6. MBD Acquisition and Population Flow Analysis

6.1 MBD Acquisition

6.1.1 MBD Acquisition Process

Common methods of acquiring MBD include acquiring location information via smartphone application GPS data, cell phone base station data, Wi-fi access point data, etc. Of these, the smartphone application GPS data used in this project is acquired through the SDK (Software Development Kit) installed in the application, and the data acquisition process involves acquiring the latitude, longitude, time, and device ID information of the smartphone on which the application is installed. This is the data acquisition process.

Source: Nippon Koei

Figure 6-1 MBD Acquisition Process through SDK

6.1.2 Selection of MBD Provider

In order to acquire a sufficient amount of the latest MBD that could be used for public transportation planning, the Study Team collaborated with SoftBank's local subsidiary in Indonesia (PT. SB Telcom Indonesia Corp.) to select and negotiate the purchase of external data. In making the selection, the Study Team confirmed the data items, amount of data in possession, etc., and emphasized the importance of being able to purchase MBD with a large number of acquired data, high accuracy, and most suitable for the analysis of the target area.

The following MBD providers were selected, and their characteristics, such as data items and the amount of data held, were compared, and organized. As a result of these comparisons, "ADA" was selected as the data supplier because it is considered to have more data (number of ID) in Indonesia, and to have the necessary data items and sufficient data volume for conducting the analysis.

Table 6-1 Feature Comparison of MBD Providers

MBD Provider	Company Profile	Data Items	Number of Data held in Indonesia
Onemata	Headquartered in the U.S., the company holds cell phone location data on approximately 860 million people in more than 200 countries.	GPS data Advertisement ID	36.5 million ID
Lifesight	Headquartered in Singapore, providing offline services for digital advertising, primarily using location-based information.	GPS data Advertisement ID	14 million ID (Number of active users by month)
ADA	Headquartered in Singapore and Malaysia, the company uses location information to provide a wide range of analytical information on consumer behavior, including behavioral characteristics and attributes.	GPS data Advertisement ID	155 million ID

Source : Nippon Koei

6.1.3 Selection of Areas to Purchase MBD

In purchasing the MBD from ADA, it was necessary to select five areas within South Sulawesi Province due to the purchase budget. Therefore, as shown below, a list of public transportation operations, data volume, and population for each area to be analyzed was compiled, and the selected cities were discussed at a meeting (the second meeting) with South Sulawesi Province Transportation Office, Makassar City Transportation Office and related agencies.

As a result of the discussions, four regions in Maminasata metropolitan area: Makassar City, Maros Regency, Gowa Regency, and Takalar Regency are selected. In addition, it was agreed to add Pare Pare City, which could become a hub for the movement of people and goods between Nusantara and other regions.

Table 6-2 List of Regions Eligible for MBD Purchases

Location Name	Selection Result	Main Transport	Feeder Transport	MBD data volume (number of users in August 2023 (persons))	Population (2023)
Makassar City	○	✓Teman Bus	✓Pete Pete	278,535	1,436,626
Maros Regency	○	✓Teman Bus M-P Railway	✓Pete Pete	62,709	410,699
Gowa Regency	○	△Teman Bus (currently suspended)	✓Pete Pete	102,863	793,061
Takalar	○	✓Teman Bus	△Pete Pete	17,797	307,445

Regency			(currently suspended)		
Pangkep Regency		✓M-P Railway	✓Pete Pete	31,417	354,614
Barru Regency		✓M-P Railway	✓Pete Pete	21,381	188,285
Pare Pare Regency	○	-	✓Pete Pete	23,745	156,795
Bone Regency		-	✓Pete Pete	53,794	819,590

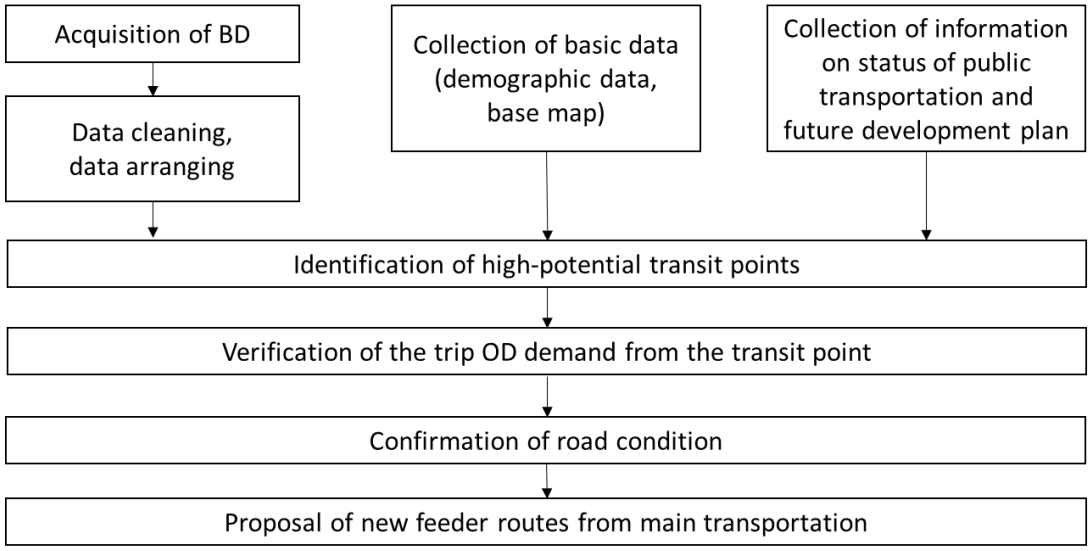
Source : Nippon Koei

6.2 Result of MBD Analysis

6.2.1 Method of Analysis

(1) Analysis Process

The overall data analysis process is shown in Figure 6-2. Based on the cleaned and arranged data, areas with high trip demand are identified, OD is visualized, and finally feeder routes are proposed.



Source: Nippon Koei

Figure 6-2 Data Analysis Process

(2) Data Item

As shown in Table 6-3, the MBD data items obtained from ADA include device ID, latitude, longitude, and time, and this GPS information was used to analyze trip demand in the target area.

Table 6-3 Example of Data Item

device id	lat	long	timestamp
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.15477	119.4369	2023/11/1 7:28
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.15348	119.4371	2023/11/1 7:30
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.14407	119.4385	2023/11/1 7:31
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.13511	119.4264	2023/11/1 7:36
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.13495	119.4242	2023/11/1 7:36
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.13487	119.4226	2023/11/1 7:37
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.12686	119.4185	2023/11/1 7:39
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.12312	119.418	2023/11/1 7:40
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.12313	119.418	2023/11/1 7:40
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.12186	119.4117	2023/11/1 7:42
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.12187	119.4117	2023/11/1 7:42
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.12194	119.412	2023/11/1 7:44
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.1204	119.4122	2023/11/1 7:48
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.1203	119.4121	2023/11/1 7:48

Source: Nippon Koei

(3) Data Cleaning & Arranging

The MBD in raw data format is likely to contain data that is outside of analysis area or of low accuracy, and it is not possible to determine whether an individual is in the status of “stay” or “trip”. Therefore, a process of data cleaning and arranging was conducted to improve the accuracy of the data and to prepare it for the necessary analysis.

The definition and processing method of data cleaning and arranging are shown in Figure 6-3.

Flow	Procedure	Purpose of processing	Processing Method
Step 1	Data Cleaning	Removal of unreliable or unusable data for analysis	• Delete entries with only one data point per day • Delete points where calculated speed is extraordinary
Step 2	Data Arranging	Determination of points into “Trip” and “Stay” status	• Classify data status (“Trip” or “Stay”) based on the following definition

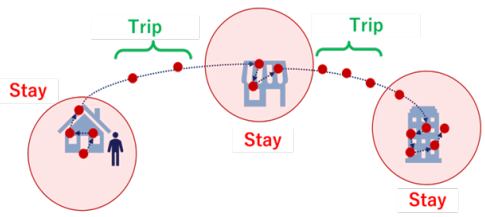


Image of data arranging
(Determination of “Trip” and “Stay”)

Definition of classifying “Trip” and “Stay”

Stay point:
A point where one has stayed for more than 20 min within a 150m radius

Trip point:
Stay points where one has moved more than 300m within 2 hour

Definition of data arranging

Source: Nippon Koei

Figure 6-3 Definition of Data Cleaning & Arranging

In addition, since the amount of data handled in the cleaning and arranging of big data is large and difficult to process with Excel or other software, programming was used to perform the process. Specifically, SQL as shown in Figure 6-4 was constructed and executed through AWS

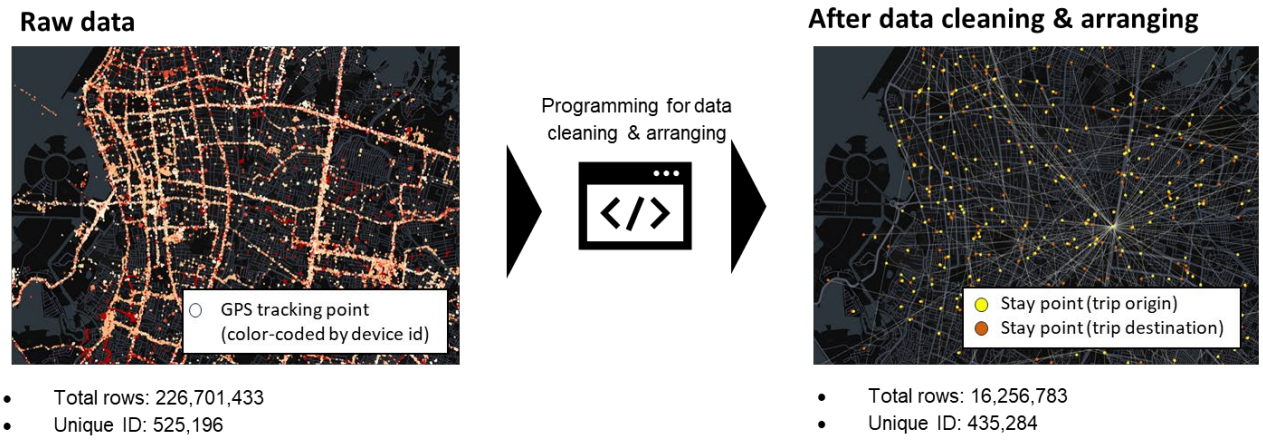
Athena.

```
CREATE TABLE "Maminasata.MBD" AS
SELECT * FROM (
SELECT dev_ifa, lat, long, ts_start, lat_end, long_end, ts_end,
    dur_secs, dur_mins, dur_hours,
    round(dist_m, 0) AS dist_m,
    round(dist_km, 2) AS dist_km,
    round(dist_m/dur_secs, 2) AS ave_mps,
    round((dist_m/dur_secs)*3.6, 2) AS ave_kmph
FROM (
SELECT dev_ifa, lat, long, ts_start, lat_end, long_end, ts_end,
    date_diff('second', ts_start, ts_end) AS dur_secs,
    date_diff('minute', ts_start, ts_end) AS dur_mins,
    date_diff('hour', ts_start, ts_end) AS dur_hours,
    great_circle_distance(lat, long, lat_end, long_end) * 1000 as dist_m,
    great_circle_distance(lat, long, lat_end, long_end) as dist_km
```

Source: Nippon Koei

Figure 6-4 Example of SQL Code

By implementing data cleaning and arranging through SQL, in addition to reducing the number of data, the starting and ending points of daily trips can be identified. By processing one month's worth of raw MBD data in Makassar City, the number of data was reduced by about 10% (from 226,701,433 to 16,256,783), as shown in Figure 6-5, and the points of stay and the starting and ending points of trips are clarified. This process makes it possible to analyze and visualize where exactly many people are staying and where many trips are occurring.



Source: Nippon Koei

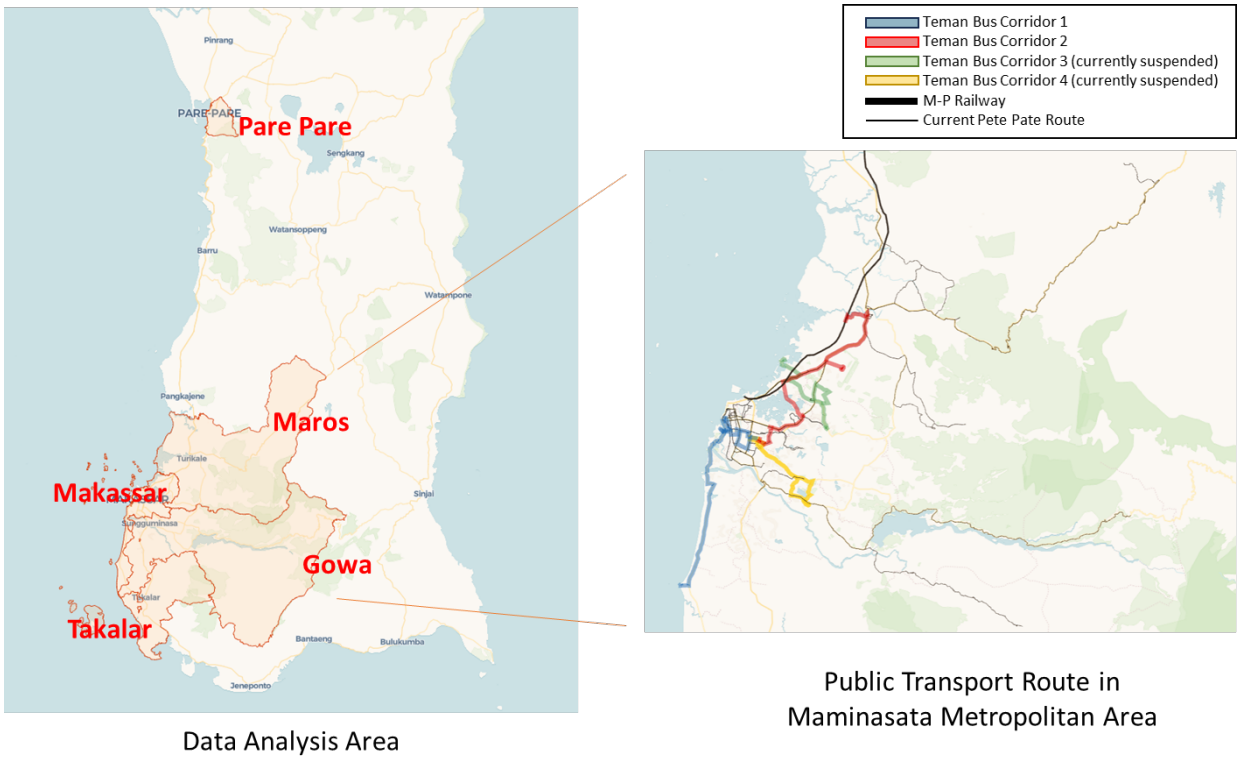
Figure 6-5 Processing Image of Data Cleaning & Arranging

(4) Data Analysis Approach

1) Data Analysis Area

The five areas for data analysis are shown in Figure 6-6 (Makassar City, Maros Regency, Gowa Regency, Takalar Regency, and Pare Pare City). Public transportation services such as Teman Bus, Pete Pete, and Makassar - Pare Pare Railway are in operation in Mamminasata metropolitan area (Makassar City, Maros Regency, Gowa Regency, and Takalar Regency). In order to propose feeder

transportation routes in these areas, the Study Team focused on bus stops and stations of trunk line transportation (Teman Bus and M-P Railway) and picked up areas where more trips are generated as nodes, and proposed feeder transportation routes from these points.



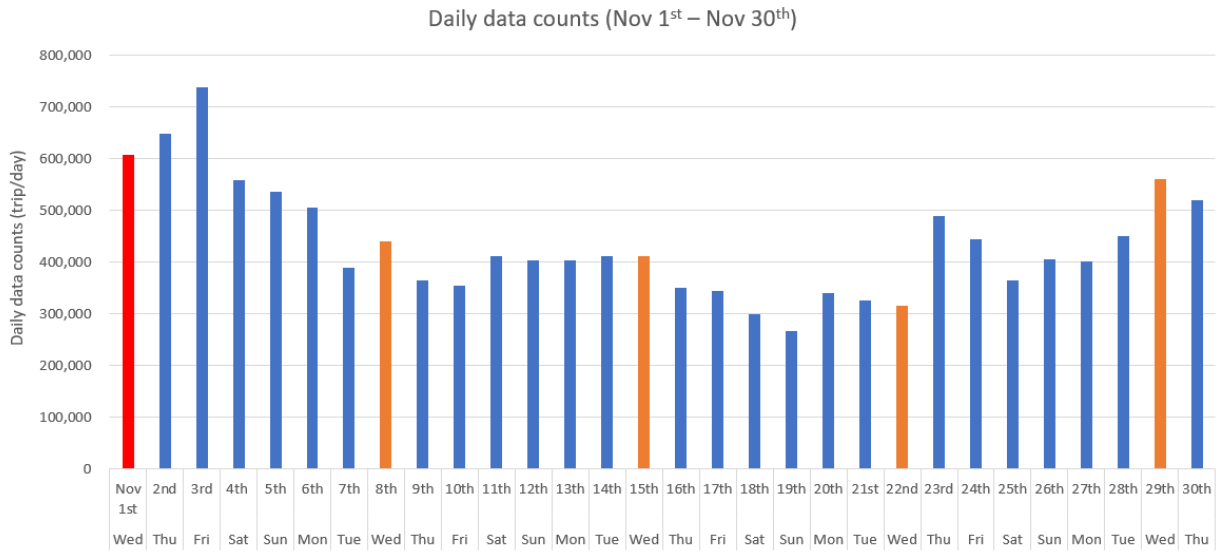
Source: Nippon Koei

Figure 6-6 Data Analysis Area

2) Data Analysis Period

The MBD data obtained this time covers one month from November 1 to November 30, 2023. A representative day during this period was selected for analysis and visualization of trip trends in each area.

Figure 6-7 shows the total number of data (trips/day) for all five regions for each day to select the target days. The results show that the number of trips varies by day and day of the week, but in this case the feeder suggestions are based on typical trip trends, especially on weekdays. In particular, the middle day of the weekday was focused on, resulting in the selection of November 1, which had the highest number of trips among all Wednesdays in November. Based on these procedures, the next and subsequent sections will use the MBD for Wednesday, November 1 to analyze trip generation trends in each region.

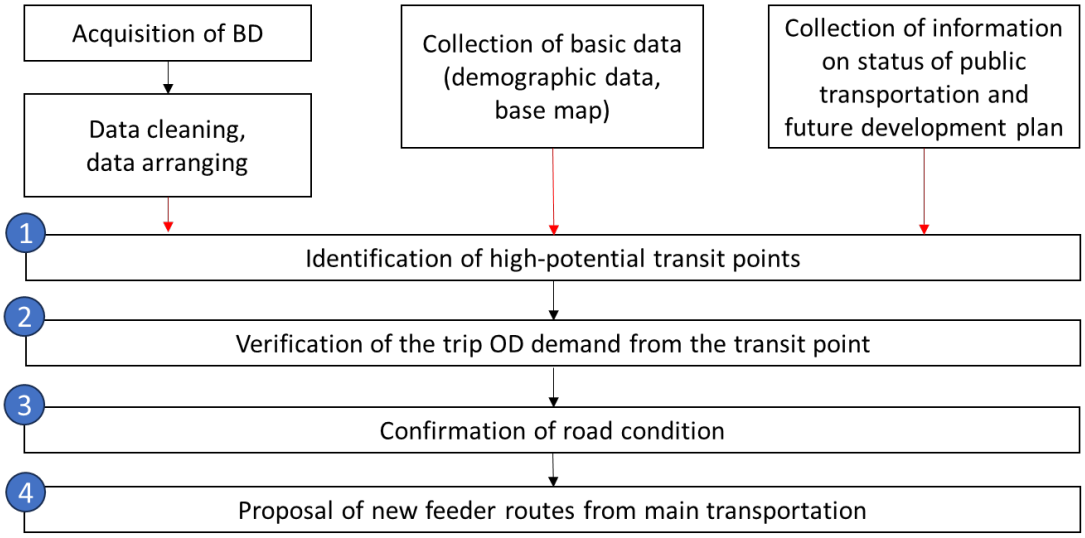


Source: Nippon Koei

Figure 6-7 Daily Trip Counts (total of 5 areas)

6.2.2 Data Analysis Result

In this section, the objective is to propose feeder transportation routes based on trip demand analysis, utilizing the cleaned and arranged MBD as of Wednesday, November 1. Specifically, the analysis of (1) - (4) of the process in Figure 6-8 are conducted in the five regions. However, Pare Pare City is currently not served by any trunk line transportation (bus or rail), so routes were proposed, but only the visualization of current trip demand was conducted.

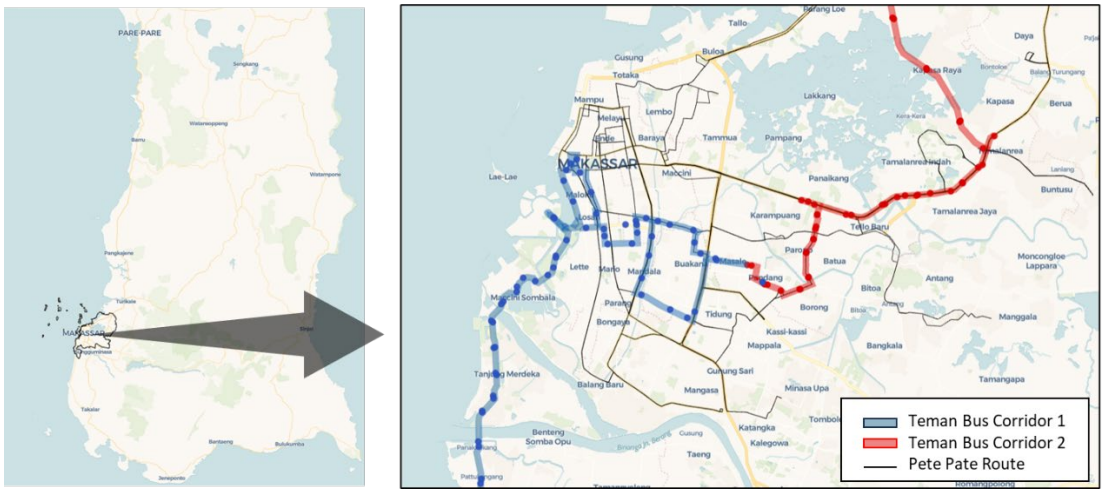


Source: Nippon Koei

Figure 6-8 Data Analysis Process

(1) Analysis Result in Makassar City

Since Teman Bus and Pate Pete are currently in operation in Makassar City, a new feeder transportation route is proposed based on people's trip demand, focusing especially on the area along Teman Bus. The analysis area of Makassar City is shown in Figure 6-9.



Source: Nippon Koei

Figure 6-9 Data Analysis Area (Makassar City)

1) Identification of High-potential Transit Points

First, Figure 6-10 shows the results of a cluster analysis of trip locations in Makassar City. The larger the circle in the cluster, the more trips are generated. Based on this analysis, three nodal points are selected along the Teman Bus route in Makassar City where the demand for trips is relatively high.

- A: Around Pakui Seyang Park
- B: Around Phinisi Point Mall
- C: Around Universitas Hasanuddin

Source: Nippon Koei

Figure 6-10 Cluster Analysis of Trip Generated Area (Makassar City)

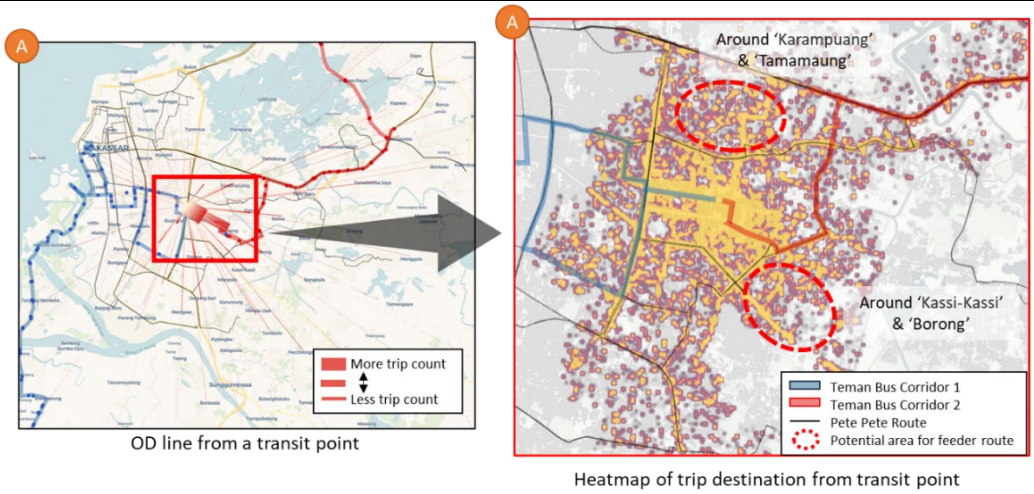
2) Verification of Trip OD Demand from the Transit Point

Next, focusing on the points extracted in 1), the trip ODs (Origin - Destination) originating from each node are visualized and analyzed which area generated the most trips as a destination. The results are also compared with the current public transportation routes to identify areas with high potential for new feeder transportation operations.

A) Around Pakui Seyang Park

The left figure in Figure 6-11 shows the OD diagram for each subdistrict when starting from the Pakui Seyang Park area. The thicker the line, the more trips are generated.

The right figure shows a heat map of specific trip destinations, focusing on areas where more trips are occurring. Comparing the results of this heat map with the current public transportation routes, it is shown that there are areas with high demand for travel but inaccessible by public transportation, with representative areas indicated by red circles (around 'Karampuang', 'Tamamaung', 'Kassi-Kassi' and 'Borong'). This area in particular can be considered as an area with high potential to operate new feeder transportation.



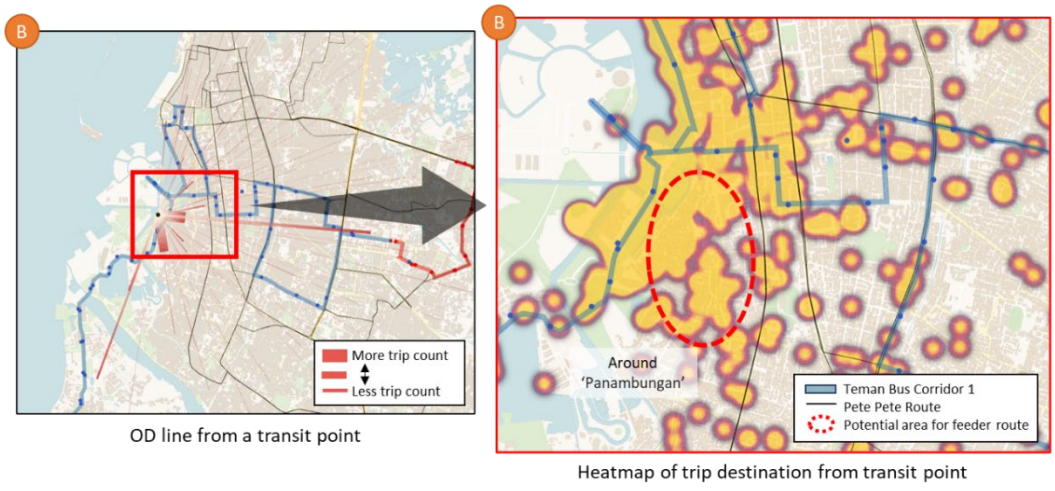
Source: Nippon Koei

Figure 6-11 OD Analysis Result (Makassar City- Around Pakui Seyang Park)

B) Around Phinisi Point Mall

The OD diagram to each subdistrict when starting from the Phinisi Point Mall area is shown in the left diagram of Figure 6-12. The thicker the line, the more trips are generated.

The right figure shows a heat map of specific trip destinations, focusing on areas where more trips are occurring. Comparing the results of this heat map with the current public transportation routes, there are areas with high trip demand that are inaccessible by public transportation, and these areas are circled in red (around "Panambungan"). This area in particular can be considered as an area with high potential for new feeder transportation.



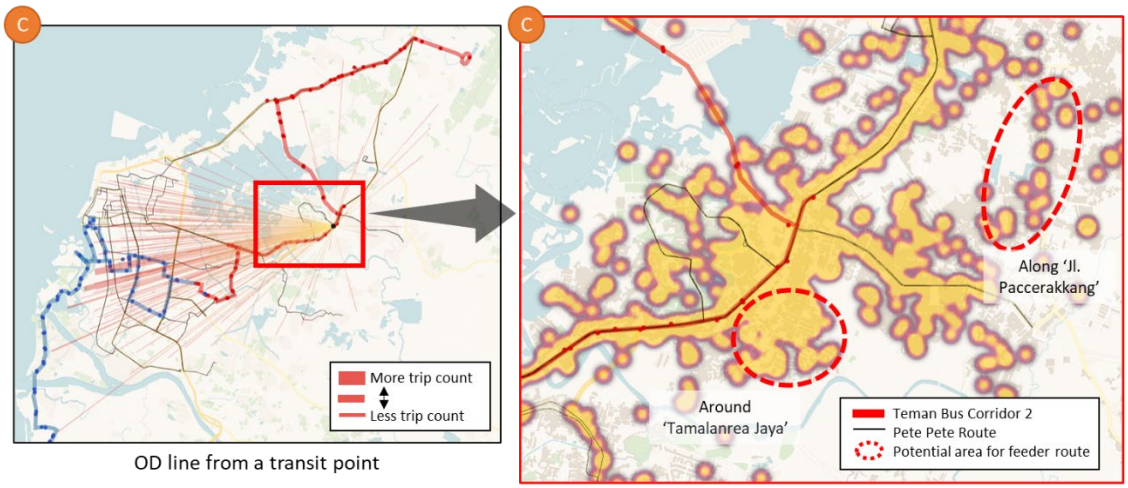
Source: Nippon Koei

Figure 6-12 OD Analysis Result (Makassar City- Around Phinisi Point Mall)

C) Around Universitas Hasanuddin

The OD diagram to each subdistrict when starting from the area around Universitas Hasanuddin is shown in the left diagram of Figure 6-13. The thicker the line, the more trips are generated.

The right figure shows a heat map of specific trip destinations, focusing on areas where more trips are occurring. Comparing the results of this heat map and the current public transportation routes, there are "areas with high demand for travel but inaccessible by public transportation," and these representative areas are indicated by red circles (Around 'Tamalanrea Jaya' and Jl. Paccerakkang'). This area in particular can be considered as an area with high potential to operate new feeder transportation.



Source: Nippon Koei

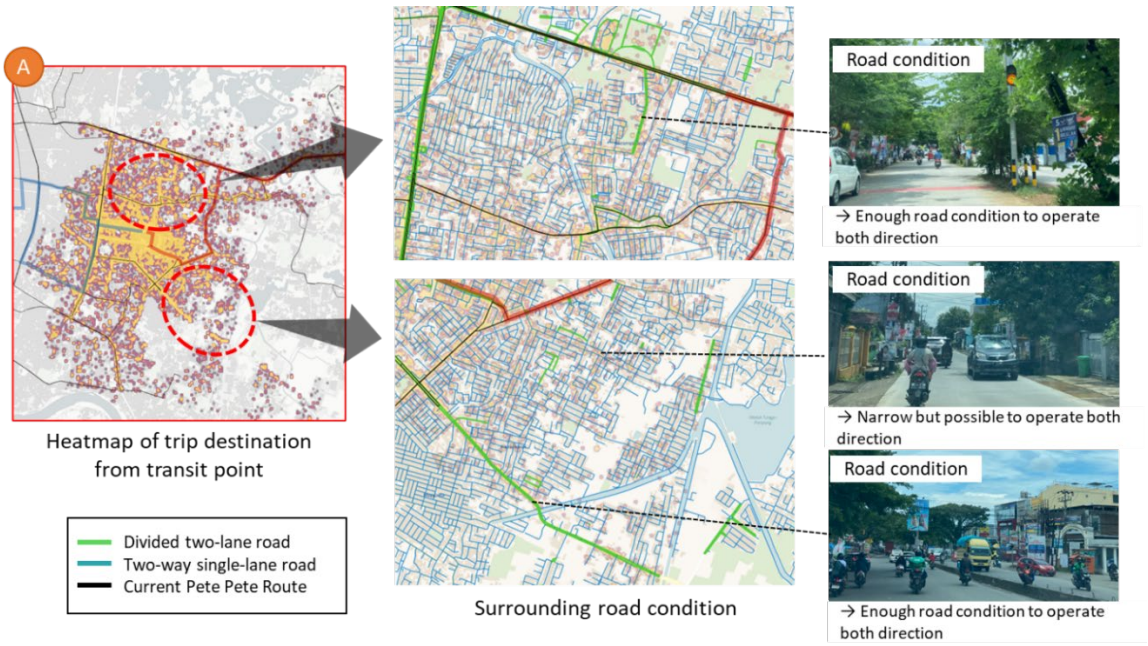
Figure 6-13 OD Analysis Result (Makassar City- Around Universitas Hasanuddin)

3) Confirmation of road condition

Further, focusing on the areas with high potential for new feeder transportation operations identified in 2), the road condition in these areas by overlaying trip demand is confirmed. The road condition was verified using road network information of the Open Street Map, field surveys, Google Street View, etc.

A) Around Pakui Seyang Park

Figure 6-14 shows the confirmation of the road condition results for the area surrounding the area with high feeder transportation operation potential based on the trip demand starting from the Pakui Seyang Park area. The results of the analysis confirm that there are no particular problems with the roads connecting the high trip demand areas, such as road width and traffic conditions, for feeder transportation operations.

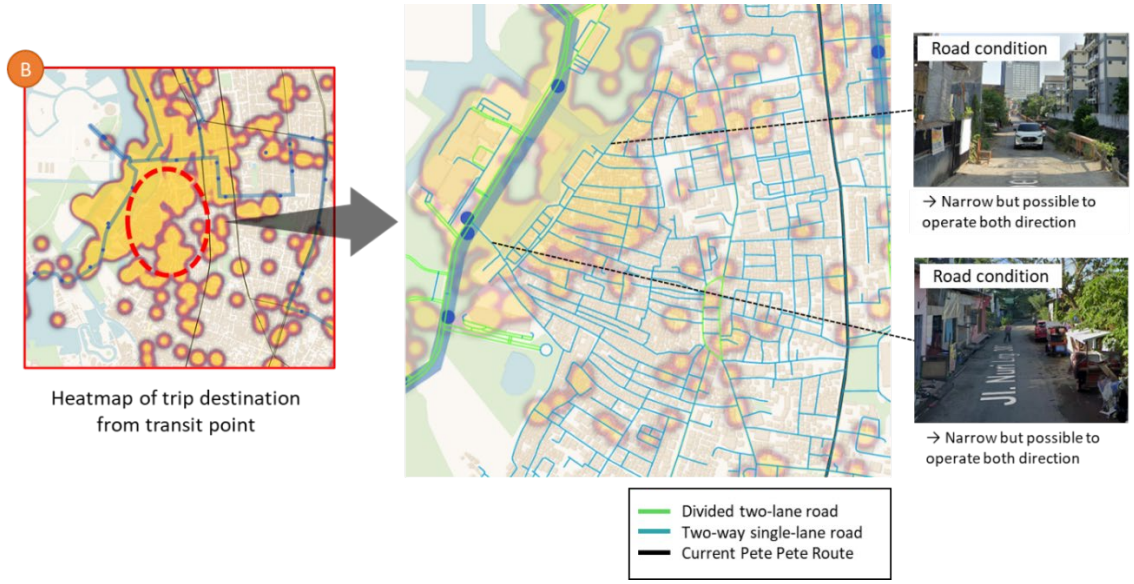


Source: Nippon Koei

Figure 6-14 Surrounding Road Condition (Makassar City - Around Pakui Seyang Park)

B) Around Phinisi Point Mall

Further, Figure 6-15 shows the confirmation of road condition results for the area surrounding the area with high feeder transportation operation potential based on trip demand starting from the Phinisi Point Mall area. The results of the analysis confirmed that there are no particular issues with feeder transportation operations, such as road width and traffic conditions, on the roads connecting the areas with high trip demand.

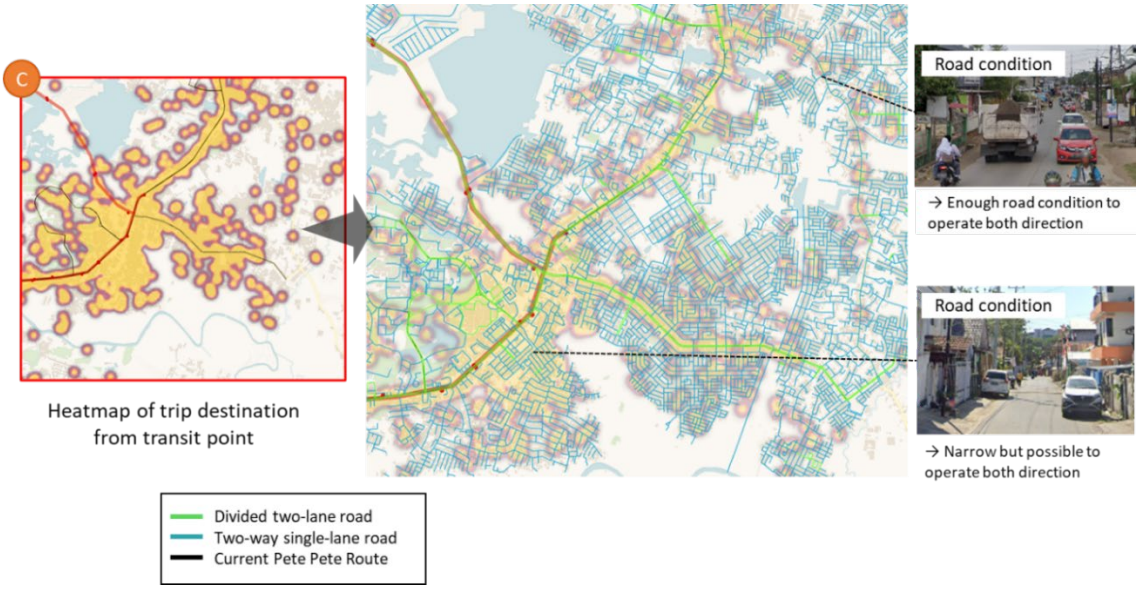


Source: Nippon Koei

Figure 6-15 Surrounding Road Condition (Makassar City- Around Phinisi Point Mall)

C) Around Universitas Hasanuddin

Furthermore, Figure 6-16 shows the confirmation of road condition results for the area around the area with high feeder transportation operation potential based on trip demand starting from the area around Universitas Hasanuddin. The results of the analysis confirm that there are no particular challenges to feeder transportation operations, such as road width and traffic conditions, on the roads connecting the areas with high trip demand.

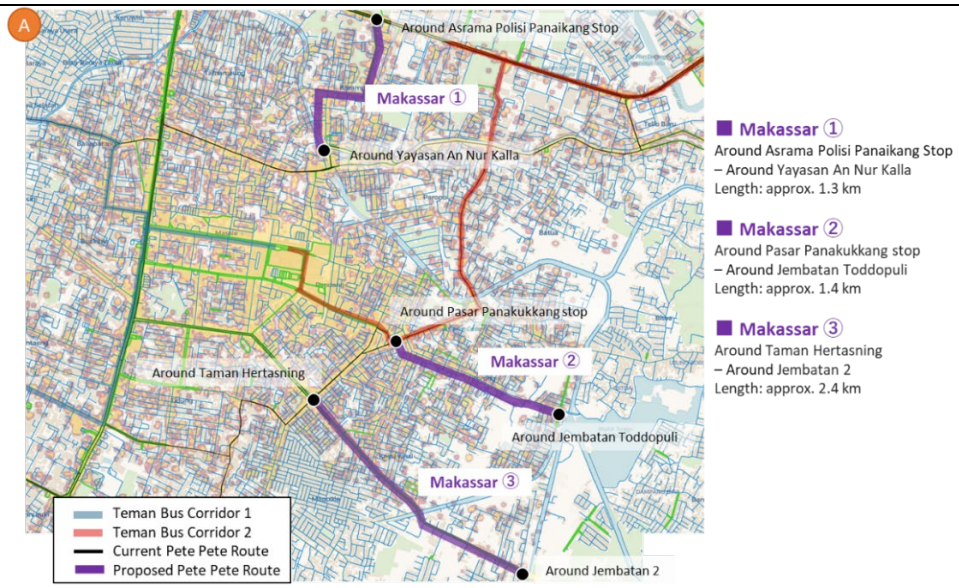


Source: Nippon Koei

Figure 6-16 Surrounding Road Condition (Makassar City- Around Universitas Hasanuddin)

4) Proposal of New Feeder Transportation Route

Finally, based on the results analyzed in 1) through 3), new feeder transportation operation routes within Makassar City based on the current public transportation routes, trip demand, and road condition are proposed as shown in Figures 6-17 through 6-19.

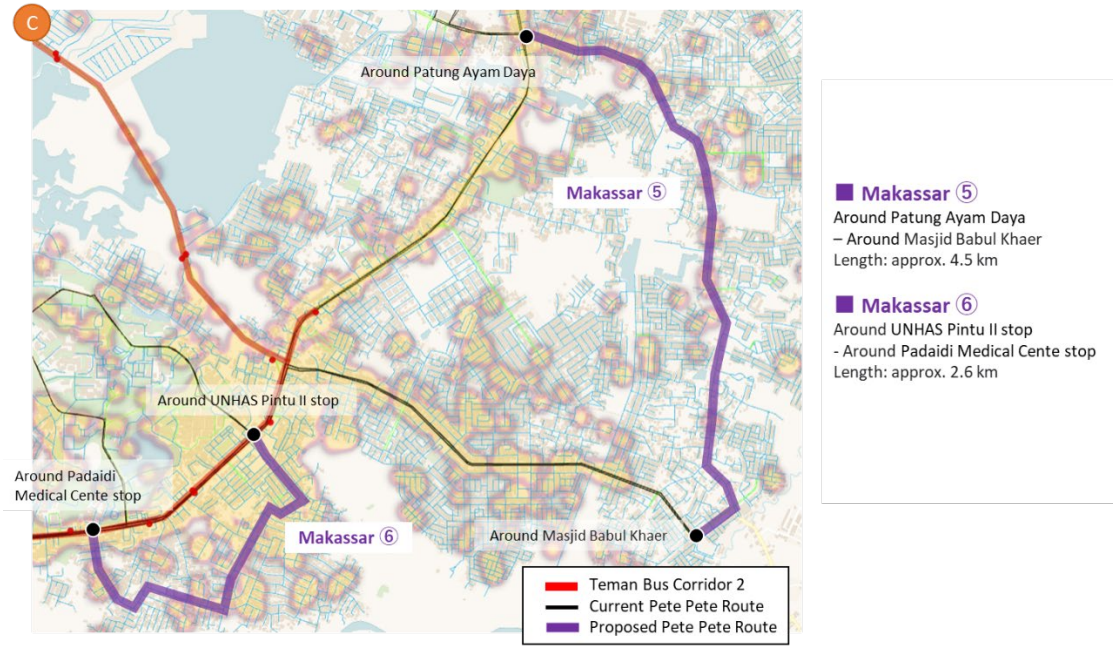


Source: Nippon Koei

Figure 6-17 Proposed Route (Makassar City- Around Pakui Seyang Park)

Source: Nippon Koei

Figure 6-18 Proposed Route (Makassar City- Around Phinisi Point Mall)

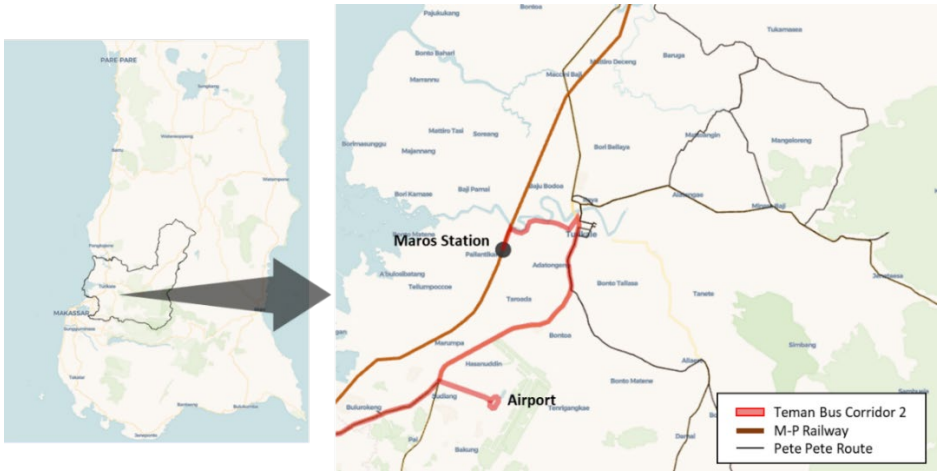


Source: Nippon Koei

Figure 6-19 Proposed Route (Makassar City- Around Universitas Hasanuddin)

(2) Analysis Result in Maros Regency

Since Teman Bus, M-P Railway, and Pete Pete are currently in operation in Maros Regency, these public transportation lines are focused on, and new feeder routes are proposed based on people's trip demand. The study area in Maros Regency is shown in Figure 6-20.

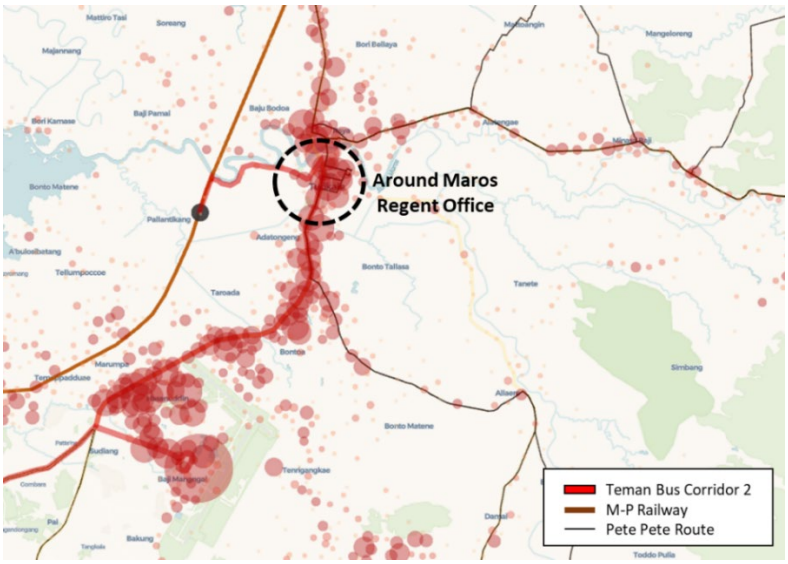


Source: Nippon Koei

Figure 6-20 Data Analysis Area (Maros Regency)

1) Identification of high-potential transit points

First, Figure 6-21 shows the results of the cluster analysis of trip-generating locations in Maros Regency. The larger the circle in the cluster, the more trips tend to be generated. Based on this analysis, a point along the Teman bus route is identified where the demand for trips is relatively high (around the Maros Regent Office). On the other hand, the area around the Makassar – Pare Pare railway station was not included because no significant trip generation was observed.

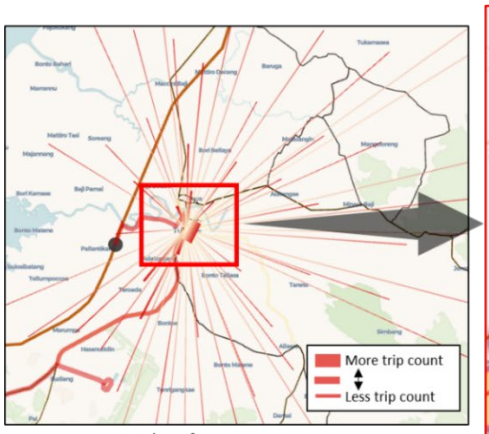


Source: Nippon Koei

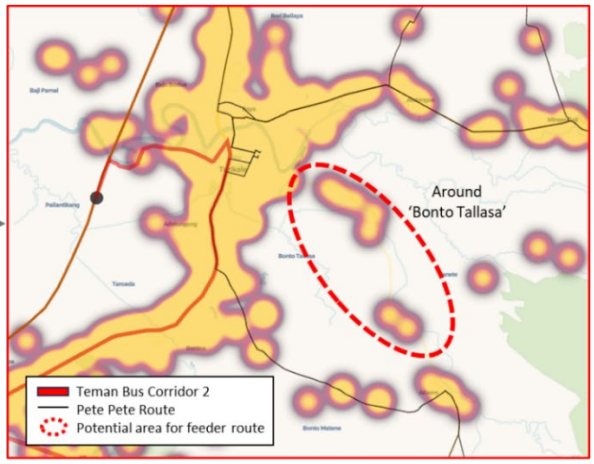
Figure 6-21 Cluster Analysis of Trip Generated Area (Maros Regency)

2) Verification of trip OD demand from the transit point

Next, focusing on the points extracted in 1), the trip ODs (Origin - Destination) originating from each point are visualized, and analyzed which area generated the most trips as a destination (Figure 6-22). The current public transportation routes are also compared, and areas with high potential for new feeder transportation operations are identified (Around Bonto Tallasa).



OD line from a transit point



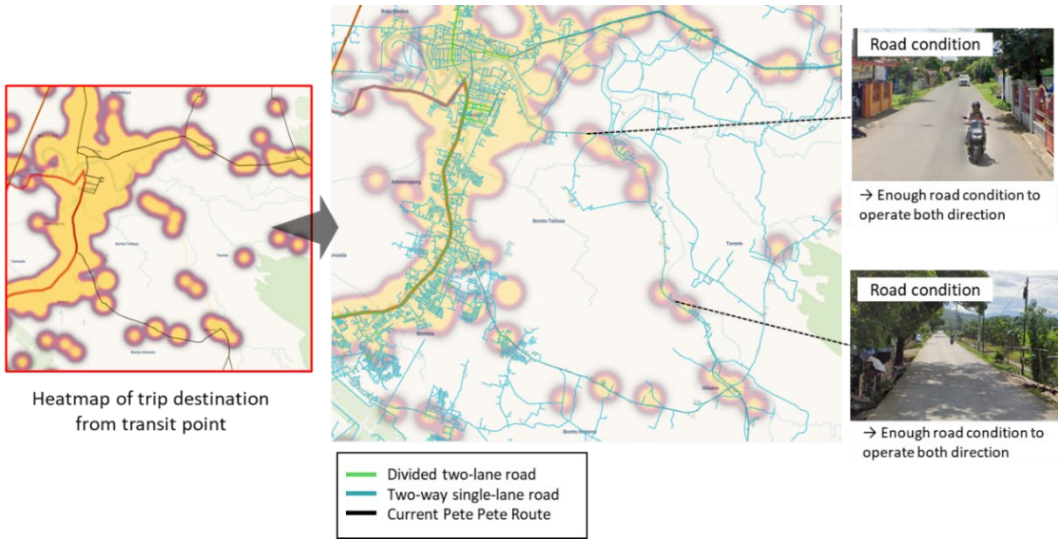
Heatmap of trip destination from transit point

Source: Nippon Koei

Figure 6-22 OD Analysis Result (Maros Regency)

3) Confirmation of road condition

Further, focusing on the areas with high potential for new feeder transportation operations identified in 2), the road condition in these areas is confirmed by overlaying the trip demand. Here, the road condition is confirmed using road network information of Open Street Map, field surveys, Google Street View, etc. (Figure 6-23). As a result of the consolidation, it is confirmed that there are no particular issues in the operation of feeder transportation, such as road widths and traffic conditions, for roads connecting areas with high trip demand.

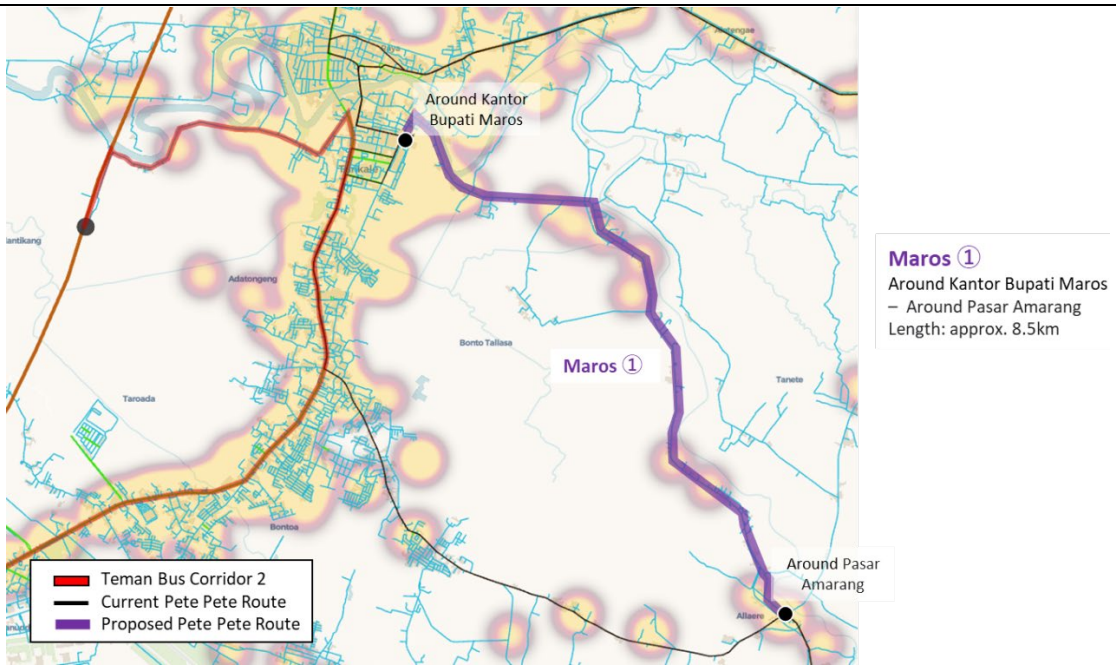


Source: Nippon Koei

Figure 6-23 Surrounding Road Condition (Maros Regency)

4) Proposal of New Feeder Transportation Route

Finally, based on the results analyzed in (i) through (iii), new feeder transportation operation routes within Maros Regency based on the current public transportation routes, trip demand, and road condition are proposed as shown in Figures 6-24.

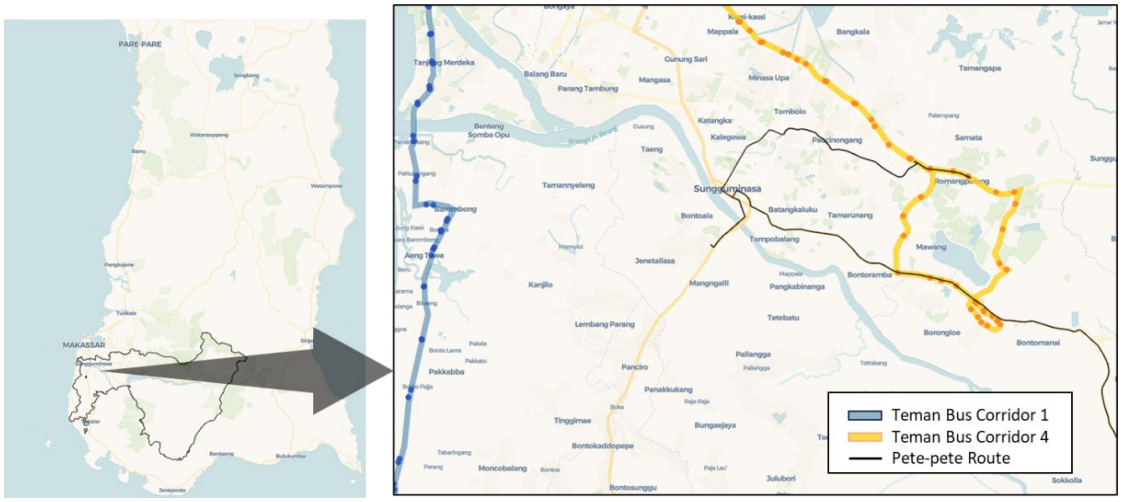


Source: Nippon Koei

Figure 6-24 Proposed Route (Maros Regency)

(3) Analysis Result in Gowa Regency

As Teman Bus (including routes currently out of service) and Pete Pete are currently in operation in Gowa Regency, these public transportation routes are focused on, and new feeder transportation routes based on people's demand for trips are proposed. The analysis area of Gowa Regency is shown in Figure 6-25.

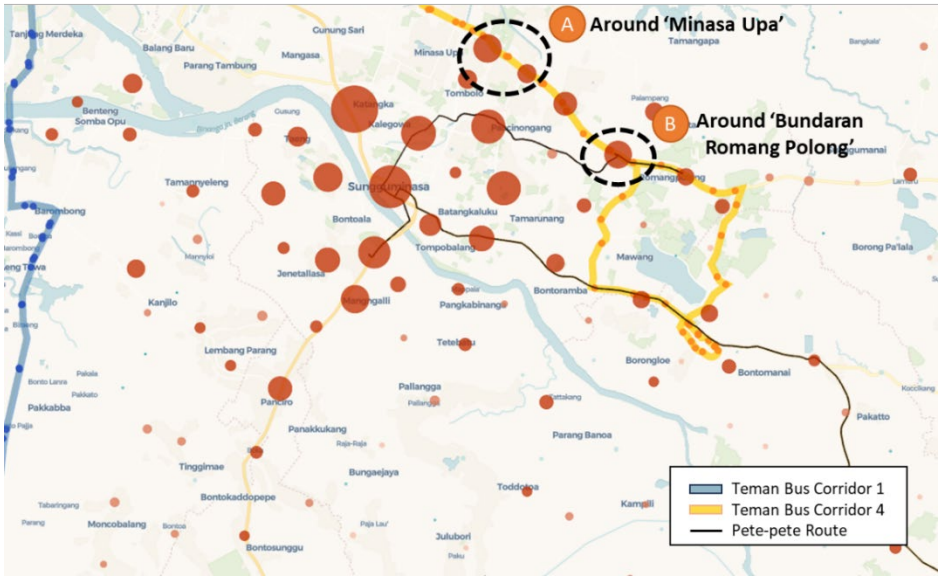


Source: Nippon Koei

Figure 6-25 Data Analysis Area (Gowa Regency)

1) Identification of Hhigh-potential Transit Points

First, Figure 6-26 shows the results of a cluster analysis of trip-generating locations in Gowa Regency. The larger the circle in the cluster, the more trips tend to occur. Based on this analysis, points along the Teman bus route where the demand for trips is relatively high are identified (A: around Minasa Upa, B: around Bundaran Romang Polong).

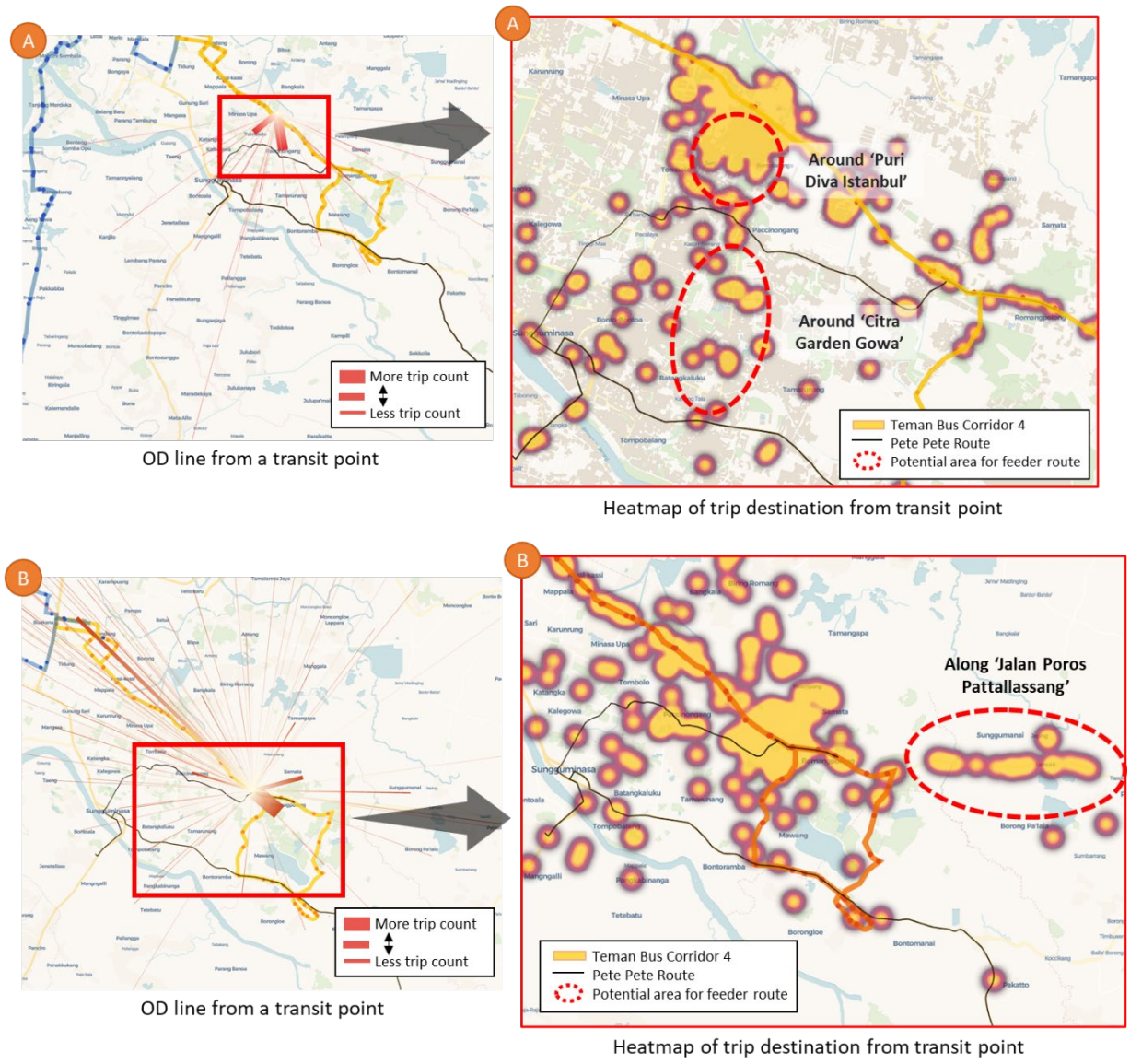


Source: Nippon Koei

Figure 6-26 Cluster Analysis of Trip Generated Area (Gowa Regency)

2) Verification of Trip OD Demand from the Transit Point

Next, focusing on the points extracted in 1), the trip ODs (Origin - Destination) originating from each point are visualized, and analyzed which area generated the most trips as a destination (Figure 6-27). The current public transportation routes are also compared, and areas with high potential for new feeder transportation operations are identified (Around 'Puri Diva Istanbul', 'Citra Garden Gowa' and 'Jalan Poros Pattallassang').

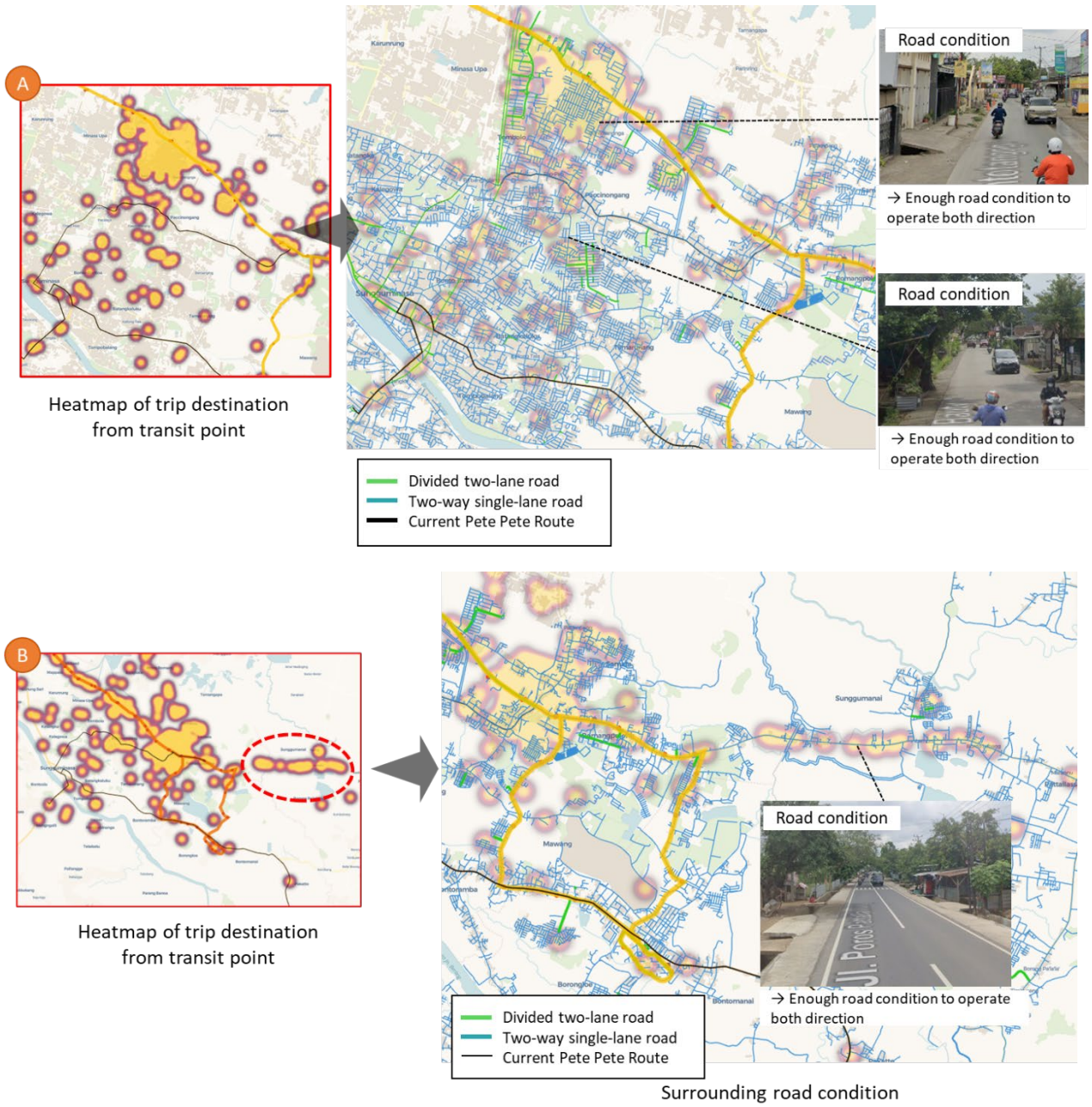


Source: Nippon Koei

Figure 6-27 OD Analysis Result (Gowa Regency)

3) Confirmation of road condition

Further, focusing on the areas with high potential for new feeder transportation operations identified in 2), the road condition in these areas is confirmed by overlaying the trip demand. Here, the road condition is confirmed using road network information of the Open Street Map, field surveys, Google Street View, etc. (Figure 6-28). As a result of the consolidation, it is confirmed that there are no particular issues in the operation of feeder transportation, such as road widths and traffic conditions, for roads connecting areas with high trip demand.

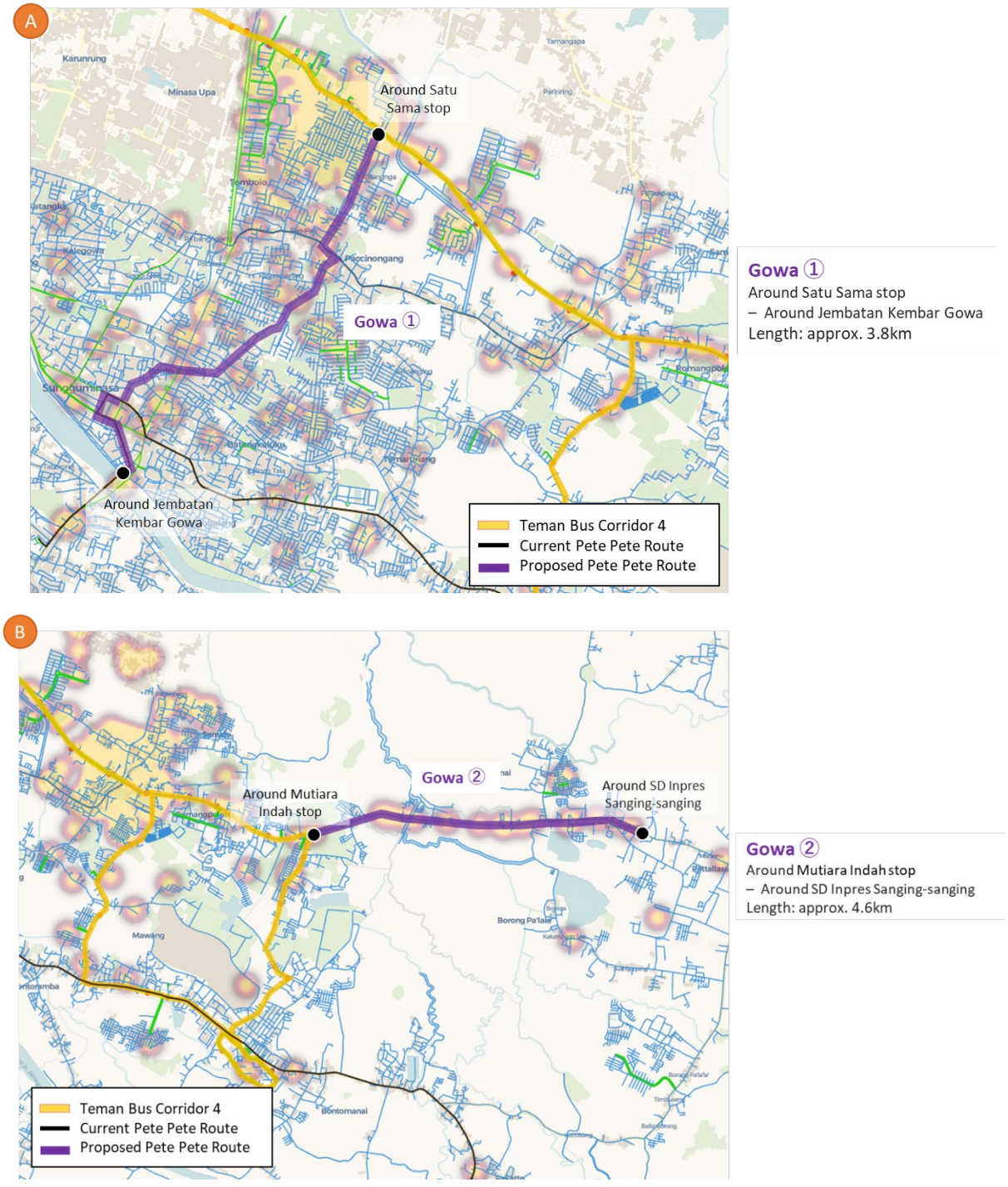


Source: Nippon Koei

Figure 6-28 Surrounding Road Condition (Gowa Regency)

4) Proposal of New Feeder Transportation Route

Finally, based on the results analyzed in 1) through 3), new feeder transportation operation routes within Gowa Regency based on the current public transportation routes, trip demand, and road condition are proposed as shown in Figures 6-29.



Source: Nippon Koei

Figure 6-29 Proposed Route (Gowa Regency)

(4) Analysis Result in Takalar Regency

Since Teman Bus is currently in operation in Takalar Regency, this public transportation line is focused on, and a new feeder transportation route is proposed based on people's trip demand. Figure 6-30 shows the analysis area of Takalar Regency.

Source: Nippon Koei

Figure 6-30 Data Analysis Area (Takalar Regency)

1) Identification of High-potential Transit Points

First, Figure 6-31 shows the results of a cluster analysis of trip-generating locations in Takalar Regency. The larger the circle in the cluster, the more trips tend to occur. Based on this analysis, a point along the Teman bus route where the demand for trips is relatively high is identified (Around Aene Towa).

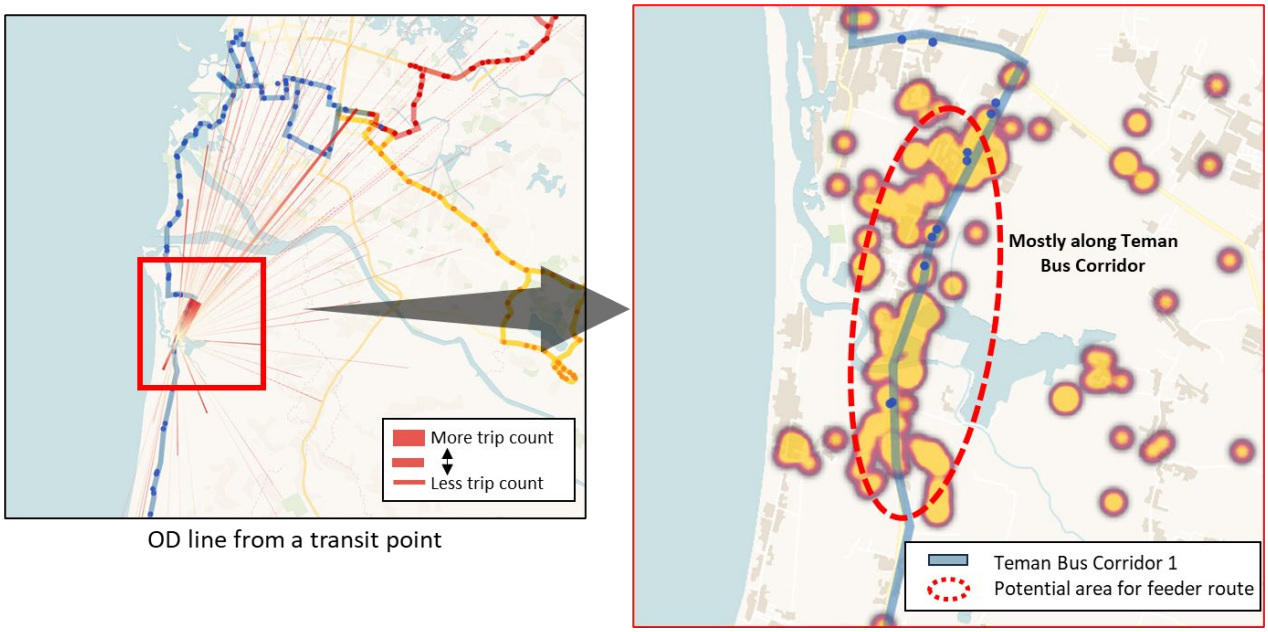
Source: Nippon Koei

Figure 6-31 Cluster Analysis of Trip Generated Area (Takalar Regency)

2) Verification of Trip OD Demand from the Transit Point

Further, focusing on the points extracted in 1), the trip ODs (Origin - Destination) originating from the point is visualized, and it is analyzed which areas are frequently used as trip destinations (Figure 6-22). The results of the analysis indicated that most of the trip destinations from the point are concentrated along the Teman Bus lines that are already in operation, and that there may not be much significance in operating a new feeder transportation system.

Based on the above results, it is decided not to implement the proposed new feeder transportation route in Takalar Regency.

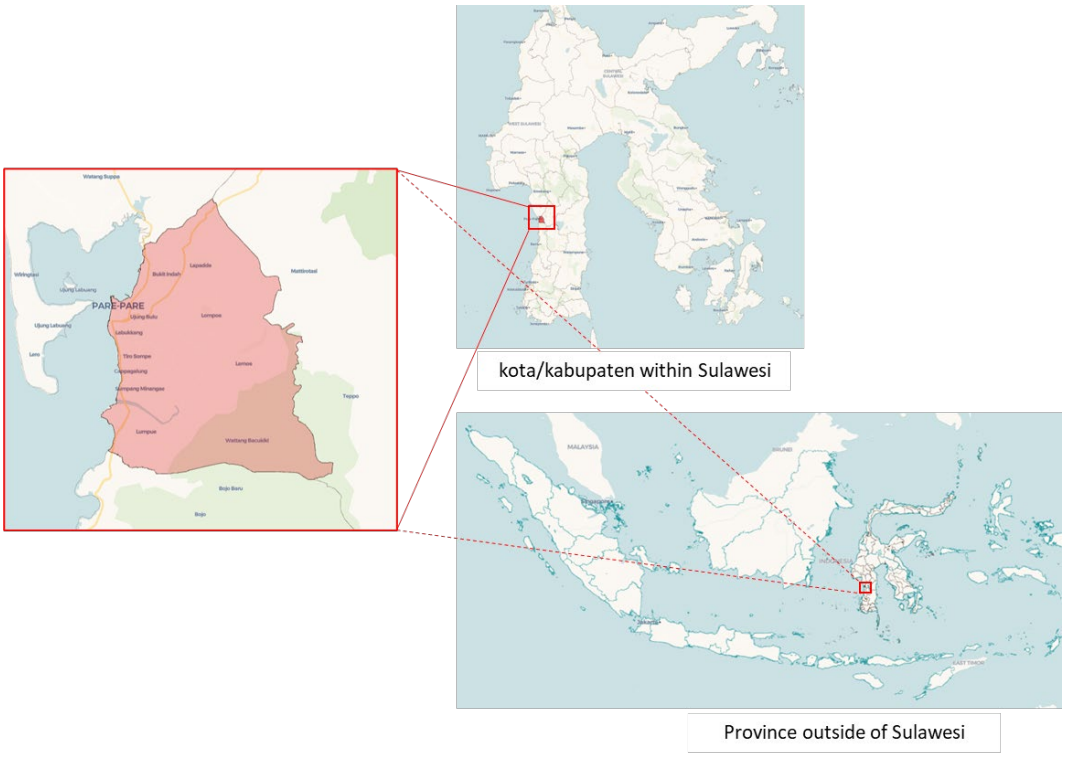


Source: Nippon Koei

Figure 6-32 OD Analysis Result (Takalar Regency)

(5) Analysis Result in Pare Pare City

Unlike Mamminasata metropolitan area, Pare Pare City does not currently have a trunk line transportation system (e.g., bus and rail), so the proposal of new feeder route is not conducted through the MBD analysis. On the other hand, Pare Pare City is the core city of Sulawesi and is expected to become more active in the future in terms of traffic to and from the new capital area through the port, so the trip generation status between Pare Pare City and Sulawesi and between Pare Pare City and outside Sulawesi are organized through MBD analysis. Trip generation from current traffic points within Pare Pare City is also organized for reference. The analysis area of Pare Pare City is shown in Figure 6-33.

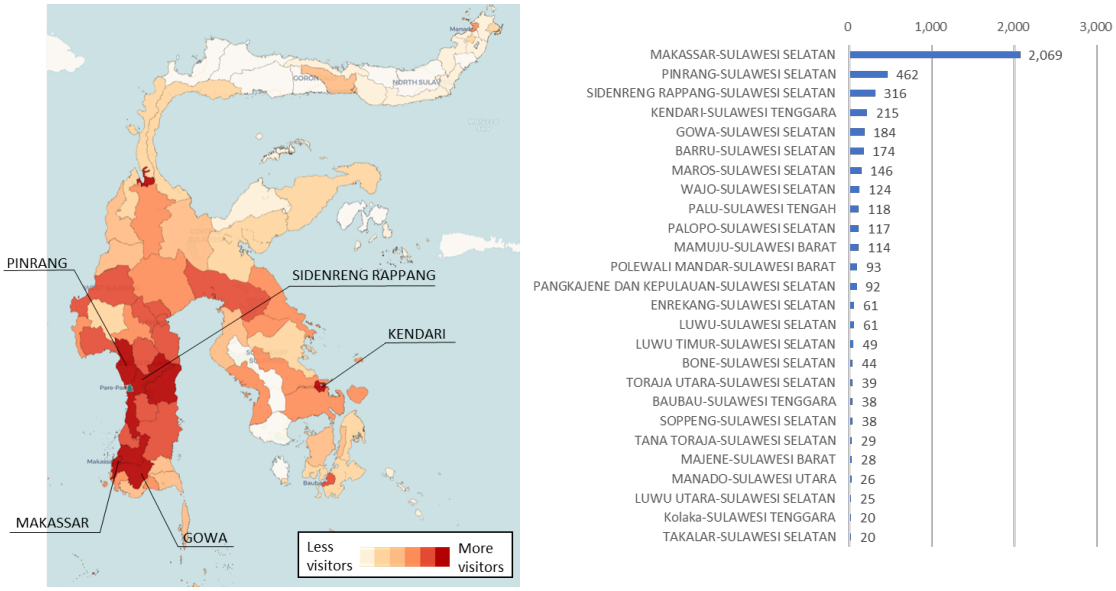


Source: Nippon Koei

Figure 6-33 Data Analysis Area (Pare Pare City)

1) Trend of Trip Generation within Sulawesi and between Pare Pare City

First, trip generation between Pare Pare City and areas within Sulawesi (City/Regency units) is organized as shown in Figure 6-34. The analysis showed that trips to Makassar City are by far the most common, followed by Pinrang, Sidenreng Rappang (Sidrup), Kendari, and Gowa Regency.

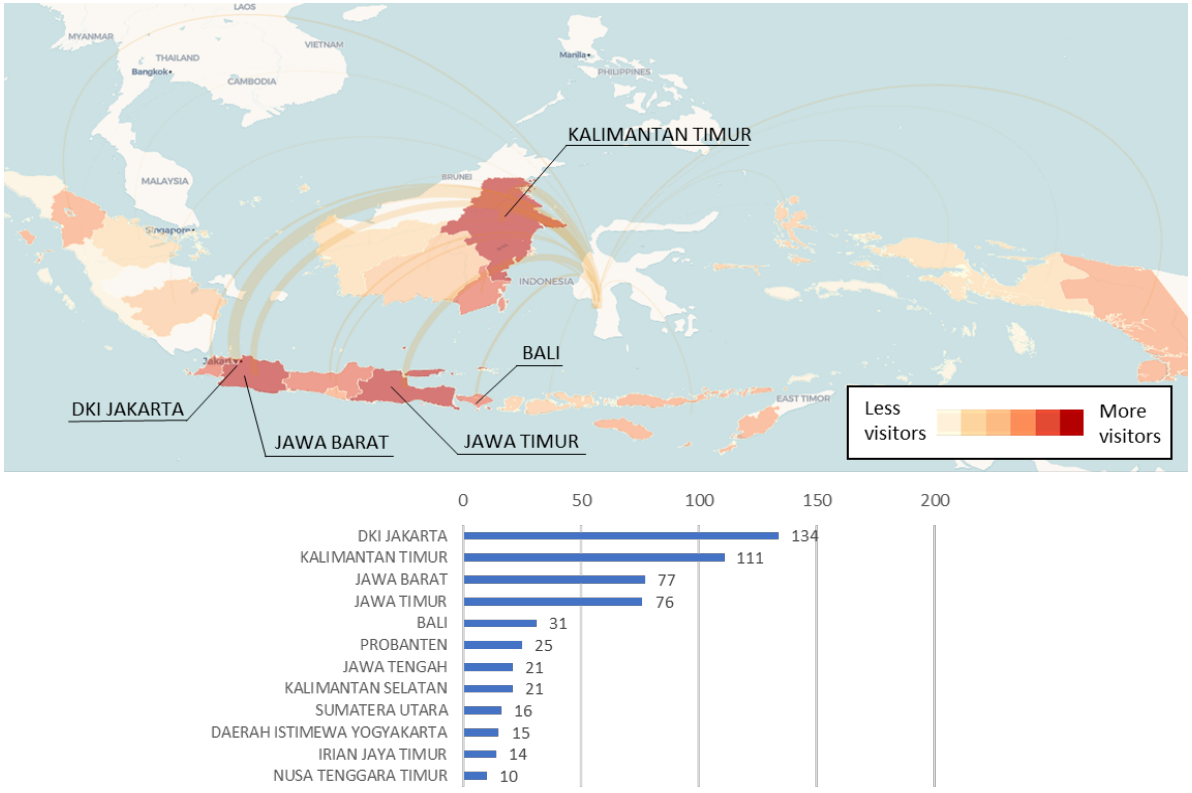


Source: Nippon Koei

Figure 6-34 Trip generation trends within Sulawesi and between Pare Pare City

2) Trend of Trip Generation outside Sulawesi and between Pare Pare City

Further, figure 6-35 shows the trip generation status for Pare Pare City and areas outside of Sulawesi (Province units). The result of the analysis shows that trips to DKI Jakarta are the most common, followed by Kalimantan Timur on the other side of the island, and so on.

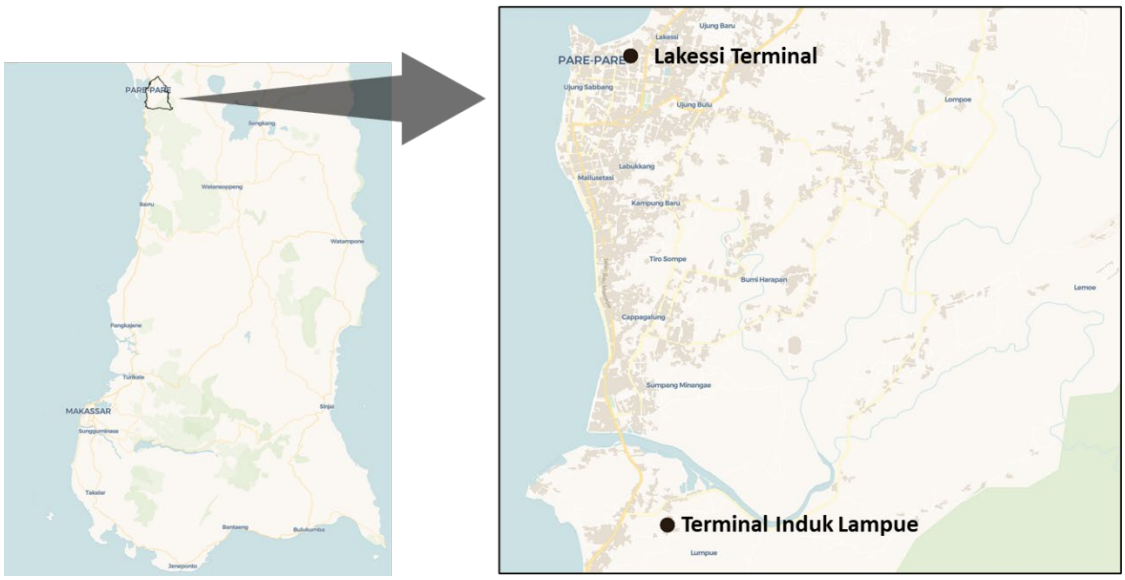


Source: Nippon Koei

Figure 6-35 Trend of Trip Generation outside Sulawesi and between Pare Pare City

3) Trend of Trip Generation within Pare Pare City

Finally, trip generation trends within Pare Pare City are summarized from two traffic terminals (Lakessi Terminal and Terminal Induk Lampue). The locations of the transportation terminals are shown in Figure 6-36.

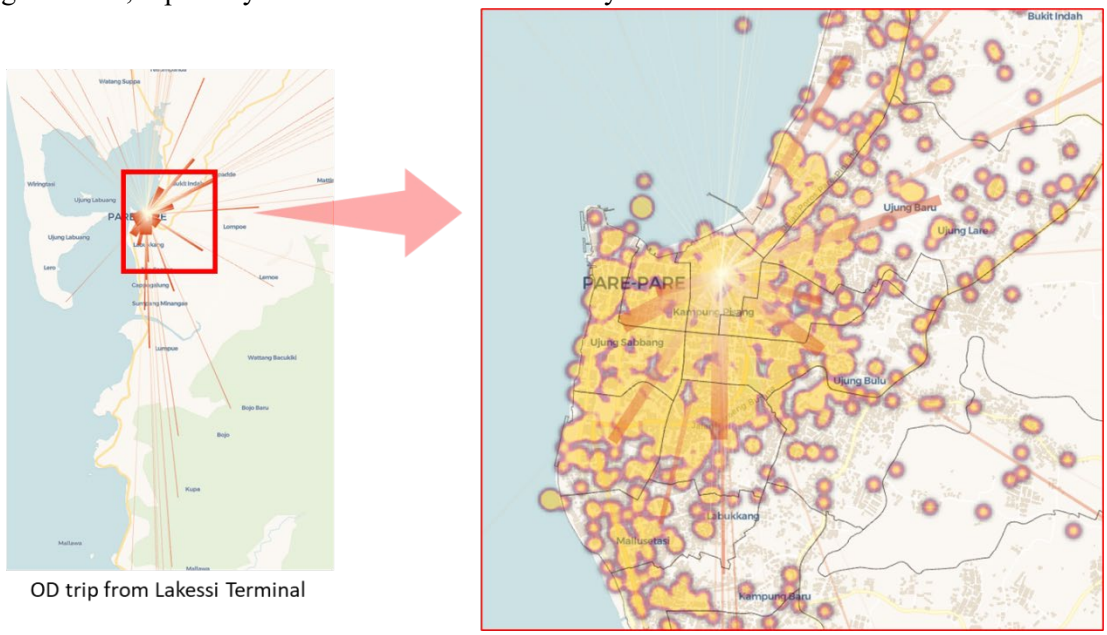


Source: Nippon Koei

Figure 6-36 Transportation Terminals in Pare Pare City

A) Trip generated from Lakessi Terminal

Figure 6-37 shows trip generation from the "Lakessi Terminal," one of the transportation terminals in Pare Pare City. The results of the analysis indicate that there is a wide range of trip generation, especially in the center of Pare Pare City.

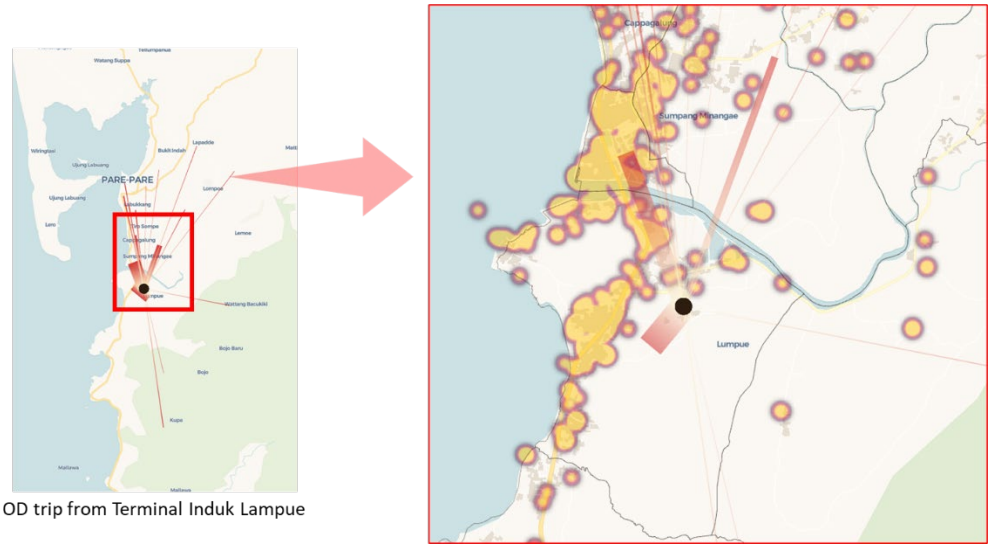


Source: Nippon Koei

Figure 6-37 OD Analysis Result (Lakessi Terminal)

B) Trip generated from Terminal Induk Lampue

Figure 6-38 shows trip generation from "Terminal Induk Lampue,". The results of the analysis indicate that trips tend to occur mainly near the coast, although they are less frequent than those at the Lakessi Terminal.



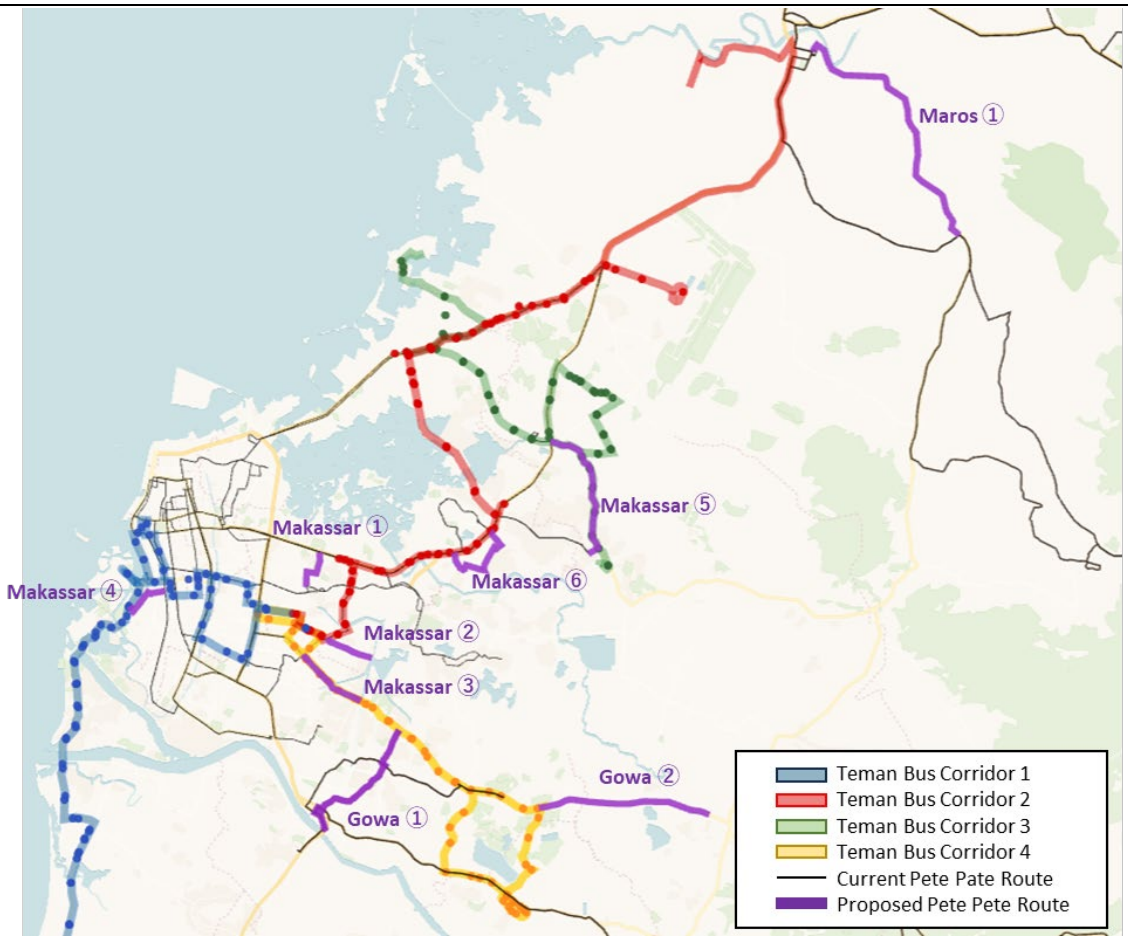
OD trip from Terminal Induk Lampue

Source: Nippon Koei

Figure 6-38 OD Analysis Result (Terminal Induk Lampue)

6.2.3 Proposal of Feeder Transportation Route based on Data Analysis

Based on the trip generation trends from the MBD analysis in the target area, the current public transportation operation routes, and the surrounding road condition, new feeder transportation routes in Mamminasata metropolitan area are proposed as shown in Figure 6-39 and Table 6-4.



Source: Nippon Koei

Figure 6-39 Proposed Route of Feeder Transportation

Table 6-4 List of Proposed Route of Feeder Transportation

No	Route	Length
Makassar City ①	Around Asrama Polisi Panaikang Stop – Around Yayasan An Nur Kalla	1.3 km
Makassar City ②	Around Pasar Panakukkang stop– Around Jembatan Toddopuli	1.4 km
Makassar City ③	Around Taman Hertasning – Around Jembatan 2	2.4 km
Makassar City ④	Around Bengkel MPJ – Around Merpati Fashion	1.3 km
Makassar City ⑤	Around Patung Ayam Daya – Around Masjid Babul Khaer	4.5 km
Makassar City ⑥	Around UNHAS Pintu II stop – Around Padaidi Medical Cente stop	2.6 km
Maros Regency ①	Around Kantor Bupati Maros Regency – Around Pasar Amarang	8.5 km
Gowa Regency ①	Around Satu Sama stop– Around Jembatan Kembar Gowa	3.8 km
Gowa Regency ②	Around Satu Sama stop– Around Jembatan Kembar Gowa	4.6 km

Source: Nippon Koei

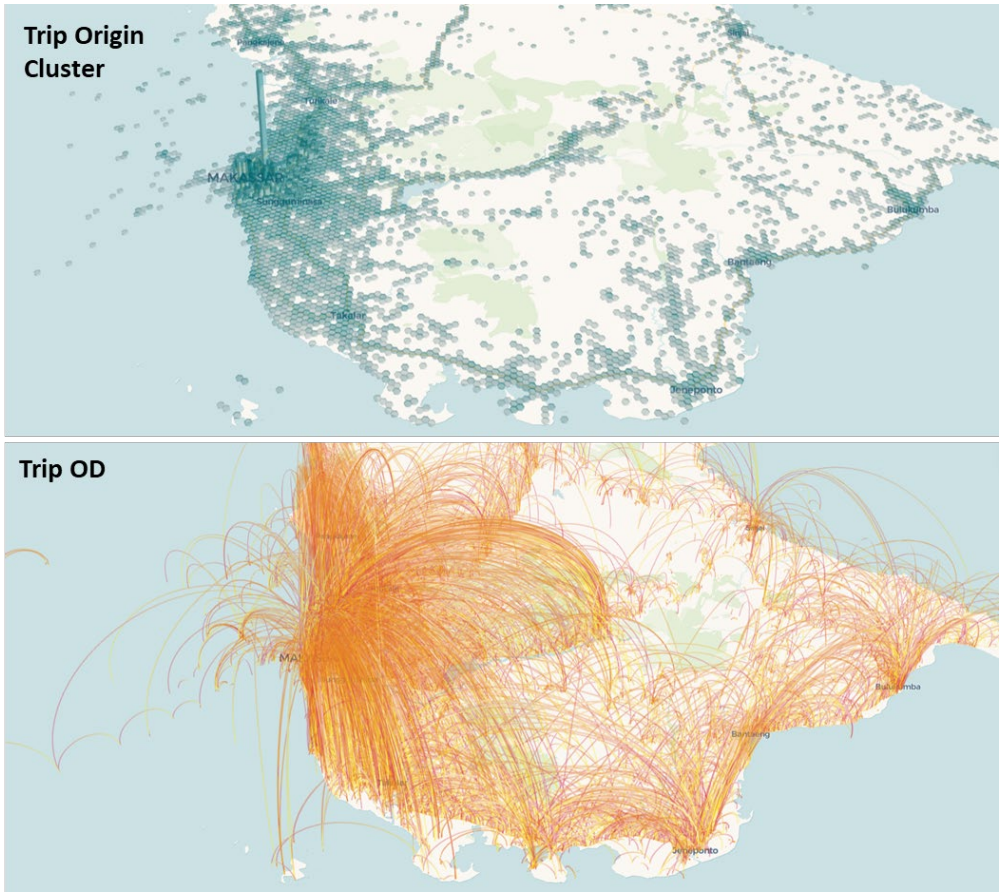
7. Proposal for Possible Utilization of MBD in the Transportation Field

7.1 Utilization for Transportation Planning

In this project, MBD analysis and visualization were conducted to propose new feeder traffic operation routes. Different MBD analysis methods can be applied for transportation planning in various situations such as traffic congestion, tourist traffic, and sustainable transportation planning. Based on the above, this chapter discusses the applicability of MBD to transportation planning.

7.1.1 Identification of Daily Travel Demand

By utilizing MBD, it is possible to analyze daily travel demand (trip generation locations and trip OD) as shown in Figure 7-1Source: Nippon Koei
Figure 7-1 and propose optimal public transportation routes that meet demand. Although this work proposed feeder traffic based on demand from traffic nodes, it is possible to propose trunk line traffic and study route changes, based on the supply-demand balance between current routes and actual demand.

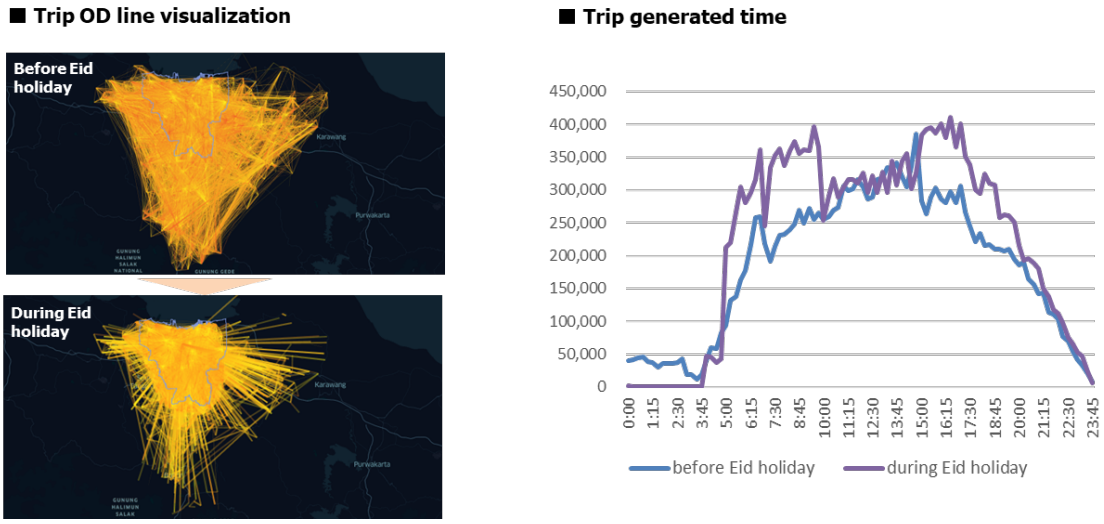


Source: Nippon Koei

Figure 7-1 Example of Analysis of Daily Travel Demand using MBD

7.1.2 Identification of Migration Characteristics Over a Specific Period of Time

By utilizing MBD, it is possible to identify trip generation trends (trip ranges and trip duration) during specific periods when there is significant movement of people, as shown in Figure 7-2. For example, in Indonesia, the vacation period after Ramadan is a time when a large number of trips occur, and it is difficult to respond adequately with normal traffic control measures.

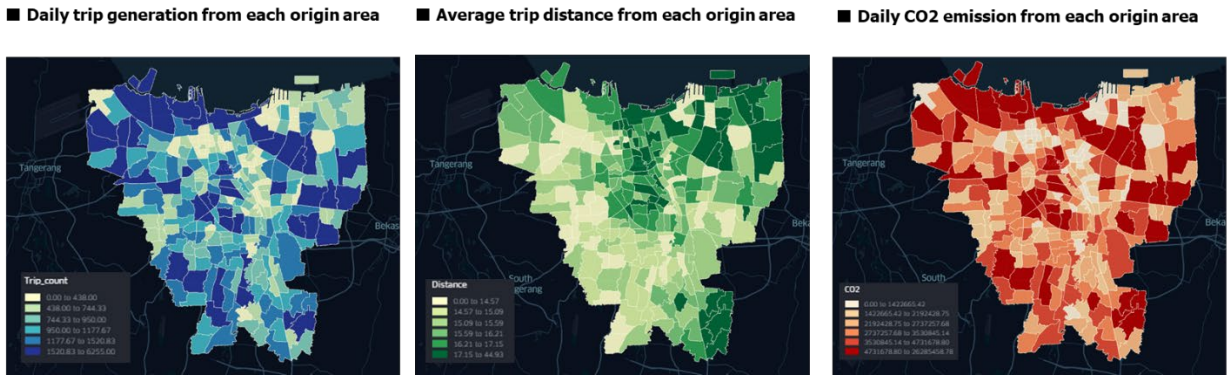


Source: Nippon Koei

Figure 7-2 Example of Analysis of Migration Characteristics over a Specific Period of Time using MBD

7.1.3 Understanding CO_2 Emissions from Vehicle Travel

By utilizing MBD, it is possible to estimate the frequency and distance people travel by car, and by combining these values, the amount of CO_2 emissions from car travel in each area can be visualized (Figure 7-3). Based on this analysis, it is possible to consider which areas in particular need to be regulated in terms of car use and which areas need to be improved in terms of public transportation in order to reduce overall CO_2 emissions.



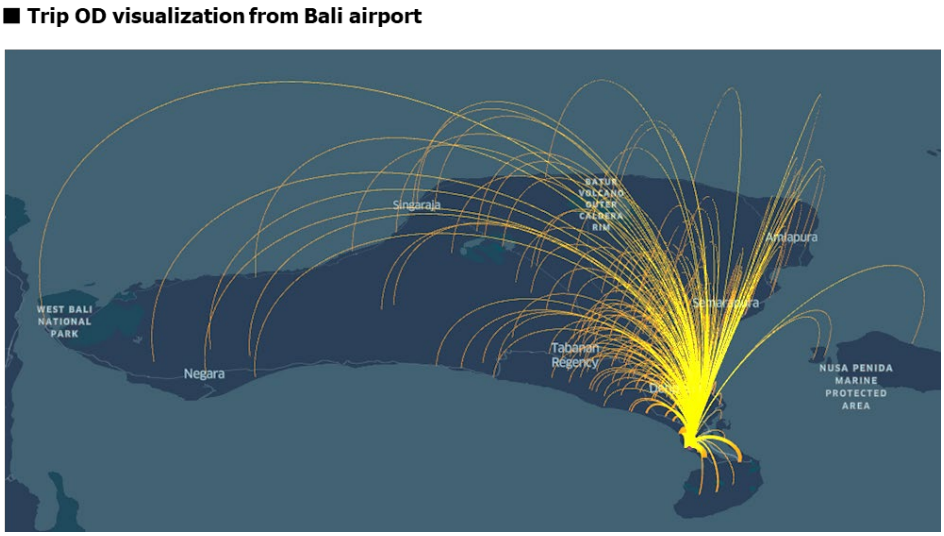
Source: Nippon Koei

Figure 7-3 Example of Analysis of CO_2 Emissions from Vehicle Travel using MBD

7.1.4 Identification of Tourist Trip Trends

By utilizing MBD, as shown in Figure 7-4, it is possible to estimate the trip generation tendency of specific groups such as tourists, which leads to the study of public transportation development and facility layout to promote tourism. For example, by excluding IDs who are presumed to reside in the

target area and analyzing and visualizing the travel information of IDs who make trips from the gateway points of the area (airports and ports), it is possible to determine which areas tend to be frequently traveled to for tourism purposes.

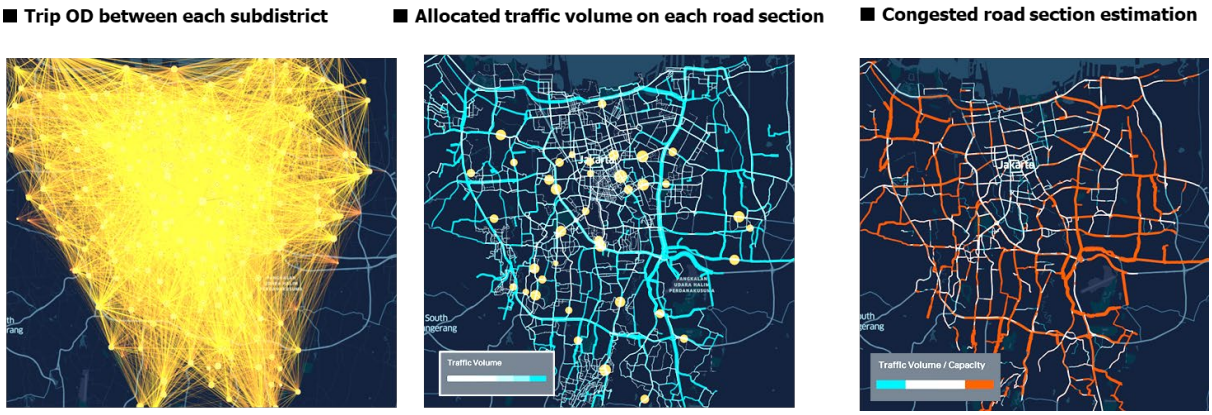


Source: Nippon Koei

Figure 7-4 Example of Analysis of Tourist Trip Trends using MBD

7.1.5 Understanding Traffic Congestion

By utilizing MBD, trip OD can be tabulated as shown in Figure 7-5, and by applying the results, traffic volume allocation based on road network data (width, road structure, and traffic capacity) within an area can be implemented. Based on these results, it is possible to identify which roads are most likely to experience congestion, leading to the selection of specific congestion control points.



Source: Nippon Koei

Figure 7-5 Example of Traffic Jam Analysis using MBD

8. Results of the Study

8.1 Support for the Formulation of Public Transportation Plans utilizing MBD in Indonesia

As shown in Table 8-1, fourth meetings were held with the South Sulawesi Province Transportation Office, the Makassar City Transportation Office, and related agencies.

At the 1st and 2nd meetings, the needs for MBD utilization in South Sulawesi Province were identified and the MBD utilization plan and target area for analyzing were approved.

In the 2nd meeting, the Study Team shared examples of Japanese companies' use of MBD in transportation planning, which contributed to the promotion of understanding of the various methods of use, and the Study Team were also able to grasp the needs of the Indonesian side. In the 3rd meeting, the Study Team presented the results of the MBD analysis of the target area and proposed a new route for Pete Pete, and received feedback.

Table 8-1 Summary of Meetings with Related Agencies

No.	Date & Time	Agendas	Participants
1	8 December, 2023 14:00～16:00	＜Kick-off meeting＞ 1. Background of the MBD study 2. Outline of the study 3.Opinion exchange	・South Sulawesi Province Transportation Office ・Makassar City Transportation Office
2	12 December, 2023 10:30～12:00	＜Interview to South Sulawesi Land Transportation Management Center ＞ 1. Background of the MBD study 2. Outline of the study 3.Opinion exchange	・South Sulawesi Land Transportation Management Center, the Ministry of Transportation
3	26 January, 2024 14:30～17:00	＜2nd Meeting＞ 1. Confirmation of comments in the kick-off meeting 2. Explanation of MBD analysis results in Makassar City 3.Opinion exchange	・South Sulawesi Province Transportation Office ・South Sulawesi Land Transportation Management Center, the Ministry of Transportation ・Makassar City Transportation Office
4	19 March, 2024 10:30～13:40	＜Final meeting＞ 1. Confirmation of comments in the 2nd meeting 2. Status of data collection 3. Explanation of MBD analysis results 4. Opinion exchange	・South Sulawesi Province Transportation Office ・South Sulawesi Land Transportation Management Center, the Ministry of Transportation ・Makassar City Transportation Office ・Gowa Regency Transportation Office ・Maros Regency Transportation Office ・Takalar Regency Transportation Office ・Pare Pare City Transportation Office

Source: Nippon Koei

8.2 Technical Cooperation (TA)

The technical assistance (TA) was conducted to the three agencies as shown in Table 8-2. The overview of MBD and process of data analysis were explained, and an exercise was conducted on how to visualize data using the data samples (Figure 8-1).

Table 8-2 Summary of TA

No.	Date and time (local time)	Contents	Participants
1	21 March, 2024 11:00～14:00	1.What is MBD 2.MBD Analysis Process 3.Exercise on how to visualize data using GIS 4.Introduction of specific examples of data visualization	・Transportation Office,South Slawesi Province-5 ・Transportation Office, Makassar City-4 ・Land Transportation Management Center Region 19th , Ministry of Transportation -3

Source: Nippon Koei

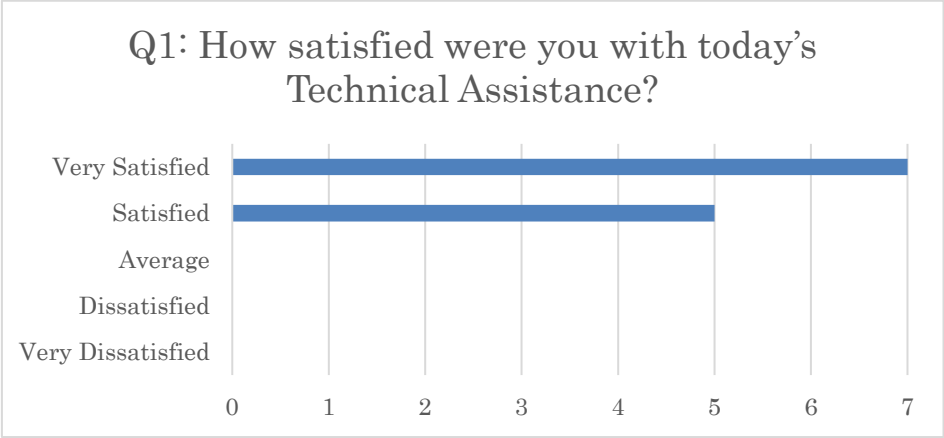
Source: Nippon Koei

Figure 8-1 TA Photo

A questionnaire survey was conducted to participants. The questions were as follows.

No.	Questions
Q1	How satisfied were you with today's Technical Assistance?(5-point rating)
Q2	How much could you understand today's contents?(5-point rating)
Q3	Do you think the BD analysis (e.g., Heatmap, OD lines) is useful for your work?(5-point rating)
Q4	If available, would you be interested in using the dashboard service?(5-point rating)
Q5	What problems do you think can be solved by using BD analysis?
Q6	Free Answer

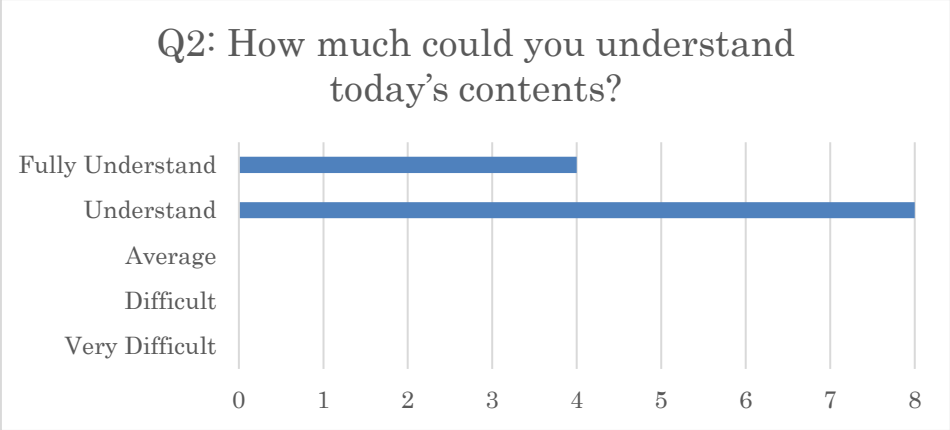
The results of the survey are presented below.
Regarding Q1, all participants answered "very satisfied" or "satisfied" with the TA. It is considered that the content of the lectures was meaningful to the participants.



Source : Nippon Koei

Figure 8-2 Summary of Q1 Answers

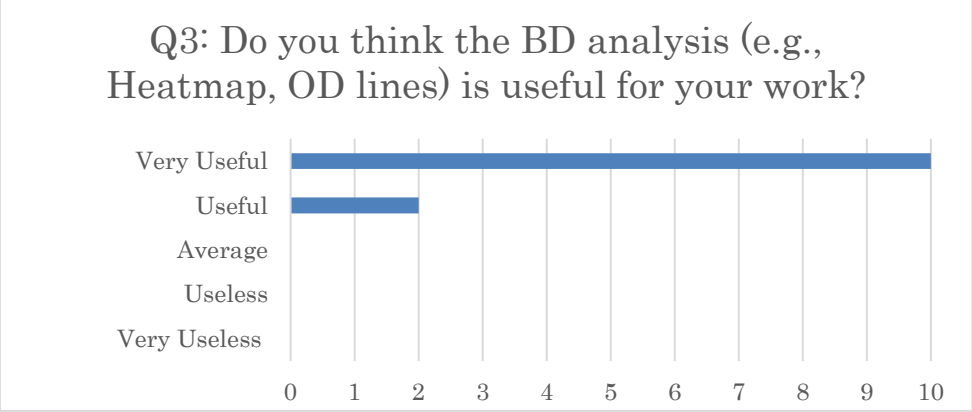
Regarding Q2, level of understanding of the TA, all participants answered, "Fully understand" or " understand". This indicates that the difficulty level of the lectures was considered appropriate.



Source: Nippon Koei

Figure 8-3 Summary of Q2 Answers

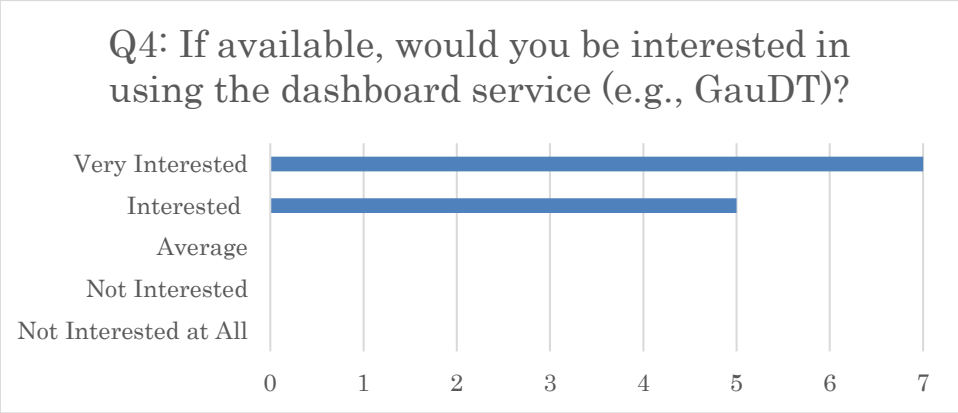
Regarding Q3, the degree to which MBD analysis is useful for their work, 10 respondents answered, "very useful," indicating that the use of MBD analysis results in their work is considered very useful.



Source: Nippon Koei

Figure 8-4 Summary of Q3 Answers

Regarding Q4, level of interest in using dashboard services, all participants indicated that they were "very interested" or "interested" in using dashboard services. This indicates a high level of interest in dashboard services.



Source: Nippon Koei

Figure 8-5 Summary of Q4 Answers

Q5, "What issues do you think can be solved using MBD analysis?" the following responses were obtained. Regarding issues that could be solved, some respondents answered that it could be used for public transportation planning, such as studying routes for Teman bus, and that it could contribute to reducing traffic congestion in the city on a daily basis and during events. Some respondents also answered that the survey could be used to identify tourism demand in specific areas and for development planning, and that the survey would be more effective and efficient than conventional surveys.

Table 8-3 Summary of Q5 Answers

Q5: What issues do you think can be solved using MBD analysis?
・I believe that many transportation problems can be solved by using MBD. Among them, Teman Bus are an interesting issue, and their routes have been changed many times. This is due to a lack of mature route decision-making capacity, indicating that routes are frequently changed. I also believe that MBD can be used to map road congestion and that congestion data can be used for urban traffic assessment/engineering studies. ・It can be used for 1. urban public transportation planning, 2. intercity transportation planning, 3. traffic handling and mitigation during specific periods such as Christmas and New Year. ・It can conduct regional studies, such as making recommendations using the results of analyzing actual data. In particular, it can be used to study the status of traffic congestion at intersections in Makassar City and to develop a comprehensive public transportation program. ・It can be used for transportation issues, market (economic) forecasting and regional development planning. ・It can be used for traffic congestion, disasters, transportation planning, and transportation business. ・It is useful to count the movement of people and vehicles as a factor for considering future transportation policy. ・It can be used for 1. issues related to understanding tourism demand for specific destinations, 2. countermeasures for traffic congestion and other traffic problems, and 3. forecasting traffic demand. ・The use of MBD allows for more effective and efficient surveys. ・It can solve problems such as traffic congestion during holidays, Christmas, New Year's, and Ramadan. ・It saves time.

Source: Nippon Koei

The following responses were received in response to the Q6: Some respondents were satisfied with the TA, while others wished it had been conducted more than once in order to gain more in-depth knowledge.

Table 8-4 Summary of Q6 Answers

Q6 Free Answers
・First, I would like to thank you for the opportunity to participate in this MBD activity; I am very interested in MBD because of the relevance of MBD to the primary work of my institution and my own educational background in land transportation. In addition to today's TA, I would like to participate in any other activities related to land transportation applications and research. ・We feel that it will be very useful for urban planning research. We hope that this TA can be a partner in urban planning in other regions in Indonesia and in education in high schools under the jurisdiction of the Ministry of Transportation. ・I think it would be good if we could work directly with the regulators when planning and operating programs related to MBD. ・It would be very beneficial to gain insight into how MBD can be used to help solve a variety of problems. ・I feel that today's TA is only an introduction and more time is needed to gain more in-depth knowledge. ・Thanks for sharing your knowledge about MBD. Hope it will be useful in the future. ・TA like today's is very much appreciated. I consider it very useful knowledge. ・Very impactful and I hope TA will be done more often to increase knowledge. ・Today's TAs are helping me learn more about geographic information systems. ・The results of this MBD need to be shared with the government. ・Regarding the number of TA sessions, we would like to see TA sessions held more than once, as one session is not sufficient.

Source: Nippon Koei

The following are the presentation materials.

Utilization of Big Data to Improve Mobility in South Sulawesi Province

- Technical Assistance -

March 2024

MLIT
Ministry of Land, Infrastructure, Transport and Tourism

NIPPON KOEI

Contents of Technical Assistance

1. Introduction of Big Data
2. Big Data Analysis Process
3. Practicing for Visualization by GIS
4. Cases of Traffic Data Visualization
5. Conclusion

1

1. Introduction of Big Data

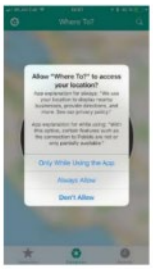
2

1.1 Feature of Big Data

Types of Big Data (BD)

Item	Detail	Subject	Unit of location data	Acquisition time interval
Mobile phone base station data	Communication history between mobile phone and base station	Mobile phone users	By base data (hundreds of meter)	1 hour
GPS data	Longitude and latitude data collected from mobile phone	User of specific mobile apps	Longitude & latitude	A few seconds (minimum)
Wi-Fi access point data	Communication history between mobile phone and Wi-Fi access point	User of each Wi-Fi service spot	By access point (50- 100 meter)	A few seconds (minimum)
Smart card data	Card usage history collected at gate of railway/bus stations	Smartcard user	By railway/bus station	Timing of tap the card

Base station



Permission of GPS data acquisition

Wi-Fi access point

Tapping of smart card at gate of station

3

1.1 Feature of Big Data

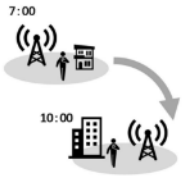
○Mobile phone base station data

Image of items of mobile phone base station data

MSISDN*	Communication date & time	Latitude	Longitude
acd78fee7xxxx19a	2020-04-10 04:30:10	-6.234291	106.641391
acd78fee7xxxx19a	2020-04-10 04:30:41	-6.234291	106.641391
Bf0c7910xxxxxxxxxx3d1	2020-04-10 04:30:57	-6.324280	106.541599
4567cd1fxxxx35e	2020-04-10 04:35:21	-6.324785	106.641072

*Mobile Subscriber Integrated Services Digital Network Number

- ✓ Big data that understands people's movements based on historical information that mobile phones regularly communicate with base stations to ensure stable communication.
- ✓ If the mobile phone is turned on, it will be subject to data acquisition.
- ✓ Based on the location and time of the base station where communications were recorded, it is possible to determine the area of stay and movement.



Source: MLIT

4

1.1 Feature of Big Data

○GPS data

Image of items of GPS data

maid	Latitude	Longitude	Horizontal accuracy(m)	Time stamp	Province name	City/Regency name	Postcode
8axse2b9-xxx3d-481a	-6.18379	106.94891	6.5	1656500382	DKI Jakarta	East Jakarta	13912
8axse2b9-xxx3d-481a	-6.18379	106.94890	6.5	1656500380	DKI Jakarta	East Jakarta	13912
26490392-d5wsa21	5.229322	97.02894	1.0	1656603692	Ache	Lhokseumawe	24354
7cb2b13f-xxx2-bfra6f	-7.105404	112.1682	20.0	1656407090	East Java	Lamongan	62271
7cb2b13f-xxx2-bfra6f	-7.105404	112.1682	8.0	1656407032	East Java	Lamongan	62271

*Mobile Advertising ID

- ✓ Movement data provided by telecommunications carriers and app providers based on location information obtained by the GPS function of smartphones, etc.
- ✓ Compared to mobile phone base station data, it has the advantage of being able to accurately and frequently determine latitude and longitude.

Source: MLIT

5

1.1 Feature of Big Data

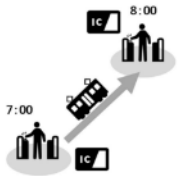
○Smart card data

Image of items of smart card data

Transaction date & time	Transaction ID	Card user number	Card bland	Getting on station	Getting off station	Fare (IDR)
2022/11/20 10:00:10	6deb18b2-0cb82a32	1136efca83225d27c	e-money	Bundaran HI	ASEAN	7,000
2022/11/20 10:00:10	2sef23h2-3tg84a65	7748sfvr84415t76k	e-money	Lebak Bulus	Senayan	10,000
2022/11/20 10:00:11	1dtb25k1-9tn24d78	4238gtrr24811t33l	Flazz	Blok M*	-	5,000
2022/11/20 10:00:18	8fcv75a6-7zn51y98	9420gfoc54038b29j	Kci	Gambir	Juanda	3,000

*Data of Trans Jakarta passengers

- ✓ Big data that understands the OD between railway stations and bus stops based on the boarding and alighting history read by IC card readers installed at station ticket gates and inside buses.
- ✓ If personal attribute information (ex. gender, age, etc.) are linked to smart card, it is possible to understand the actual movement status by attribute.

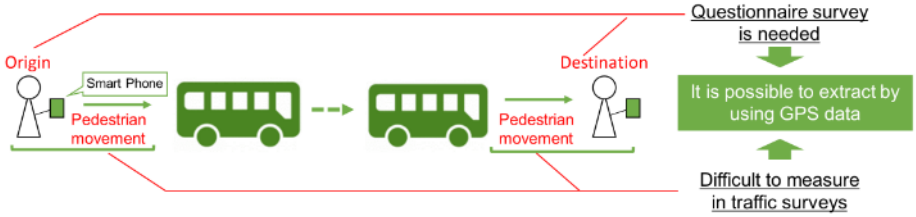


Source: MLIT

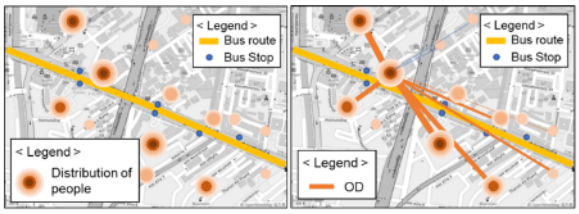
6

1.2 Feature of GPS Data

- Large scale traffic survey was required to extract pedestrian movements and OD
  ⇒It is possible to easily extract pedestrian movements and OD by using GPS data



- It is possible to analyze the place where people are staying and traffic demand (origin – destination volume)

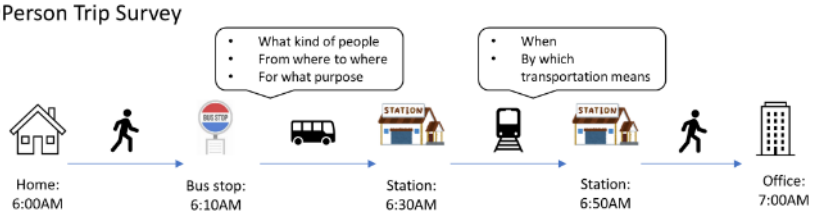


⇒Utilize the results of BD analysis to support public transport planning

7

1.3 Person Trip Survey and BD Study (GPS data)

○Person Trip Survey



Information collected by Person Trip Survey

- ✓ Household interview to collect necessary data and information for estimating the present traffic demand of the inhabitants in the target area.
- ✓ The survey has done by direct interview or posting of questionnaire. (According to JICA, minimum 3% out of total number of households is necessary for the sample)
- ✓ Collected data is utilized for formulation of master plan, public transportation plan etc,

Comparison between Person Trip Survey and BD study

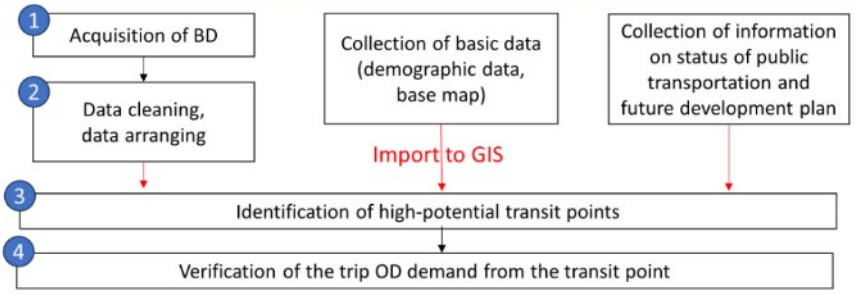
Item	Person Trip Survey	BD Study (GPS data)
Advantage	• Accurate trip data on one day can be collected	• Trip data can be collected continuously
Disadvantage	• A lot of human resource is necessary • Survey cannot be done frequently	• There is some bias of data depending on data source (Apps user)

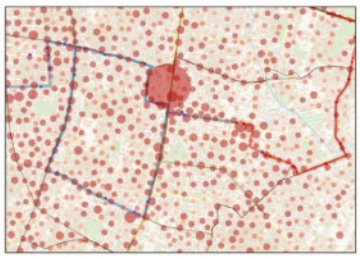
8

2. Big Data Analysis Process

9

2.1 Analysis Process





Identification of transit point

Checking trip demand

10

2.1 Analysis Process

1 Acquisition of BD

- Data is obtained from the smartphone application with SDK (Software Development Kit) and purchased from data company (ADA)
- Data analysis and visualization can be done by BD (using Device ID/Lat & Lon/Timestamp)

Sample data field

device id	lat	long	timestamp
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.15477	119.4369	2023/11/1 7:28
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.15348	119.4371	2023/11/1 7:30
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.14407	119.4385	2023/11/1 7:31
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.13511	119.4264	2023/11/1 7:36
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.13495	119.4242	2023/11/1 7:36
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.13487	119.4226	2023/11/1 7:37
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.12686	119.4185	2023/11/1 7:39
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.12312	119.418	2023/11/1 7:40
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.12313	119.418	2023/11/1 7:40
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.12186	119.4117	2023/11/1 7:42
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.12187	119.4117	2023/11/1 7:42
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.12194	119.412	2023/11/1 7:44
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.1204	119.4122	2023/11/1 7:48
00aff21d-0327-6fbb-b0d1-7817d2d830aa	-5.1203	119.4121	2023/11/1 7:48

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2.1 Analysis Process

2 Data Cleaning & Data Arranging

Implement the following process through programming for removing unreliable data and determining data status for accurate analysis

Flow	Procedure	Purpose of processing	Processing Method
Step 1	Data Cleaning	Removal of unreliable or unusable data for analysis	• Delete entries with only one data point per day • Delete points where calculated speed is extraordinary
Step 2	Data Arranging	Determination of points into "Trip" and "Stay" status	• Classify data status ("Trip" or "Stay") based on the following definition

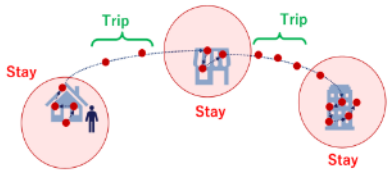

Image of data arranging
(Determination of "Trip" and "Stay")

Definition of classifying "Trip" and "Stay"

Stay point:
A point where one has stayed for more than 20 min within a 150m radius

Trip point:
Stay points where one has moved more than 300m within 2 hour

Definition of data arranging

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2.1 Analysis Process

2 Data Cleaning & Data Arranging

Data cleaning and arranging process based on programming (SQL) contributes to eliminating unreliable entries and distinguishing people's stay point and their trip origin/destination

Raw data

- Total rows: 226,701,433
- Unique ID: 525,196

Programming for data cleaning & arranging

After data cleaning & arranging

- Total rows: 16,256,783
- Unique ID: 435,284

Example (through SQL in AWS)

```
CREATE TABLE "Naminasata.HBD" AS
SELECT * FROM (
SELECT dev_ifa, lat, long, ts_start, lat_end, long_end, ts_end,
    dur_secs, dur_mins, dur_hours,
    round(dist_m, 0) AS dist_m,
    round(dist_km, 2) AS dist_km,
    round(dist_m/dur_secs, 2) AS ave_mps,
    round((dist_m/dur_secs)*3.6, 2) AS ave_kmph
FROM (
SELECT dev_ifa, lat, long, ts_start, lat_end, long_end, ts_end,
    date_diff('second', ts_start, ts_end) AS dur_secs,
    date_diff('minute', ts_start, ts_end) AS dur_mins,
    date_diff('hour', ts_start, ts_end) AS dur_hours,
    great_circle_distance(lat, long, lat_end, long_end) * 1000 as dist_m,
    great_circle_distance(lat, long, lat_end, long_end) as dist_km
```

13

2.1 Analysis Process

3 Identification of high-potential transit points

Visualize clusters of people's stay points using BD to identify high-potential transit points, focusing on the following areas in Makassar.

Data visualization area

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2.1 Analysis Process

3 Identification of high-potential transit points

According to the cluster visualization of stay points, people mainly concentrated in the following black circles (A: around 'Pakui Seyang Park', B: around 'Phinisi Point Mall', C: around 'Universitas Hasanuddin'), which could potentially serve as suitable locations for transit points

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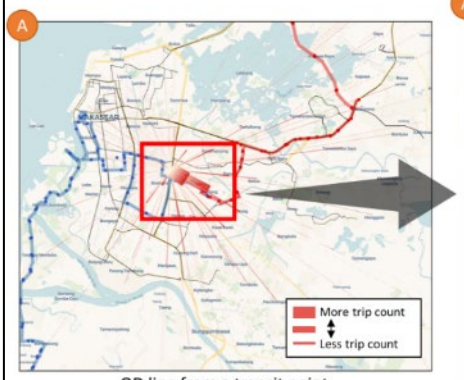
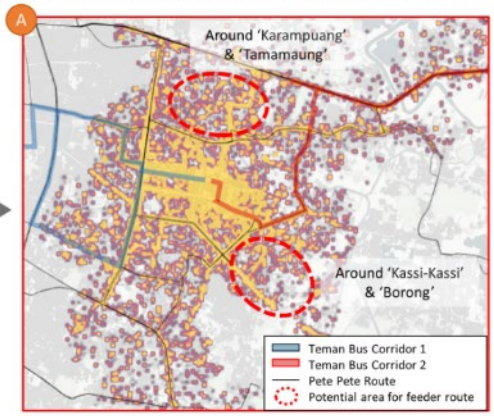
2.1 Analysis Process

4 Verification of the trip OD demand from the transit point

Trip demand from the area A: around 'Phinisi Point Mall' is visualized through the OD line.
Further, based on the heatmap focusing on high demand trip areas, the following red circles (around 'Karampuang', 'Tamamaung', 'Kassi-Kassi' , 'Borong') indicate specifically high demand of trips that are currently inaccessible by bus and pete-pete, which would be the potential area for new feeder route



OD line from a transit point



Heatmap of trip destination from transit point

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3. Practicing for Visualization by GIS

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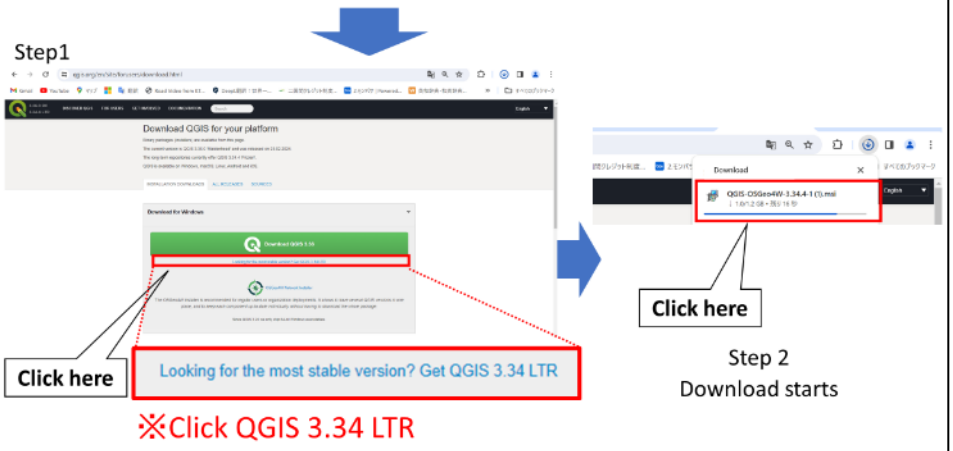
3.1 Outline of QGIS

(1) How to Download and Install - 1) Download

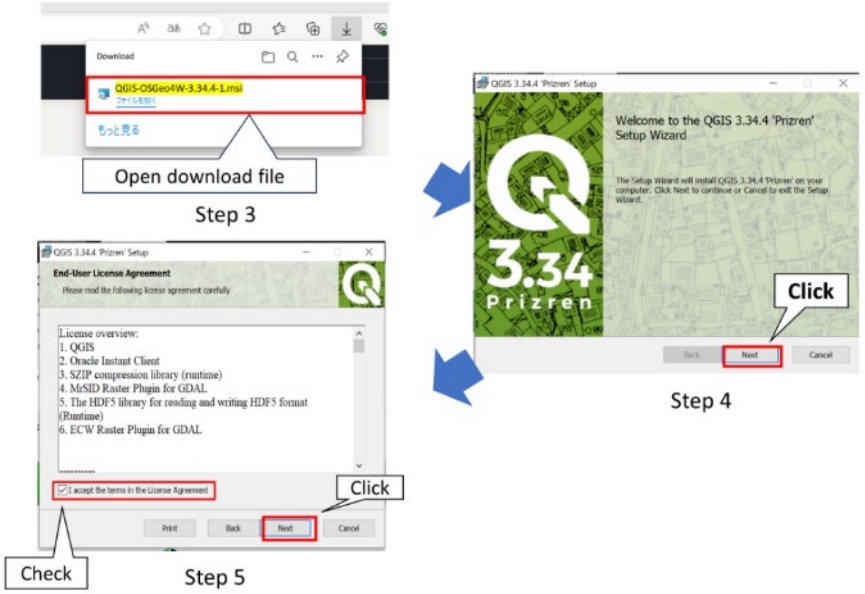
Link to download files https://www.qgis.org/en/site/forusers/download.html



18

3.1 Outline of QGIS

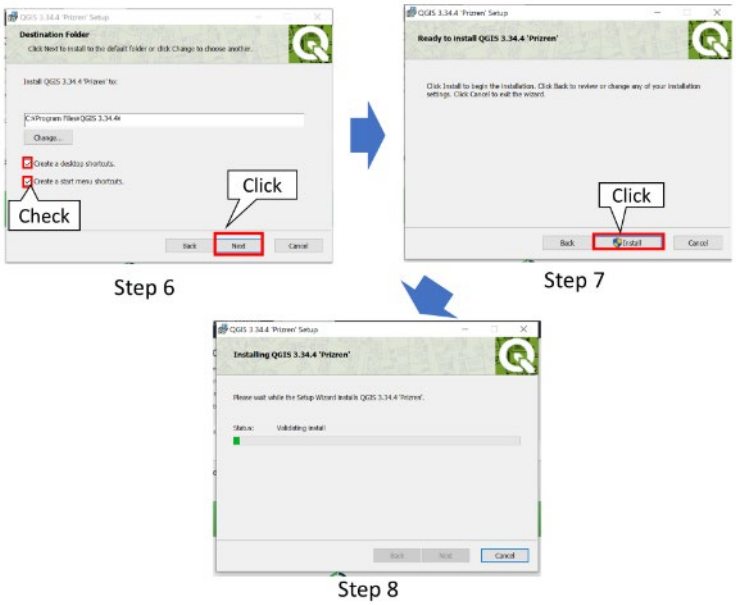
(1) How to Download and Install - 2) Install



19

3.1 Outline of QGIS

(1) How to Download and Install - 2) Install



20

3.1 Outline of QGIS

(1) How to Download and Install - 2) Install

Step 9

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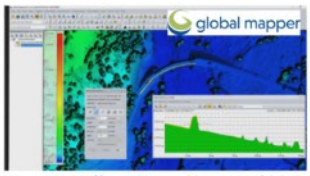
3.1 Outline of QGIS

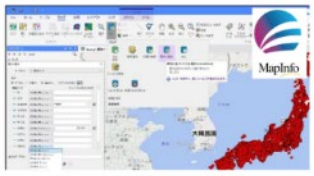
(2) What is QGIS?

GIS (Geographic Information System): A tool that allows geographic information to be analyzed and visualized on maps.

Source: https://www.esrij.com/products/arcgis-pro/



Source: https://www.bluemarblegeo.com/global-mapper-download/



Source:https://ssl.japan.mapinfo.com/location/products/software/software_1_8.php

Source: https://qgis.org/ja/site/

Advantage of QGIS

- ✓ Gratis
- ✓ Functions equivalent to paid software
- ✓ Big global user community

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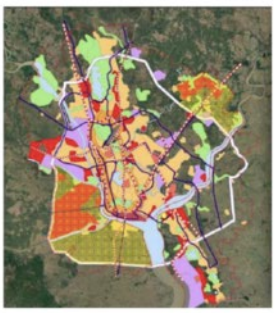
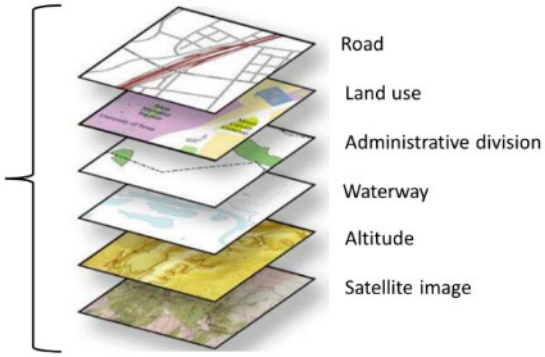
3.1 Outline of QGIS

(2) What is QGIS?

Project file is consisted of multiple layers with their own unique data



Project File (.qgs)

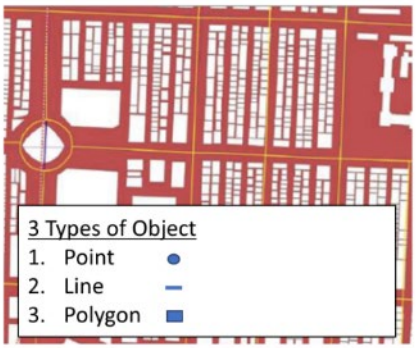


Layer File (.lyr)

23

3.1 Outline of QGIS

(2) What is QGIS?



Vector File (=Shape)

Raster File (=Image)

Layer file has two types of the file (Vector file and Raster file)

- Vector file: ex. Location information (Point), Bus route (Line), land use information (Polygon)
- Raster file: ex. Satellite image

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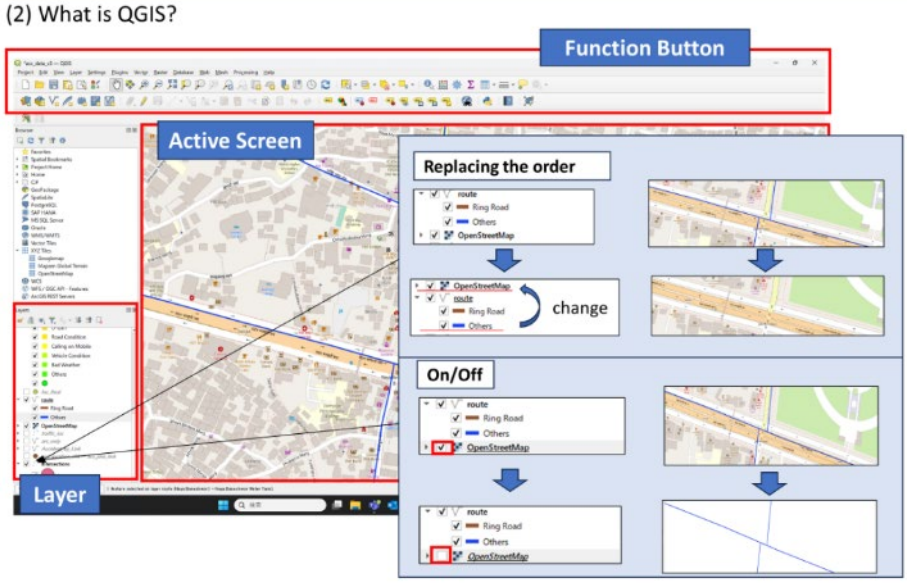
3.1 Outline of QGIS

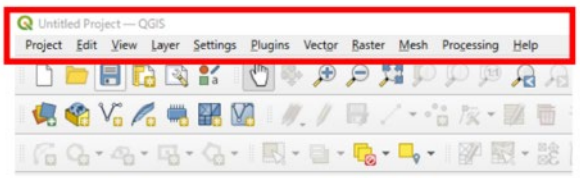
(2) What is QGIS?



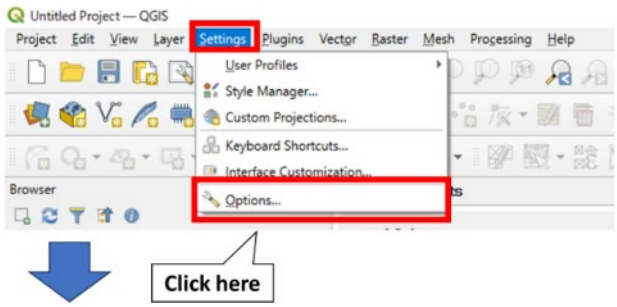
25

3.2 Changing Language

※ If the language is not English, you can change it.

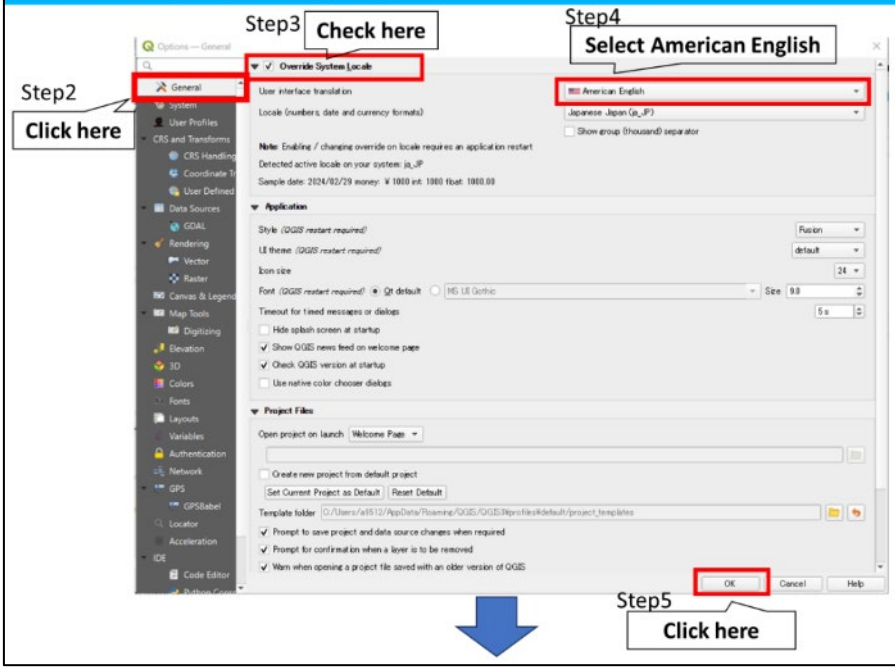


Step1



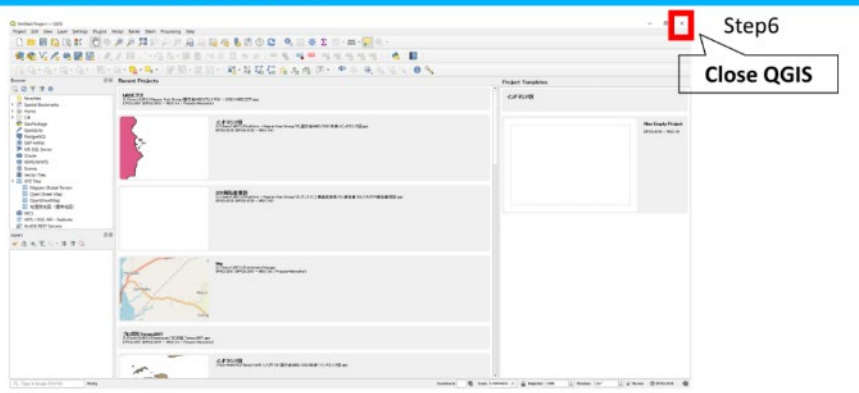
26

3.2 Changing Language



27

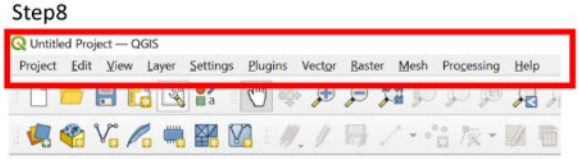
3.2 Changing Language



Step7

Reopen QGIS

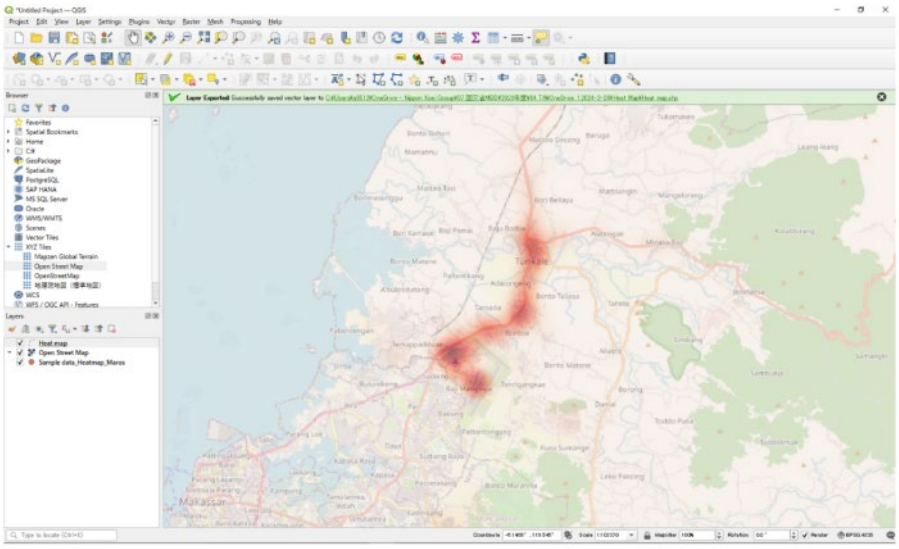
Step8



Check if it has been changed to English

28

3.3 Making Heat Map



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3.3.1 Outline of Sample Data(Heatmap)

Step 1
Outline of sample data for Heat Map

01_Sample data_Heatmap_Maros.csv 2024/03/01 18:01 Microsoft Excel CSV ... 928 KB

1.Positional Data in Maros (1 day)

Items	Contents
dev_ifa	User ID
Time	Recorded time
O_lat	Latitude (Origin)
O_longtiude	Longitude (Origin)

Data are stored in CSV file

Snapshot of data

dev_ifa	time	O_lat	O_long
76ea0bc5-441f-4cd6-9749-559ff6d9d25a	0:12:54	-5.112389	119.601555
76ea0bc5-441f-4cd6-9749-559ff6d9d25a	0:25:05	-5.111057	119.60239
76ea0bc5-441f-4cd6-9749-559ff6d9d25a	0:34:28	-5.009644	119.64187
78436662-aeaf-45d7-8d7f-4c9629b94d2c	11:53:57	-5.05217	119.54536
78436662-aeaf-45d7-8d7f-4c9629b94d2c	15:13:01	-5.07694	119.54455
78436662-aeaf-45d7-8d7f-4c9629b94d2c	15:33:25	-5.07783	119.54571
785cf7ee-23d9-4f3b-b4bc-d987133372a5	21:12:04	-5.0526023	119.5799
785cf7ee-23d9-4f3b-b4bc-d987133372a5	21:50:46	-5.01229	119.57412
7716d874-9df6-4a86-8a18-936fe88d44bb	12:33:48	-5.050154	119.51021
7716d874-9df6-4a86-8a18-936fe88d44bb	14:17:08	-5.05068	119.51157
7716d874-9df6-4a86-8a18-936fe88d44bb	19:48:55	-5.08602	119.54122
7857f48c-33e3-499d-9f76-c0cd336e8771	8:17:16	-5.036432	119.52881
78586e6c-1c10-4bbe-a2e9-73d947d682b7	0:40:17	-5.00374	119.56857

How can we open the csv file using QGIS?

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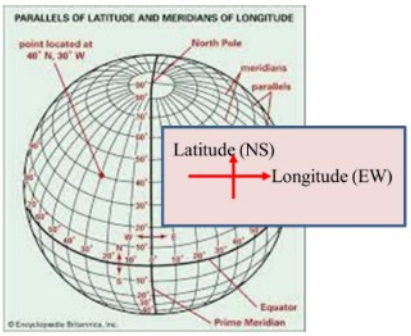
3.3.2 Image of Latitude and Longitude

Lt = Latitude
Ln = Longitude

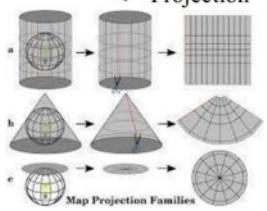
Position of a point on globe

For analysis (distance etc.), data should be projected to map

Position of a point on Map



Projection



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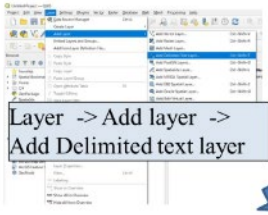
3.3.3 Importing Large Data to QGIS

Step 2-1: Add Delimited text layer

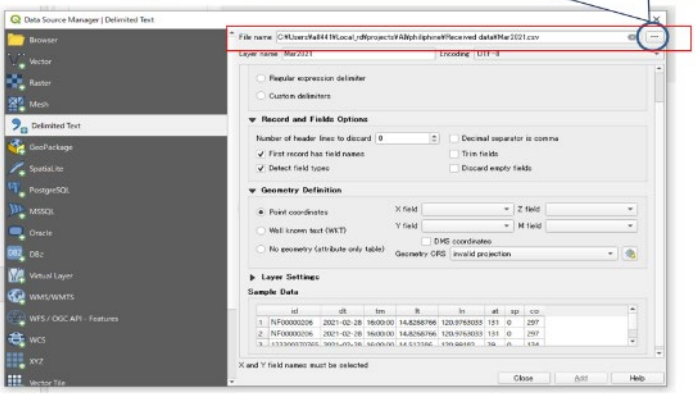


Layer -> Add layer -> Add Delimited text layer

1. File

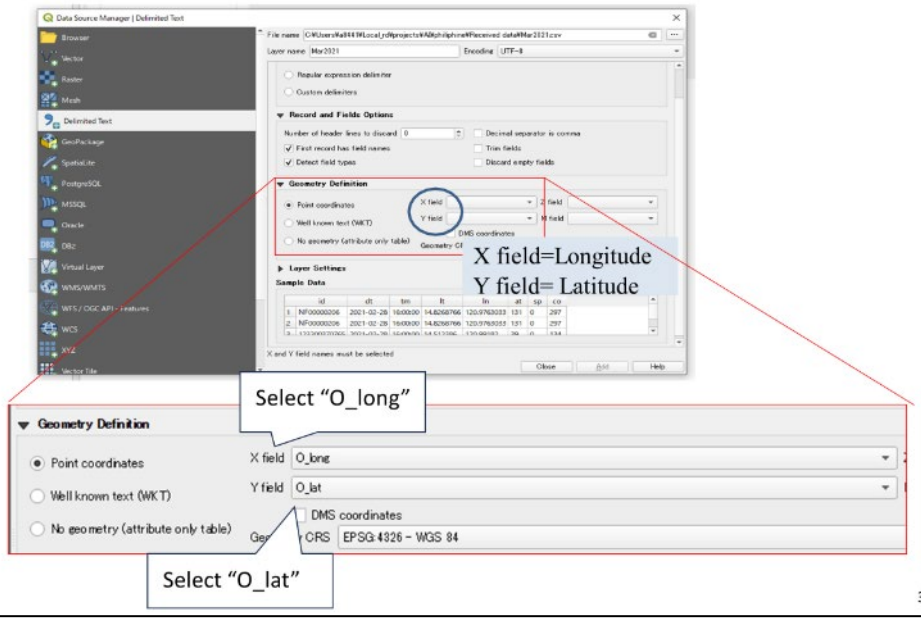
Select “Sample Data_Heatmap_Maros.csv”

Sample data_Heatmap_Maros.csv



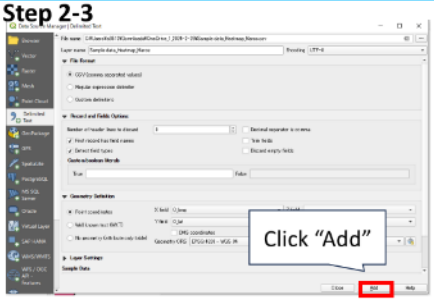
3.3.3 Importing Large Data to QGIS

Step 2-2:Geometry Definition

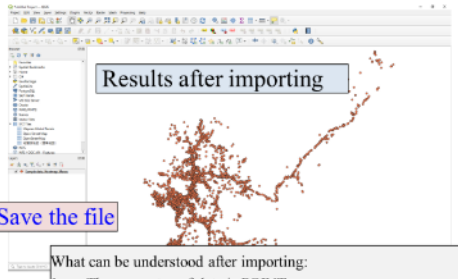


3.3.3 Importing Large Data to QGIS

Step 2-3



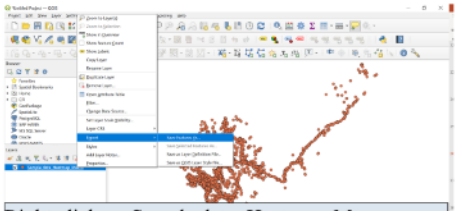
Step 2-4



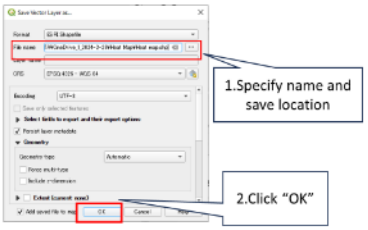
What can be understood after importing:

1. The geometry of data is POINT
2. Large data set requires longer time to import
3. The file format after importing is called Shape file.

Step 2-5:Save the file



Right click on Sample data_Heatmap_Maros
-> Export ->Save features as new layer



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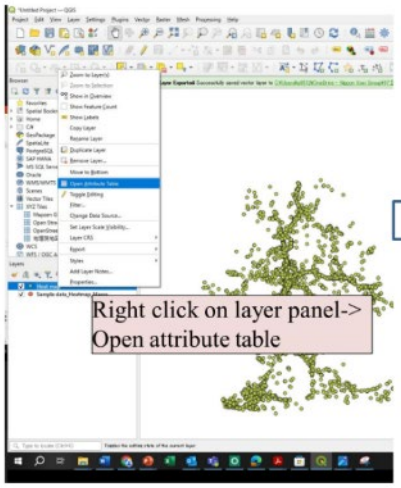
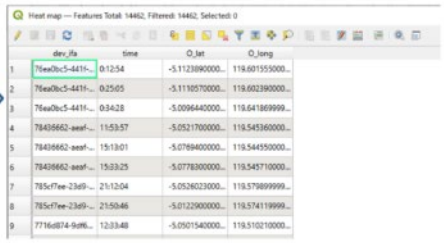
3.3.4 Observing Data

Step 3: Observing data





1. All data has been imported
2. This operation is highly dependent on computer’s memory
3. Column’s name and values came from csv

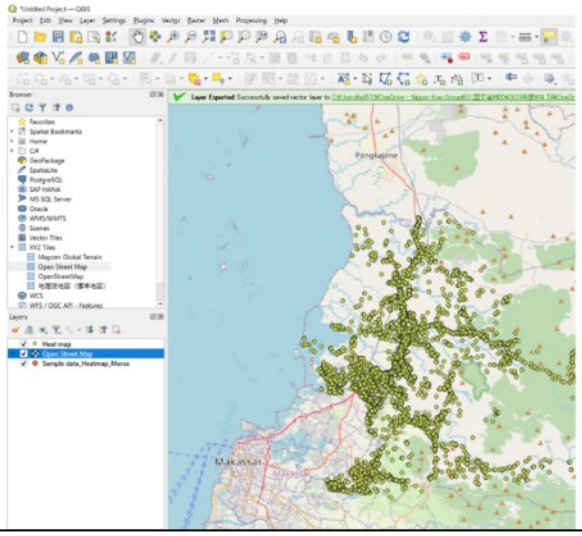
35

3.3.5 Viewing on Map

Step 4: Viewing on Map

View ▸ Panel ▸ Browser (check box)
xyz Tiles ▸ openstreet map

- The location of point can be seen on map



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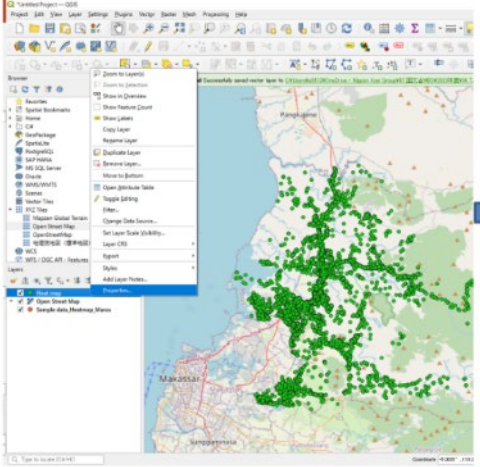
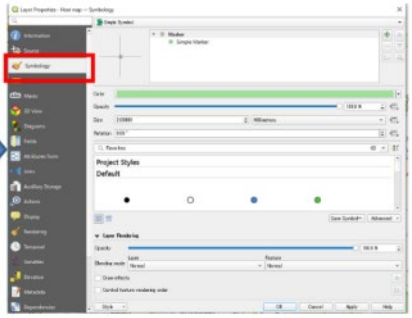
3.3.6 Viewing on Heat Map

Step 5-1: Open Properties

Right click on layer panel-> Open Properties



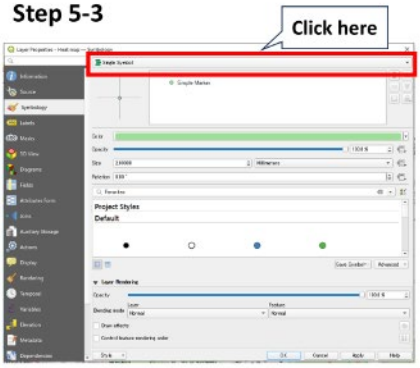
Step 5-2: Select Symbology



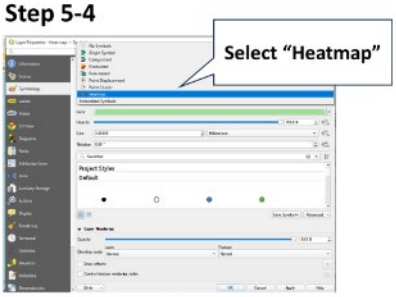
37

3.3.6 Viewing on Heat Map

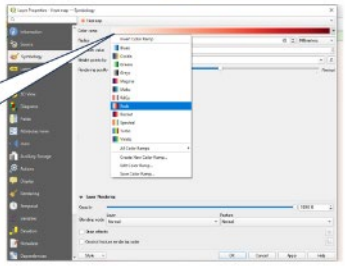
Step 5-3



Step 5-4



Step 5-5

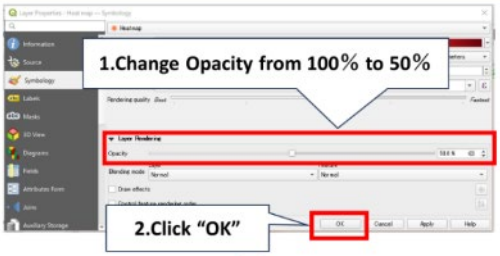


1.Left click on Color ramp
2.Select “Reds”
※Color may be freely changed

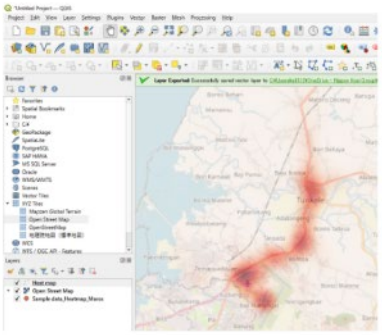
38

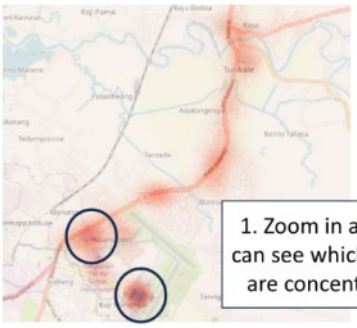
3.3.6 Viewing on Heat Map

Step 5-6



Step 5-7





1. Zoom in and you can see which points are concentrated.

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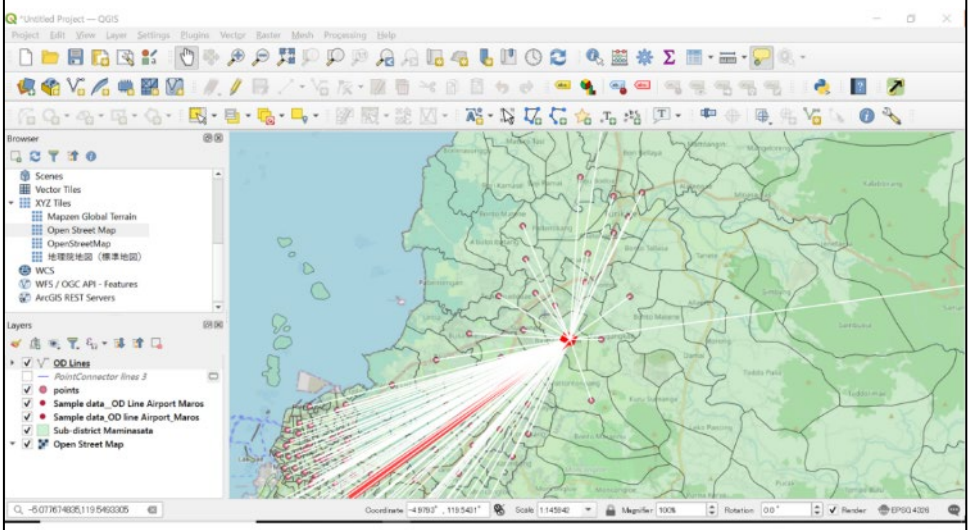
3.4 Making OD Line



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3.4.1 Outline of Sample Data(OD Line)

1.OD data from Sultan Hasanuddin International Airport (1 day)

Sample data_OD line Airport_Maros.csv 2024/02/28 16:00 Microsoft Excel CSV ... 9 KB

Items	Contents
O_lon	Longitude (Origin)
O_lat	Latitude (Origin)
D_lat	Latitude (Destination)
D_lon	Longitude (Destination)
ADM2_EN	Zoning (Prefecture / City)
ADM3_EN	Zoning (District)
ADM4_EN	Zoning (Sub-District)
Trip_Count	Number of trips per day

Snapshot of data

	O_lon	O_lat	D_lat	D_lon	ADM2_EN	ADM3_EN	ADM4_EN	Trip_Count
1	119.549331	-5.07767484	-5.23987784	119.432187	Gowa	Bajeng	Panciro	4
2	119.549331	-5.07767484	-5.21593037	119.434088	Gowa	Pallangga	Jenetallasa	2
3	119.549331	-5.07767484	-5.2229028	119.462989	Gowa	Pallangga	Pangkabinanga	1
4	119.549331	-5.07767484	-5.19185642	119.448263	Gowa	Somba Opu	Katangka	1
5	119.549331	-5.07767484	-5.19574059	119.472648	Gowa	Somba Opu	Paccinongan	2
6	119.549331	-5.07767484	-5.19738141	119.44507	Gowa	Somba Opu	Pandang Pandang	1
7	119.549331	-5.07767484	-5.09167042	119.534166	Kota Makassar	Biring Kanaya	Bakung	2
8	119.549331	-5.07767484	-5.1228589	119.514663	Kota Makassar	Biring Kanaya	Berua	2
9	119.549331	-5.07767484	-5.07551121	119.499551	Kota Makassar	Biring Kanaya	Bulurokeng	5
10	119.549331	-5.07767484	-5.10672138	119.506864	Kota Makassar	Biring Kanaya	Daya	14
11	119.549331	-5.07767484	-5.13610202	119.52085	Kota Makassar	Biring Kanaya	Katimbang	1
12	119.549331	-5.07767484	-5.10005526	119.53143	Kota Makassar	Biring Kanaya	Laikang	3
13	119.549331	-5.07767484	-5.12503033	119.528866	Kota Makassar	Biring Kanaya	Paccerakang	2
14	119.549331	-5.07767484	-5.08742532	119.51532	Kota Makassar	Biring Kanaya	Pai	27

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3.4.1 Outline of Sample Data(OD Line)

Shapefile (Sub-district Maminasata)

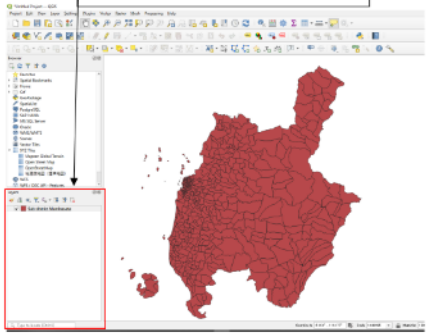
How can we open the shapefile using QGIS?

Sub-district Maminasata.cpg	2024/02/28 16:00	CPG file	1 KB
Sub-district Maminasata.dbf	2024/02/28 16:00	DBF file	1,850 KB
Sub-district Maminasata.prj	2024/02/28 16:00	PRJ file	1 KB
Sub-district Maminasata.qmd	2024/02/28 16:00	QMD file	2 KB
Sub-district Maminasata.shp	2024/02/28 16:00	AutoCAD Shape Source	1,039 KB
Sub-district Maminasata.shx	2024/02/28 16:00	SHX file	5 KB

※Shapefile consists of a set of multiple files with the same file name.

File extension	Roles
.shp (required)	Stores information of shapes
.dbf (required)	Stores attribute information of shapes
.shx (required)	Stores index information of shapes
.prj (mostly required)	Stores definition information of coordinate system
.cpg (option)	Stores character codes of attribute information
.sbn (option)	Stores spatial index
.sbx (option)	Stores spatial index
.shp.xml (option)	Meta-data

Step1
You can open the shapefile by dragging and dropping it



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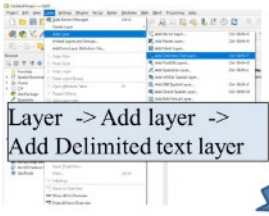
3.4.2 Importing csv Data to QGIS

Step 1-1: Add Delimited text layer

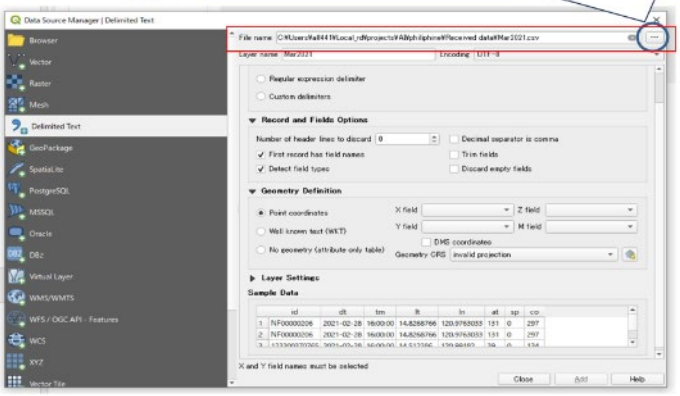


Layer -> Add layer -> Add Delimited text layer

1. File

Select “Sample Data_OD line Airport_Maros.csv”

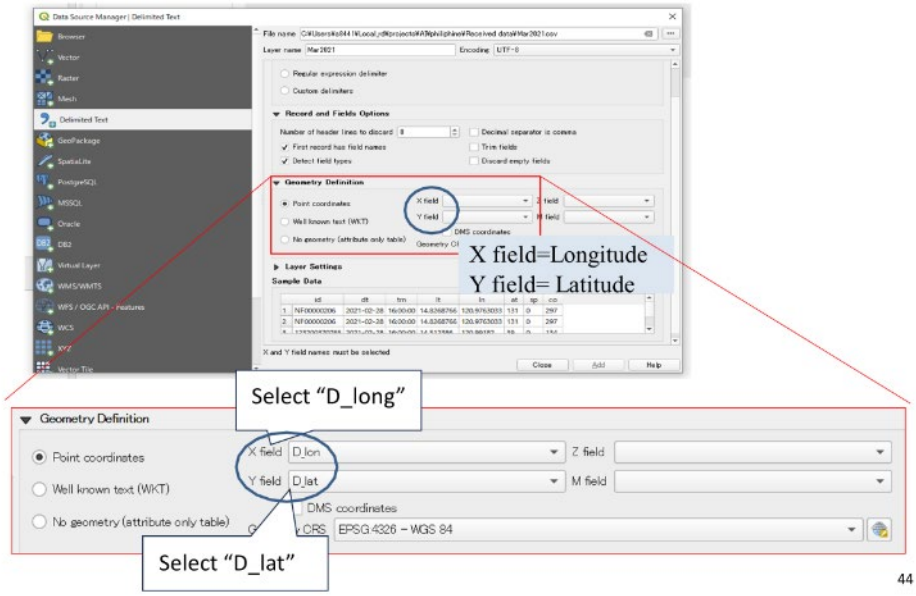
Sample data_OD line Airport_Maros.csv



43

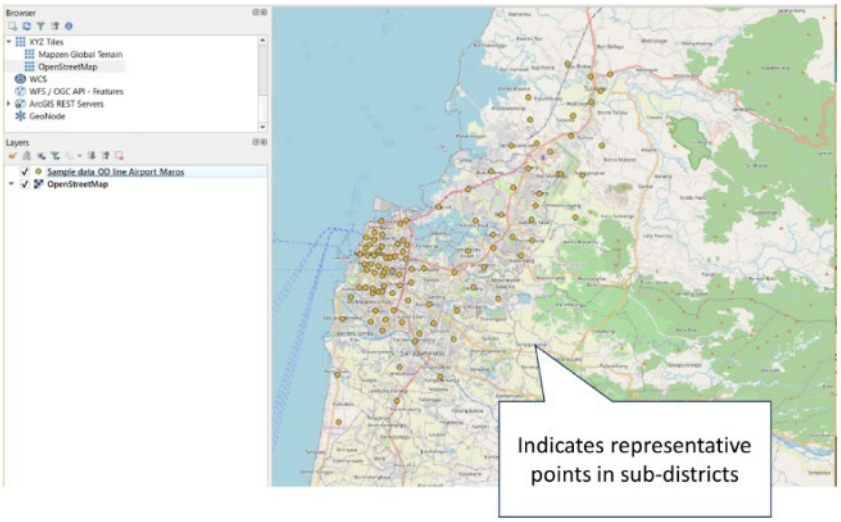
3.4.2 Importing csv Data to QGIS

Step 1-2:Geometry Definition



44

3.4.2 Importing csv Data to QGIS

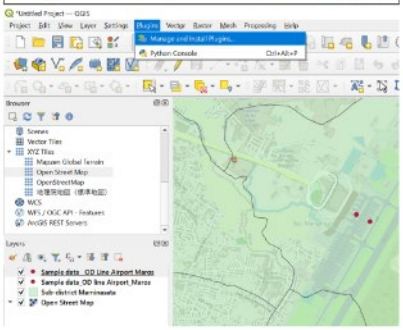


45

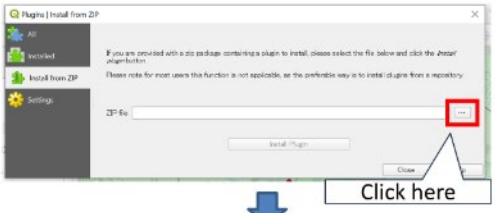
3.4.3 Plugins / Install from ZIP

Step 4-1:

Plugins ▶ Manage and Install Plugins



Step 4-2:



Step 4-3:

Step 4-4:

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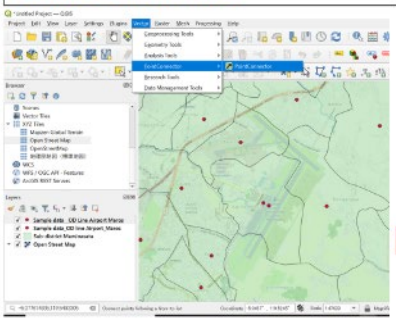
3.4.4 Connection Origin Point and Destination Points

Step 5-1:

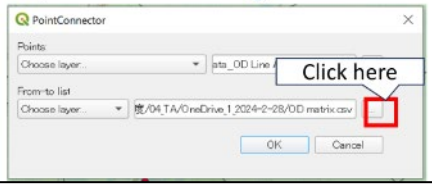
Vector ▶ PointConnector



Step 5-2:

Step 5-3:

Step 5-4:



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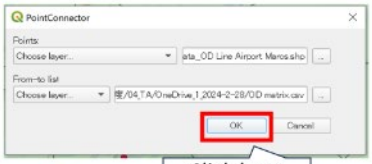
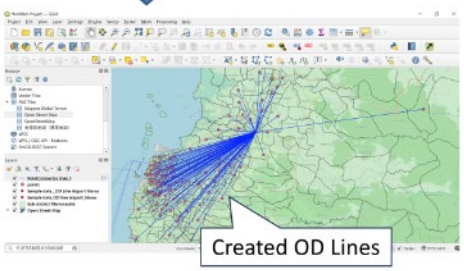
3.4.4 Connection Origin Point and Destination Points

Step 5-5:

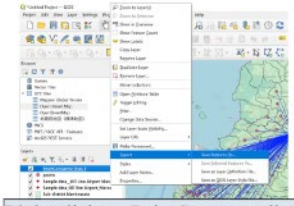
Step 5-6:



Step 5-7:

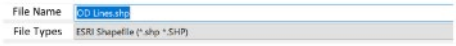


Step 5-8:Save the file



Right click on PointConnector lines
-> Export ->Save features as new layer

File Name: OD Lines



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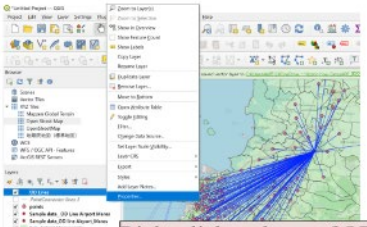
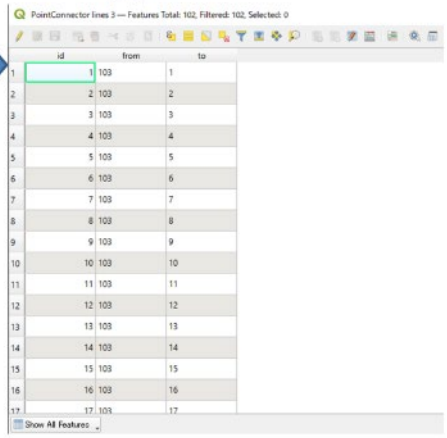
3.4.5 Addition of Attribute Information

Step 6-1:



Right click on layer of OD lines-> Open attribute table

Only the OD matrix is listed.
Attribute information does not include, which needs to be added.



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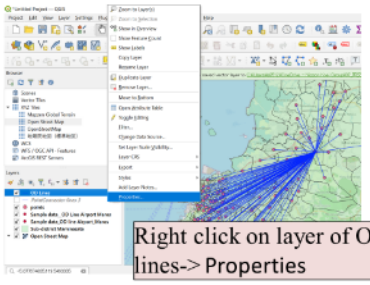
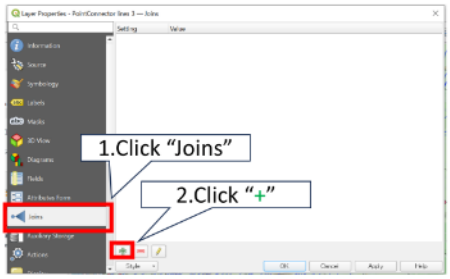
3.4.5 Addition of Attribute Information

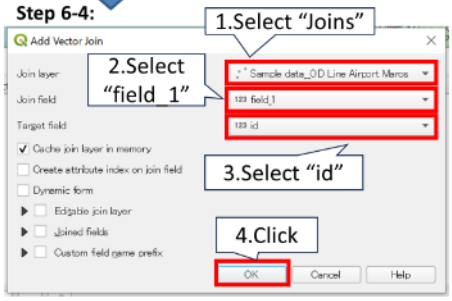
Step 6-2:



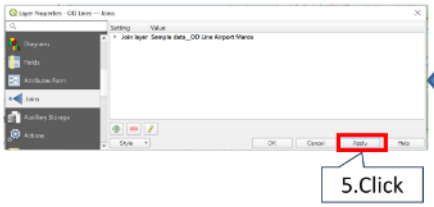
Step 6-3:



Step 6-4:



Step 6-5:



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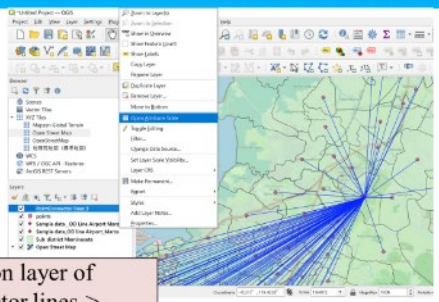
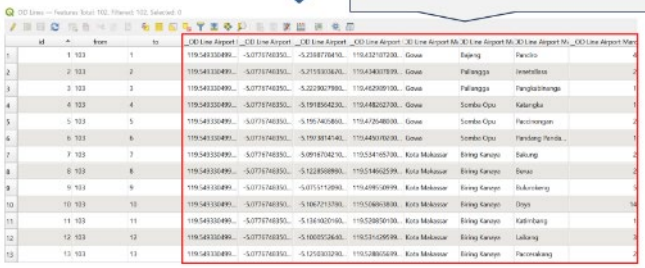
3.4.5 Addition of Attribute Information

Step 6-6:

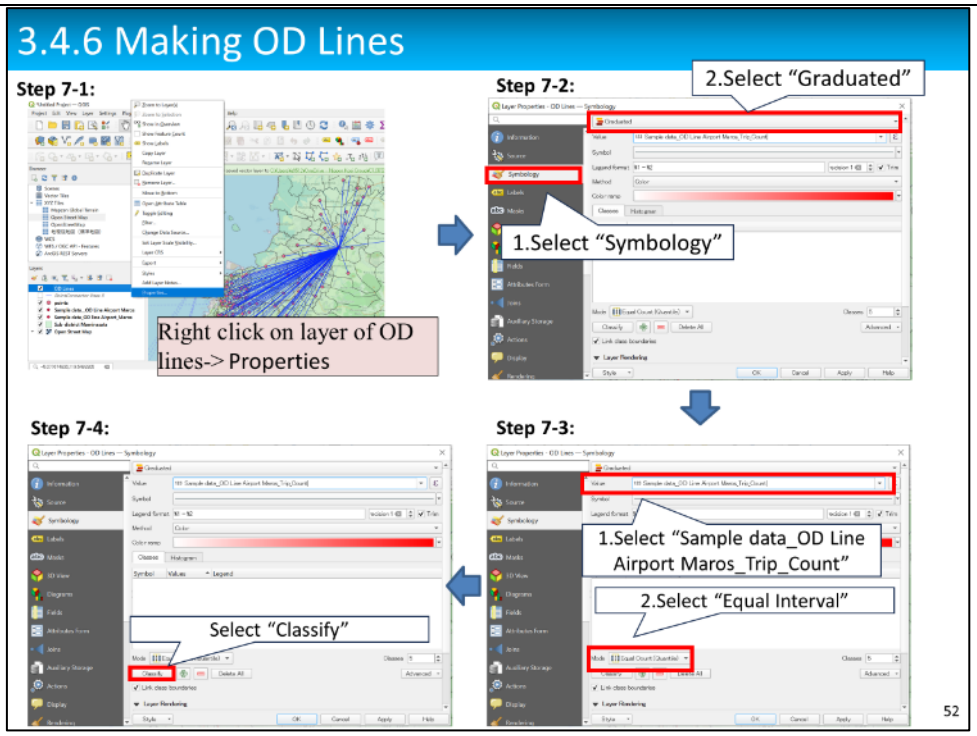


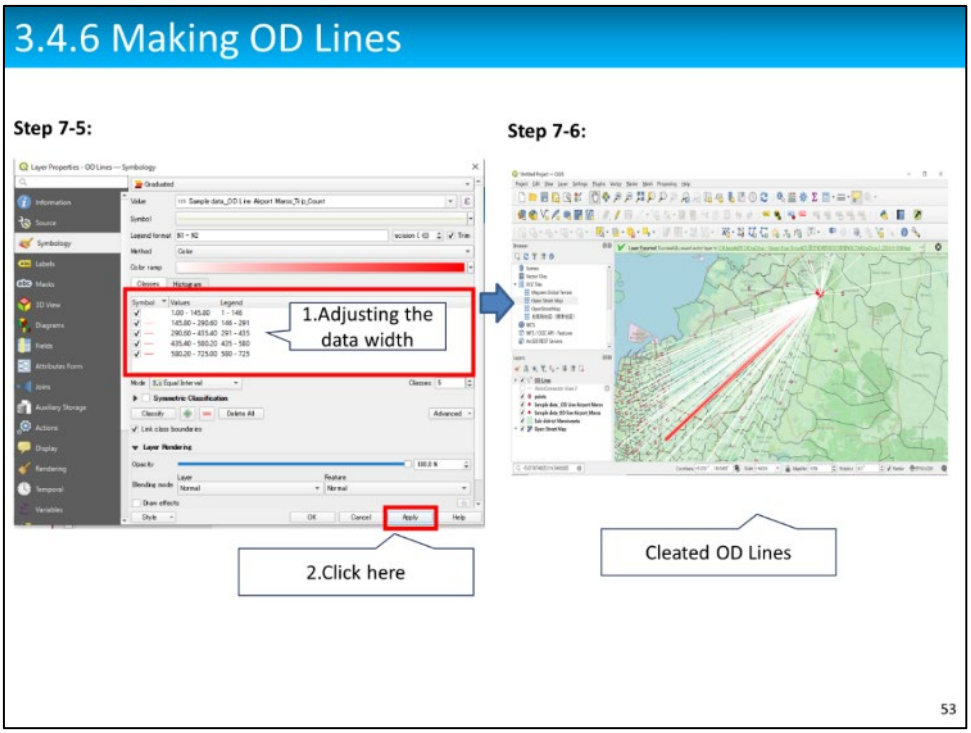
Right click on layer of PointConnector lines-> Open attribute table

Added Attribute Information



51


3.4.6 Making OD Lines
Step 7-1:
Right click on layer of OD lines-> Properties
Step 7-2:
2.Select “Graduated”
1.Select “Symbology”
Step 7-3:
1.Select “Sample data_OD Line Airport Maros_Trip_Count”
2.Select “Equal Interval”
Step 7-4:
Select “Classify”
52


3.4.6 Making OD Lines
Step 7-5:
1.Adjusting the data width
2.Click here
Step 7-6:
Cleated OD Lines
53

4. Cases of Traffic Data Visualization

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4.1 Visualization of Traffic Data Analysis Results

Dashboard: a tool that visualizes various data online using maps, graphs, etc.

Advantage of the dashboard over the issues for realization of Urban Transport M/P

Issue for realization of Urban Transport Master Plan	Advantage of traffic data analysis dashboard
• It is difficult to foster a common understanding of urban transportation issues among diverse stakeholders based on quantitative evidence such as traffic surveys.	• Interactive visualization that incorporates all kinds of information such as graphs and maps enables multifaceted information sharing with the stake holders.
• It is difficult to understand and share detailed proposals for each sector int the plan in an integrated manner by sharing information with paper report.	• Data sharing over the Internet enables instant sharing of information to the stakeholders.
• It is difficult to immediately share the latest status of progress of realization of the plan among various stakeholders.	• Cloud system enables to update the latest status on the dashboard at any time.

Source: https://committees.jsce.or.jp/kenc04/system/files/%E7%AC%AC4%E5%9B%9E%E5%9C%9F%E6%9C%A8%E6%8A%80%E8%A1%93%E8%80%85%E5%AE%9F%E8%B7%B5%E8%AB%96%E6%96%87%E9%9B%86%E7%A0%94%E7%A9%B6%E7%99%BA%E8%A1%A8%E4%BC%9A%EF%BD%9C%E9%85%8D%E5%B8%83%E8%B3%87%E6%96%99.pdf

- Promotion of public understanding of the current state of urban transportation
- Promotion of information sharing and cooperation among various local stakeholders to realize the urban transportation master plan

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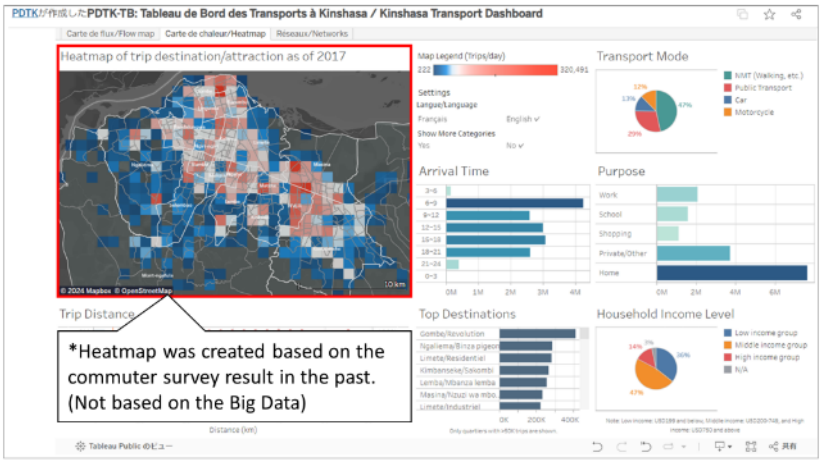
4.1 Visualization of Traffic Data Analysis Results

Case1 : Project for Capacity Development for the realization of the Urban Transport Master Plan in Kinshasa City (JICA, 2021~2025)



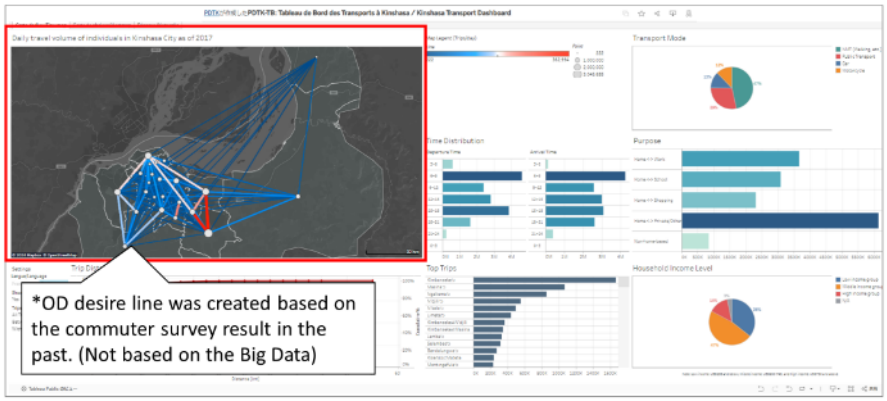
Source: https://public.tableau.com/app/profile/pdtk/viz/PDTK-TBTableaudeBorddesTransportsKinshasaKinshasaTransportDashboard/CartedefluxFlowmap

UI of the traffic data analysis dashboard in Kinshasa (Heatmap)

56

4.1 Visualization of Traffic Data Analysis Results

Case1 : Project for Capacity Development for the realization of the Urban Transport Master Plan in Kinshasa City (JICA, 2021~2025)



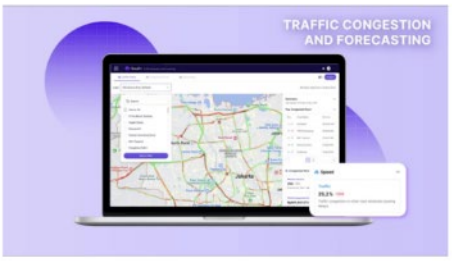
Soource: https://public.tableau.com/app/profile/pdtk/viz/PDTK-TBTableaudeBorddesTransportsKinshasaKinshasaTransportDashboard/CartedefluxFlowmap

UI of the traffic data analysis dashboard in Kinshasa (OD desire line)

57

4.1 Visualization of Traffic Data Analysis Results

Case2: Data Insight Dashboard -GauDT-



58

4.1 Visualization of Traffic Data Analysis Results

Case2: Data Insight Dashboard -GauDT-

Economy

Economic Insights transform complex data into clear metrics on Traffic Congestion and Forecasting, Transportation Affordability, and Market Segments

Traffic Congestion & Forecasting

Viewed 3 days ago

Affordability

Viewed 5 days ago

Transportation Market Segment

Coming Soon

Infrastructure

Infrastructure Insights reveal Multimodal Scoring, Transport Demand & Capacity, and Environmental Impacts for holistic urban planning.

Multimodal Scoring

Viewed 1 month ago

Environmental Impact

Viewed 3 month ago

Transport Demand & Capacity

Viewed 6 month ago

People

People Insights delve into People Movement and Policy Analysis.

People Movement

Viewed 1 year ago

Policy Analysis

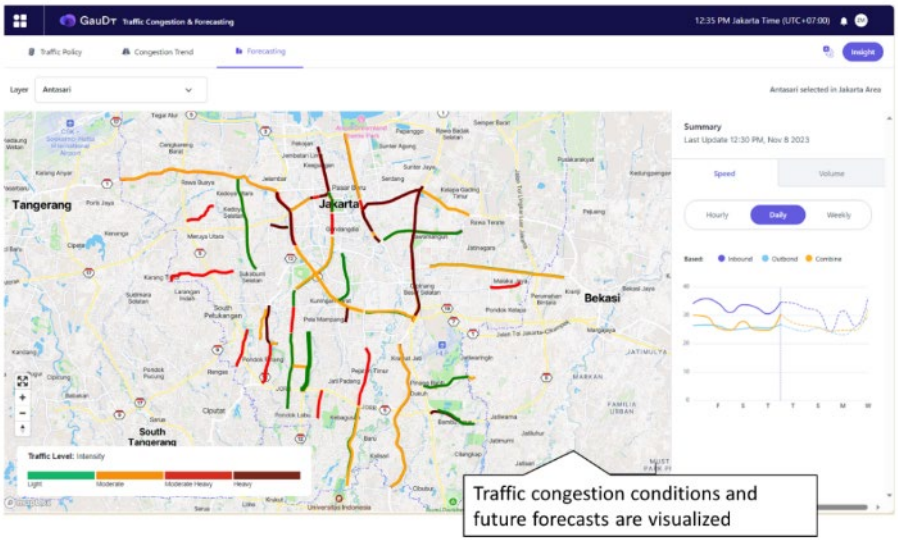
Coming Soon

59

4.1 Visualization of Traffic Data Analysis Results

Case2: Data Insight Dashboard -GauDT-

GauDT Function Example: **Traffic Congestion and Forecasting**

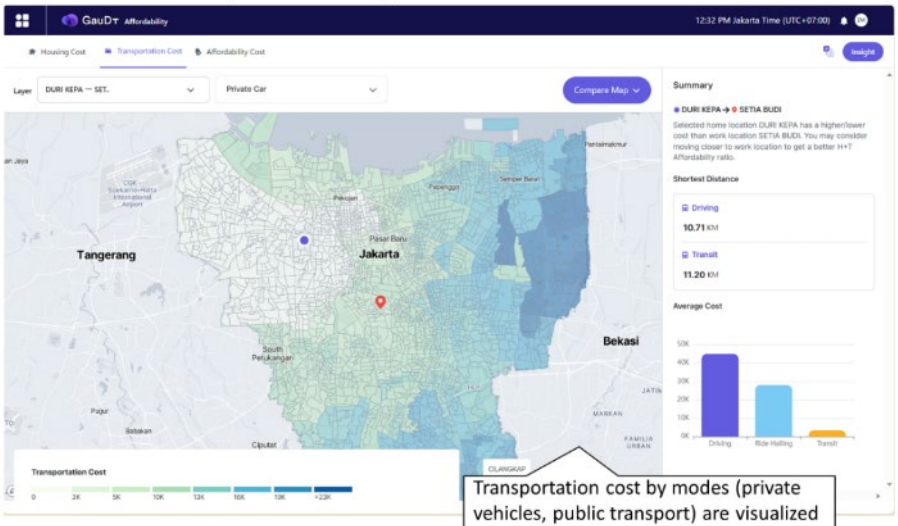


60

4.1 Visualization of Traffic Data Analysis Results

Case2: Data Insight Dashboard -GauDT-

GauDT Function Example: **Affordability**



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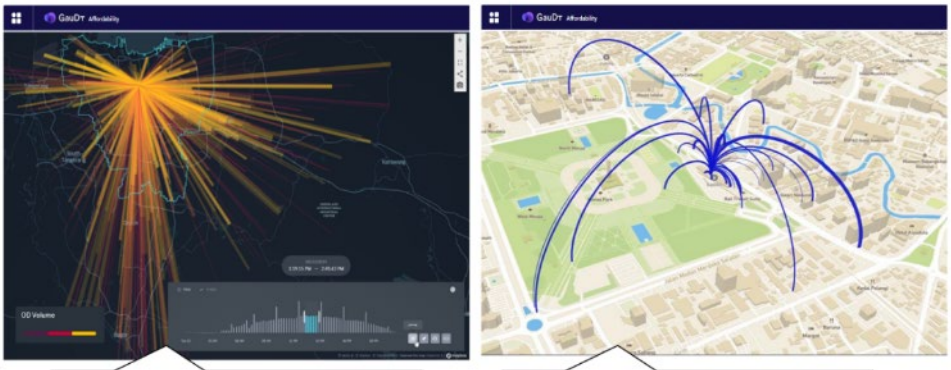
4.1 Visualization of Traffic Data Analysis Results

Case2: Data Insight Dashboard -GauDT-

GauDT Function Example: **People Movement**



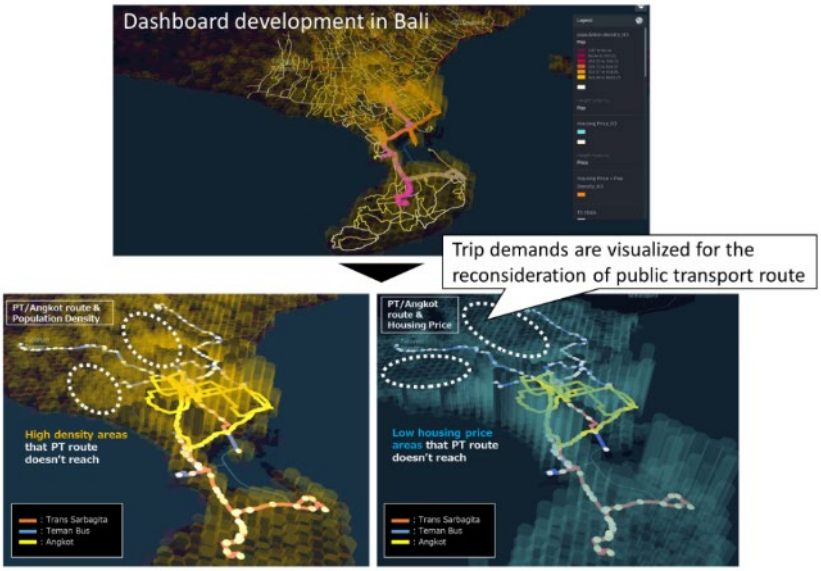
People movement from target location (by private vehicles) are visualized

People movement from target location (by walking) are visualized

62

4.1 Visualization of Traffic Data Analysis Results

Case2: Data Insight Dashboard -GauDT- (in Bali)

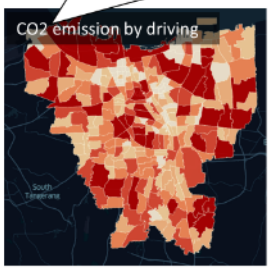


63

4.1 Visualization of Traffic Data Analysis Results

Case2: Data Insight Dashboard -GauDT- (in DKI Jakarta)

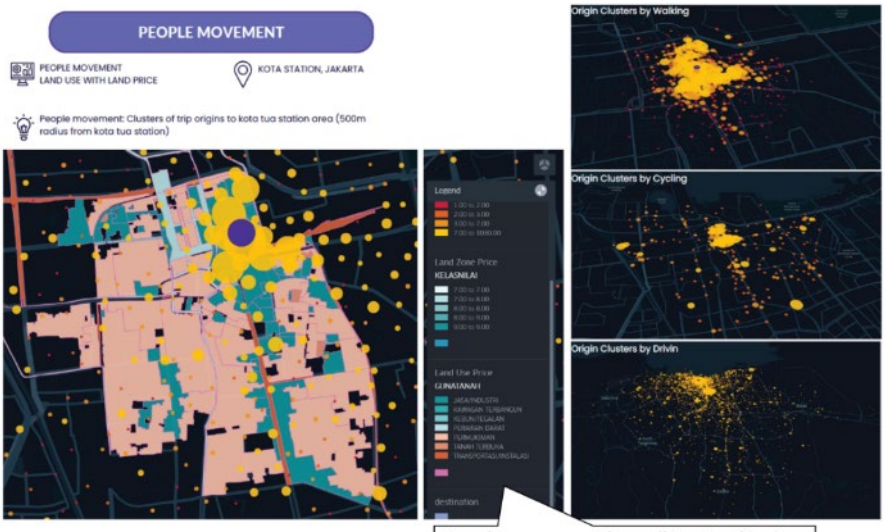
Congested road and CO2 emission are visualized for traffic-related policy making



64

4.1 Visualization of Traffic Data Analysis Results

Case2: Data Insight Dashboard -GauDT- (in Kota area, DKI Jakarta)



People movement by walk is visualized with land use for TOD planning

65

4.2 Substitution of Conventional Masterplan

Data analytics dashboard

Continuously data collecting & analyzing dashboard can support for:

- ✓ Review on development progress of transportation
- ✓ Socioeconomic change
- ✓ Current situation of transportation and future perspective

Benefits

- ✓ Quick visualization including latest data
- ✓ Cheaper cost for data collection and analysis

✚

Consulting by experts

Evidence-based consulting can support for:

- ✓ Master plan evaluation and progress management

Benefits

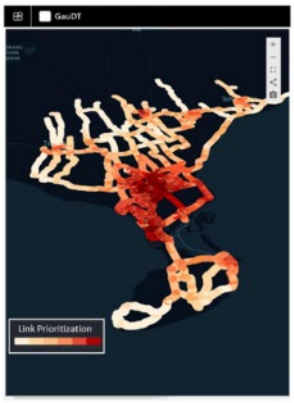
- ✓ Evidence-based actionable insights and solutions for masterplan
- ✓ Detailed assessment such as financial and sensitivity analysis

66

4.2 Substitution of Conventional Masterplan

Use-cases of Data Analytics Dashboard for transport planning

1) Estimate the catchment area of population, employment & POI



2) Compare the link prioritization, popular pattern of OD flow, land use

3) Propose PT route network

67

5. Conclusion

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5.1 Conclusion

1. Introduction of Big Data

- Big Data has various type of data and GPS data is one of them.
- Advantage of GPS data is accurate and frequent determination of people's location information (latitude and longitude).

2. Big Data Analysis Process

- Data cleaning and arranging process based on programming (SQL) will be require for more accurate analysis using GPS data.

3. Practicing for Visualization by GIS

- GIS is a tool that allows geographic information to be analyzed and visualized on maps.
- Analysis and visualization of GPS data can be done for free by using QGIS.

4. Cases of Traffic Data Visualization

- Visualization of traffic data analysis results using dashboards and the formulation of policies based on the results are becoming a common trend.
- Dashboard service (e.g., GauDT) can support quick visualization including latest data and continuous monitoring for evidence-based policy making.

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5.1 Conclusion

- BD analysis has advantages and disadvantages, so it is important to select survey/study method depending on the purpose. (ex. large scale questionnaire survey is conducted every 10 years and BD analysis is conducted for daily monitoring and reconsideration of transport plan.)
- If the governments develop and own their application such as apps for citizen or public transportation passenger, BD (GPS data) can be collected and accumulated to the government's server.
- BD can be utilized for not only transport planning but also EBPM (Evidence Based Policy Making) in a lot of fields like urban planning and tourism planning.

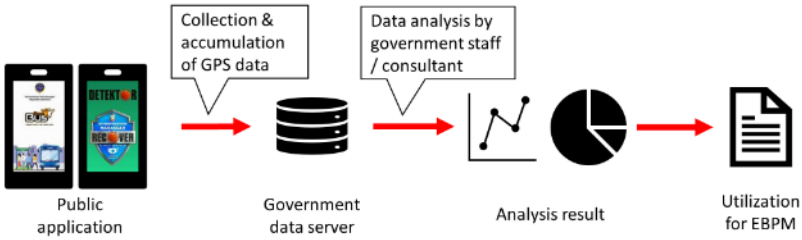

Image of EBPM utilizing GPS data collected from public apps.

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Terima kasih atas dukungan dan kerja sama selama 3 tahun ini !

8.3 Report Presentation at The 17th ASEAN-Japan Experts Group Meeting on Information Platform for Transport Statistics

ASEAN-Japan Experts Group Meeting on Information Platform for Transport Statistics is a forum for transport officials from Japan, ASEAN countries and the ASEAN Secretariat to share information and exchange opinions related to statistical information in the field of transportation, as part of the "Information Platform for Transport Statistics", which is one of the studies based on ASEAN-Japan Transport Partnership. The 17th ASEAN-Japan Experts Group Meeting was held online on March 22, 2024 (Friday).

At this experts meeting, the results of this study were presented to report on the utilization of MBD for transportation planning. In response to the report on the results, the following questions were raised by the ASEAN Secretariat.

Table 8-5 Contents of Q&A

・What was the reaction of the Indonesian counterparts to the proposal for a feeder route utilizing MBD? Based on the proposal from the Japanese counterpart, are they considering any changes to the route? When will this project be completed? 【ASEAN Secretariat】 →Participants in the final meeting expressed a desire to utilize the results of the analysis to study feeder routes, and there was a positive response to use the results of the analysis. The project will end in March 2024. 【Nippon Koei】
・We would like you to share not only the report of this project implemented in Indonesia, but also the reports of similar projects that Japan has previously implemented in Thailand and the Philippines. We would like to refer to the reports and use them for monitoring. In addition, if other member countries wish to collaborate with Japan on the use of data in their respective cities, Japan should respond to their requests. 【ASEAN Secretariat】 →As for the report, once the reports for the three projects in Thailand, the Philippines, and Indonesia are compiled, we will send to the ASEAN Secretariat. 【MLIT】

Source : Nippon Koei

Below are the presentation materials and photos of the online meeting.

Utilization of Mobile Big Data to Improve Mobility In South Sulawesi Province, Indonesia

22 March 2024

NIPPON KOEI

Table of Contents

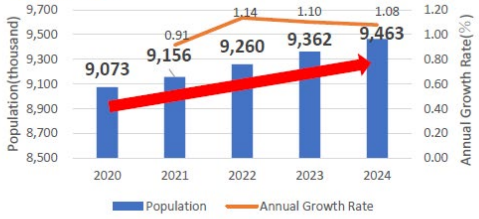
1. Outline of South Sulawesi Province

2

1.1 Current Situation of the South Sulawesi Province

Population Growth (Million)

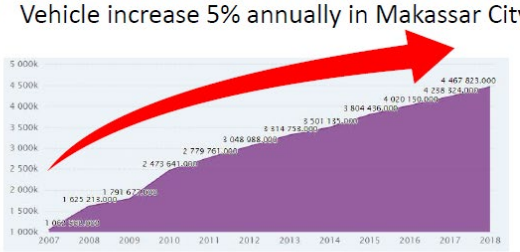
- Population of the South Sulawesi Province is growing.



Source:Kota Makassar Dalam Angka 2024

Vehicle Increase

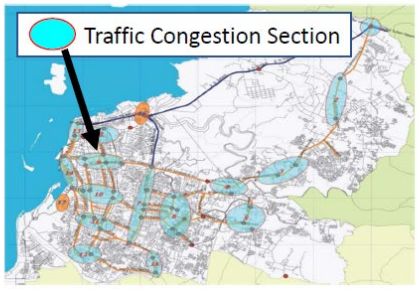
- Vehicle increase 5% annually in Makassar City



Source:https://www.ceicdata.com/en/indonesia/number-of-motor-vehicle-registered/no-of-motor-vehicles-south-sulawesi

Traffic Congestion

- Traffic congestion is occurred entire Makassar city.



Source:Makassar transportation plan

Source:https://kumparan.com/makassar-indeks/sulsel-black-out-kota-makassar-jadi-macet-total-1542373541876269667

Further traffic congestion may occur in the future

3

1.2 Basic Information on Public Transportation

(1) Pete Pete

Operation area:
- South Sulawesi Province (TBC)

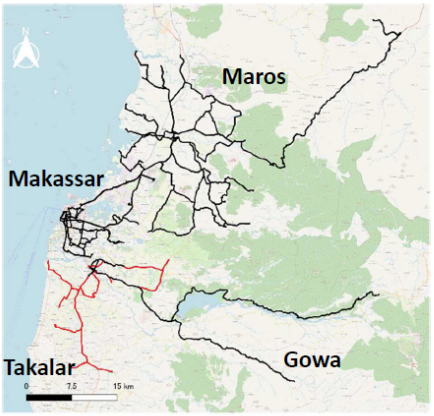
Service frequency:
- No schedule (passengers can get on and off anywhere along the route)

Fare:
- 7,000 IDR

Operator:
- Drivers operate on their own with permission from the City or Regency Transportation Office
- "ORGANDA" (an association of Pete Pete drivers) coordinates and negotiates route changes and fare revisions with City or Regency Transportation Office

Note:
- Also known as "Angkot"
- the vehicles are old and many of them are not equipped with air conditioning

Vehicle body of Pete Pete



*Red lines indicate suspended operations (as of March 23, 2023)

Pete Pete routes in Mamminasata

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1.2 Basic Information on Public Transportation

(2) Teman Bus

Operation area:
- Mamminasata Metropolitan Area

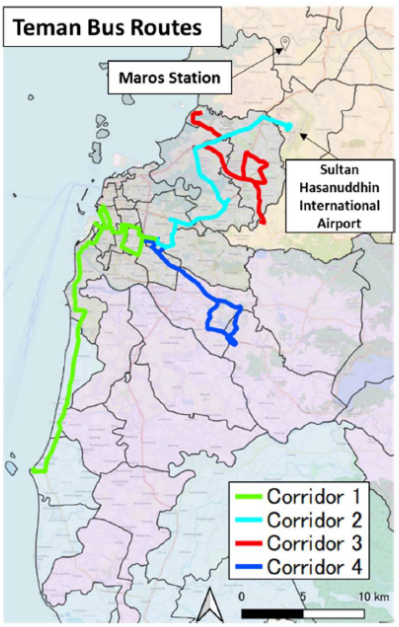
Service frequency:
- Depending on route

Fare:
- 4,600 IDR (from Oct 31, 2022)
- Fare is free for students, senior citizens, and passengers with disabilities

Operator:
- PT Sinar Daya

Note:
- The payment methods;
  - IC card payment
  - e-wallet registered in Bank Indonesia's QRIS
  - QR code payment using the M-Banking application
- An application for searching for bus location and routes is developed

Vehicle body of Teman bus



Teman Bus routes

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1.2 Basic Information on Public Transportation

(3) Makassar-Pare Pare Railway

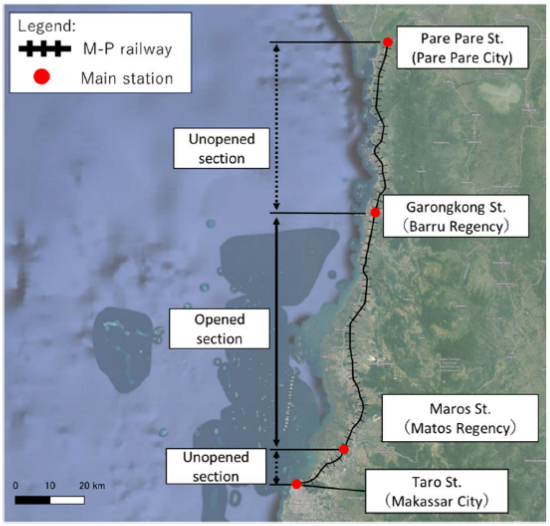
Operation section:
- Garongkong St. - Maros St. (80km/145km)

Service frequency:
- 2 trips/day

Fare:
- Max. 10,000 IDR

Operator:
- PT Celebes Railway Indonesia

Note:
- Operation of all section will be started in 2026.
- Ticket can be purchased at each station.
- Operation of railway facility is done by South Sulawesi Railway Consortium (JV of PT KAI & PT Sulsel Citra Indonesia)



Opened/Unopened section of M-P Railway

Actual operation with fare collection from passengers was partially started on June 2023 between Garongkong St. and Maros St..

Source: Simak Tarif Terbaru Kereta Api Makassar-Parepare Per 1 Juni 2023 Halaman 2 - Kompas.com

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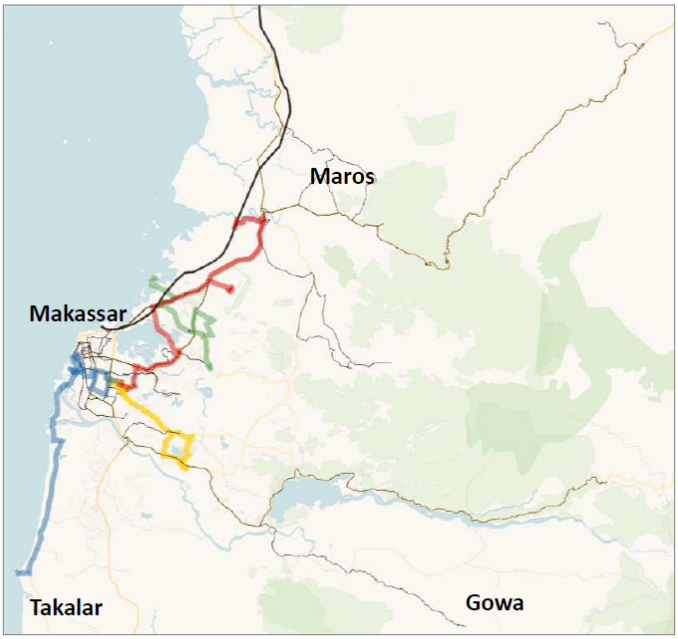
1.2 Basic Information on Public Transportation

(4) Public Transportation in Mamminasata

- Public transportation is concentrated in the Maminasata metropolitan area (Makassar, Maros, Gowa, Takalar).
- The main public transportation in other areas is the Pete Pete.

Teman Bus Corridor 1
Teman Bus Corridor 2
Teman Bus Corridor 3
(currently suspended)
Teman Bus Corridor 4
(currently suspended)
Makassar-Pare Pare Railway
Current Pete Pate Route
- Makassar city: 17 routes
- Maros regency: 4 routes
- Gowa regency: 3 routes



Map of Public Transportation

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2. Proposal of Feeder Routes using MBD

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2.1 Analysis Process

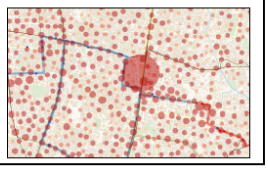
1. Acquisition of MBD
2. Data cleaning, data arranging

Collection of basic data (demographic data, base map)

Collection of information on status of public transportation and future development plan

Import to GIS

3. Identification of high-potential transit points



Identification of transit point

4. Verification of the trip OD demand from the transit point

Checking trip demand

5. Confirmation of road condition
6. Proposal of **new feeder routes** from main transportation

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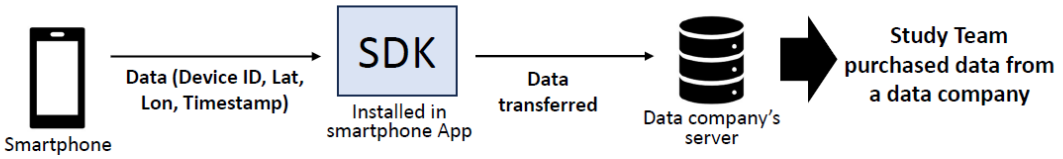
2.1 Analysis Process

1 Acquisition of MBD

- Data is obtained from the smartphone application with SDK (Software Development Kit) and purchased from data company (ADA)
- Data analysis and visualization can be done by MBD (using Device ID/Lat & Lon/Timestamp)



List of Data Companies

Name	Outline	Data Contents	No. of Users (In Indonesia)
Onemata	Headquartered in the United States, the company holds cell phone location data on approximately 860 million people in over 200 countries.	• GPS Data • Advertisement ID	36.5 Million ID
Lifesight	Headquartered in Singapore, the company provides offline services for digital advertising, primarily using location-based information.	• GPS Data (via SDK) • Advertisement ID	MAU 14 Million (MAU: Monthly Active User)
ADA	Headquartered in Singapore and Malaysia, the company uses location information to provide extensive analytical information on Indonesian consumer behavior, including behavioral characteristics and attributes.	• GPS Data (via SDK) • Advertisement ID	155 Million ID

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2.1 Analysis Process

2 Data Cleaning & Data Arranging

Flow	Procedure	Purpose of processing	Processing Method
Step 1	Data Cleaning	Removal of unreliable or unusable data for analysis	• Delete entries with only one data point per day • Delete points where calculated speed is extraordinary
Step 2	Data Arranging	Determination of points into "Trip" and "Stay" status	• Classify data status ("Trip" or "Stay") based on the following definition

Stay point:
A point where one has stayed for more than 20 min within a 150m radius

Trip point:
Stay points where one has moved more than 300m within 2 hour

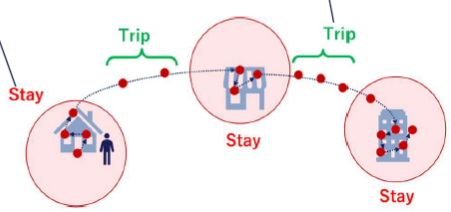
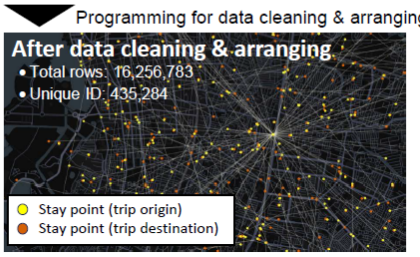


Image of data arranging
(Determination of "Trip" and "Stay")

Programming for data cleaning & arranging



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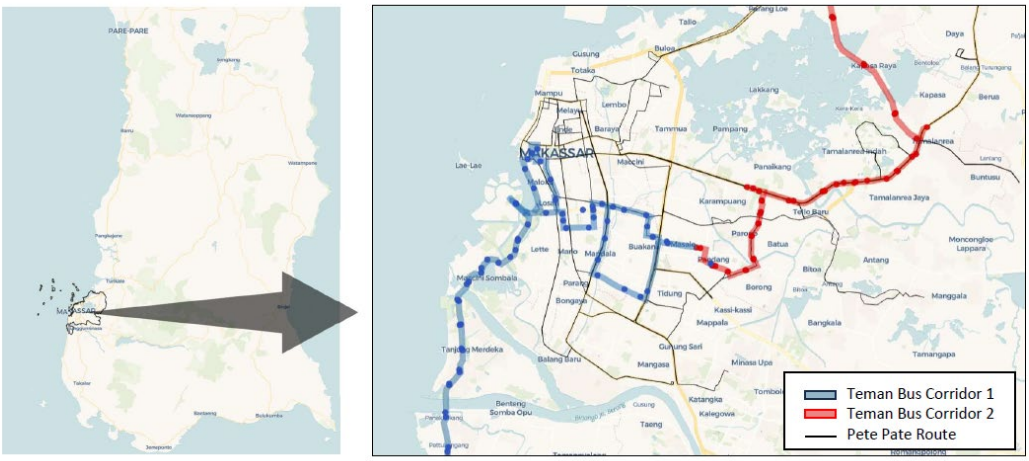
2.1 Analysis Process

3 Identification of high-potential transit points

Visualize clusters of people's stay points using MBD to identify high-potential transit points, focusing on the following areas in Makassar.



Data visualization area

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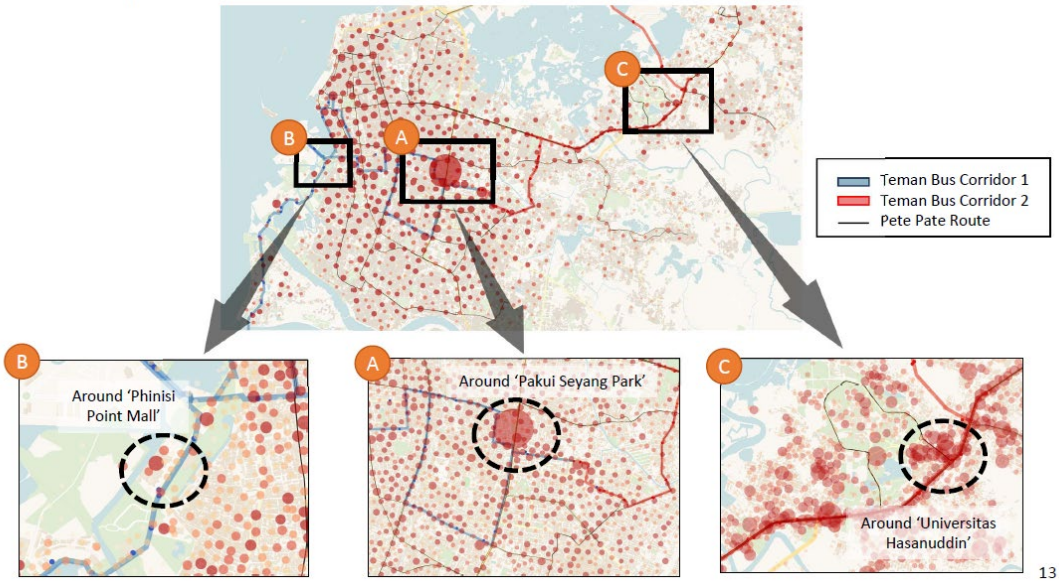
2.1 Analysis Process

3 Identification of high-potential transit points

According to the cluster visualization of stay points, people mainly concentrated in the following black circles (A: around 'Pakui Seyang Park', B: around 'Phinisi Point Mall', C: around 'Universitas Hasanuddin'), which could potentially serve as suitable locations for transit points



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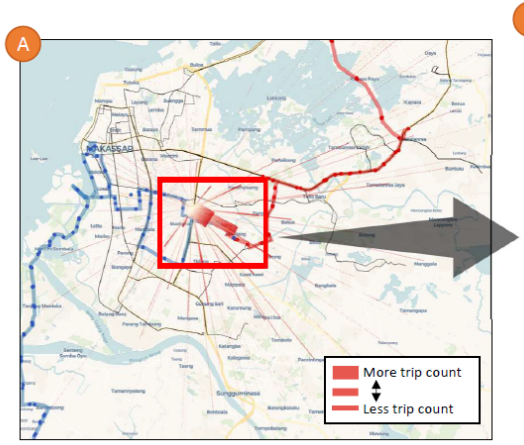
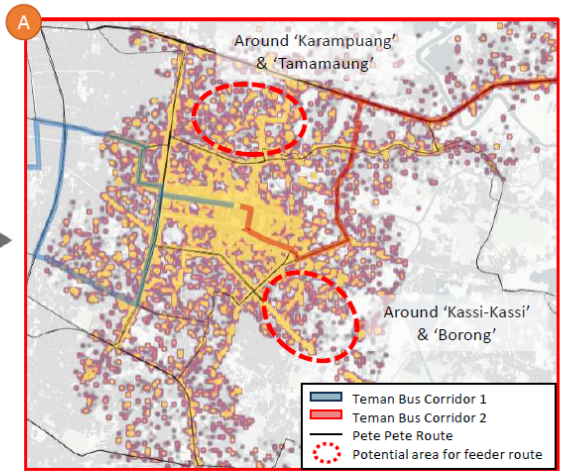
2.1 Analysis Process

4 Verification of the trip OD demand from the transit point

Trip demand from the area A: around 'Phinisi Point Mall' is visualized through the OD line.
Further, based on the heatmap focusing on high demand trip areas, the following red circles (around 'Karampuang', 'Tamamaung', 'Kassi-Kassi' , 'Borong') indicate specifically high demand of trips that are currently inaccessible by bus and pete-pete, which would be the potential area for new feeder route



OD line from a transit point



Heatmap of trip destination from transit point

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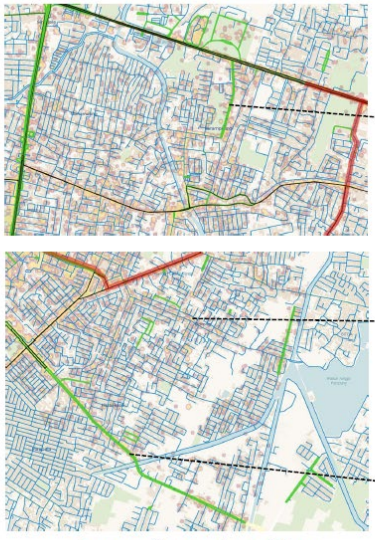
2.1 Analysis Process

5 Confirmation of road condition

For each potential area identified for a new feeder route, it seems that the surrounding road conditions do not pose a problem for feeder transport operations

Heatmap of trip destination from transit point



Surrounding road condition

→ Enough road condition to operate both direction

→ Narrow but possible to operate both direction

→ Enough road condition to operate both direction

Divided two-lane road
Two-way single-lane road
Current Pete Pete Route

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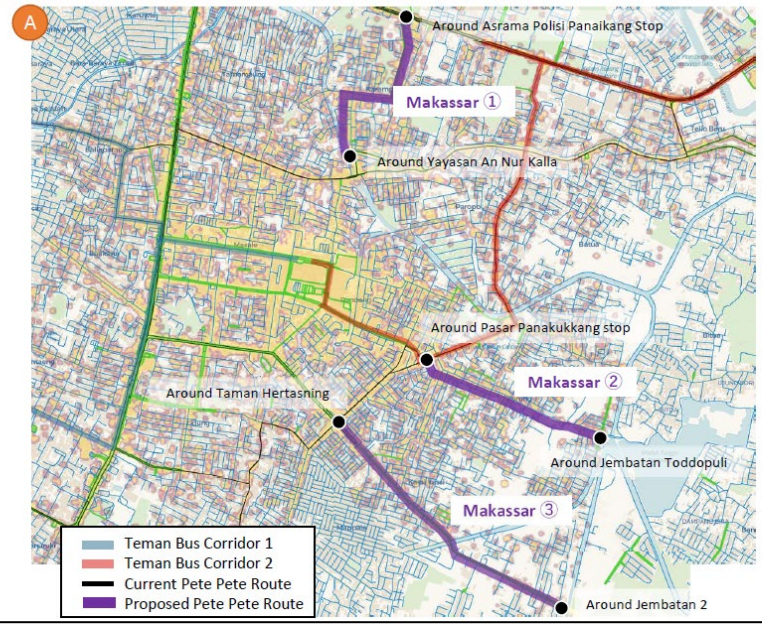
2.1 Analysis Process

6 Proposal of new feeder routes from main transportation

Based on the trip OD demand, existing public transport routes, and the surrounding road condition, examples of a proposed new feeder route are outlined as below



■ Makassar ①
Around Asrama Polisi Panaikang Stop
– Around Yayasan An Nur Kalla
Length: approx. 1.3 km

■ Makassar ②
Around Pasar Panakukkang stop
– Around Jembatan Toddopuli
Length: approx. 1.4 km

■ Makassar ③
Around Taman Hertasning
– Around Jembatan 2
Length: approx. 2.4 km

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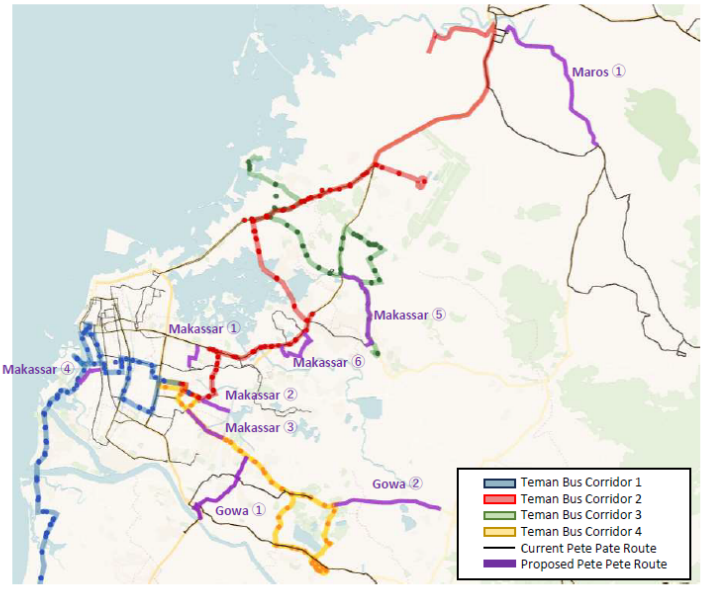
2.2 Proposed Pete Pete Routes

○ **Proposed feeder route in Maminasata Metropolitan Area**

Based on the trip OD demand, existing public transport routes, and the surrounding road condition, new feeder routes are proposed in Maminasata Metropolitan Area as follows.



No.	Route	Length
Makassar ①	Around Asrama Polisi Panaikang Stop – Around Yayasan An Nur Kalla	1.3 km
Makassar ②	Around Pasar Panakukkang stop – Around Jembatan Toddopuli	1.4 km
Makassar ③	Around Taman Hertasning – Around Jembatan 2	2.4 km
Makassar ④	Around Bengkel MPJ – Around Merpati Fashion	1.3 km
Makassar ⑤	Around Patung Ayam Daya – Around Masjid Babul Khaer	4.5 km
Makassar ⑥	Around UNHAS Pintu II stop – Around Padaidi Medical Cente stop	2.6 km
Maros ①	Around Kantor Bupati Maros – Around Pasar Amarang	8.5 km
Gowa ①	Around Satu Sama stop – Around Jembatan Kembar Gowa	3.8 km
Gowa ②	Around Satu Sama stop – Around Jembatan Kembar Gowa	4.6 km

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3. Technical Assistance

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3.1 Outline of Technical Assistance

■ Date:
- 21 March 2024 (Thusday)

■ Time:
- 9:00 a.m. – 12:00 p.m.

■ Participants:
- Regional Land Transportation Management Office Class 2 South Sulawesi, South Sulawesi Province Transportation Office
- South Sulawesi Province Transportation Office
- Makassar City Transportation Office
- Total 9 persons

■ Contents:

1. Introduction of Mobile Big Data : Lecture
2. Mobile Big Data Analysis Process : Lecture
3. Practicing for Visualization by GIS : Practice
   i. Outline of QGIS
   ii. Making Heat Map
   iii. Making OD Line
4. Cases of Traffic Data Visualization : Lecture

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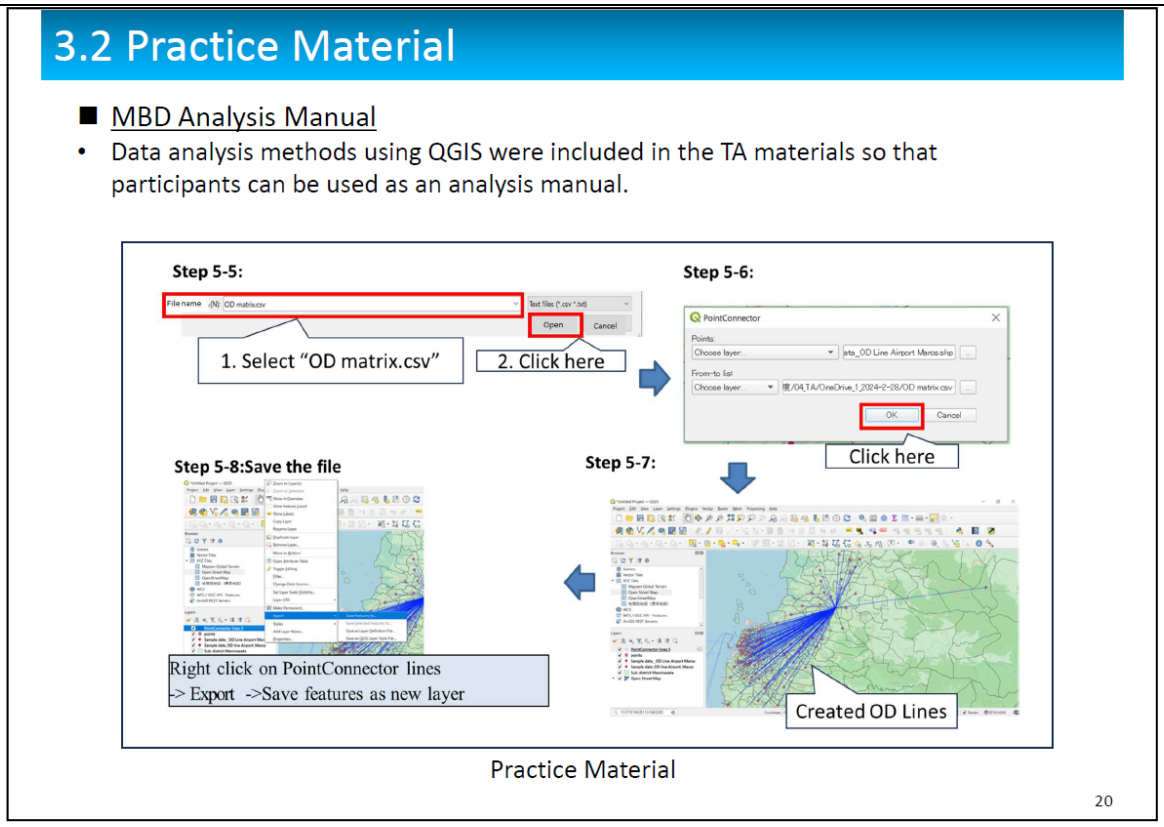
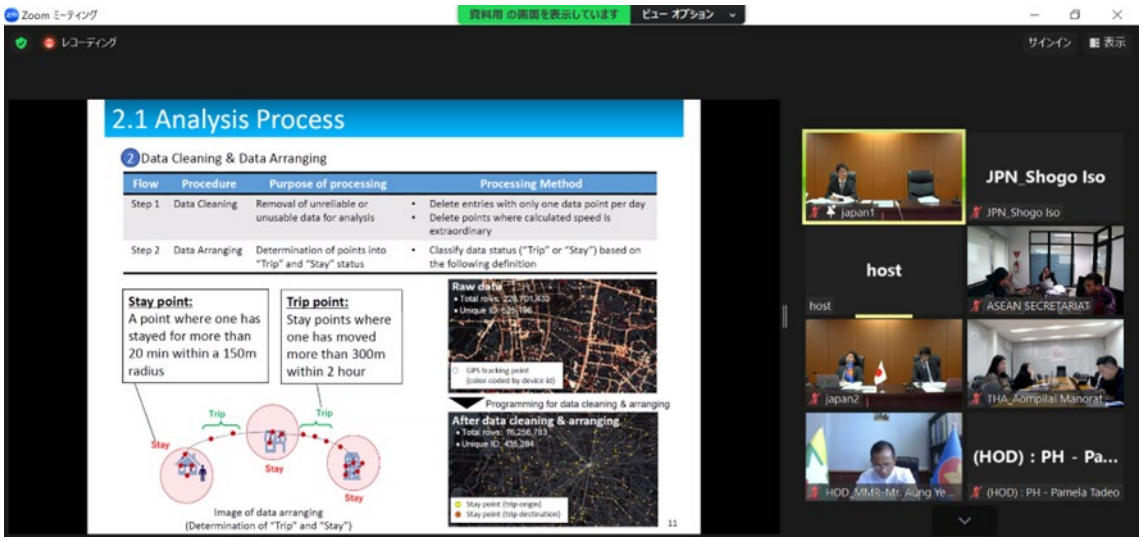




Source : Nippon Koei

Figure 8-6 ASEAN-Japan Experts Group Meeting (online)

8.4 Potential Participation of Japanese Companies in Assistance for Formulation of Public Transportation Planning using MBD in the ASEAN Region

8.4.1 Consulting for Analysis and Transportation Planning using MBD

If the local government and public transportation operator does not have MBD, such as in South Sulawesi Province, Japanese companies need to purchase external data. In that case, the cost of purchasing MBD would be high and the cost of the entire consulting service would also rise, making it too costly to provide consulting services to local governments and public transportation operators for the formulation of transportation plans using MBD as a viable business.

On the other hand, if some local partners of Japanese company own MBD, there is a possibility that the business will become viable as there is no data purchase cost.

For example, Nippon Koei Co., Ltd. has signed an MOU with PT Jakarta Lingko Indonesia, an Indonesian company that provides electronic fare payment services for public transportation in Jakarta. Moreover, Nippon Koei Co., Ltd. also has an equity stake in PT AINO, an Indonesian company that is an IC card payment processing/payment gateway operator and is responsible for system development and operation of the electronic fare payment service. Therefore, the big datas such as passenger boarding and alighting data owned by the Indonesian companies are being shared with Nippon Koei Co., Ltd. The Japanese company is using these big data to provide consulting services related to transportation planning and urban development to local governments and local developers in Indonesia.

If Japanese companies try to develop consulting services related to analysis and transportation planning using MBD, not only in Indonesia but also in other ASEAN countries, it will be important to establish a collaborative relationship with local stakeholders who own MBD in the country. In addition, in such cases, Japanese companies need to thoroughly examine the contents of the local personal information protection laws and confirm whether there is any problem with receiving MBD from the data provider.

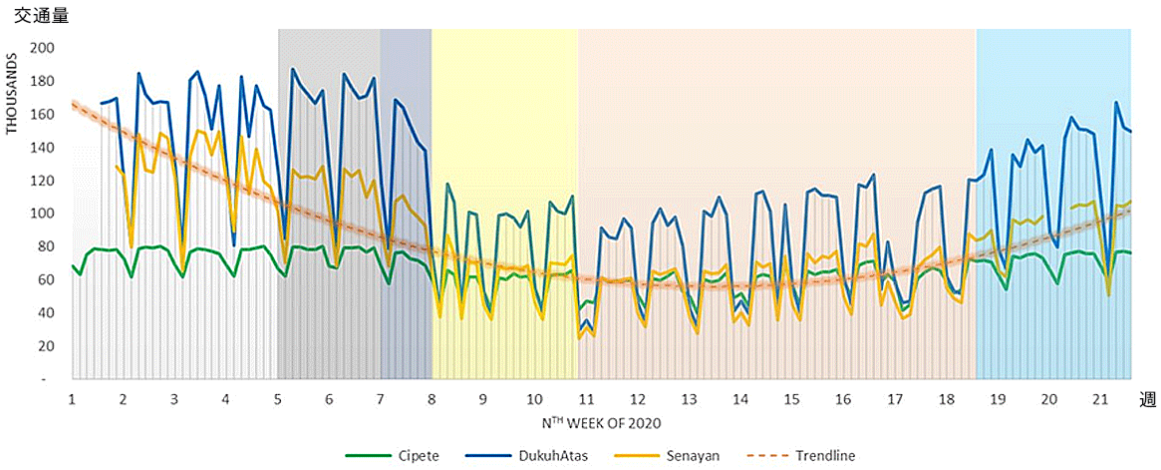
8.4.2 Sales/Subscription of Dashboards and Other Tools for Visualization of MBD Analysis Results

Since numerous parties are often involved in the development of transportation plans, it is not easy to achieve a common understanding using quantitative data such as analysis results or reports of analysis results on paper. In addition, it is necessary to always base studies on the latest data in order to respond to the latest traffic conditions.

As one means of resolving the above issues, it would be very useful to create an environment in which MBD analysis can be visualized in an easy-to-understand manner and viewed on the web by those involved. To achieve this, it is necessary to introduce visualization tools such as dashboards. Visualization tools can organize analysis results using graphs, tables, figures, and maps, display time

series, and link to the latest data, making it easier to deepen understanding of transportation planning among stakeholders than existing methods of summarizing analysis results.

Although not MBD, Murata Manufacturing Co., Ltd. is developing a data provision service in Indonesia through a local provider using a traffic counter system to visualize traffic volume as a visualization tool to support traffic planning. Traffic data (traffic volume, speed, vehicle type classification, etc.) collected by the traffic counter is stored on a server, processed for easy handling, and provided. Specifically, the data is processed so that it can be easily examined by visualizing it, for example, by tabulating travel speeds for each location and extracting those that are lower than the standard speed as locations with high carbon dioxide emissions, or by tabulating and displaying changes in traffic volume over a given period. In fact, the Jakarta provincial government has purchased this service, and the infrastructure planning and traffic management departments of the provincial government are using it for measures to improve traffic infrastructure and control traffic volume. The service is sold in the form of viewing and data download rights for the tools.[16]

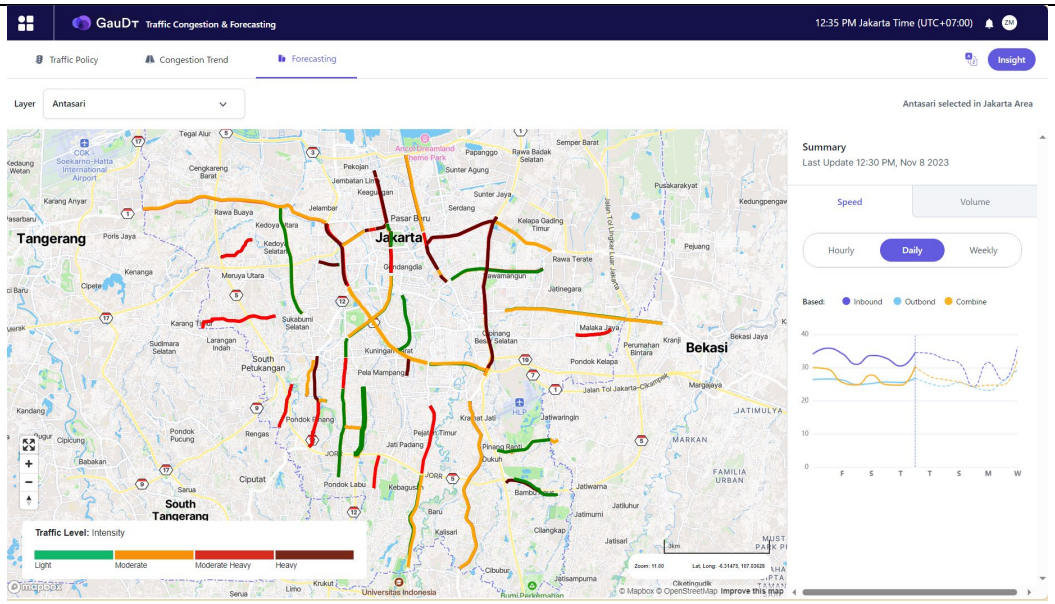


Source：https://article.murata.com/ja-jp/article/new-businesses-through-business-alliances-2

Figure 8-7　Transition in Traffic volume by area in Jakarta In the traffic counter system

In addition, Nippon Koei sells a visualization tool called GauDT, which can visualize the results of traffic congestion forecasting, human flow analysis, and other analyses. This tool is highly versatile as it can import external MBD for analysis and visualization. Figure 8-8 shows an example of analysis results.

[16] Source：Murata Manufacturing Co., Ltd「https://article.murata.com/ja-jp/article/new-businesses-through-business-alliances-1」



Source：Nippon Koei

Figure 8-8 Current and Forecasted Traffic Congestion by Road
（Traffic congestion can be color-coded by road and shown in a time series that includes future projections）

8.5 Future Challenges

8.5.1 Acquisition of MBD

In the study, MBD (GPS data) used for analysis was purchased from an external data company. However, purchasing external data is costly and requires repeated data purchases for continuous data analysis. Therefore, it is difficult to utilize MBD sustainably in transportation planning. It is important to build a collaborative system with private businesses and central ministries which are in charge of public transportation that hold MBD, and how to reduce the cost of acquiring MBD.

8.5.2 Personal Data Protection Law

In Indonesia, the PDPL, a uniform law on personal data protection, was enacted on October 17, 2022. This fiscal year, Study Team obtained the opinion of a lawyer. lawyer said that there is room for interpretation that laws and regulations regarding personal information protection do not apply when only location information is acquired and transferred overseas. However, since specific sub-regulations will be drafted in the future, ongoing monitoring of the progress of the Law will be necessary.

8.5.3 Utilization of MBD in Other Sectors

The development of mass transit systems such as MRT and LRT is being planned not only in South Sulawesi Province but also in various regions of ASEAN countries. Accordingly, the introduction of TOD (Transit-Oriented Development) is being considered. When considering TOD, urban development needs to take into account the flow of people around stations. Therefore, it is

useful to utilize MBD to analyze the movement of people in areas surrounding stations and consider real estate development and shopping mall store opening strategies. The challenge for the future is how to utilize MBD analysis in the introduction of TOD.

Moreover, from the perspective of tourism development, some measures are being taken to disperse tourists by analyzing the movement of tourists with MBD in Japan in order to solve the problem of tourists concentrating in specific places at tourist destinations. So MBD shall be utilized to propose optimal routes for tourists to visit in various tourist destinations in ASEAN countries.

8.5.4 Utilization of MBD in the ASEAN-Japan Experts Group Meeting on Information Platform for Transport Statistics

ASEAN-Japan Experts Group Meeting on Information Platform for Transport Statistics updates statistical information related to roads, railways, ports, and airports every year. The statistical information and MBD analysis results have a high affinity. By regularly conducting MBD analysis, it is possible to quantitatively monitor the effects of infrastructure development such as roads.

Furthermore, by conducting MBD analysis across ASEAN countries, it is possible to formulate more efficient infrastructure development plans. For example, identifying road sections where there is travel demand but where road infrastructure is not well developed and it takes longer time for travel, and promoting the development of road infrastructure in those sections will lead to economic revitalization in ASEAN. In order to revitalize the economy of the ASEAN region, it is necessary to utilize MBD analysis for the entire ASEAN region in the ASEAN-Japan Experts Group Meeting on Information Platform for Transport Statistics.

8.5.5 Challenges for Japanese Companies to Participate in MBD Business

For Japanese companies entering the MBD business, as mentioned above, (1) obtaining MBD and (2) monitoring the Personal Data Protection Law are major issues.

In addition, the needs of counterpart governments include (3) utilizing the results of MBD analysis not only in the field of transportation, but also in a wide range of other areas, such as urban development and tourism.

Based on this, it is believed that business opportunities can be expanded by addressing not only transportation planning but also urban development and tourism studies.