The effect of urban spatial structure on rapid bus transit services in Yogyakarta and Surakarta, Indonesia: A comparative study of the Trans Jogja and the Batik Solo Trans

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Abstract

Yogyakarta and Surakarta have a different spatial structure that affect the operation of rapid bus transit services – the Trans Jogja and the Batik Solo Trans in those two cities. This study investigates how differences in the spatial structure of the two cities shape the operational pattern of the two rapid bus transit services and explores the prospect of an alternative development. Descriptive quantitative and qualitative methods were used in examining the influence of the Yogyakarta concentric structure on the operation and performance of the Trans Jogja routes and that of the Surakarta grid on the operational spread of the Batik Solo Trans . It was found that the performance of Trans Jogja and Batik Solo Trans did reflect differences and disparities in terms of travel time, distance shelters, coverage area, number of passengers and operational time, with the net result that the Trans Jogja enjoyed high affordability in contrast to Batik Solo's low affordability. It may thus be concluded that there are legitimate re-evaluation needs for enhancing both performance and coverage of the two rapid bus transit services.

Keywords: Bus Rapid Transit, Batik Solo Trans, Minimum of Standard Services, network analyst, Trans Jogja, urban spatial structure

Introduction

Urban transportation is one of key factors in increasing urban productivity and development (Tjahjati, 1993) where transportation is one of parts in urban aspects playing an important role in running the wheel of life - especially in transporting people, goods, or services from one area to other area. It then emphasizes that the transportation sector has a strategic role in encouraging the economic growth of urban area.

Currently, Yogyakarta and Surakarta are facing a number of problems in urban transportation. Some portraits of frequent urban transportation problems are, for instance, a high personal vehicle growth, traffic congestions in some streets - especially in rush hours, the growth of traffic flow imbalanced with the growth of infrastructure, mixed traffic, a poor management in transportation, and unstructured transportation network.

These problems are due to the absence of comprehensive planning, controlling, and managing that cover all aspects through an approach of urban special structure on public transportation itself (Warpani, 1991). They certainly bring an effect on a low effectiveness and efficiency of current public transportation system and an increase of traffic congestion level.

Transportation services in Yogyakarta and Surakarta are supported by transit-based public transportation - Trans Jogja bus and Batik Solo Trans. Trans Jogja is supported by six corridors and 67 shelters, while Batik Solo Trans is supported by one corridor and 35 shelters. It is expected that the presence of those transportation systems can be the solution for the increasing population that is comparable with the increase of community capacity to have vehicles that in turn leads to the increase

of the vehicle number (Directorate General of Land Transportation, 2011). Table 1 below shows the data of population growth in Yogyakarta and Surakarta and the number of vehicles in the period of 2010 – 2011.

Table 1. Population and the number of vehicles in Yogyakarta and Surakarta in the period of 2009 – 2011

	Yogyakarta		Surakarta	
	2010	2011	2010	2011
Population (person)	457,668	465,482	565,835	588,110
Number of vehicles (unit)	243,848	252,726	280,925	334,956

Source: Transportation Agency of DIY Province and Surakarta City, 2011

However, the service from both two buses is not able to provide the satisfying transportation service for the customers so far due to the insufficiency of numbers of shelters, poor maintenance and non-strategic locations. In addition, the condition of some facilities in buses is ruined, poorly maintained. It is also accompanied with the overlapping routes in certain streets and the few armadas with the quite high need causing the bus service less qualified (UPTD Trans Jogja, 2011).

Though Yogyakarta and Surakarta tend to have a quite similar social-cultural condition, they have the different characteristic of spatial structure model. Yogyakarta tends to be concentric (ring radial), while Surakarta tends to be grid (rectilinear) (Engineering Faculty of UGM, 1991). The difference of spatial structures in Yogyakarta and Surakarta indirectly affects the performance of Bus Rapid Transit service - Trans Jogja and Batik Solo Trans. Hence, a comparative study is deemed essential to be done on the performance of Bus Rapid Transit service between Trans Jogja and Batik Solo Trans related to urban spatial structure.

Several recent studies have addressed accessibility to BRT systems in Latin America to evaluate the effect on land values (Munoz-Raskin, 2010; Rodriguez and Mojica, 2009; Rodriguez and Targa, 2004). This research contributes on comparison of urban spatial structure, service performance, public perception, and alternative development of Trans Jogja and Batik Solo Trans in order to increase the service.

This study aims to investigate the difference in the spatial structure characteristics between Yogyakarta and Surakarta; to examine differences in the service characteristics between Trans Jogja and Batik Solo Trans; to identify the effect of the city spatial structure on the Rapid Bus Transit services of Trans Jogja and Batik Solo Trans; and to explore the prospects of developing alternatives to further enhance the services of the Trans Jogja and Batik Solo Trans.

Literature study

Spatial structure refers to the structure of residential centres and network system of infrastructure and facilities functioned as the support of social-economic activity of community that hierarchically has a functional relation (Law No. 26, 2007). The development of a city is that if the components of the city change; then, the urban structure will physically change. The factors forming the morphology of the city include transportation network pattern, population condition, activity centres, and paradigm of current city planning (Bourne, 1982). At last, the description of central hierarchy and linkage is implied in the accessibility and transportation needs (Ernanet.al. 2009).

Transportation is an activity of people or goods movement from a place (origin) to another place (destination) (Morlok, 1985). In the movement of people or the distribution of goods, accessibility has an important role. Accessibility of public transportation is a concept combining land use system and transportation networking system (Setijowarno D. and Frazila R.B., 2000). It is used to identify problems and evaluate proposed transportation planning alternative.

Transportation system brings many advantages and disadvantages for land use patterns along corridors and stations. High density transportation development increases property values along transit corridors and around station areas (Huang, 1996; Cervero and Landis, 1997; Cervero, 1997; and Ryan, 1999).

One of public transportation accessibility aspects is the accessibility of shelter (bus stop) from or to the activity centre. Spatial transportation modelling to see the relationship is by Network Analysis - network-based analysis, such as a route, transportation route, direction, travel direction, closest facility, service area, and locations. Through network analysis, shelter service area can be known based on travel time or distance by the function of Service Area Analysis. Again, it produces the matrix of travel fare from each origin network (bus shelter) to all destinations (service facility) by the function of Origin-Destination (OD) Matrix Analysis.

Bus Rapid Transit (BRT) is a bus with high quality based on fast, convenient, and low cost transit system to urban mobility, fast-service operation, difference and excellence of marketing and service to customer. Directorate General of Land Transportation Law of Number: 687/AJ.206/DRJD/2002 about the technical organization guidance of Passenger Public Transportation in Urban Area in Fixed and Regular Route and *World Bank* in 1986 prioritizes performance indicator in 3 main substances: reliability, accessibility, and capacity. Table 2 and Table 3 below present the service indicator from Directorate General of Land Transportation and *World Bank*, respectively.

Table 2. Service Indicator of Directorate General of Land Transportation

Variable	Definition	Standard
Reliability:		
Load Factor	The ratio of passenger transported with vehicle capacity (%).	70%
The number of vehicles operating on the route	Number of buses operating on certain route (unit).	20
Accessibility:		
Distance between shelters	The distance between one shelter and the next shelter in a route (meter).	300 – 400
Coverage Area Ratio	The length of road network passed by the public transportation compared to the covered area.	1.00
Capacity:		
The number of maximum passengers	The number of maximum capacity passenger that can be accommodated in a bus, sitting and standing (person).	30
Variable	Definition	Standard
Capacity:		
Mode Integrity	Integration/interconnection of the transportation mode and other transportation modes.	Available
Service Time	Bus service time in a day (hour).	15
Opening and closing service hour	Bus service hour from opening to closing service.	05.00 - 22.00

Source: Directorate of Land Transportation, 2002

Table 3. World Bank Service Indicator

Variable	Definition	Standard
Reliability:		
Headway	Time average between one bus and the following bus (minute).	5-10
Travel Time	Average travel time (hour).	1 - 1,5
Travel Speed	High density area (km/hour).	10 - 12
Variable	Definition	Standard
Convenience:		
Passenger waiting time	Time used by passenger for waiting the bus (minute).	5 - 10
Capacity:		
The number of passengers	The number of passenger transported/bus/day.	250 - 300 (medium bus)

Source: World Bank, 1986

Research method

This research was conducted in two cities: Yogyakarta and Surakarta (Picture 1(a) and 1 (b)). This is a quantitative and qualitative descriptive research. The quantitative and qualitative research approach is an approach in research conducted by combining qualitative and quantitative data collecting procedures in a single study (one research) (*Creswell*, 1996). Observation and measurement, interview, and questionnaire distribution were conducted in collecting the primary data, while secondary data was obtained through literature study and documentation. Furthermore, in this research, purposive sampling was carried out in collecting the respondent sample in which 100 respondents were selected as the samples at each permanent shelter passed by Trans Jogja buses in route 3A (Yogyakarta City) and Batik Solo Trans buses in corridor 1 (Surakarta City). Table 4 below shows analysis technique in this research.

Table 4. Analysis technique

Objective	Data	Data Collecting Technique	Analysis Technique	Result/Presen-tation
To investigate the difference of urban spatial structure characteristic between Yogyakarta City and Surakarta City	• Land use system • The number of service facilities • Population • Road network	• Observation and measurement • Secondary data from the agency	• Spatial analysis • Descriptive analysis • Qualitative and quantitative analysis	• Descriptive statistic table • Map
To investigate the difference of Bus Rapid Transit service characteristic between Trans Jogja and Batik Solo Trans	• Passenger characteristic • BRT characteristic	• Observation and measurement • Secondary data from the agency • Questionnaire • Interview	• Qualitative analysis • Calculation according to the standard of Land Transportation Directorate General and World Bank • Public perception: Scoring	• Quantitative descriptive statistic table
To identify the effect of urban spatial structure on Bus Rapid Transit service	• Land use system • The number of service facilities • Population • Road network • Service standard	• Observation and measurement • Secondary data from the agency • Questionnaire • Interview	• Spatial Analysis: Network Analyst (Service Area Analysis dan Origin – Destination (OD) Matrix Analysis)	• Map of urban spatial structure effect on Bus Rapid Transit service • Descriptive table
To analyse the alternative need of development needed	• Service standard • Public perception • The effect of spatial structure on service	• Questionaire • Interview • Secondary data from the agency	• Qualitative descriptive analysis	• Policy alternative recommendation

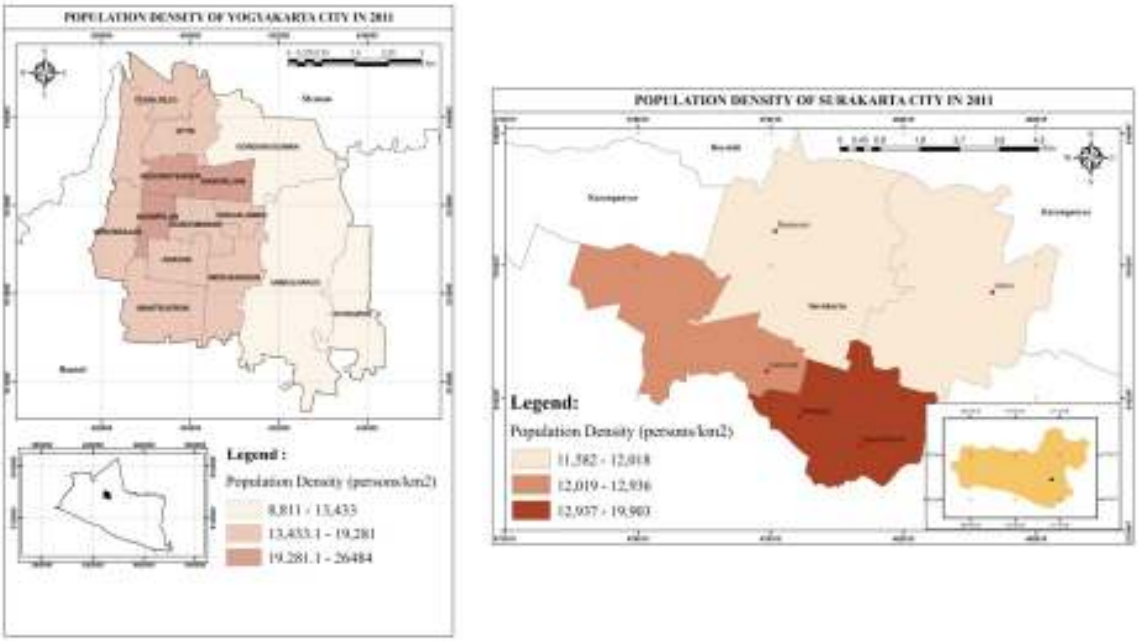
Research results

Analysis of urban spatial structure difference

Spatial structure is formed because of urban morphology development including population pattern and activity centres viewed from land use system and the number of service facilities (Bourne, 1982).

- Population analysis

In 2011 the population in Yogyakarta reached 465,482 with the population growth average at 1.74% per year and population density at 14,323 persons per kilometre square. Surakarta in that year was more populated reaching 588,110 persons with the smaller population growth average of 1.29% and the lower population density of 13,354 persons per kilometre square. Picture 1 below shows the difference of population density in Yogyakarta City and Surakarta City in 2011.

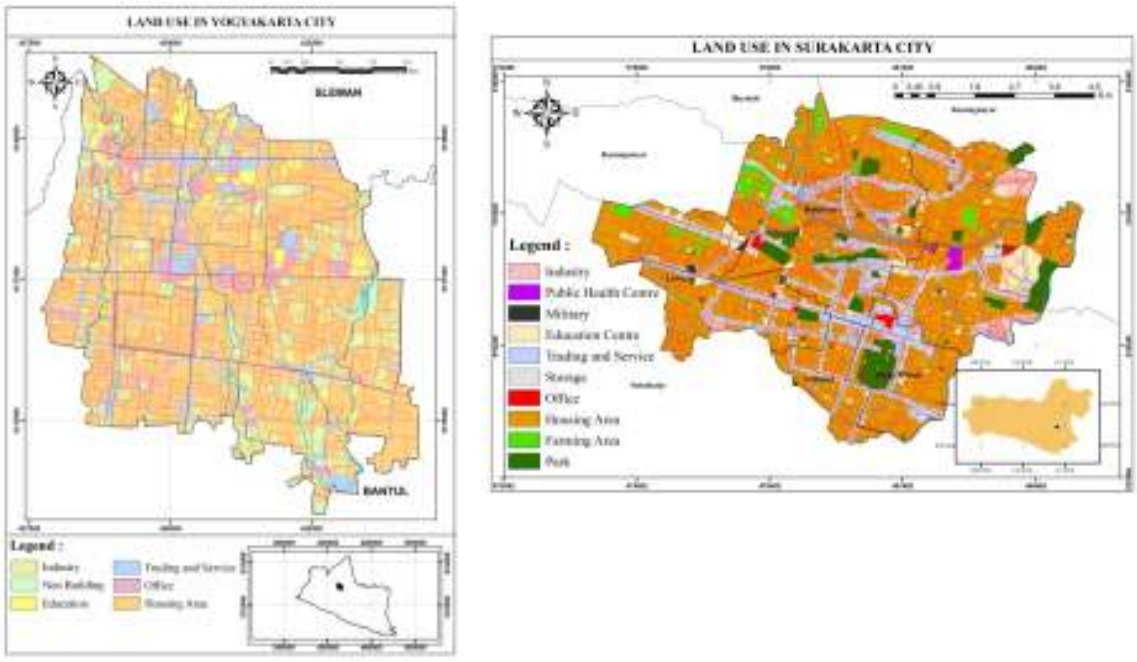


(a) (b)

Picture 1 (a) and 1 (b). *Map of Population Density in Yogyakarta and Surakarta*

- Land use system analysis

Land use system in Yogyakarta and Surakarta was dominated by housing area. In Yogyakarta it was 21,816,147.51 m^2, while if it was viewed on the condition of land allocation in Surakarta City with the area of 29,842,069.89 m^2 in 2012. The significantly increasing land use was trading and service that had the area of 3,719,625.11 m^2 for Yogyakarta and 8,473,305.27 m^2 for Surakarta. Picture 2 below is the map showing the difference of land use with domination of housing area in Yogyakarta and high intensity of trading and service area growth that is linear in Surakarta in 2011.

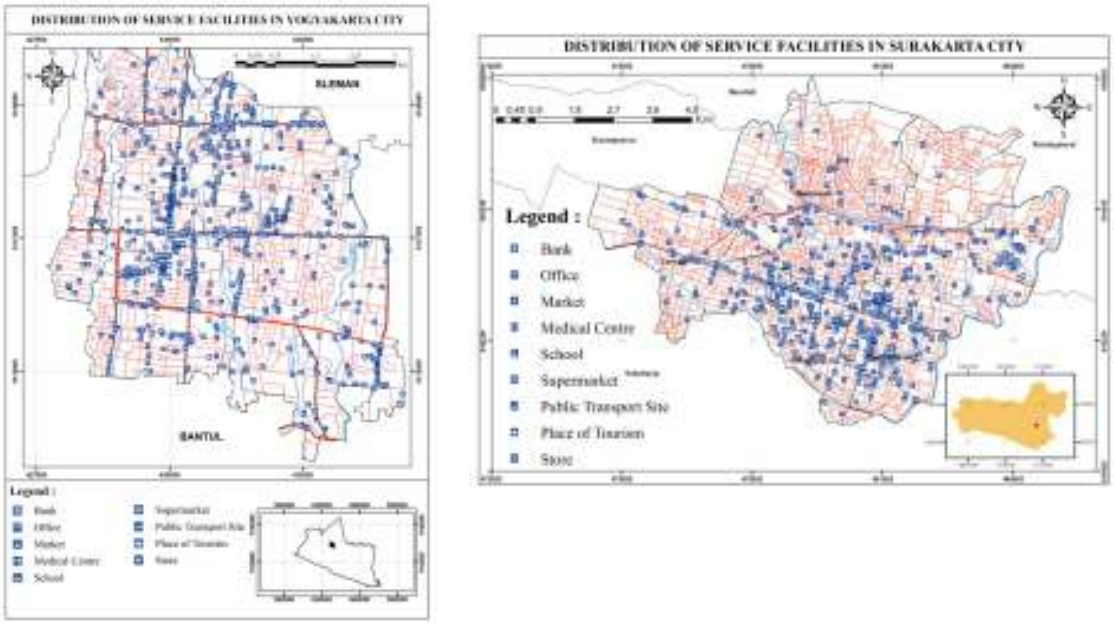


(a) (b)

Picture 2 (a) and 2 (b). *Comparative Map of Land Use in Yogyakarta and Surakarta*

- Service facility analysis

Service facilities in the centre of Yogyakarta City (Danurejan District, Gondomanan District, and Gedongtengen District) have a function as a downtown with a trading and service oriented activity. For this, the movement tends to the downtown. Meanwhile, the movement of people in Surakarta is spread in the entire city area. This, as a result, has not merely led the service facilities as the service centre but the sub-city centres develop evenly distributed. Picture 3 below is a map showing the distribution of service facilities in Yogyakarta and Surakarta in 2011.



(a) (b)

Picture 3 (a) and 3 (b). *Map of Service Facilities in Yogyakarta City and Surakarta City*

Based on the data analysis done, the difference of spatial structure between Yogyakarta City and Surakarta City can be seen on Table 5 below.

Table 5. The difference of spatial structure in Yogyakarta City and Surakarta City

	Yogyakarta City	Surakarta City
Population	a. Districts in the city centre have a low growth, with a high growth in suburb area (Districts of Kota Gede 3.01%, Umbulharjo 2.86%, Mantrijeron 2.58%, and Jetis 0.52%). b. Population distribution pattern is cantered.	a. The highest population grow this in the north of the city; the city centre is having decreasing growth (Districts of Banjarsari3.12% and Serengan-0.04%). b. The population distribution pattern is centred in the south of the city.
Land Use System	➢ Dominated by housing area (67.07%) and increasing in service (11.3%) with the decrease in farming land (1.01%).	➢ Dominated by housing area (64.34%) as well as trade and service (17.99%).
Service Facility	➢ Centred in the city centre functioned as a downtown with the activities oriented to trade and service, office, and education.	➢ Development of service centre and sub centre both in the city centre and suburb develop evenly distributed with a special activity orientation.

Source: Analysis and Data Processing Result, 2013

*Rapid Bus Transit Service of Trans Jogja and Batik Solo Tran***s**

Bus Rapid Transit service is work of Bus Rapid Transit currently running to serve all public activities in travelling or activity (Warpani, 1991). Service performance is classified into three main indicators: reliability, convenience, and capacity. Meanwhile, public perception tries to analyse the level of performance and satisfaction from community as the user of Trans Jogja and Batik Solo Trans according to the determined indicators.

- Service Performance

In observing the service performance of Bus Rapid Transit between Trans Jogja and Batik Solo Trans, three indicators are involved: reliability, convenience, and capacity.

a. **Reliability Indicator**: *Load factor* of Trans Jogja and Batik Solo Trans buses are relatively inadequate with the average of 37.47% and 39.43%, respectively. Meanwhile, *Headway* for all routes of Trans Jogja takes 10 - 12 minutes – longer than Batik Solo Trans taking in the average of 8 - 10 minutes. The average of travel time for bus route of Trans Jogja takes around one hour and 32 minutes, and Batik Solo Trans buses are able to reach the average time of 2 hours and 6 minutes. The average of Trans Jogja route length is 33.68 km, while Batik Solo Trans has longer route that is 41 km. The average speed of all Trans Jogja bus routes is good at 21.97 km/hour, and Batik Solo Trans buses have lower travelling speed at 19.43 km/hour. The number of buses in each route for Batik Solo Trans and Trans Jogja can be mentioned as the average of 8 buses for Trans Jogja and 15 buses for Batik Solo Trans.
b. **Convenience Indicator**: Trans Jogja and Batik Solo Trans have not fulfilled the criteria of the determined standard for the distance of each route that is >500 meters. Passenger waiting time for Trans Jogja has the average of 5 – 6 minutes. In contrast, Batik Solo Tran takes around 4–5 minutes better than the standard of 5 – 10 minutes. Trans Jogja has a better *coverage area* compared to Batik Solo Trans because the average of coverage area for all routes for Trans Jogja buses is at 1.04, while Batik Solo Trans is only at 0.93.
c. **Capacity Indicator**: the average number of Trans Jogja bus passengers is good reaching 295 passengers per bus per day. This number is much different from Batik Solo bus that has the very inadequate number of passenger/bus/day reaching 151 passengers per bus/day on weekdays. Bus capacity of Trans Jogja and Batik Solo Trans are good. For Trans Jogja, the bus capacity is 41 passengers including 22 sitting passengers and 19 standing passengers. Batik Solo Trans bus on

the other hand has the capacity of 31 passengers including 21sitting passengers and 10 standing passengers. Trans Jogja and Batik Solo Trans have integrated transportation system connecting a number of transportation spots in order to support people movement. Trans Jogja has connected six important facility spots around the city including Tugu Train Station, Giwangan Bus Terminal as the centre of inter-provinces and regional bus route transportation, Condong Catur Rural Transportation Terminal, Jombor Regional Terminal, Prambanan and Adisucipto Airport Terminal. Batik Solo Trans also integrates a number of transportation facility spots, such as Palur Terminal as inter-regional bus transportation, Purwosari Train Station, and Adi Soemarmo Airport. Service hour of Trans Jogja and Batik Solo Trans tends to have a significant difference in which Trans Jogja operates for 16 hours started from 05.30 to 21.30. The operational hour of Batik Solo Trans, meanwhile, is still inadequate - 13 hours started from 05.30 to 18.30.

Table 6 shows the significant performance difference between Trans Jogja and Batik Solo Trans.

Table 6. The difference between Trans Jogja Service and Batik Solo Trans Service

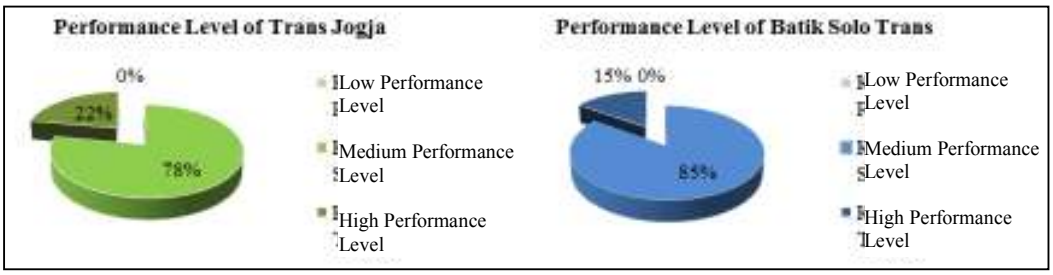
	Parameter	Trans Jogja	Batik Solo Trans
CAPACITY	Load Factor	37.47 %	39.43 %
	Head way	10 - 12 minutes	8 - 10 minutes
	Travel Time	1 hour and 32 minutes	2 hours and 6 minutes
	Traveling Speed	21.97 km/hour	19.43 km/hour
	The number of vehicles operating on the route	8 (in average) units	15 units
CONVENIENCE	The distance between shelter	1,084.30 meters	668.15 meter
	Passenger waiting time	5 – 6 minutes	4 – 5 minutes
	Coverage area	1.04	0.93
CAPACITY	The number of passengers	295 passengers/ bus/day	151 passengers/bus/day
	The maximum number of passengers	41 passengers	31 passengers
	Mode Integrity	Available	Available
	Service Time	16 hours	13 hours
	Starting and Ending of Service Hour	05.30 - 21.30	05.30 – 18.30

Source: Analysis and Data Processing Result, 2013

As shown from the result analysis in Table 6, the inadequate performance parameters include load factor, number of vehicle, and distance between shelters for Trans Jogja. For Batik Solo Trans, the inadequate performance parameters include load factor, number of buses, distance between shelters, coverage area, number of passengers, and service time.

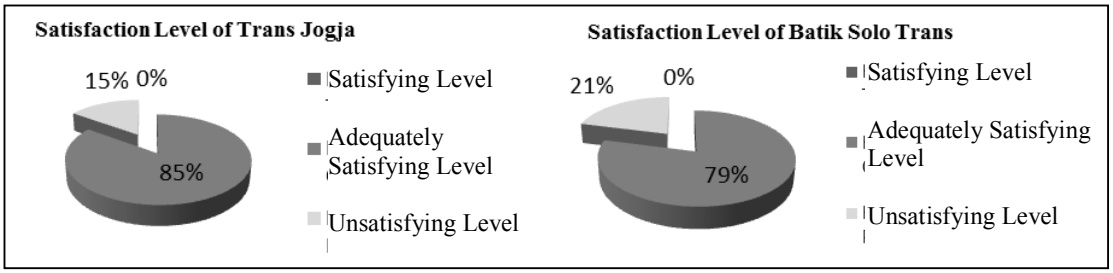
- Perception of user community

Parameters used to assess the perception of community are passenger transportation by bus, shelter access, and bus arriving time, travelling convenience, number of bus, ticket fare, seat availability, integrity, and service time. Picture 4 shows that the user community evaluation on Bus Rapid Transit performance of each transport is at medium level with the percentage of 78% for Trans Jogja and 85 % for Batik Solo Trans. The evaluation of Trans Jogja bus user community that is inadequate is on the parameter of bus arriving time (43%) and the number of operating buses (51%). For Batik Solo Trans bus, the evaluation of community that is inadequate is the bus arriving time (49%) as well as the bus service time that is inadequate (42%).



Picture 4. *Performance Level Comparison of Trans Jogja and Batik Solo Trans*

Meanwhile, Picture 5 shows the evaluation level of user community on the satisfaction of Bus Rapid Transit of each transport that is quite satisfying - 85% for Trans Jogja and 79% for Batik Solo Trans. The evaluation is unsatisfying for Trans Jogja on the arriving time (44%) and the number of operating bus (45%). Meanwhile, in Batik Solo Trans, the less community satisfaction is found in arrival waiting time (47%) as well as time and bus operating hour (30%) considerably less satisfying for only serving for 13 hours.



Picture 5. *Satisfaction Level Comparison of Trans Jogja and Batik Solo Trans*

The effect of urban spatial structure on the service of Trans Jogja and Batik Solo Trans

Urban spatial structure in urban area has a strong relationship with the transportation service, one of which is related to the land use system pattern and facility distribution. The effect of urban spatial structure on Bus Rapid Transit service can be seen from the shelter accessibility to activity centres. This research uses network analyst analysis in the form of service area and O-D matrix.

Service area can be determined as an evaluation on the ability and accessibility by considering the convenience access that can be seen from travel time. The parameter of impedance for selected service area is the time with the score of 5, 10, and 15 minutes. The selection is based on the assumption of the most ideal time to reach a shelter in 5 minutes and the maximum of more than or equal to 15 minutes.

Origin – Destination (OD) Cost Matrix Analysis is the analysis to see the best travel time from origin factor to destination factor, for this *O-D cost matrix* includes score 10 in Default *Cut-off Value* as the best time to reach destination place. From the result obtained, the accessibility of Trans Jogja bus shelter has a high accessibility because the shelter is distributed evenly to almost entire area of Yogyakarta to surrounding area .

Table 7. The number of Trans Jogja shelters in each regency

Regency/City	The number of shelters
Sleman Regency	30
Bantul Regency	4
Yogyakarta City	42
Total	76

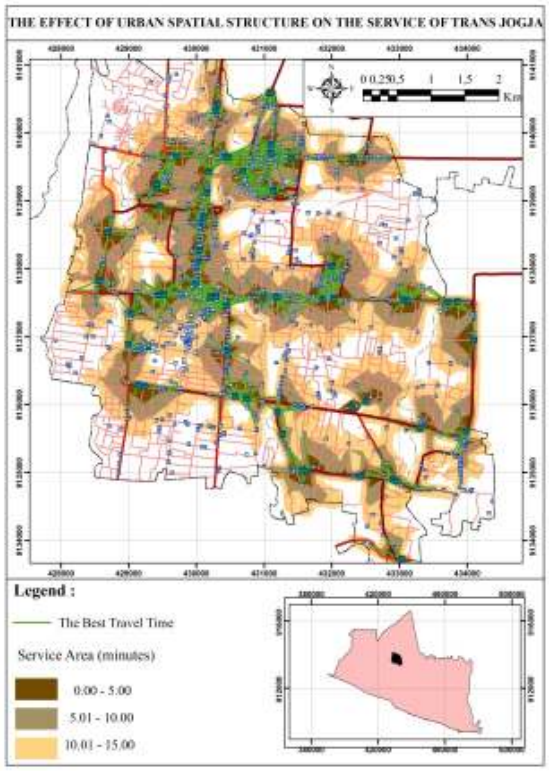
Source: Transportation Agency of DIY, 2012

Table 8. The number of Batik Solo Trans shelters in and out town

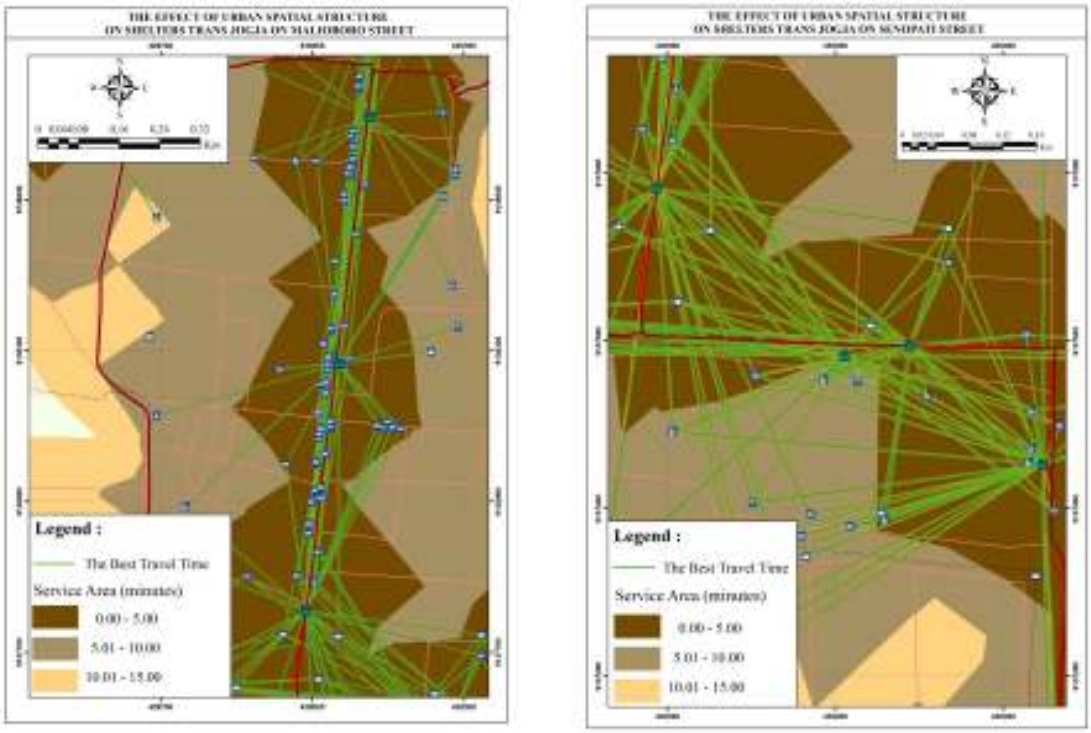
Regency/City	The number of shelters
Surakarta City	24
Out town of Surakarta	11
Total	35

Source: Transportation Agency of Surakarta City, 2012

Trans Jogja shelters in the city centre of Yogyakarta especially in Malioboro Street and Senopati Street have a high accessibility with the access to destination well. Thus, those shelters can help community in order to fulfil various activities oriented to trade and service, education, tourism, and office buildings as shown on Picture 6.



(a)



(b) (c)

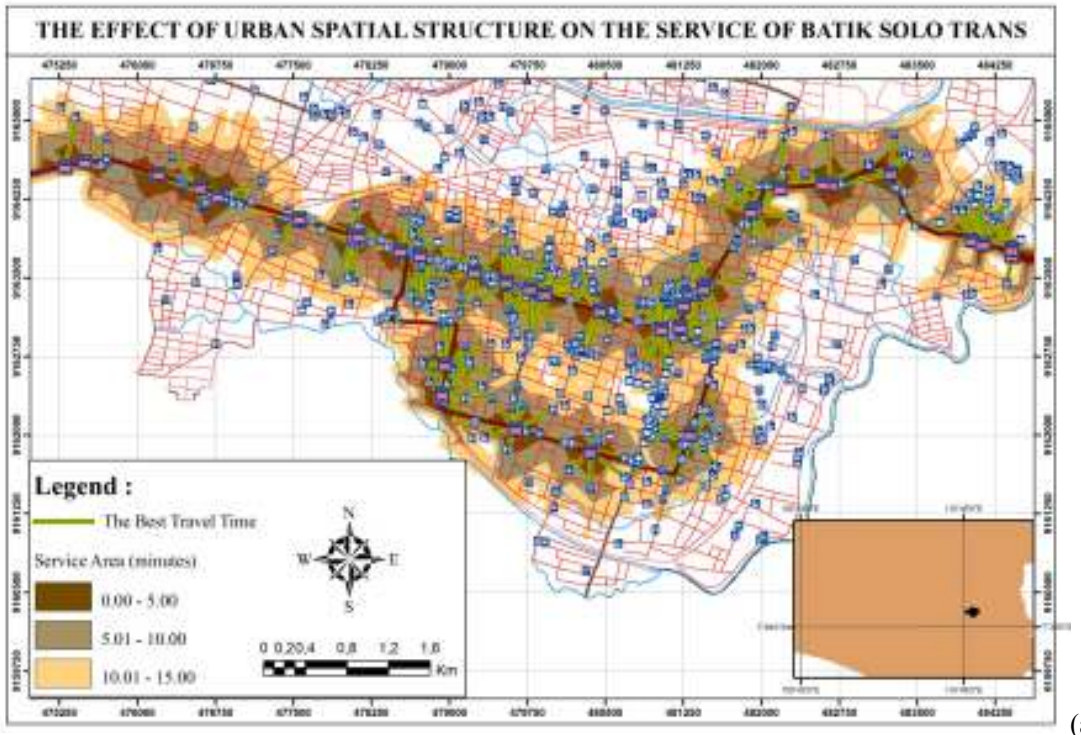
Picture 6 (a), 6 (b) and 6 (c). *The effect of urban spatial structure on the location of shelters in Yogyakarta City, on Malioboro Street and Senopati Street*

Meanwhile, Batik Solo Trans shelters on Slamet Riyadi Street also have a high accessibility, but more concentrated on trading and service activities. Shelters on Ir. Sutami Street also have a quite high accessibility, but more concentrated for educational activities as shown on Picture 7.

Exploring service development alternative for Trans Jogja and Batik Solo Trans Bus Rapid Transit

Some alternatives can be considered, namely, (1) *Low level of Load factor* in Trans Jogja bus (37.47 %) and Batik Solo Trans (39.43 %) can be increased by conducting bus trip scheduling in every shelter. Moreover, it can be changed by increasing armada frequency or by eliminating competitor modes on existing corridor; (2) Trans Jogja and Batik Solo Trans performances need to be increased by conducting additional units by opening and activating new corridors/routes; (3) The low *coverage area* of Batik Solo Trans bus (0.93) can be increased by conducting additional route distance and opening new corridors for the wider opportunity of community to use the existing bus service; (4) The inadequate number of passengers/bus/day for Batik Solo Trans bus (151 passengers in one bus in a day) requires persuasive means from government to community to choose a public transportation compared to private vehicles, for instance, by limiting the use of private vehicles; (5) The Batik Solo Trans has lower performance in the operation hour and service time (13 hours) compared to Trans Jogja (16 hours). For this, the presence of service time prolongation to fulfil the needs of community fully is needed; (6) Community perception about the performance and satisfaction is low - especially on the late bus arriving time and the low number of buses for Trans Jogja and Batik Solo Trans buses can be recommended by adding buses on every route. Therefore, it is able to accommodate the travelling needs of community, and the passenger waiting time and headway would be reduced; (7) Route management with direct route would shorten the travel time. As shown, some routes on Trans Jogja bus are circular routes. It somehow is inefficient, so direct routes directly to the city centre or the growth of centres needs to be developed to shorten the travel time; and (8) The Batik Solo Trans tends to have low shelter accessibility due to the fact that it is still operating one corridor that did not

serve the entire area of Surakarta City. Therefore, it needs additional shelters both in and out of the Surakarta City so that it can reduce the distance and travelling time between shelters thus enhancing its accessibility.



(a)

(b)

(c)

Picture 7(a), 7 (b) and 7 (c). *The effect of urban spatial structure on shelter location in Surakarta City, Slamet Riyadi Street and Ir. Sutami Street*

Conclusion

Yogyakarta City and Surakarta City have populations that tend to be less evenly distributed and concentrated in the city centre. Because Yogyakarta City has the service function of a city centre with various activity orientations, all movements tend toward the city centre. By contrast, public movement in Surakarta City tends to distribute more evenly resulting in a more even development of service sub-centres. Thus, based on reliability, convenience, and capacity indicators, the service

performance of Trans Jogja was perceived by users as better and more satisfying (85%) than that of the Batik Solo Trans (79%).

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References

Bourne LS (1982) *Urban transport spatial structure.* In: Larry S. Bourne (ed) *Internal structure of the city*. Oxford University Press, New York.

BPS Kota Surakarta (2011) *Kota Surakarta Dalam Angka tahun 2011.* Biro Pusat Statistik, Kota Surakarta.

BPS Kota Yogyakarta (2012) *Kota Yogyakarta Dalam Angka tahun 2012.* Biro Pusat Statistik, Kota Yogyakarta.

Cervero R (1997) Transit-induced accessibility and agglomeration benefits: A land market evaluation. Working Paper 691. Institute of Urban and Regional Development, Berkeley.

Cervero R, Landis J (1997) Twenty years of the bay area rapid transit system: Land use and development impacts. *Transportation Research Part A: Policy and Practice* **31** (4), 309–333.

Creswell JW (1996) *Designing and conducting mixed methods research*. Sage Publications Inc., Singapore.

Directorate of Land Transportation (2011) *Kebijakan dan program untuk mewujudkan efisiensi energi di transportasi darat*. Jakarta.

Directorate of Land Transportation (2002) SK Direktorat Jenderal Perhubungan Darat Nomor: Sk.687/AJ.206/DRJD/2002 Tentang Pedoman Teknis Penyelenggaraan Angkutan Penumpang Umum di Wilayah Perkotaan dalam Trayek Tetap dan Teratur. Jakarta.

Engineering Faculty of UGM (1991) Penyusunan pedoman pelestarian pengembangan dan pemanfaatan Keraton Kasunanan Surakarta (Final Project Report). Bappeda, Surakarta.

Ernan R, Sunsun SH, Dyah RP (2011) *Perencanaan dan pengembangan wilayah*. Yayasan Pustaka Obor Indonesia, Jakarta.

Huang H (1996) The land-use impacts of urban rail transit systems. *Journal of Planning Literature* **11**, 17-30.

Morlok EK (1985) *Pengantar teknik dan perencanaan transportasi*. Erlangga, Jakarta.

Munoz-Raskin R (2010) Walking accessibility to bus rapid transit: Does it affect property values? The case of Bogota, Colombia. *Transport Policy* **17**, 72–84.

Rodriguez DA, Mojica CA (2009) Capitalization of BRT network expansion effects into prices of non-expansion areas. *Transportation Research Part A: Policy and Practice* **43**, 560–571.

Rodriguez DA, Targa F (2004) Value of accessibility to Bogota's bus rapid transit system. *Transport Reviews* **24**, 587–610.

Ryan S (1999) Property values and transportation facilities: finding the transportation-land use connection. *Journal of Planning Literature* **13** (4), 412–427.

Setijowarno D, Frazila RB (2000) *Pengantar sistem transportasi*. Universitas Katholik Soegijapranata, Semarang.

Tjahjati SB (1993) Perkembangan kota dan sistem angkutan umum (*Prosiding Plano-32*). Bandung.

UPTD Trans Jogja (2011) *Hasil survei kepuasan penumpang terhadap layanan Bus Trans Jogja*. UPTD Trans Jogja, Yogyakarta.

Warpani S (1991) *Merencanakan sistem perangkutan*. Penerbit ITB, Bandung.

World Bank (1986) Cities on the move: A World Bank urban transport review. Urban Transport Thematic Group. World Bank, Washington.