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The Willingness to Walk of Urban Transportation Passengers (A Case Study of Urban Transportation Passengers in Yogyakarta Indonesia)

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Abstract. A measure of the quality of urban transport services is divided into two main categories, namely: quantitative and qualitative measures. Quantitative aspects can be measured from services judged by numbers. On the other hand, qualitative aspect is the assessment of the aspects of services that cannot be expressed in figures of the size value. This paper discusses one of several ways to determine a benchmark assessment scale quantitatively of the willingness of passengers of the urban transportation in the city of Yogyakarta Indonesia using a questionnaire based on the values of an existing benchmark. The study shows that the results of quantitative performance rating scale for urban transportation can be the benchmark to assess the condition of the urban transportation in other cities along with the scale and the conditions which are considered similar.

1. Introduction

The willingness to walk for urban public transport passengers is a measure of the quality of urban transport services which is measured quantitatively in which the aspects of the services are assessed with a numeric measure. On the other hand, qualitative assessment measures difficult aspects of services that cannot be expressed in value size figures.

The willpower is the desire of passengers to walk in the walking distance from the origin to the place or stop to get the nearest transit stops and the walking distance from the end towards the goal. The willingness to walk is influenced by a lot of things, especially environmental problems. Habits of the local community influence people in doing their activities. Problems of self-esteem and prestige are also possible because there are some sorts of assumptions that walking or using public transport is seen as part of a community with a low level of social status. Environmental climatic conditions also give a certain comfort level for pedestrians in tropical countries like Indonesia as they can also be problems affecting the habits of people to walk. The problems of walking comfort is also influenced by the condition of the solar heat received by pedestrians so that greening will provide shade effects which protect pedestrians conveniently from the sun.

How much is the desire of Indonesian people in their daily activities to walk to where they get transportation? The desire for people to walk has a reference or standard quantitative assessment of the quality of existing legislation if this conditions is applied may not be appropriate for Indonesian situation. Therefore, it is of interest to address a fundamental question: how to assess a user's desire of urban transport quantitatively that could be used as a benchmark in assessing the quality of services?

This paper discusses a possible way to determine quantitative grading scale benchmark willingness to walk of the urban passenger transport in the city of Yogyakarta Indonesia using a questionnaire for urban transport in Yogyakarta Indonesia.

2. Literature Review

2.1 Transit Capacity and Quality of Service Manual

The quality of urban transport services is measured in a continuous management process from planning, implementation and evaluation. These include infrastructure and facilities in the operation of the urban transport. The planning application process involves people such as assessors who experience the quality of urban bus services, namely passengers / consumer direct urban bus, urban bus operators who operate, regulators who determine policy on urban bus operation and also external parties who are directly involved in the operation of urban bus as other traffic users [1]. In general, every person wants to walk which is not far from the stopping place. Based on the density of activities, then the stopping distances are presented in Table 1.

Table 1. Standard distance stopping place

Zone	Land Use	Location	The Stop Location Distance (m)
1	very dense activity centers: markets, shops	CBD, City	200 -- 300 *)
2	Dense environment : offices, schools, public services	City	300 -- 400
3	Habitation	City	300 -- 400
4	Mixed dense environment : housing, schools, public services	outskirts	300 -- 500
5	Mixed rare : housing, land, rice field, Vacant land	outskirts	500 -- 1000

Remarks: *) = distance of 200m is used only when strictly necessary, while the typical range of 300 m.

Walking distance is related to the density of urban transportation route. Where the density trajectory should be structured in such a way in order to reach all areas of the city that require transportation services. Affordable in terms of understanding that the service can be reached by walking up to 400 m by 70-75 population living area together with a solid or walking for 5-6 minutes. Thus, the distance between the parallel maximum service ranges between 1600 m, meanwhile the suburban maximum distance 1600 m can be reached by 50-60 people.

In Service Manual [2], the results of several studies in cities in North America are shown in Fig 1. Although there are several variations between cities and between income groups in the study, it can be seen that the majority of passengers (75 to 80 on average) walk a quarter mile (400 meters) or less to the bus stop. At an average walking speed of 3 mph (5 km / h), this is equivalent to a maximum of 5 minutes running time.

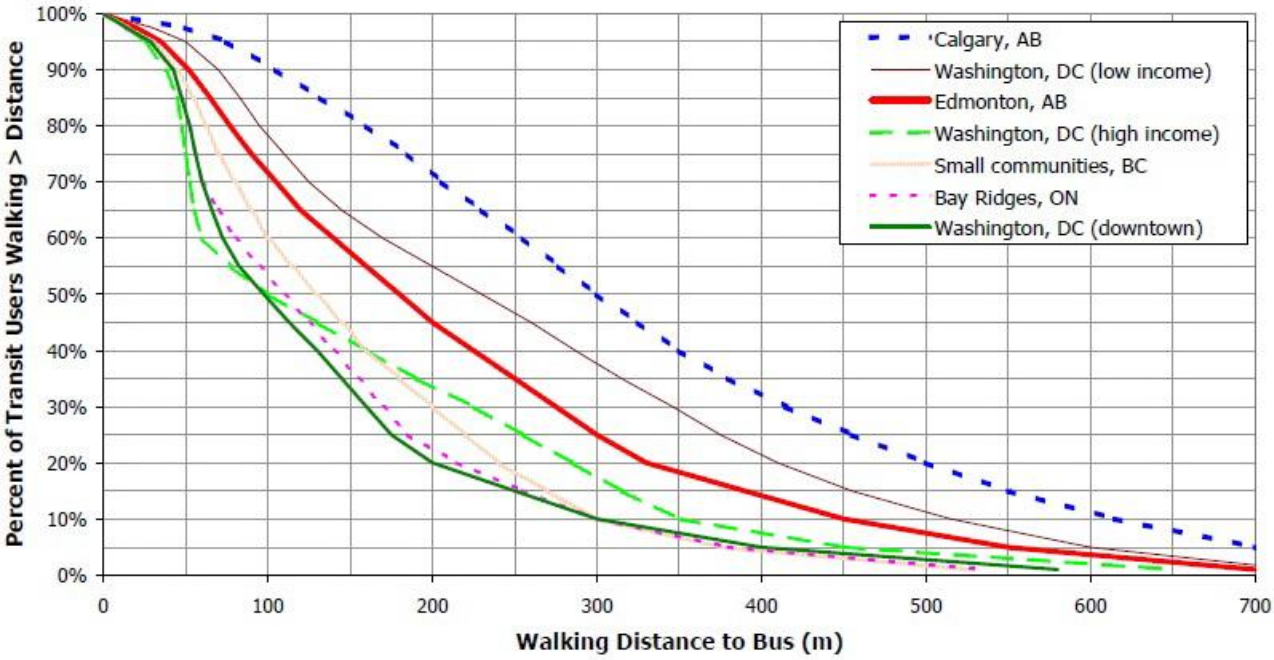

Fig. 1. Walking distance to the bus stop
Source: Transit Capacity and Quality of Service Manual, 2nd Edition (2003)

2.2 World Bank

World Bank [3] proposes issues of service standards for urban transport which are divided into two terms, namely: indicators of quality of service and operating performance indicators. The willingness to walk in service quality indicators is presented in Table 2. Indicators of the quality of service of the World Bank in Table 2 presents quantitative thresholds regarding accessibility and reliability / accuracy that must be fulfilled, but in this case it does not expressly distinguish the condition of the city that serves. Condition or classification scale is essential due to different characteristics between the city conditions. Besides that, it does not provide levels of services, but it only gives maximum and average course.

2.3 Public Transport Service Standard in Indonesia

Public Transport Service Standard in Indonesia based on decision of the Director General of Land Transportation Number: SK. 687/AJ.206/DRJD/2002 on Technical Guidelines for the Implementation of Public Transport Urban region and Regular Fixed Route [4]. In operating public passenger transport vehicles, operators must meet two minimum conditions of services, namely: a general requirement and a specific prerequisites. In general, the prerequisite walking distances are listed as follows:

Distance to reach the stop
in downtown 300 - 500 m;
for suburban 500 - 1000 m.

Table 2. Quality of Service Indicators

Indicators	Explanation		Standards of Service
Waiting time	Passengers waiting time at bus stops	average (minute)	5 – 10
		maximum (minute)	10 – 20
Walking distance to bus stop		dense urban areas	300 – 500 m
		low-density urban areas	500 – 1.000 m
Interchanges between Routes and Services	The number of times a passenger has to change buses or other modes on a journey to or from work	average	0 – 1
		maximum (less than 10% of commuters)	2
Journey times	Hours traveling each day to and from work	average	1,0 – 1,5
		maximum	2 – 3
	Journey speeds of buses	dense areas in mixed traffic	10 – 12 km/hour
		Bus-only lanes	15 – 18 km/hour
		low-density areas	25 km/hour
Travel Expenditure	household expenditures on travel as a percentage of household income		10

Sources : World Bank, 1987, Bus Services : Reducing Costs and Raising Standards

3. Determination Concept Standard

In principle, the benchmark should be easy to understand and can be implemented. Performance benchmarks in urban public transport services in this paper basically developed from two things, namely: (1) the assessment of the results of the analysis based on passengers, guidelines, and rules and (2) related literature. In the service of choice in this case, the desire of quantitative walk urban public transport of passengers is expected to provide a benchmark options as desired.

Benchmark is based on the desire of passengers who describes the polygon probability density function and cumulative density function into a revamp, where earlier in the quantitative analysis of service options normality testing process is done first so that the data can be analyzed using parametric statistics that can be described by the probability density function (PDF) polygon and then converted into cumulative density function (CDF) as illustrated in Fig 2. According to [5], in transportation planning, the trip distribution model can be called maximizing entropy or maximizing the probability that the final part of the equation includes a negative exponential function (or variance) which has a maximum value of 1 probability theory for finite sample space establishing a set of numbers called weights and valued from 0 to 1 so that the probability of occurrence of an event can be calculated. Each point on the sample space is associated with weights so that the sum of all weights is equal to 1 [6].

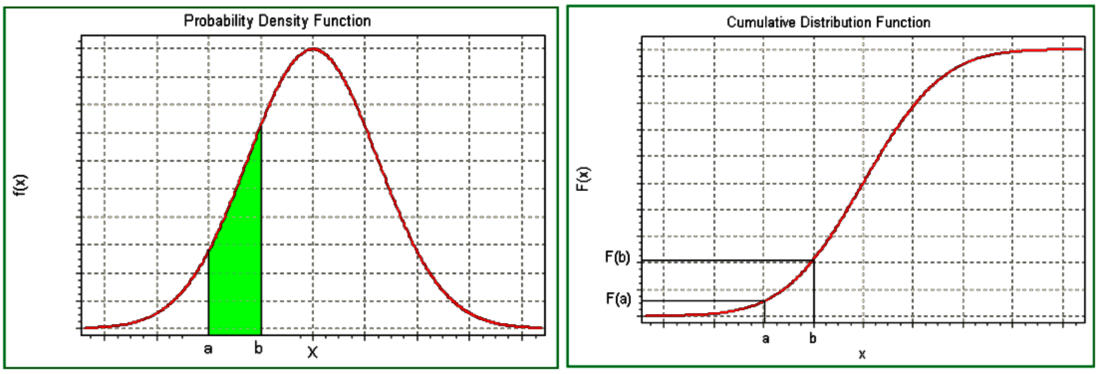

Fig. 2. The changing of polygon probability density function to cumulative density function

Harkey [7] presents how to determine the LOS (Level of Service) for the convenience of cycling based on the value of the comfort level by dividing the percentile level corresponding to the level of service desired amount. Minnesota Department of Transportation [8], the estimated demand public transport will use the percentile charts of cumulative density function.

4. Quantitative Determination of the Amount in Willingness to Walk

Based on the results of the research, the percentages of walking option distance urban transport users in Yogyakarta Indonesia to walk are presented in Table 3. Then, the Function Probability Density Function (PDF) and Cumulative Density Function (CDF) are depicted in Fig 3. Because the data come from populations with a normally distributed, then by using descriptive statistics it can be calculated the quartile values. To illustrate the quartile values, it is obtained smooth function graph Cumulative Density Function. The quartile values entered in a drawing graph are presented in Fig 4. Thus, the scale walking distance service assessment can be made as shown in Table 4.

Table 3. The Percentage of walking option distance

Walking distance (meter)	Regular Transport			Trans Jogja Transport		
	Responden option	Probability Density Function (PDF)	Cumulative Density Function (CDF)	Responden Option	Probability Density Function (PDF)	Cumulative Density Function (CDF)
150	387	0.7663	1.0000	340	0.7069	1.0000
450	101	0.2000	0.2337	110	0.2287	0.2931
750	14	0.0277	0.0337	21	0.0437	0.0644
1050	1	0.0020	0.0060	7	0.0146	0.0208
1350	2	0.0040	0.0040	3	0.0062	0.0062

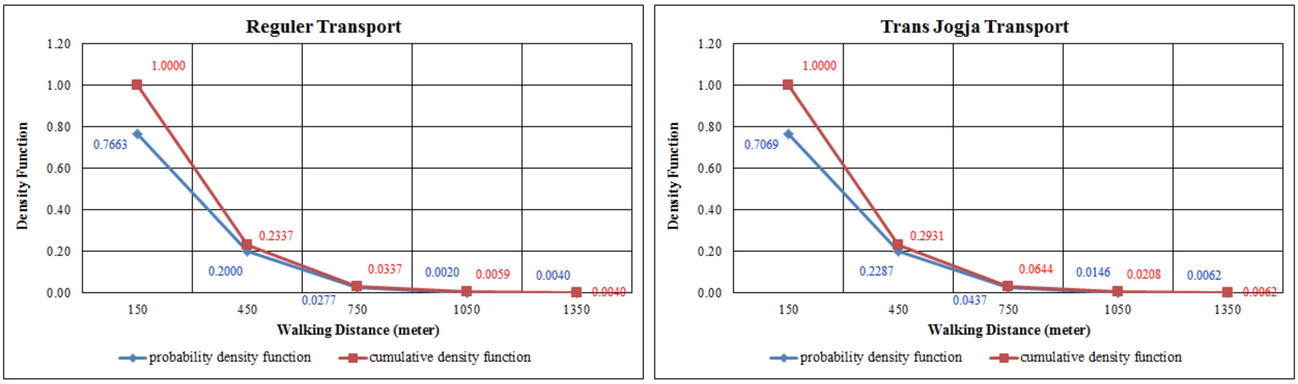

Fig. 3. The probability density function of walking distance graphic

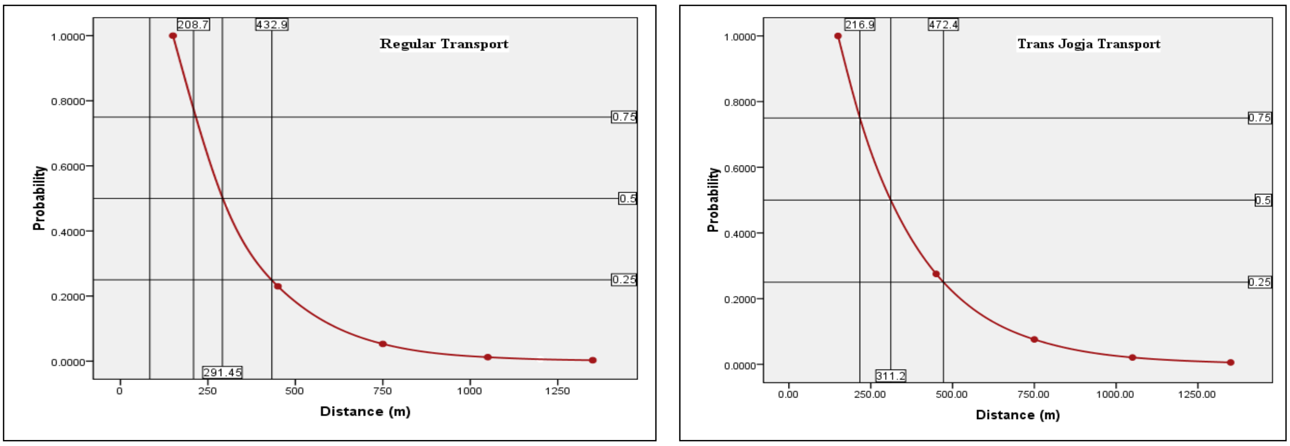

Fig. 4. The Probability walking distance graphic

Table 4. The Standardized benchmarks walking distance

Indicator	**The Standardized benchmarks**	
	Regular Transport	**Trans Jogja Transport**
Walking Distance	A. < 208,70 m	A. < 216,90 m
	B. 208,70 – 291,45 m	B. 216,90 – 311,20 m
	C. 291,45 – 432,90 m	C. 311,20 – 472,40 m
	D. > 432,90 m	D. > 472,40 m

It can be seen that that the value of the benchmark results between regular freight and transport modified BRT is not so much different. Therefore, it can be said that the desire of passengers to walk based on the quantitative results measured, basically the users want as close as possible without considering the type of urban public transport services.

Compared with the Transportation Research Board and World Bank [2, 3], passengers' desire is excessive given the circumstances, including the city of Yogyakarta with the level of medium density. Based on all the above references, the desire limits the maximum passengers' walking distance as it is still below 500 meters.

Additionally, the standard benchmarks for systems of regular and Trans Jogja is not much different. The modifications in a diagram considering the results of both systems are shown in Fig 5. The standard benchmark results for both systems are shown in Table 5.

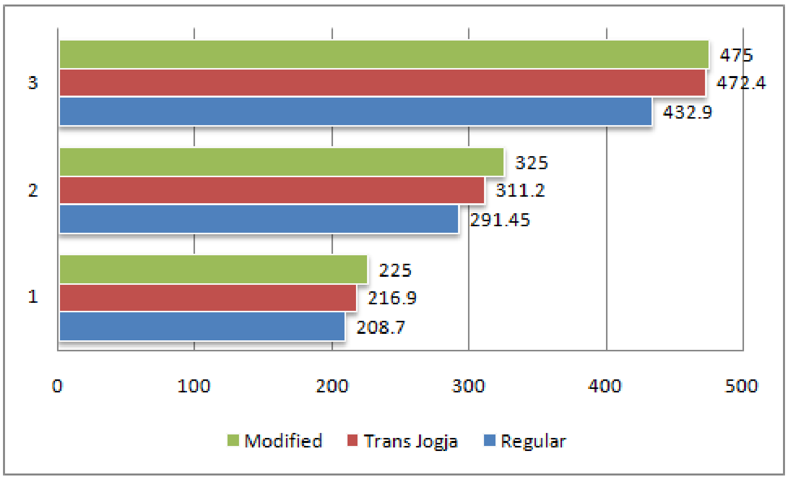

Fig. 5. The Diagram of modified standard setting limits in walking distance

Table 5. Standardized benchmarks walking distance modification

Indicator	Standardized Benchmarks (Modification)
Walking Distance	A. < 225 meter
	B. 225 – 325 meter
	C. 325 – 475 meter
	D. > 475meter

The standardized benchmarks walking distance selected in this study, the choice of the highest level is < 225 meters. The willingness of people to walk depends on the habits and environmental conditions. There is no standard in the world that classifies. It is also in line with the quote [9], that the maximum distance that people will walk towards transit varies depending on the situation.

5. Conclusions

The willingness to walk in Yogyakarta Indonesia of the urban transportation passengers is less than 225 meters. It is very different from the requirements in the existing regulations. It depends on the habits and environmental conditions. The scale of the quantitative performance of the urban transport can be made as a benchmark for assessing a condition of urban areas transportation in other cities and the conditions of the city. There should be more specific issues related to the conditions of the city where the study is done.

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