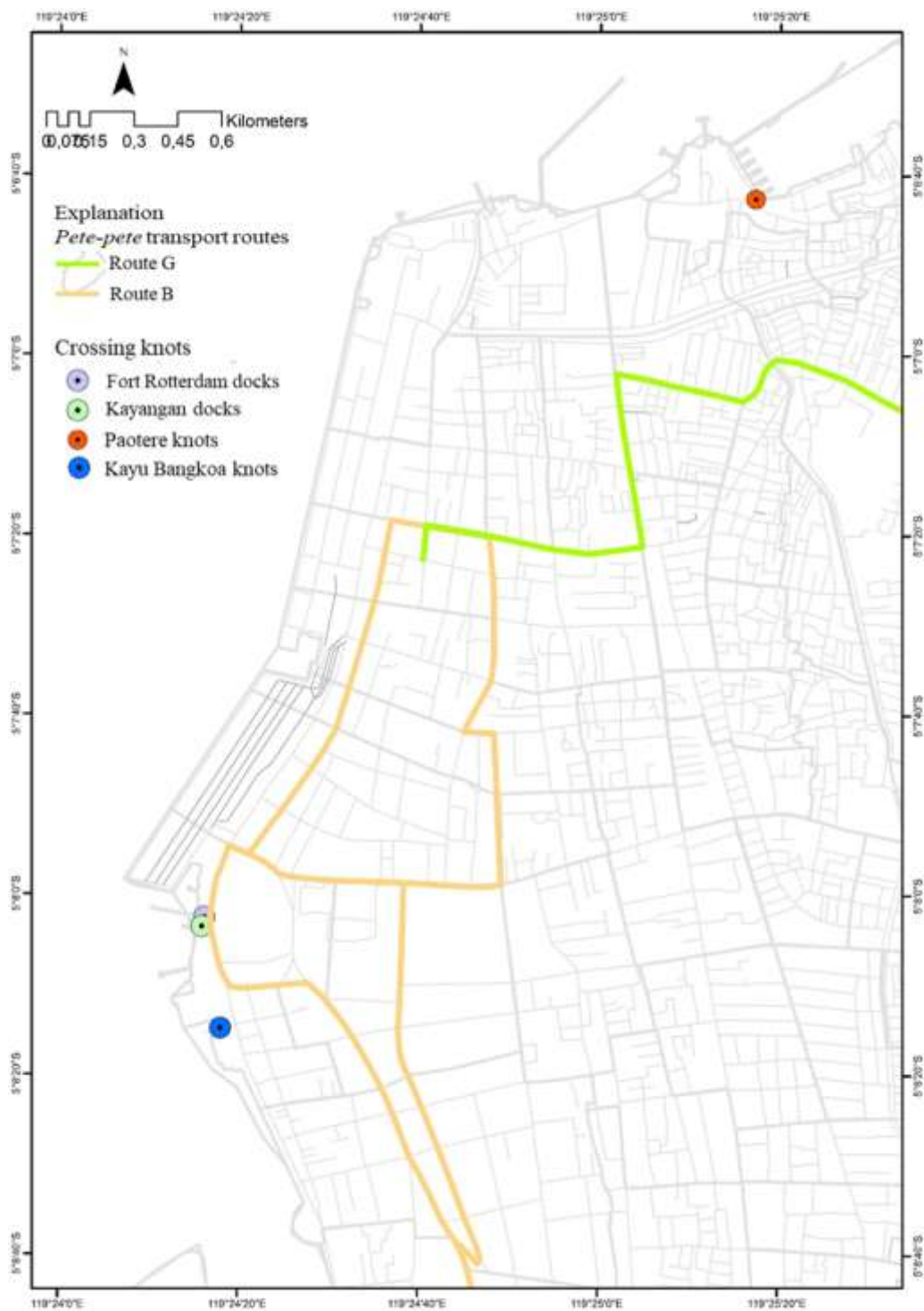
To reach these islands, crossing nodes are available, namely the KayuBangkoadock, the Kayangan Island crossing pier, the Fort Rotterdam crossing dock and the Paotere Port. The KayuBangkoadock crossing node is located in Bulogading Village, Ujung Pandang District. The KayuBangkoadock crossing node has an area of 820 m<sup>2</sup> with land use around the node dominated by trade and service activities 30.07%, tourism areas 25.06%, and residential areas 11.9% and others. This node is served by a primary arterial road network, namely the *PasarIkan* road, which is a road that connects the sub-PPK VI area with the PPK I area.

The Fort Rotterdam crossing node and Kayangan Island crossing are side by side, located in Bulogading Village, Ujung Pandang District. It has an area of 1.06 Ha and 0.156 Ha respectively, with land use dominated by trade and services 37.7%, transportation (port area) 30.2% and tourism 9.2%. These two nodes are served by a primary arterial road network, namely Jalan Ujung Pandang. The facilities owned by the Fort Rotterdam node are a pier and a vehicle parking area, while at the KayanganIsland crossing node, there are a dock, parking area, management office, clean water, and electrical installations.

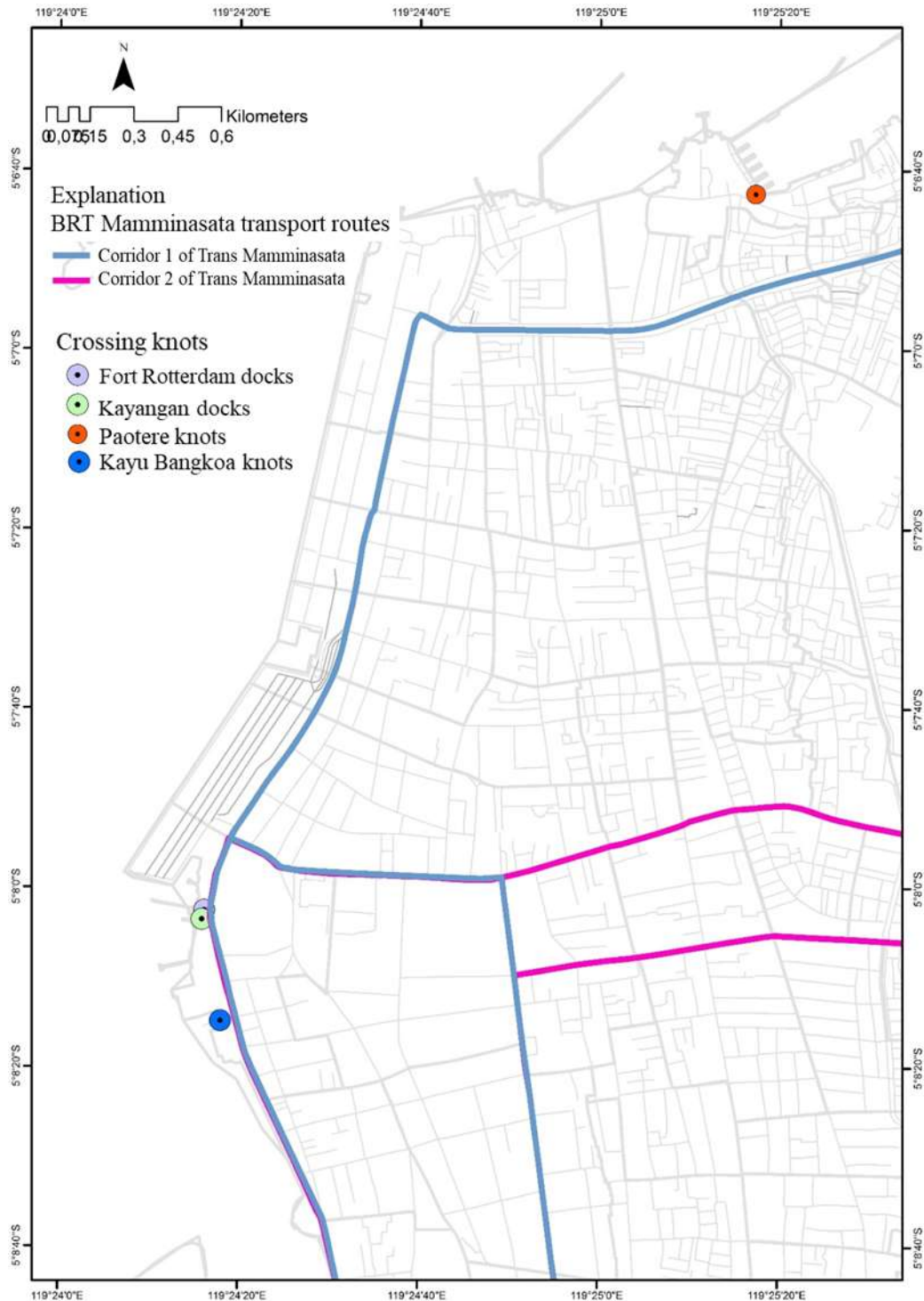
The Paotere Harbor knot is located in Gusung Village, Ujung Tanah District. Paotere Port has a land area of 3.38 Ha, with the dominance of land use in the form of settlements of 60.74%, the port area of 7.7 Ha, education area 11.18%, and trade and services 8.07%. The Paotere node is served by a local road network, namely 'SabutungBaru road', which is an urban road network that connects residential areas in the subdistrict of Gusung and Cambaya to the city center. The facilities owned by the port of Paotere are a pier, refueling facilities, clean water and electricity installations, a vehicle parking area, an office, and a port development area.

The shipping lanes in the waters of Makassar City have been stipulated in the zoning plan for the coastal areas and small islands of Makassar City. The shipping channel zone refers to the conditions of the shipping lanes which are often used locally, regionally/nationally, and internationally. Makassar port shipping lane is 25 miles long and 1 mile wide with a minimum depth of 10-16 m LWS.

The existing regular routes are KayuBangkoa-BarrangLompo Island, KayuBangkoa-BarrangCaddi Island, and KayuBangkoa-KodingarengLompo Island, and pete-pete transportation route code route B. Meanwhile, the Bangkoa Timber crossing and Paotere Port are not served by public transportation routes. The routes of public transport 'pete-pete' and Mamminasata Mass transit can be seen in Figures 1 and 2.



**Figure 1.** Public Transportation Routes (Pete-Pete) Serving Small Island Crossing Nodes in Makassar City  
**Source:** Results Analysis, 2016

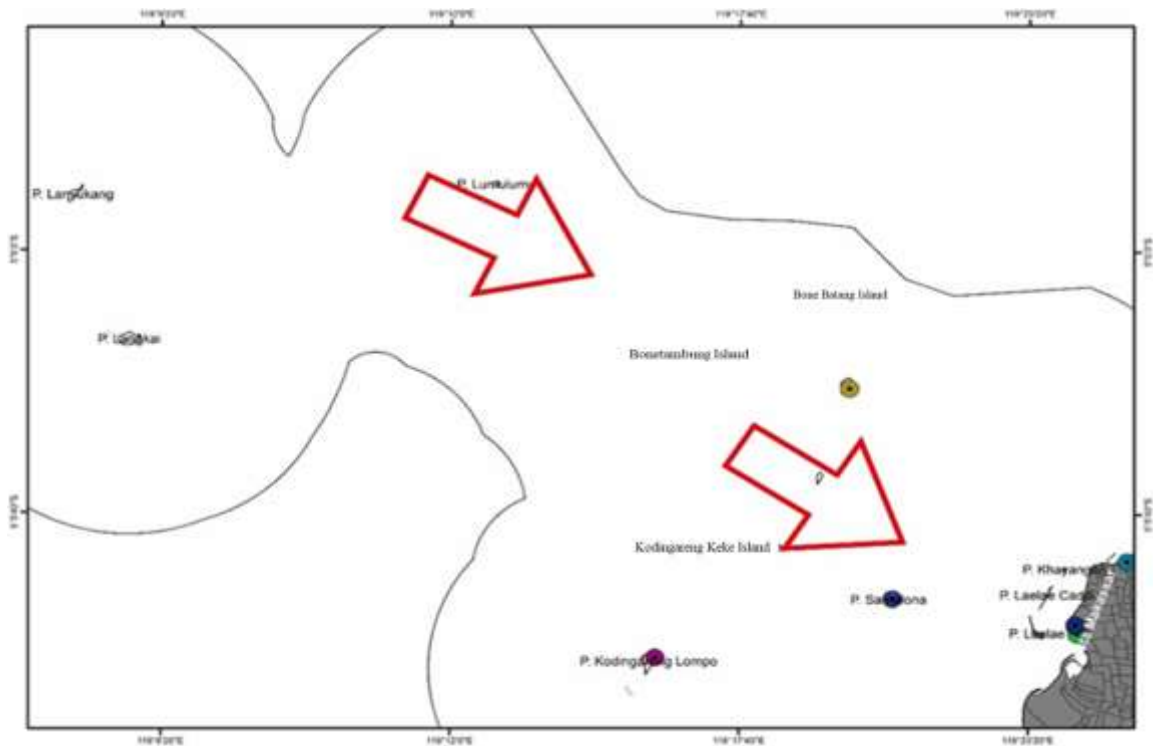


**Figure 2.** Trayek Transport Mass (BRT) Mamminasata Serving Small Island Crossing Nodes in Makassar City  
**Source:** Analysis Results, 2016

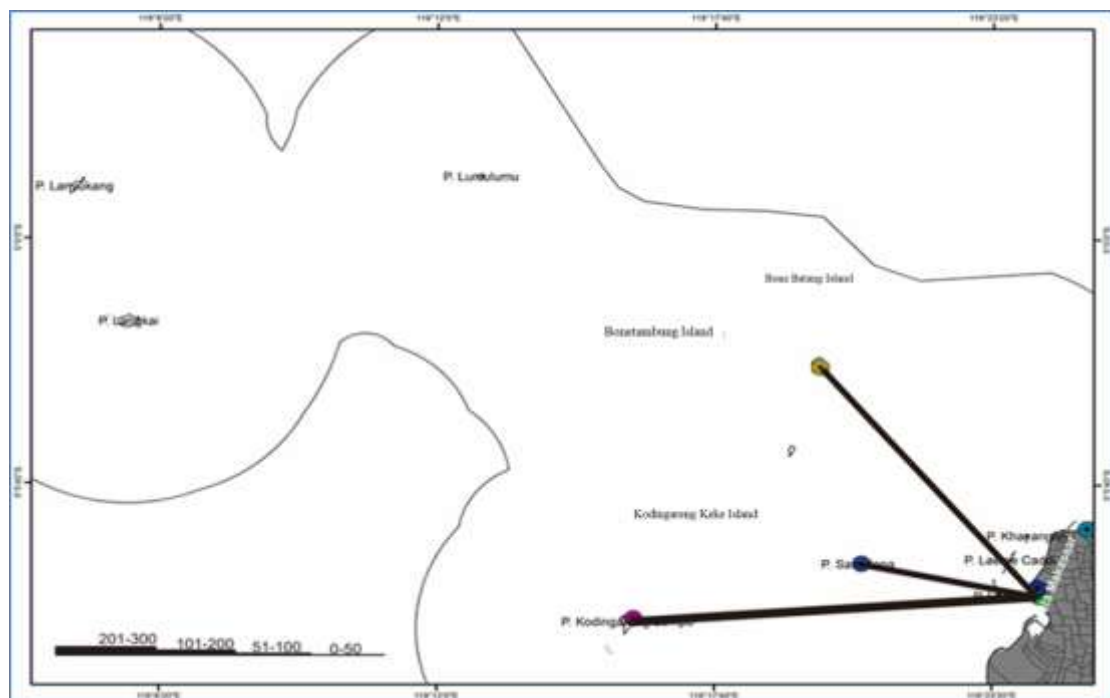
Based on the results of the household survey, data shows that the intentions of the movement of the islanders are shopping, work, visiting relatives, and education. The purpose of movement on the island of Kodingareng Lompo is 40.22% for work, 32.61% for shopping, and 26.09% for visiting relatives. On the island of Barrang Lompo 47.30% for shopping, 24.32% for work, 6.76% for social, and 1.35% for education, while on the island of Samalona 75% for shopping and 25% for social.

On holidays, the interaction for the purpose of movement between Kodingareng Island-Makassar City is 261 people per day, Barrang Lompo Island-Makassar City is 186 per day and Samalona Island-Makassar City is 160 per day. On weekdays, the destination interactions between Kodingareng Lompo islands Makassar City are 209 people/day, Barrang Lompo Island - Makassar City Center is 146 people/day, and Samalona Island - Makassar

City Center is 36 people/day. Projections of population movements in 2016, 2020, and 2025 are obtained based on the ODM movement data population in 2015 with an average growth of population movement in small islands is assumed to be the same as the average population growth in Ujung Tanah District, namely 0.83%. The movement pattern and desire line of small island communities can be seen in Figures 3 and 4.



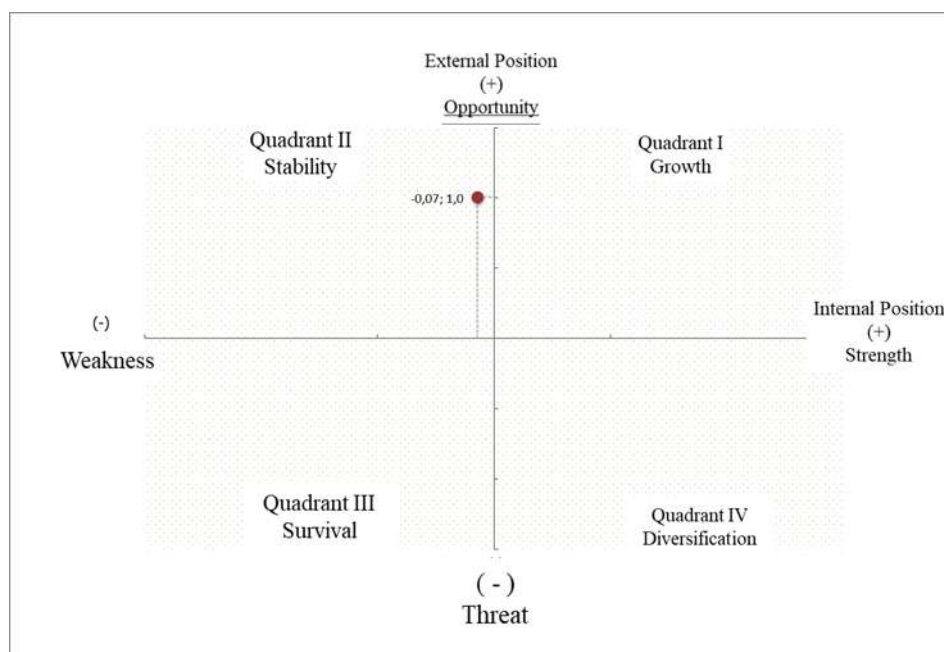
**Figure 3.** The Movement Pattern of Small Islands Communities in Makassar City  
**Source:** Analysis Results, 2016



**Figure 4.** Desire Line for Small Island Communities in Makassar City  
**Source:** Analysis Results, 2016

The formulation of a strategy for developing the transportation infrastructure and services network for the islands of Makassar City is carried out by analyzing internal (strengths and weaknesses) and external (opportunities and threats) factors. Identify strategic factors that are selected from each category of strengths, weaknesses, opportunities, and threats. The strategic factors for the strength category are (1) the movement of people from and to small islands increases every year, (2) development and construction of crossing nodes in accordance with the spatial plan for the City of Makassar, and (3) availability of public transportation routes ‘pete-pete’ and BRT Mamminasata mass transportation serving the Fort Rotterdam and Kayangan nodes. The categories of weakness are (1) inadequate modal transfer facilities at crossing nodes, (2) public transport ‘pete-pete’, and mass BRT service patterns that are unscheduled, regular, and integrated with other corridors, (3) land availability at the nodes very minimal crossings. Opportunity categories are (1) Makassar City Government policy related to the expansion of Sangkarang District, (2) the development and construction of a jetty on small islands and crossing nodes in Makassar City, (3) government policies that support the development of intermodal transportation to realize transportation effective and efficient islands. While the threat category, namely (1) the government's attention to the implementation of urban transportation development policies (land and crossings) is still very low, (2) the potential for traffic jams on roads that serve crossing nodes in the center of Makassar City.

Based on the total weight value, the priority for the development of the transportation network infrastructure and services for the Makassar City archipelago with the W-O strategy is a strategy of using opportunities to eliminate threats. The grand strategic matrix can be seen in Figure 5.



**Figure 5.** The Grand Strategic Matrix for the Development of the Makassar City Islands Transportation Network and Service Network

**Source:** Analysis Results, 2016

#### IV. Discussion

This research shows that the condition of the availability of archipelagic infrastructure and service networks in Makassar City is still low, especially mode shift nodes and integration of ferry routes with road transportation. According to Adisasmita (2011<sup>b</sup>)[7], the marine transportation infrastructure network consists of nodes in the form of seaports and traffic space, which takes the form of shipping lanes. Meanwhile, the sea transportation service network is in the form of routes.

The node is one of the places that function for the activities of raising and/or dropping passengers, unloading and/or loading goods, arranging trips as well as a place for intra-mode and intermodal transfer, 61 of 2009 that seaport facilities to be used to serve ferry transportation include land and water facilities. Land facilities include (1) jetty, (2) offices for government activities and services, (3) passenger terminals, (4) bunker facilities, (5) clean water, electricity and telecommunications installations, (6) road access, (7) fire fighting facilities, (8) parking lots and (9) development areas. Water facilities include (1) shipping lanes, (2) ship mooring facilities, (3) anchoring waters, (4) port pools for mooring, and ship handling needs.

Based on the availability of facilities, the Paotere Port node has the most complete port facilities between the Bangkoa, Fort Rotterdam, and Kayangan Island crossing nodes. Other things that are taken into consideration are public transportation services, road infrastructure, and land use around the node. According to Wunas (2011)<sup>[8]</sup>, Transit-Oriented Development (TOD) is a transit-based development concept, which is integrated with several elements of urban and regional space, including public transportation and road infrastructure, as well as mixed land functions. The TOD component consists of (1) circulation network, (2) Bus Rapid Transit and its stops, (3) pedestrian and bicycle facilities, (4) public facilities such as parks, plazas, fitness centers, schools, libraries, post offices, etc.

Shipping lanes are waters which in terms of depth, width, and other shipping barriers are considered safe and safe to navigate. Shipping lanes are used to direct ships that will enter the port pool. Shipping lanes and port pools must be calm enough against the influence of the waves and currents (Triatmodjo, 2003)<sup>[9]</sup>. with a minimum depth of 10-16 m LWS, and a channel boundary has been made provided that on the left and right sides of the channel a border of 250 meters is made (sub-national shipping zone) or twice the length of the ship crossing the ship.

The integrity of the island transportation service network is still very low. Regular ferry routes that serve 3 (three) docking islands at the BangkoaKayuSimpul, however, public transportation services in the form of 'pete-pete' and mass BRT transportation at this node are not available. The 'pete-pete' transportation route B which stops at the KayuBangkoa node has a route not via PasarIkanroad, while the Mamminasata BRT mass transportation does not have a stop at the KayuBangkoa node. Pete-pete transportation services and BRT Mamminasata mass transportation are only available at the Fort Rotterdam crossing node and the Kayangan Island crossing.

The results of the process hierarchy analysis (AHP) for determining the potential nodes, obtained the potential nodes, namely the Fort Rotterdam crossing node and the Bangkoa Wood node. The process hierarchy analysis (AHP) uses criteria, namely the availability and suitability of land, availability, and suitability of road networks, availability and suitability of service networks for archipelagic transportation routes and further routes, and available node facilities..

According to Tamin (2003)<sup>[10]</sup>, movement generation is the number of movements originating from a zone or land use and the number of movements attracted to land use or zone, whereas according to Miro (2005)<sup>[11]</sup>, movement generation can be interpreted as a large number of traffic movements, generated by a zone (area) per unit time. The rise of the largest community movement on the island of KodongarengLompo and then BarrangLompo is caused by land use on the island which is dominated by residential areas of 74.69% and 63.74%, and the movement of movement to Makassar City through the Bangkoa Wood crossing node. Samalona Island with the potential for tourist attraction creates movement and tends to increase on holidays.

The movement pattern of small island communities tends towards the center of Makassar City. The movement pattern towards the center of Makassar City is distributed based on the distance of the island from the center of Makassar City and the purpose of movement. Islands within proximity are KayanganIsland, Lae-lae Island, KodongarengLompo Island, BarrangLompo Island, BarrangCaddiIsland, and SamalonaIsland to KayuBangkoa jetty, Fort Rotterdam pier, and Kayangan jetty. Meanwhile, islands with a relatively further distance are BonetambungIsland, Lumu-lumuIsland, LanyukangIsland, and LangkaiIsland to Paotere harbor / Paotere canal. The interaction between islands tends to below, while the interaction between small islands and the center of Makassar City is very high.

Based on the analysis matrix of SO, WO, ST, and WT strategies, a strategy for the development of archipelago transportation infrastructure and service networks is formulated as follows: SO development strategy, namely (1) Development of archipelagic transportation facilities and infrastructures such as island docks and modal shift nodes in the framework of support the movement pattern from/to and between islands, (2) improve the performance of the BRT Mamminasata mass transport route through the Fort Rotterdam and KayuBangkoa crossing nodes. The WO development strategy, namely (1) building mode transfer facilities at the Fort Rotterdam and Bangkoa wood crossing nodes, (2) improving the performance of mass transportation services that are integrated with island crossing nodes, (3) Land acquisition at the Bangkoa Wood crossing nodes and fort Rotterdam to build node facilities and (4) planning a crossing node for long-term use. The WT development strategies, namely (1) increasing the capacity of human resources and strengthening urban transportation institutions to realize quality urban transportation planning with good implementation. (2) The Makassar City Government coordinates with the provincial government regarding the planning of the Mamminasata BRT mass transit corridor so that it is integrated with the crossing nodes of small islands. The ST development strategy, namely (1) the government encourages the involvement of the private sector in investing (public-private partnership) in the development of urban transportation systems (2) the development of facilities and infrastructure at crossing nodes that are integrated with the urban transportation system to anticipate potential traffic congestion at these nodes, crossing nodes, such as transit-oriented development, pedestrian, part and ride, mass transportation based on buses and rail. An urgent strategy for the development of infrastructure networks and island transportation services based on the results of the SWOT analysis is the WO strategy.



#### **IV. Conclusions And Recommendations**

The condition of availability and suitability of archipelagic transportation infrastructure and service networks is still low, especially at the mode shift node and the integration of the service network for small islands crossing with road transportation in the city of Makassar. The potential nodes developed are the Fort Rotterdam crossing node as a tourist node and KayuBangkoa node as an economic node. The movement pattern of small island communities is centered in the center of Makassar City, while the interaction between islands is relatively low. The highest movement generation was on Kodingareng Island and BarrangLompo, while the movement was to the center of Makassar City and Samalona Island. The development priority strategy is the W-O strategy, namely the construction of modal transfer facilities at the island crossing nodes; improve the performance of mass transportation services that are integrated with the island crossing nodes; land acquisition at the Fort Rotterdam and KayuBangkoa nodes; and planning crossing nodes for long-term use. Financing for infrastructure development, especially transportation, does not only have to come from the APBD and APBN, but can be carried out by the private sector through the Public-Private Partnership program, therefore the City government is expected to encourage private involvement in an investment in the archipelago transportation infrastructure sector.

#### **References**

- [1] Department of Marine, Fisheries, Agriculture and Livestock (2014). Coastal Zone and Small Islands Zoning Plan in Makassar City. Makassar: Makassa City Government
- [2] Adisasmita S. A. (2011<sup>a</sup>). Transport and Regional Development. Yogyakarta: Graha Ilmu
- [3] Narua L. A. (2011). Inter-Island Sea Transportation Development Strategy in the Context of Increasing Regional Economic Development. Bogor: Bogor Agricultural University
- [4] BAPPEDA of Makassar City. (2010). Makassar City Spatial Plan 2015-2035. Makassar: Makassar City Government
- [5] Central Bureau of Statistics Makassar City. (2016). Makassar City in Figures 2016. Makassar: BPS Makassar City
- [6] Djamaluddin I. (2010). Development of Inter-Small Island Transportation in the City of Makassar. FSTPT XIII Symposium (p. 1). Semarang: Soegijapranata Catholic University Indonesia. Government Regulation on Ports, Government Regulation No. 61 of Central Bureau of Statistics
- [7] Adisasmita S. A. (2011<sup>b</sup>). Transportation Network (Theory and Analysis). Yogyakarta: Graha Ilmu
- [8] Wunas S. (2011). Humanist City (Integration of Land Use and Transportation in Suburban Areas). Surabaya: Brilliant International
- [9] Triatmodjo B. (2003). Port. Jogjakarta: Beta Offset
- [10] Tamin O. Z. (2003). Transportation Planning & Modeling (Sample Questions and Applications) First Edition. Bandung: Bandung Institute of Technology
- [11] Miro F. (2005). Transportation Planning for Students, Planners and Practitioners. Jakarta: Erlangga Publisher

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