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THE CHARACTERISTICS OF PARATRANSIT AND NON-MOTORIZED TRANSPORT IN BANDUNG, INDONESIA

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Abstract: Angkutan Kota (paratransit) and non-motorized vehicles still exist in many small and big cities in Indonesia. This paper intends to explore the characteristics of paratransit and NMT in Bandung. Operational, financial, perception, and users' ability and willingness to pay data were collected using survey. There is significance difference in becak operational characteristics between 1984 and 2001. Analysis shows that NMT provides mobility for women, student, low-income user, and job opportunity for people with limited skill and education, including exercise. Survey shows that NMT still accepted by community. Paratransit is 61.24% of total public transportation in Bandung. The minimum load factor is 29.17% and the maximum is 82.34%. 70.7% of paratransit user answers that the service quality of paratransit is good enough and 53% respondent says that tariff is suitable with the service quality. User ability and willingness has been analyzed according to service quality, trip purpose, user expenses, and fare perception.

Keywords: Non-motorized, Paratransit, Characteristics, Operation, Urban Transportation.

1. INTRODUCTION

Many transportation planners have noted that cities in all parts of the world are struggling to achieve some acceptable standard of mobility (Koutsopoulos & Schmidt, 1986). Mobility of people and goods is an essential part of all social and economic activities. In most countries of the world, even developing countries, passenger cars and trucks have become the most important transport modes. In many developing cities high growth of the vehicle fleet has taken place in recent years. Non-motorized transport, which in earlier times was the common way of linking together places of activities, has to a large extent been substituted by the car in daily mobility, and by trucks, for freight movement (Fjellstrom, 2002).

Non-motorized transport (NMT) has an ambiguously benign/beneficial environmental impact. In many cities, it is the main mode of transportation for the poor, and in some a significant source of income for them. It therefore has a very significant poverty impact. Where non-motorized transport is the main transport mode for the work journeys of the poor, it is also critical for the economic functioning of the city. Despite this obvious merit, NMT has tended to be ignored by policymakers in the formulation of infrastructure policy and positively discouraged as a service provider (The World Bank, 2002).

Bandung is the capital city of West Java Province and one of the big cities in Indonesia. According to population registration in 2000, the population of Bandung City was 2,585,446 people and the area is 167.67 km^2. The population density was 155 inhabitants per one hectare. Gross Regional Domestic Income (PDRB) of Bandung in year 2000 is 14.4 million rupiah, as the forth-highest PDRB in West Java Province. As a big city with more than one million populations, Bandung faces a transportation problem. One of the transportation problems is how to provide mobility services for all segment of community.

There are 8,876 vehicles of public transportation in Bandung and 5,436 vehicles of them are paratransit (angkutan kota), so paratransit is 61.24% of operated public transportation. Totally, in Bandung there are 221,942 vehicles of passenger cars. This situation figures the important role of paratransit, which is a small minibus with 12-14 seats. Paratransit creates beneficial role including negative impacts to transportation system in urban area. This paradox situation needs a solution in regards of mobility and urban transportation system.

This paper intends to describe the findings on the characteristics of NMT and paratransit in Bandung city. A survey has been conducted to study the characteristics of NMT and paratransit, both user and operator. This research has an objective to explore the characteristics of NMT and paratransit as an urban transportation mode in the city of Bandung, Indonesia.

2. SUSTAINABLE URBAN TRANSPORT IN DEVELOPING COUNTRIES

The “*income poor*” makes less trips, and more of their trips are undertaken on foot. For most purposes they are restricted to whatever services (usually poor) can be accessed within walking distance, making them “*accessibility poor*”. The journey to work may be relatively long. Even if it is not, it will use slow modes and may be very time consuming, so they are also “*time-poor*.” For poor people, and particularly women, children and the elderly, trip making is often discouraged by their vulnerability as pedestrian both to traffic accidents and to personal violence, making them “*safety poor*.” Finally there is evidence that long walking distances and times also creates a tiredness and boredom … adding an “*energy-poverty*” dimension to their deprivation (The World Bank, 2002).

First of all, appropriate urban and land use planning is required to reduce poor access. As a derived demand, a transport infrastructure enabling low-cost transport (access) can make a crucial contribution to poverty reduction. However, poverty-oriented urban transport and traffic policy has to focus on the majority of the population rather than on marginalized groups, as has often been claimed (GTZ, 2002).

Until the seventies, urban transport projects initially planned on the premise of being beneficial to the population as a whole, which expressed in the overall economic (net) benefit on the base of cost-benefit analyses. At the same time with the introduction of environmental impact assessments in the eighties, ecological sustainability, economic efficiency, and competitiveness of urban transport systems came to the fore against the background of increasingly deficit-ridden budgets in the cities of the developing countries. However, in most cities in the developing countries, traditional transport planning resulted in worsening condition of LPT (local public transport) access for the (growing) poorer sections of the population. Over the last two years, the introduction of targeting poverty as an additional element of urban transport policy and planning in the framework of the new poverty alleviation policy the international donor organizations have adopted. However, targeting poverty only remains a partial goal of sustainable urban transport policy and planning, alongside such as economic and operational efficiency and long-term ecological sustainability. Optimizing these targets in a manner that will ensure an overall maximum of benefit has so far not been achieved in most cities of the developing countries. Finding the right LPT mix to optimize the diverging targets for the system, as a whole is the challenge urban transport and traffic planning has to address (GTZ, 2002). Figure 1 shows the urban transport policy spectrum.

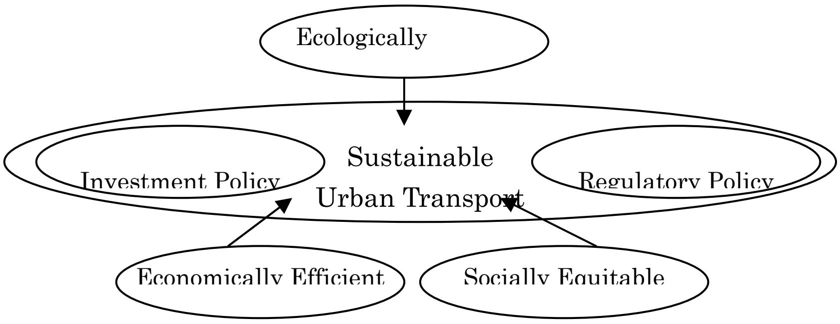


Figure 1. Urban Transport Policy Spectrum (GTZ, 2002)

2.1 Type of Non-Motorized Transport in Bandung

Bicycle is the most efficient of the urban transport modes in both economic terms (maintenance and operating costs) and in engineering terms (on the base of energy inputs/output). Its history of mechanical refinement has led to an enhancement of its efficiency whereby an eightfold increase in the ideal trip length (from 0.4 to 3.3 km) has been achieved. Bicycle basic characteristics are speed limit 15 kph, average speed 6 kph, ideal trip length 3.3 km, and average trip length 2.8 km (Dimitriou, 1995). In many respects, the bicycle shares many of the advantages of walking in that it does not pollute, as a flexible travel mode, and offers healthy exercise to those who choose this means of travel. Despite being of a lightweight and low speed, it can also carry limited personal freight and does not present a significant danger to pedestrians. The bicycle often used for educational trips, particularly in cities containing major tertiary education establishments. This mode of travel, however, shares the negative characteristics associated with walking, namely, it offers no protection against vehicular collision or pollutant emissions from motorized vehicles. Nor does the bicycle readily lend itself to multi-stage journeys, since parking bicycle in public places is not always practical because provision is not always made for this.

The *becak* or pedicab or cycle rickshaw is the public transport equivalent of the bicycle. The operation of this mode indicates that becak relies on an unproductive use of the driver's time rather than any high capital or running cost. In which respect the becak is extremely economical. When alternative employment is however scarce and the opportunity cost of the driver is thereby reduced (which is often the case in Indonesia), the becak is much more competitive and attractive as a mode of public transport. The becak has basic characteristics such as cruising speed or speed limit is 10 kph, average speed 5.3 kph, ideal trip length 1.5 km, and average trip length 2.3 km. The becak has low capital costs and relatively has an informal arrangement in licensing which places it within easy reach of the permanently or temporarily unemployed. The becak can negotiate narrow roads in local communities, and therefore provides services for which there is at present no alternative. These include taking produce to markets, carrying the elderly, transporting small children to school, providing freight and passenger capacity for housewives or going to the market. The becak uses no scarce economic resources, easy maintenance, constitutes an effective means of carrying freight, and provides a flexible/personalized public transport service. Despite these advantages, however, becak has been criticized from time to time, mainly from the point of view that it obstructs traffic. The other aspect, which has been criticized, is that it is degrading to those who operate them by virtue of the vehicle's movement being totally reliant upon human pedal power (Dimitriou, 1995).

The *andong/delman* is one of the many types of horse-drawn carriages which vary in size and which are still in use in several cities in Indonesia. Now, horse drawn carriages are increasingly relegated to rural and peripheral urban areas, but still play a significant role in small cities. In several cities in Indonesia, the bus terminal or *angkutan kota* (paratransit) terminal has a large number of horse drawn carriages operating as taxis, providing feeder services to bus routes or angkutan kota (paratransit) routes. Andong/delman has basic characteristics such as cruising speed/speed limit is 10 kph and ideal trip length is 1.6 km. Andong/delman relatively has a large in size and slow speed. This type of mode is not suitable for negotiating narrow urban community roads, while the obstruction they present to motorized traffic is considerable. It is appropriate in areas with reasonable wide roads and where motorized traffic is still sparse. In general, horse drawn carriages are not a viable mode of transport in an urban setting, other than perhaps in tourist areas along special routes (Dimitriou, 1995).

2.2 Angkutan Kota (Paratransit) Classifications

Angkutan Kota (Angkot) is famous mode of urban transport. Angkutan Kota classified as a paratransit. Almost all cities in Indonesia have this mode with its local name. Angkutan Kota is a public transport for passenger with fixed route, but without fixed schedule. Angkutan Kota operates in one route of route network in a city. Table 1 and 2 explain the position of Angkutan Kota according to right of way (ROW) and type of technology. Angkutan Kota is classified as public transport mode with ROW category-A and included in paratransit class.

Angkutan Kota provides passenger movement in many urban areas in Indonesia. Several advantage possesses by Angkutan Kota compared to others public transport mode are a) the services have high accessibility and mobility, b) operating cost is more beneficial for short trip, c) lane movement is easy and unimpeded, and d) maintenance cost relatively low (DLLAJ, 2001). Angkutan Kota operates in Bandung can be divided in two groups, namely in fixed route and regular (majority) and unfixed route. Angkutan Kota operates in fixed route generally is minibus (small van) with capacity 12 seats. Number of fleet in Bandung is 5.346 vehicles operating in 38 routes (DLLAJ, 2001).

Table 1. Public Transportation Classification by ROW and Technology (LPPM-ITB, 1997)

Right-of-Way	Technology		
	Road Vehicle	Full Guided or Partial with Rubber Tire	Rail Vehicle
A	Ojeg, Becak, Bemo, Bajaj, Angkutan Kota, Metromini, Reguler Bus, and Rapid Bus	Trolley Bus	Tram, Streetcar
B	Bus in bus-lane, Semi rapid bus		Light Rail Transit
C	Bus in busway	Rubber-tired rapid transit Rubber-tired monorail Automated-guided transit	Light Rail Rapid Transit Rail Rapid Transit Regional Rail

Table 2 Public Transportation Classification by Mode (LPPM-ITB, 1997)

Public Transportation Class	Type of Mode
Paratransit	Ojek, Bajaj, Becak, Angkutan Kota, Taxi
Street Transit	Metromini, Reguler Bus, Rapid Bus, Trolleybus, Streetcar, Trem
Semirapid Transit	Light Rail Transit, Semirapid buses
Rapid Transit	Light Rail Rapid Transit, Rubber-tired Monorail, Rubber-tired rapid Transit, Rail Rapid Transit

3. THE CITY OF BANDUNG

The city of Bandung is located in West Java and as the capital city of West Java Province. The city of Bandung is in 1070 East Longitude and 6055’ South Latitude. City of Bandung is on 768 meters above the sea level, the highest point is in North, which is 1,050 meters above the sea level, and the lowest point is in South, which is 675 meters above the sea level. The land level of Southern Bandung City is relatively flat, but the Northern Bandung City is mountainous and has beautiful natural scenery. Bandung has a strategic location considering its communication, economic, and safety aspects. It is due to city of Bandung is located in the road axis between West to East road axis that makes the transportation to Capital City of Indonesia and North to South road axis that make the transportation to plantation areas (Subang and Pangalengan) much easier. In 2000, the population of Bandung City was 2,585,446 people and the area was 167.67 km^2. The population density was 155 inhabitants per one hectare. Foreign people who live in Bandung City were 4,301 inhabitants.

Bandung has several types of public transport services as shown in Table 3. Number of motorcycle is 296.230 vehicles and passenger car is 221.942, which total number of motorize is 518.172. The percentage of motorcycle is 57.17%.

Table 3. Number of Road Public Transport in Bandung

No.	Type of Services	Number of Operator	Number of Vehicle	Number of Route
1	Inter City Inter Province (AKAP)	41	552	174
2	Inter City Intra Province (AKDP)	13	225	25
3	Bus	2	237	13
4	Angkutan Kota (Paratransit)	3	5,436	38
5	Taxi	9	989	-
6	Tourist Car	21	294	-
7	Rent Car	11	230	-
8	Goods Car	288	1,886	-
9	Becak	-	4,845	-

Source: http://www.bandung.go.id/ downloaded in 24/11/04

4. CHARACTERISTICS OF NON-MOTORIZED

The survey to study NMT is conducted using questionnaire. The development of questionnaire needs a precise research problem definition, so building a questionnaire structure is an initiation step before conducting the survey. There are five questionnaires structure, namely for delman driver, delman user, becak user, becak driver, and bicycle user. The questionnaire structure is a representation of object characteristics and factor relationship. The next step is the data collection by distributing questionnaire to user and operator. In this study, the sampling technique used was probability sampling and the method was simple random sampling. Respondent was selected form several place in Bandung, where the NMT's driver usually choose it as a base place, likes market, residential area, terminal, and road intersection. The survey was conducted in several weeks in March up to June 2004. The numbers of respondent collected in this survey are as follow 1) 46 respondents of delman driver, 2) 120 respondents of delman user, 3) 21 respondents of bicycle user, 4) 100 respondents of becak user, and 5) 70 respondents of becak driver.

This questionnaire is used as a data collection tool, so it is needed a test to ensure that the questionnaire is valid and reliable. This questionnaire assessment used two kinds of test, namely validity and reliability test. The assessment of questionnaire validity used construct validity, while questionnaire reliability used internal consistency test.

The whole question in questionnaire is build according to its structure, so the questionnaire has been convergent with the research problem. It means that the questionnaire is a valid measurement to collect data. In this research, the internal consistency was expressed by alpha-cronbach. The questionnaire with a higher alpha-cronbach value means the questionnaire has a higher reliability. The value of alpha-cronbach for each respondent targets are as follow 1) delman driver (0.852), 2) delman user (0.950), 3) bicycle user (0.886), 4) becak driver (0.998), and 5) becak user (0.992). According to the reliability and consistency test, it can be concluded that the questionnaire is valid and reliable.

4.1 Becak Driver Characteristics

According to 70 respondent of cycle rickshaw driver in Bandung, 89% of becak driver has married and 90% has more than two family members. 1.43% of driver is younger than 20 years, 62.86% is 20-50 years old, and 35.7% is older than 50 years. The becak driver has an education up to senior high school, and 85.71% of drivers come from outside of Bandung.

80% of becak driver operates becak with leasing. 87.5% of them must pay Rp. 2,000 up to Rp. 4,000 per day and 12.5% must pay more than Rp. 4,000 per day. The retribution taxation is not applied to all drivers, but only 14.29% of them must pay retribution below Rp. 1,500 per day. The operating cost per day of becak is Rp. 8,000 for 82.86% respondent and only 1.43% respondent spend less than Rp. 4,000 per day. The driver gross income per day is in a range around Rp. 10,000 up to Rp. 25,000, which only 31% of respondent have an income more than Rp. 25,000 per day. The net income per day is between Rp. 5,000 up to more than Rp. 20,000, which only 18.57% of them have an income more than Rp. 20,000.

62.86% becak drivers work seven day per week. 80% of the driver operates between 5 to more than 12 trips per day. There is a variation in travel time, which 37.14% spend less than 15 minutes per trip, 12.86% spend more than 30 minutes per trip, and the rest has variety travel times. 88.57% of the becak driver is still want to be a becak driver, because they have no alternate work. 61.43% of the respondent agrees to use special lane for becak. The becak is used not only for passenger, but for freight too. 88.57% of becak user is a female.

Table 4 explains the operational characteristics of becak. The statistical inference to analyze the difference between 1981 and 2004 data using 0.05 level of significance shows that travel distance in 2004 is not significantly higher than 1981, but longest travel distance and travel speed in 2004 is significantly higher than 1981.

Table 4. The Cycle Rickshaw (Becak) Operational Characteristics in Bandung (Prianto, 2004)

Year	Mean of Distance (km)	Longest Distance (km)	Travel Speed (kph)
1981	1.5	2,3	5,53
2004	1.13	2,46	9,93

4.2 Becak User’s Characteristics

According to the answers from 100 becak’s user, 52% respondent is 19-29 years old and only 4% respondent is older than 50 years old. 36% of becak user has a trip purpose to go to market and 36% respondent uses becak because they have no other vehicle. 55% respondent feels that becak has a low speed. 62% respondent uses becak only once per day.

47% of user respondent pay the tariff between Rp. 3,000 up to Rp. 5,000 per trip. 48% of them have an ability to pay between Rp. 3,000 up to Rp. 5,000 per trip. 54% of them have a willingness to pay between Rp. 3,000 up to Rp. 5,000 per trip.

79% of users never get an accident and 62% of them feel comfort to use becak. 81% of them still want to use becak to fulfill their mobility need and 74% agree if becak use a special lane.

4.3 Delman Driver's and Operational Characteristic

Delman is a horse-drawn vehicle, which used as a mode of transport. Delman has two primary functions in Bandung, which are as a recreational mode and mode of transportation. In many recreational locations in Bandung, delman has a lot of user who likes to try this type of mode, especially children. Delman has another function as a vehicle involved in carnival or other festive. The fact is rather different in residential and market places, where delman has a primary function as a mode transport from market to dwelling area and vice versa. Delman operates as a feeder system in several places. There is no exact data about the number of delman operates in Bandung.

From 46 delman driver (operator), 56.52% driver has an age less than 25 years old. 63.04% of them have married and 41.30% have one up to two family members. 60.87% of respondent has an education below elementary school and no education at all. There is a small number respondent with an education up to Senior High School. 56.52% of respondent has no other job, but 17.39% of them are small entrepreneur and 15.22% of them have other jobs.

45.65% of respondent answer that the delman is their own and 50% of them say that they have only one delman. Figure 2 shows the trip characteristics served by delman driver.

43.48% of delman drivers have an income between 20 to 25 thousand rupiah per day and only 15.22% of them have an income more than 25 thousand rupiah per day. The operating cost per day is less than six thousand rupiah per day, which 52.17% respondent spend less than two thousand rupiah. The financial data related with the operation of delman shown in Figure 3.

4.4 Delman User's Characteristics

From 120 respondents, it appeared that 79.17% delman user is woman with 79.17% respondent has an age between 15 to 25 years. 71.67% of the user is a student. The respondent use delman to reach public transportation terminal from home and vice versa. The reasons why people use delman are because delman is the only alternative in their residential area (41.67%), can be used for passenger and freight (9.17%), available any time (30.83%), and can reach destination on time (18.33%). The majority user (80%) shows the advantage for using delman is cheap. The disadvantages of using delman are slow (61.67%) and uncomfortable (30.83%).

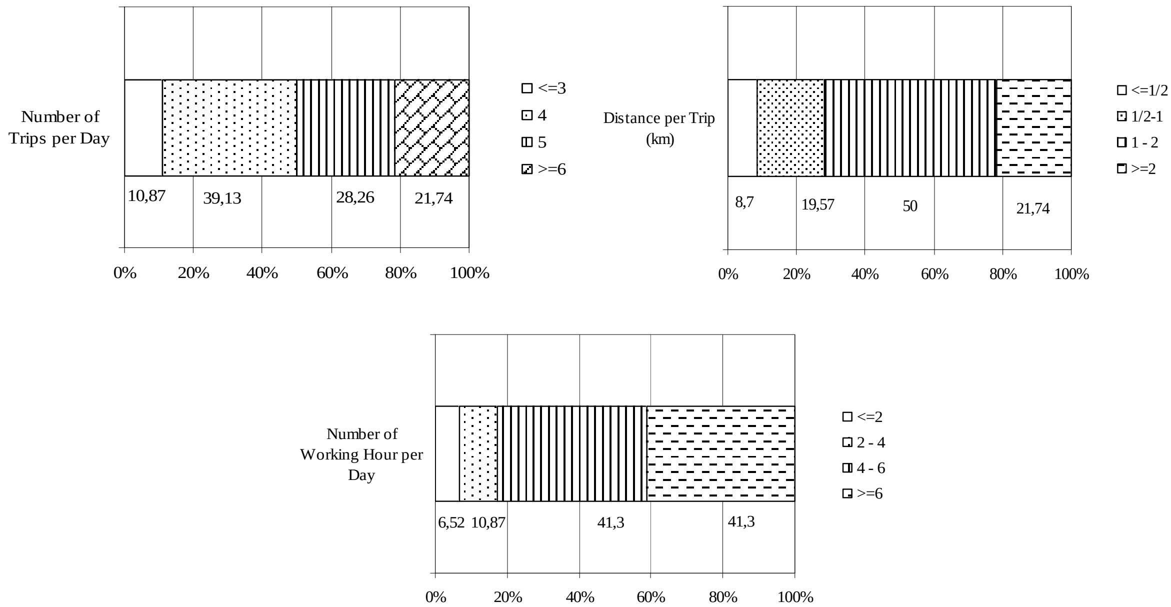


Figure 2. Trips Characteristics by Delman Driver

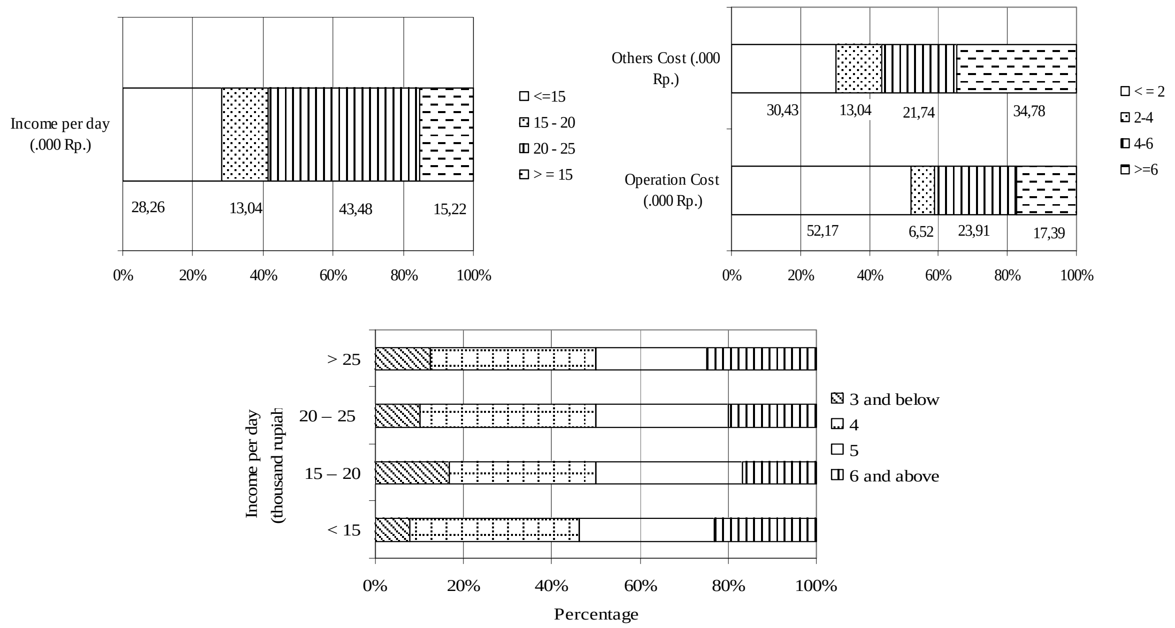


Figure 3. Delman Driver's Financial Data

The delman user uses this kind of NMT mode between one to three times per day, which only 22.50% of respondent use delman more than three times per day. The distance per trips is in range of a half to two kilometers. 33.33% of respondent use delman with travel distance more than two kilometers, 24.17% between one to two kilometers, 31.67% between a half to one kilometer, and 10.83% less than a half kilometers.

The distribution of travel cost using delman is a thousand up to two thousand rupiah (65.83%), two to five thousand rupiah (10%), and less than a thousand rupiah (22.5%). 19.17% of respondent spend less than ten minutes, 39.17% spend 10-15 minutes per trip, 27.5% spend 15-20 minutes, and 14.17% spend more than 20 minutes.

4.3 Characteristics of Bicycle

Bicycle is still has a user in Bandung, although it is not used as much as becak in number. Bicycle is mode of transportation with primarily for recreational and sport function. There is no exact data about the number of bicycle in Bandung, because of no official registration for bicycle.

This research succeeded to collect 21 respondent of user bicycle. 95.24% of bicycle user is male and 66.67% is under 15 years old. The purposes of using bicycle are going to school, doing their works, and sports. 95.24% of bicycle user uses their own bicycle and 66.67% maintains their bicycle once a week. One of the advantages using bicycle is the low cost, and 76.19% of the respondent feel this advantage. 47.62% of users said that bicycling is not comfortable.

52.38% of the respondent used bicycle 2 trip per day and 47.62% used bicycle once a week. The travel distance using bicycle is less than five kilometer per day (42.86%) and 5-10 km (38.10%). 52.38% of the user used bicycle less than one hour per day and 28.57% used bicycle between 1-2 hour per day. 80.95% of the respondent did not receive revenue, because bicycling is used as a domestic using.

5. ANGKUTAN KOTA (PARATRANSIT)

Angkutan Kota in Bandung serves 38 routes, which operates in the whole city, and the fleet size is 5.436 vehicles. As a comparison, Table 5 presents the number of Angkutan Kota in West Java Province from 1994 to 2000. The shortest and the longest route length in Bandung are 12 km and 46 km. Fleet size in each route has a variety from 25 up to 427 vehicles. Figure 4 shows the relationship between number of fleet and route length. Figure 4 also shows a model to estimate number of Angkutan Kota based on route length. Table 6 shows that the model is significance to explain the parabolic relationship. The model shows that there is an optimum number of operated Angkutan Kota and this mode is not suitable for long trip.

Table 5. Number of Angkutan Kota in West Java Provinces (DLLAJ, 2004)

Year	1994	1995	1996	1997	1998	1999	2000
Angkutan Kota	40.548	54.453	54.163	58.206	59.146	52.209	53.739

5.1 Load Factor and Travel Time

The study of load factor and travel time was conducted in one of Angkutan Kota routes available in Bandung, namely St. Hall-Ciumbuleuit (via Cihampelas). This route has 30 vehicles operated in 16 km route. This route line is located in business area including residential area. There is another Angkutan Kota route which operates in several part of this route too, namely friction route. The study was conducted by divide the route in several segments according to the activity in adjacent area of this road where the paratransit operates.

The segmentation of St. Hall-Ciumbuleuit (via Cihampelas) is shown in Table 7.

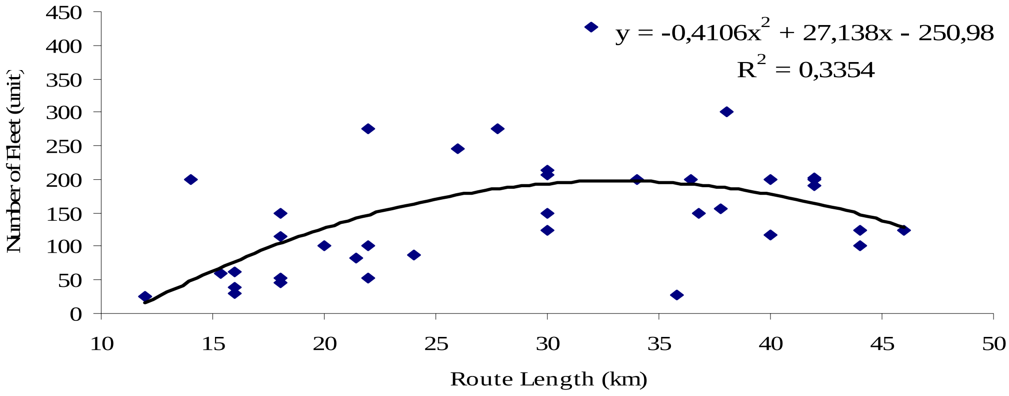


Figure 4. The Relationship between Route Length and Number of Fleet

Table 6. The Model Analysis between Route Length and Number of Fleet

SOURCE	DF	SS	MS	F	P
Regression	2	100761	50380.3	8.83328	7.84E-04
Error	35	199621	5703.5		
Total	37	300382			

Table 7. Segmentation of Angkutan Kota St. Hall – Ciumbuleuit (via Cihampelas) Route

No.	Segment	Land Use	Segment Length (m)
1	M. Salamun Hospital – Jl. Bukit Indah	Residential	1,240
2	Jl. Bukit Indah – Puri Elena	Commercial & Education	210
3	Puri Elena – Gandok	Commercial	915
4	Gandok – Sultan Plaza	Commercial	360
5	Sultan Plaza – Jl. Kapt. Abdul Rivai	Commercial & Education	2,280
6	Jl. Kapt. A. Rivai – Jl. Pasirkaliki	Commercial	865
7	Jl. Pasirkaliki – Jl. Kebonjati	Commercial & Office	1,220
8	Jl. Kebonjati – St. Hall	Commercial	500
9	St. Hall – Cicendo	Commercial, Terminal, & Station	1,430
10	Jl. Cicendo – Jl. Kapt. A. Rivai	Residential & Education	1,000
11	Jl. Kapt. A. Rivai – Jl. Eyckman	Residential	1,340
12	Jl. Eyckman – Gandok	Commercial & Office	2,230
13	Gandok – Jl. Bukit Jarian	Commercial	760
14	Jl. Bukit Jarian – Jl. Bukit Indah	Commercial & Education	410
15	Jl. Bukit Indah – M. Salamun Hospital	Commercial	1,240

The load factor value is a measurement to show the productivity of the transportation sevices. Load factor can be obtained by conducting access-egress passenger survey. The survey was done by count the number of passenger access and number of passenger egress. The number of passenger stay on board in one segment than divided by number of seat, in this case there is

12 passenger seats. The condition of load factor in St. Hall-Ciumbuleuit (via Cihampelas) routes for each segment appears in Figure 5. The minimum load factor is 29.17% (in afternoon trip) and the maximum load factor is 82.34% (in noon trip). The figure shows that there are several segments, which always have high load factor in whole day. The figure also shows the different of load factor among morning, noon, and afternoon. The result of Two-way ANOVA shows that there is significant different among morning, noon, and afternoon load factor (p-value= 1.44×10^{-6}), and there is significant different among segment (p-value = 0.000336).

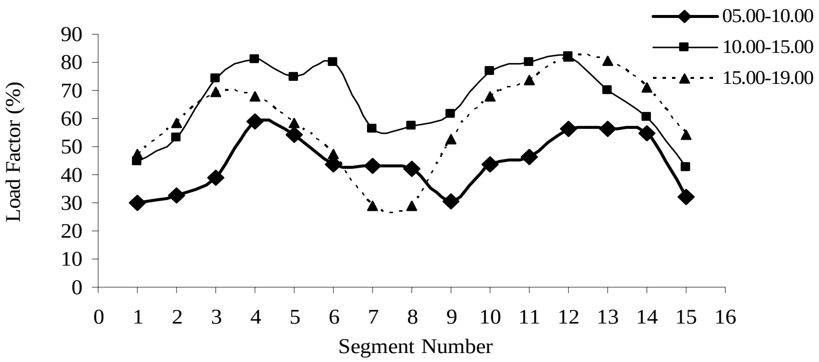
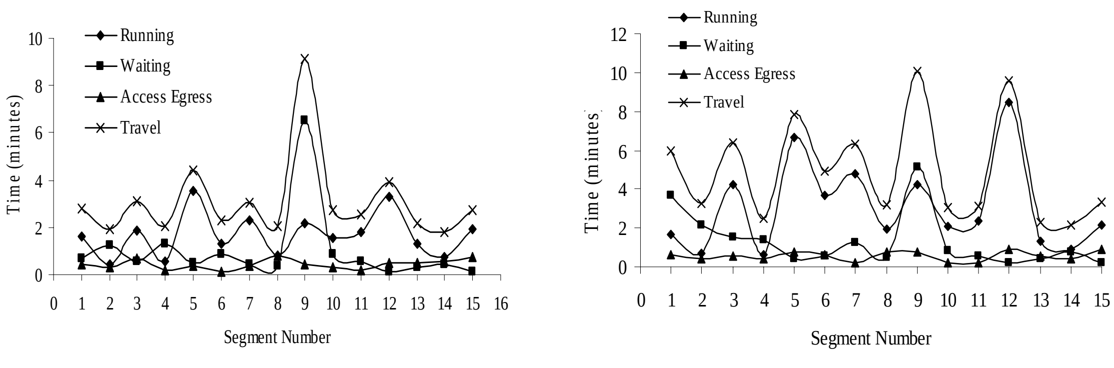


Figure 5. Load Factor Angkutan Kota in St. Hall – Ciumbuleuit (via Cihampelas) Route

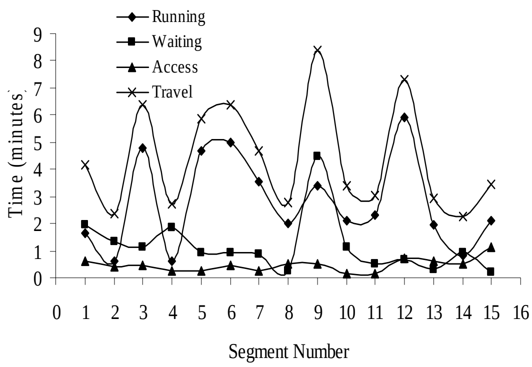
Travel time in St. Hall-Ciumbuleuit (via Cihampelas) route is presented in Figure 6 a, b, and c for morning, noon, and afternoon, respectively. In those figure, the travel time is shown as a summation of running time, waiting time, including access and egress time. According to ANOVA result, it is shown that there is significant difference of travel time among segment (p-value= 9.78×10^{-9}), including among times (p-value=7.05×10^{-5}). Figure 7 shows the relation between travel time and load factor for each segment. Table 8 presents a model to predict load factor using running, waiting, and access-egress time including the operation period. This model shows that load factor will increase when running time is higher, which means less congestion. The load factor will reduce when waiting and access-egress time increase.



a) Morning Travel Time

b) Noon Travel Time

Figure 6. Travel Time of Angkutan Kota in St. Hall-Ciumbuleuit (via Cihampelas) Route



c) Afternoon Travel Time

Figure 6. Travel Time of Angkutan Kota in St. Hall-Ciumbuleuit (via Cihampelas) Route (continued)

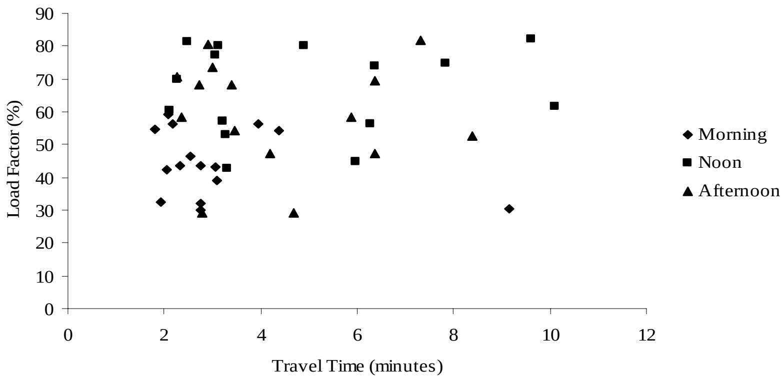


Figure 7. Relationship between Load Factor and Travel Time

Table 8. Model to Predict Load Factor (LF) for Angkutan Kota St. Hall-Ciumbuleuit (via Cihampelas)

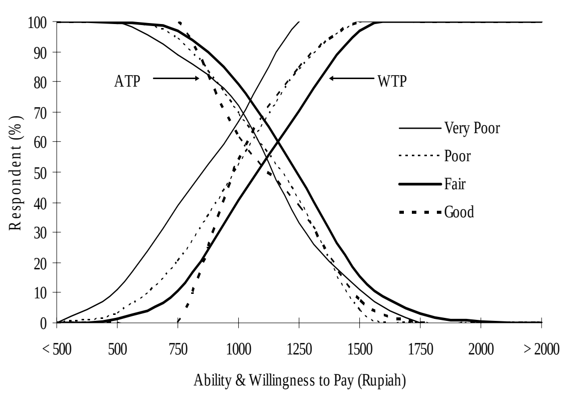
Predictor	Coef.	St. Dev	T	P
Constant	62.686	6.288	9.97	0.000
Running Time (RT)	1.581	1.207	1.31	0.198
Waiting Time (WT)	-2.696	1.507	-1.79	0.081
Access Egress Time (AET)	-9.913	8.918	-1.11	0.273
Dummy Morning (M); 1=morning, else=0	-14.093	4.991	-2.82	0.007
Dummy Noon (N); 1=noon, else=0	7.978	4.890	1.63	0.111
S = 13.18 R-Sq = 41.4% R-Sq(adj) = 33.9%				

5.2 Ability and Willingness to Pay

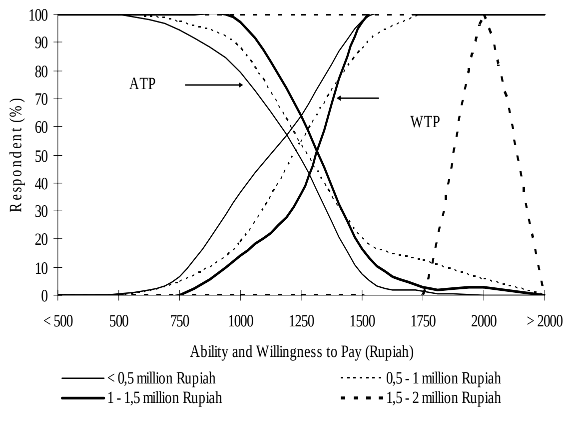
The study of paratransit has close relationship with financial aspect of the user. One important financial aspect from the user is ability to pay (ATP) and willingness to pay (WTP). This term expresses the ability of user to pay the transportation services, and their willingness regarding the utility of the transportation services they received. ATP and WTP is an important element in determining public transportation tariff. Angkutan Kota tariff can be determined more fairly and the decision maker will realize how many users will receive benefit and how many users cannot afford the transportation services, when the new tariff policy is determined. This study is conducted using questionnaire to 345 respondents in Kebon Kelapa-Ledeng route. This questionnaire has been tested its validity and its reliability. The alpha-cronbach value for this questionnaire is 0.886. The characteristics of respondent are 56.5% of respondent is male and 78.8% is single. 64.9% of respondent is 15-25 years old, with 46.1% has an education Senior High School and 40.3% hold bachelor degree. 67.2% of respondent is a university student and 43.8% of respondent has no private automobile. The trip characteristics in this routes are 63.2% of respondent has two of trip per day and 58.6% respondent has a trip purpose is education. The reason of using this mode is no private automobile (41.7%), faster (19.1%), cheaper than private automobile (22%), and others (17.1%). 48.1% respondent has a trip length less than 5 km, 18.3% between 5-10 km, 22.9% between 10-20 km, and 10.7% more than 20 km (Hadi, 2004).

Figure 8 a, b, c, and d shows the ATP and WTP of the respondent according to their perception about service quality, user expenses, trip purpose, and fare perception, respectively. The figure is a cumulative percentage of respondents, which ATP and WTP curve will cross in one point. The ATP curve show the percentage of respondent who has an ability to pay more than the price/cost stated, while WTP curve shows the percentage of respondent who has a willingness top pay less than a stated price/cost. According to service quality, there are four categories of existing quality, namely very poor, poor, fair, and good. For each quality category, it can be found one intersecting value, likes Rp.1,200,- for respondent who feels the existing quality of service is fair and Rp. 1,000,- for poor category.

The user expenses per month can be divided in four categories, namely 0.5 million rupiah and below, 0.5 up to 1 million rupiah, 1 up to 1,5 million rupiah, and 1.5 up to 2 million rupiah. For 0.5 million rupiah and below category, the intersecting value is Rp. 1,200,- The trip purposes using Angkutan Kota can be categorized in four groups, namely education, shopping, working, and business. The fare perception can be categorized in three groups, namely too cheap, fair, and too expensive.

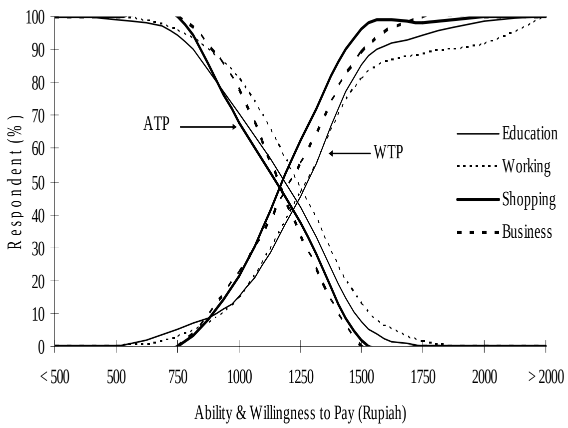


a) According to Service Quality

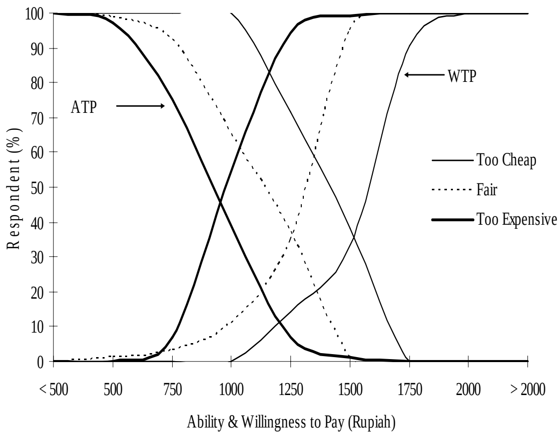


b) According to User Expenses

Figure 8. Ability to Pay and Willingness to Pay of Angkutan Kota User



c) According to Trip Purposes



d) According to Fare Perception

Figure 8. Ability to Pay and Willingness to Pay of Angkutan Kota User (continued)

6. CONCLUSIONS

The analysis of NMT and paratransit characteristics in Bandung has been conducted. The study is conducted using survey, which the questionnaire has been tested according to validity and reliability. Operational, financial, perception, and users' ability and willingness to pay data were collected using survey.

Analysis shows that there is significance difference in becak operational characteristics between 1984 and 2001. The survey result shows that NMT provides mobility for women, student, low-income user, and job opportunity for people with limited skill and education, including exercise. Survey shows that NMT still accepted by community.

Angkutan Kota (paratransit) is 61.24% of total public transportation in Bandung. The minimum load factor is 29.17% (in afternoon trip) and the maximum load factor is 82.34% (in noon or mid-day trip). Analysis shows that there are several segments, which always have high load factor in whole day. The analysis result shows that there is significance different among morning, noon, and afternoon load factor (p-value= 1.44×10^{-6}), and there is significant different among route segment (p-value = 0.000336). The travel time is shown as a summation of running time, waiting time, including access and egress time. According to ANOVA result, it is shown that there is significant difference of travel time among route segment (p-value= 9.78×10^{-9}), including among times (p-value=7.05×10^{-5}).

70.7% user in Kebon Kelapa-Ledeng route felt service quality is good enough and 53% user agreed the tariff is suitable with the service quality. User ability and willingness to pay reflects user perception about service quality, trip purpose, user expenses, and fare. The ATP curve shows the percentage of respondent who has an ability to pay more than the stated price, while WTP curve shows the percentage of respondent who has a willingness top pay less than a stated price. For each perception aspect, it can be found one intersecting value of ATP and WTP. The tariff determination should be in range of those values.

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