

Determination of Route Delivery in the Logistic Service Provider (LSP) by Reviewing the Performance of Street in The City of Malang

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Abstract. Malang as the National Activity Centre (PKN) led to increased economic growth and increased the demand for goods both primary and tertiary goods. Demand of goods which is increasing and also diversing will certainly have an impact on the process of transportation of goods involving a freight forwarder. Shipping of goods is part of the supply chain, which handles the flow of goods, distribution and delivery service or commonly called the courier. Fulfilling the request of goods would require Logistics Service Provider (LSP) that distribute goods from point of origin to destination. Delays in the distribution of goods will slow(DOWN) economic growth in Malang, therefore focused studies on the movement of goods which includes the election of the delivery route is needed. The purpose of this study is to get the delivery route for LSP by identifying its patterns of freight transport movement and to analyze the network performance of the road that is passed by freight transportation. Data collection techniques in this research are interviews, questionnaires and observations of moving-car and traffic counting to get the volume of traffic. The study used road's performance analysis to get the level of service (LOS) of roads which are used by the freight transportation of LSP and Dijkstra's algorithm analysis to determine the delivery routes. The results showed that the Level of Service of the roads (LOS) is at the level of D to F which indicates that the chosen roads experience instability of traffic flow even reach a critical condition. Therefore by considering delivery routes selection both of existing condition and analysis result as well as the condition of the road network in Malang, then given alternative is by delivering goods on the chosen routes but not at peak hour.

1. Introduction

Malang city is the second largest city in East Java province and it is an university city that will bring a lot of students and workers from outside of the Malang city to trigger an increase in goods and demand for diverse goods. The number of large population will affect the public demand for goods is higher [1]. The high demand for the goods to be supported by the performance of the urban transport of goods in an efficient manner. The pattern of the movement or distribution of goods that are not integrated with urban traffic makes the performance of the movement of goods to be obstructed [2]. Integration is needed in this case is related to the movement of goods in the form of regulatory rules on the transport of goods that pass a certain way and the determination of lane or delivery route. Transport of goods



likely to contribute to problems such as traffic congestion. This is necessary policy and planning related to the volume, composition and distribution of freight service [3]. While the existing condition of Malang City Government and the Department of Transportation in Malang yet have clear rules related to the distribution of goods, both these arrangements as well as the transport of goods specified. The traffic congestion occur on the streets in Malang also can restrict the movement of goods. Movement of goods stuttering will slow economic growth in the city. Land use management and infrastructure planning will provide a smooth traffic in the city, therefore the freight and logistics planning must be integrated [4].

Traffic congestion can be analyzed using analysis level of service (LOS), which includes the capacity of the road network and traffic volume. When the LOS on a road section has reached C, it shows that these roads in a stable category, but if it reaches D, E or F, it means the traffic flow conditions ranging unstable. Indicators of Level of Services on a road section showing the overall condition of these roads. The level of service is determined based on quantitative values such as V / C , travel speed, and other factors are determined based on qualitative as freedom in choosing the speed of the driver, the degree of traffic barriers, as well as comfort [5]. Based on these conditions, the main purpose of the study was to examine the pattern of movement of freight of LSP, the performance of the road traversed by the transportation of goods of LSP, and the recommendations on the direction of the freight transport of LSP in Malang.

2. Method

The research location is Malang city with research restrictions only to identify the movement of goods in the city of Malang. The research used descriptive analysis, evaluative and prescriptive in addressing the problem formulation. The primary data collection techniques performed by conducting interviews, questionnaires, observations road geometric form of identification, moving-car surveys and traffic counting. Time observation lasted through two phases, the first is the distribution of questionnaires and interviews at the LSP company, followed by a moving-car survey to obtain the pattern of movement of goods and sections of the road network that is often passed by the transportation of goods. The second observation is to identify geometric road and traffic counting on the street was known at the first activity. Figure 1 shows the phases of research and explanations related to analytical techniques used in each formulation of the problem.

1. Identification of the type of company and the size of the companies acquired using descriptive analysis of secondary and primary data. The identification of the second largest company obtained in Malang which will then be analyzed transport system, freight and cargo capacity to identify service delivery by surveying a moving car so we get the pattern of movement of freight.
2. Calculation of street performance based on the pattern of movement of freight transport on roads frequently traveled by freight transport. The calculation of the performance obtained from the calculation of the degree of saturation (DS) which is the ratio between the capacity of the road (C) and the volume of traffic (Q). Here's the formula for calculating the capacity of the road (1), the volume of traffic (2) and the degree of saturation (3) based on Highway Capacity Manual [6].

$$C = C_o \times F_{CW} \times F_{CSP} \times F_{CSF} \times F_{CCS} \quad (1)$$

note:

- C = Road capacity (pcu/h)
- C_o = Base capacity (pcu/h)
- F_{CW} = Width adjustment factor traffic lane
- F_{CSP} = Adjustment factor separation direction
- F_{CSF} = Adjustment factor due to side friction
- F_{CCS} = City size adjustment factor

$$Q = (QLV \times empLV) + (QHV \times empHV) + (QMC \times empMC) \quad (2)$$

note:

Q = traffic volume (pcu/h)

QLV = LV volume (car/hour)

$empHV$ = passenger car equivalents LV (car/hour)

QHV = HV volume (car/hour)

$empHV$ = passenger car equivalents HV (car/hour)

QMC = MC volume (car/hour)

$empMC$ = passenger car equivalents MC (car/hour)

$$DS = Q/C \quad (3)$$

note:

DS = Degree saturation

Q = Traffic volume (pcu/h)

C = Road capacity (pcu/h)

After the results of basic capacity and volume are known, then the level of service each corridor of road can be calculated and determined. Level of road service or Level of Service (LOS) is a measure used to determine the quality of certain roads in the serve of traffic flow through it. Level of service seen from the comparison between the volume of traffic with road capacity and speed of traffic on the roads. Level of service specified in the scale interval consists of 6 levels [7]. This level consists of A, B, C, D, E and F. Where A is the highest level, the traffic volume is higher on certain roads, the level of service road will be decreased.

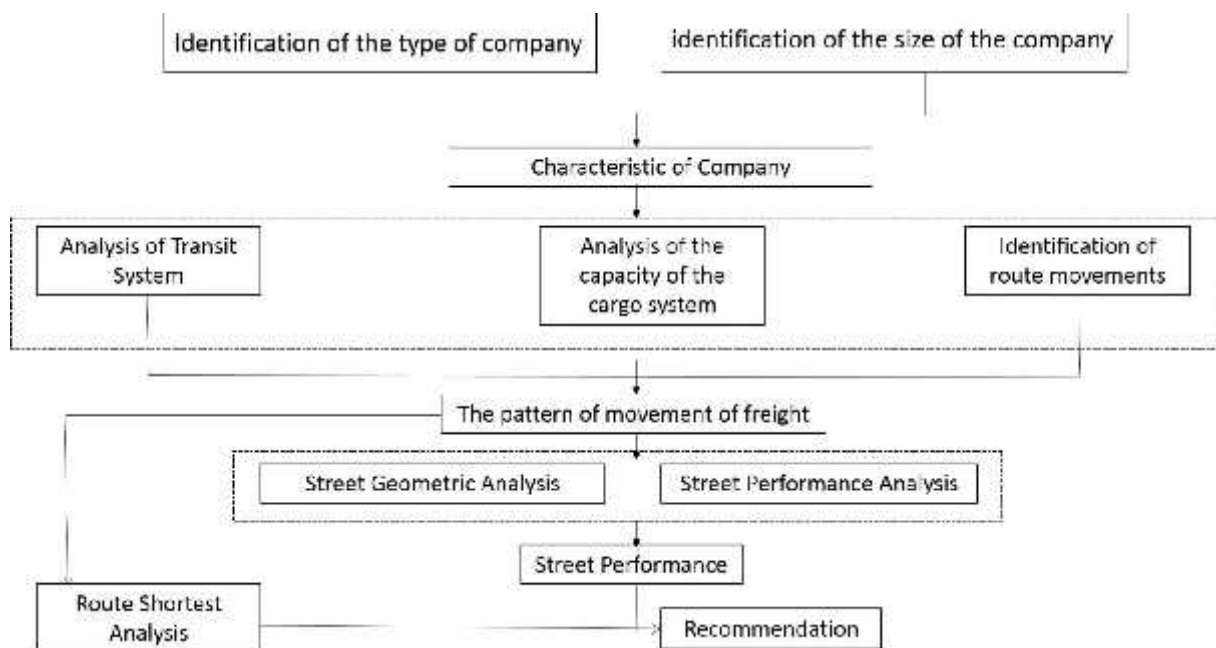


Figure 1. Research framework.

3. The road network is selected as the route should be the have a good performance, so that goods from customers can quickly arrive at the destination. Therefore we need routes that are effective in order to minimize travel time. In addition to the performance of the road and road conditions, time and cost are also considered important, therefore, in the determination of alternative routes used Dijkstra's

algorithm, which is one form of greedy algorithm. This algorithm includes a graph search algorithm is used to solve the shortest path problem with one source on a graph that does not have negative side cost, and produce a shortest path tree [8]. The assumption used is that if the distance chosen is the shortest distance then it will reduce expenses for fuel, and based on the formula $s = DXT$, that distance is directly proportional to the time, so that in the present study assumed if the distance getting close to the time it takes to cover the distance will be shorter.

4. Road performance on each road segment was elected into these revisited. The first step in the analysis is to determine digraph Dijkstra's algorithm then do these calculations by the matrix method. In order to facilitate the calculation of the matrix, then each name of the road will be symbolized by letters of the alphabet and the numbers on the diagram is the distance between the nodes in units of kilometers (km).

3. Results and Discussion

Type Service of LSP Company in Malang city consists of three types of services offered: transport by 5 companies (12%), expedition as many as 8 companies (19%) and courier are 28 companies (69%). This study examines only the Logistics Service Provider (LSP) Company in the field of courier services because the activities of the movement of goods carried by courier companies have a more intensive movement compared to other types of transportation services or expedition. Companies engaged in the field of transportation, is a company that serves the public transport, but also provide the movement of goods between cities/provinces. Company engaged in the expedition is a company that only provides services such as cargo (goods with large volume) using air or sea transport with coverage transporting goods on a larger area.

3.1. *The classification of company size LSP field of courier services in Malang*

The distribution company of Logistics Service Providers (LSP) is engaged in courier company will then be performed classification belonging to the large companies that will be the focus of the research, the classification is based on PP 74, 2014 [9] to assign weights to each criterion specified. 11 companies that have average grades or get more than 2 of the classification determined, namely: Wahana Logistics, TIKI, ESL, ELTEHA, Mandala Logistics, Pahala Express, Pandu Logistics, SAP Express Courier, KI8 Express, PCP, and TIKINDO.

3.2. *Freight transport system*

Transport system in each company is divided into two, namely, distribution of goods from outside the city of Malang are focused on customers in Malang (inbound) and goods from the city of Malang are focused on customers outside of Malang (outbound). Both of these movements also vary at each company. Goods transport systems are also concerned about the use / selection of fleet / transport of goods, it is based on the movement destination location, the amount of interest the movement, distance, as well as the volume of goods on a single day. Before sending goods to every customer, the first branch office sorting and classifying its goods in accordance with the movement of adjacent locations. Then determine the type of freight that will be used for the movement of goods at each location.

3.3. *Load capacity of freight*

The frequency of the movement of freight on each company is different, underlying these differences is the ownership type and amount of freight. The variety of types of freight owned will affect the charge / volume can once transported. Besides various types of freight, the number of each type also influence, more and more have large cargo freight it will be a lot of goods that can be transported at a time. As many as 55% of companies do not correspond between transport capacity by volume of movement (Figure 2). The discrepancy occurred compaction allow goods in transport, so that the freight transporting goods beyond capacity. Freight capacity exceeding power capacity transport means must be very dangerous for the safety of drivers and the safety of freight transported goods. Discrepancies also result in the ineffectiveness of the movement of goods to the customer, resulting in a delay in the

movement of goods in the other day. This of course will make the performance of service enterprises declined and create the image of poor service to customers.

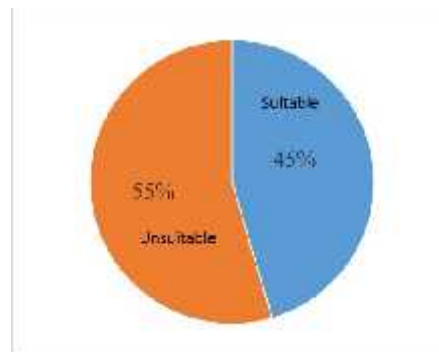


Figure 2. Consistency between transport capacity with order volume transported.

3.4. Route of freight delivery

Route selection obtained from the moving car survey conducted in November 2015 by observing the movement of freight capacity / haulage largest (vehicle types of CDD/CDE) on each company. Route selection based on location of customer objectives, the previous administration of the office will classify the delivery destination location so that multiple items can be sent in one delivery. In addition to the destination location, distance is also a factor in these elections, if the delivery location is located far from the offices and there is only one shipping location, then surely the delivered goods will postpone delivery until the goods are further those located around the first location. Based on the service that consists of data from the road traversed by the transportation of goods then overlaid, so the frequency of each roads traversed by the transportation of goods in delivering goods.

Based on the results obtained from the identification of the highest frequency is 11 times that then will be divided into five classes with the Likert scale. Class divisions are used to find a way to be chosen which is then analyzed the performance of the road that will be taken into consideration in determining the delivery route. Class division based on the frequency of freight passed can be seen in Table 1.

Table 1. Class divisions frequency.

Category	Score	Interval
Very often traversed	5	8,8-11
Often traversed	4	6,6-8,7
Quite often traversed	3	4,4-6,5
Less traveled	2	2,2-4,3
Barely traversed	1	0-2,1

Table 1 shows that the road will be chosen is a roads that has a score of 3 to 5 or road which has frequencies in the interval from 4.4 to 11 (Table 2).

Table 2. Road frequently traveled by freight transport.

No.	Name of road	No.	Name of road
1.	Jl. Letjen Sunandar Priyo Sudarmo	13.	Jl. Pasar Besar
2.	Jl. Panglima Sudirman	14.	Jl. Jendral Ahmad Yani
3.	Jl. W.R Supratman	15.	Jl. Jendral S. Parman
4.	Jl. Pattimura	16.	Jl. Letjen Sutoyo
5.	Jl. Jaksa Agung Suprpto	17.	Jl. Arif Margono
6.	Jl. Arif Rahman Hakim	18.	Jl. MT. Haryono

7.	Jl. Kawi	19.	Jl. Tlogomas
8.	Jl. KH. Hasyim Ashari	20.	Jl. Gajayana
9.	Jl. Trunojoyo	21.	Jl. Ciliwung
10.	Jl. Gatot Subroto	22.	Jl. Borobudur
11.	Jl. Laksmana Martadinata	23.	Jl. Sukarno-Hatta
12.	Jl. Kyai Tamin	24.	Jl. Ki Ageng Gribig

3.5. Road performance

LOS on every street is different, other than that peak hour on every street is different too. Peak hour in the morning (07:00 am to 08:00 am), LOS in the streets that were analyzed had a range B-F. LOS B in the morning is owned by Jl. Pattimura, Jl. Kawi A and Jl. Borobudur. LOS C in the morning are in Jl. WR. Supratman, Jl. Kyai Tamin, Jl. Pasar Besar, Jl. Jendral Ahmad Yani, Jl. Jaksa Agung Suprpto, Jl. Arif Margono, Jl. Tlogomas, Jl. Sukarno-Hatta and Jl. Ki Ageng Gribig. Peak hour in the morning has LOS E occurred in Jl. Priyo Sunandar Sudarmo, Jl. Gatot Subroto, Jl. Arif Rahman Hakim, and Jl. Gajayana, while the LOS F occurred in Jl. Laksamana Martadinata and Jl. MT. Haryono.

3.6. Determining the delivery route

Determining lane of movement of goods is required to realize the traffic and road transport that is orderly and comfortable within the scope of Malang city, therefore researchers establish alternative routes for the transportation of goods for both truck type CDE and CDD. Alternative given attention to the achievements of the area of origin and shipping destination and with regard to activities that support the economy in the area to go to, so the alternative is given will be divided into several corridors.

The determination of route also pay attention to the performance of the road to be traversed, based on the results of the analysis determining the route with the Dijkstra's algorithm, obtained the 16 roads are included in the delivery route with the shortest distance to 9 of 16 roads have an average LOS B and C it shows that route determined in accordance with the criteria of road conditions with a steady traffic flow, so if the company of LSP will send items via predetermined route, the shipment will be effective considering the specified route is the shortest route to the road conditions were relatively uneventful (traffic flow is stable), but 7 of the 16 streets that have a LOS of more than C or value the degree of saturation > 0.80 (Jl. Arif Margono, Jl. Kyai Tamin, Jl. Jendral Ahmad Yani, Jl. Tlogomas, Jl. MT. Haryono, Jl. Gatot Subroto dan Jl. Laksmana Martadinata. Jl. Arif Margono, Jl. Kyai Tamin, Jl. Jendral Ahmad Yani dan Jl. Tlogomas) had an average LOS D, whereas Jl. MT. Haryono, Jl. Gatot Subroto dan Jl. Laksmana Martadinata had an average LOS E.

LOS D and E indicate that traffic flow has begun unstable that will affect the time of delivery of goods to customers. The suggested alternative is that the LSP company should be sending goods to customers when crossing Jl. Kyai Tamin, Jl. Jendral Ahmad Yani, Jl. Tlogomas, Jl. MT. Haryono, dan Jl. Laksmana Martadinata not during peak hour (at 07.00-08.00am; at 12.00-13.00pm and at 17.00-18.00pm), Jl. Arif Margono not passed at the time of peak hour (at 07.00-08.00am; at 11.00-12.00pm and at 18.00-17.00pm) and do not pass on Jl. Gatot Subroto at the time of peak hour (at 07.00-08.00am; at 11.00-12.00pm and at 17.00-18.00pm) to avoid a delay that would slow down the delivery of goods. Based on the existing condition of the LSP company shipping goods as much as two times a day with delivery times varied. Time delivery of goods by the company should pay attention to road traffic conditions to be traversed, with carried on at. 09:00 to 11:00 for the first shipment and at eight. 2:00 p.m. to 4:00 p.m. for the second delivery.

Conclusion

Recommendations directives delivery route LSP based on analysis is divided into 3 main corridor which enables to transport equipment CDE or CDD type trucks using Dijkstra's algorithm. Corridor-1 (Jl.

Tlogomas - Jl. Jendral Ahmad Yani) obtained the delivery route, Jl. Tlogomas → Jl. MT. Haryono → Jl. Sukarno-Hatta → Jl. Borobudur → Jl. Jendral Ahmad Yani, obtained the delivery route 8,03 km. Corridor 2 (Jl. Jendral Ahmad Yani - Jl. Arif Margono) , obtained the delivery route, Jl. Jendral Ahmad Yani → Jl. Jendral S. Parman → Jl. Letjen Sutoyo → Jl. WR. Supartman → Jl. Panglima Sudirman → Jl. Gatot Subroto → Jl. Laksmana Martadinata → Jl. Kyai Tamin → Jl. Arif Margono, with a total distance traveled of 7,97 km. Corridor 3 (Jl. Jendral Ahmad Yani - Jl. Ki Ageng Gribig) obtained the delivery route Jl. Jendral Ahmad Yani → Jl. Jendral S. Parman → Jl. Letjen Sutoyo → Jl. WR. Supartman → Jl. Panglima Sudirman → Jl. Pattimura → Jl. Trunojoyo → Jl. Gatot Subroto → Jl. Ki Ageng Gribig, obtained the delivery route 8,15 km.

In determining the results of the route analysis and street performance analysis known 7 of 16 roads have LOS on the range D to F or the degree of saturation more than 0.80, by comparing the results of calculations and analysis as well as existing conditions existing route and road conditions are allowing skipped, then 7 roads can still be passed with the provision that the movement of goods is not done at the time of peak hour morning, afternoon or evening in order to reduce the level of delays in the movement of goods to the customer. Movement of goods can be circumvented by dividing the movement in the period o'clock. 09.00 to 11.00 for the first movement and at eight. 2.00 pm to 4.00 pm for the second movement.

Acknowledgments

The authors wish to express their gratitude to all members of the EIIS Laboratory in the University of Brawijaya for their cooperation and support.

References

- [1] Rosita, M. et al., 2012. Simulasi Sistem Logistik Perkotaan untuk Memenuhi Pasokan Barang ke Retail Modern di Malang dengan Penambahan Pusat Distribusi. Surabaya: Institut Teknologi Sepuluh Nopember (ITS).
- [2] Comandador, J. et al., 2012. A GPS analysis for urban freight distribution. Elsevier; 2012, p. 521-433.
- [3] Hesse, M. & Rodrigue, J.P., 2004. The Transport Geography of Logistics and Freight Distribution. USA : Elsevier; 2004, p. 171-184.
- [4] Herzog, B.O., 2013. Angkutan Barang perkotaan di Kota-Kota Negara Berkembang. Jerman : Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ).
- [5] Darmawan, Ferdy. 2014. Manajemen Lalu Lintas di Kawasan Pusat Kota Malang. Skripsi Tidak Diterbitkan, Jurusan Perencanaan Wilayah dan Kota, Universitas Brawijaya: Malang.
- [6] Direktorat Jenderal Bina Marga Direktorat Bina Jalan Kota. 1997. Manual Kapasitas Jalan Indonesia (MKJI). Jakarta: Direktorat Jenderal Bina Marga.
- [7] Tamin, O.Z., 2000. Perencanaan dan Permodelan Transportasi. Bandung: Penerbit ITB.
- [8] Blunden, W.R. & Black, J.A., 1984. The Land Use/ Transport System. New York: Pergamon Press.
- [9] Peraturan Pemerintah No. 74 tahun 2014 tentang Angkutan Jalan.

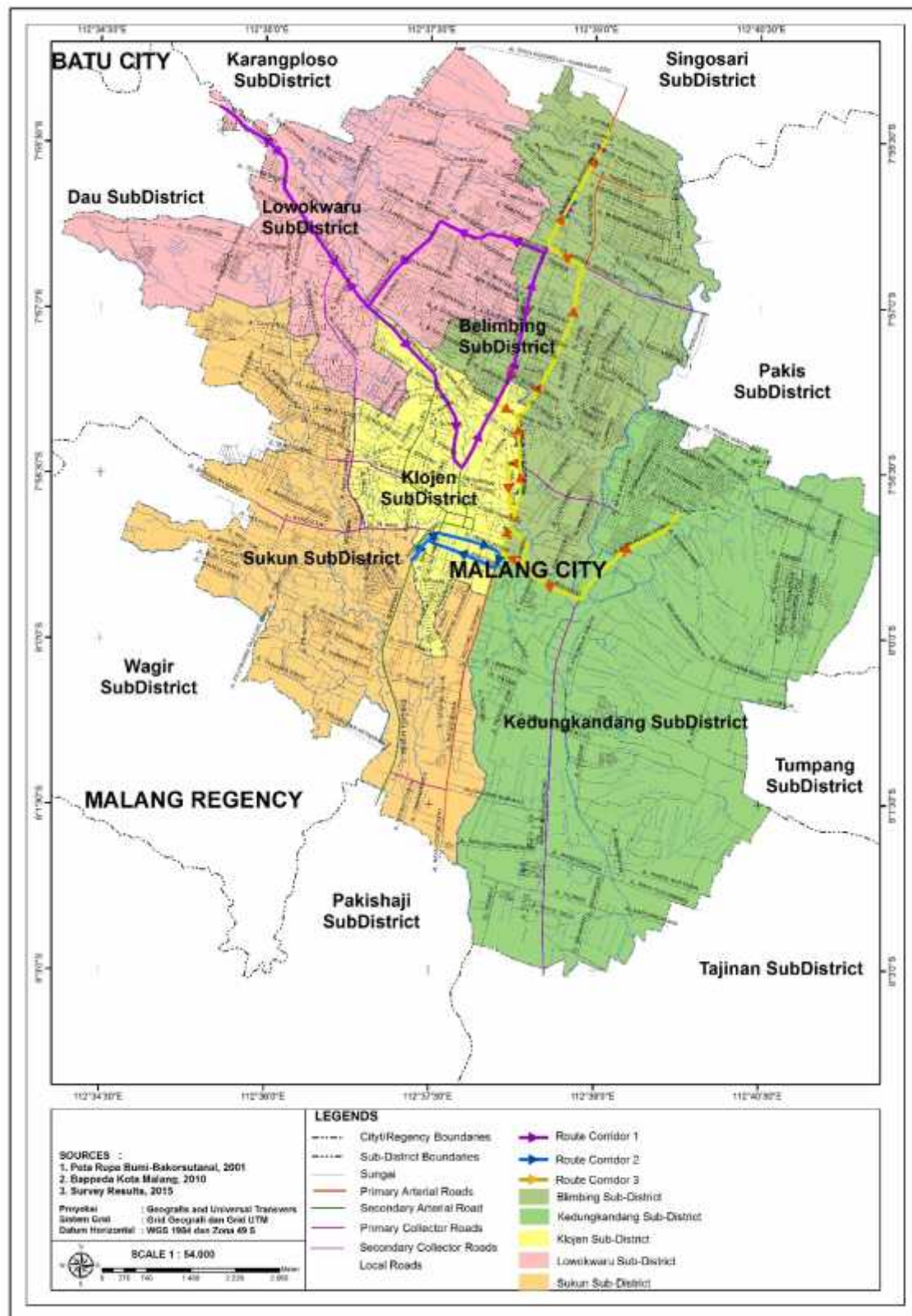


Figure 3. Concordance between transport capacity with volume transported ordering.