Chapter 6 CBD Trip Generation Survey

6.1 Scope of Work

The CBD trip generation survey shall be carried out to (a) obtain the trip generation rate by type of building, (b) accumulate the total floor area by type of use in the survey area, and (c) estimate the number of trips in the survey area.

6.1.1 Survey Area

The survey is administered within the CBD of Dar Es Salaam, as identified in Figure 6.1.1.

Source: JICA Study Team

Figure 6.1.1 Survey Area

6.1.2 Survey Days

- Land use Inventory : at any time.
- Special generator attributes: at any time.

- Person counts: continuous counts, inbound and outbound direction, over a 14 hour weekday period (0600-2000). The counts may be executed on any weekday from Monday to Thursday. Public holidays must be excluded from the survey.
- Person interviews: Concurrent with person counts. Twenty percent sample must be maintained for consistency across all building entrance points (doors).

6.1.3 Survey Contents

The Traffic Generation Survey consists of several elements:

- Land use Inventory

  Information of land use (all buildings) in the survey area and associated attributes including area of plot, the number of stories, gross floor area, and the number of parking lots shall be collected from Ilala municipality and through the field survey. The information shall be mapped using GIS. The base GIS (Arc/View format) shall be provided by the Study Team.

- Special generator attributes

  A total of 50 buildings shall be selected within the Study Area based on the findings of the land use survey. These building should intuitively be recognized as being major activity generators in the CBD. Types of building uses should include: 1) Government (public sector) office building, 2) Private sector office building (including mixed tenants), 3) Commercial building (shopping center, restaurant, etc), 4) Residential building (apartment), 5) Mixed use building (mix of residential, office and/or commercial uses), and 6) Hotel. Special uses such as mosques and churches shall be excluded.

  Detailed information is needed for each of the selected facilities to include the number of employees in the entire building and facility attributes (number of storey's, gross floor area, net leasable area, number of apartments, number of hotel rooms). The surveyors shall report all problems and difficulties encountered during the course of the survey to the Study Team.

- Person count

  A person (workers, visitors) count survey shall be carried out to continuously record the number of persons entering and leaving each of the selected high generator buildings. This will necessitate monitoring all ingress/egress points (doors) at each building.

- Person interview

  Concurrent with the person counts, interviews will be conducted with approximately 20 percent of persons entering the building.

6.1.4 Survey Method

The detailed survey method will be determined after the discussion with the Study Team. However, following guidelines generally apply.

- Land Use Inventory

  Survey can proceed at any opportune time. The subdivision of the Study Area into grids of responsibility is suggested, with surveyors using a "check off" system as they proceed with the recording of information by field observation and/or transcribing information from public records. The task can be facilitated via information available from municipal authorities, governmental records or, in some cases, discussions with owners of buildings.

- Special Generator Attributes

  Survey can proceed at any opportune time, likely over a similar time frame as the land use inventory. A "rolling list" of high generator candidates can progressively be prepared. The indicated total of less than 50 buildings is a preliminary estimate to be reviewed as findings of the land use inventory begin to emerge. The total sample could be less, but not more, than 50 buildings. Once established, it is recommended that contact be initiated with owners/managers of individual buildings to obtain details as to generator attributes. In some cases walk-through inspections, or governmental records, may facilitate this effort.

- Person Counts

  Surveyors count all entering and departing persons at each external ingress/egress point (door) of the survey building. Information is recorded on appropriate forms. Care is required to ensure that all doors are monitored, as external ingress/egress may be possible at various levels of the building, particularly if the building features on-site parking facilities or a multi-level design. In some buildings, security procedures may be in place and thus likely to simplify the counting process considerably if all persons, employees and visitors alike, are channeled via defined security gates.

  Permission for conduct of person counts must be obtained from building owners/managers.

  This survey is continuous counts, inbound and outbound direction, over a 14 hour weekday period (0600-2000). 100 percent sample.

- Person Interviews

  The survey group led by the supervisor sets up the interview area at external ingress/egress points to coincide with the person count locations. The interviews will be conducted with entering (inbound direction) persons only. Supervisor or team leader selects sampled persons at random for interviewing. Surveyors conduct the interview and fill in the interview form.

  Permission for conduct of interviews must be obtained from building owners/managers.

  Twenty percent sample of persons entering building is objective of this survey. Sample rate must be maintained across all building entrance points (doors).

  The person interviews require the collection for information on:

- Status (employee / visitor / student),

- Access mode (transport to the building),
- Trip purpose (purpose of visit),
- Origin (inside or outside of City Center), and
- Survey Time.

6.2 Survey Performance

6.2.1 Land Use Inventory

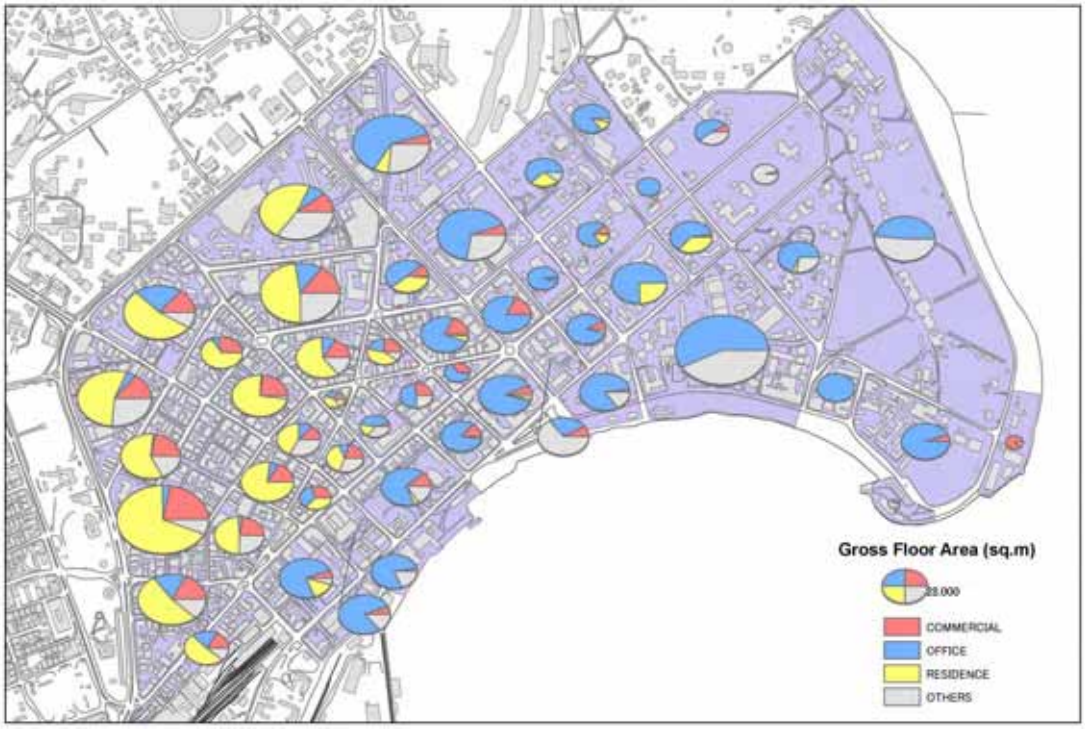
Total number of buildings in the survey area has reached almost 1,900 buildings and gross total floor area is estimated at 1,725 thousands square meters. Almost three-fourth of the gross floor area in the survey area is occupied by office use (42%) and residential use (29%). The share of commercial use such as shops, market and restaurant is only 11% of total floor area.

Table 6.2.1 Share of Gross Floor Area in the Survey Area as of July 2007

	Gross Floor Area ('000 sq.m)	Share (%) in GFA
Office	720	42
Commercial	192	11
Residence	495	29
Hotel	71	4
Hospital	10	1
School	21	1
Others	216	12
Total	1,725	100

Note1: excluding under construction building
Note2: Others includes religion, transport facilities, parking, vacant building.
Source: JICA Study Team

As shown in Figure 6.2.1, low-rise old buildings, which are mainly occupied by residence and small shops concentrates in the western part of city center. On the other hands, the eastern part is a principal business district in the Dar es Salaam and is dominated by many government offices.

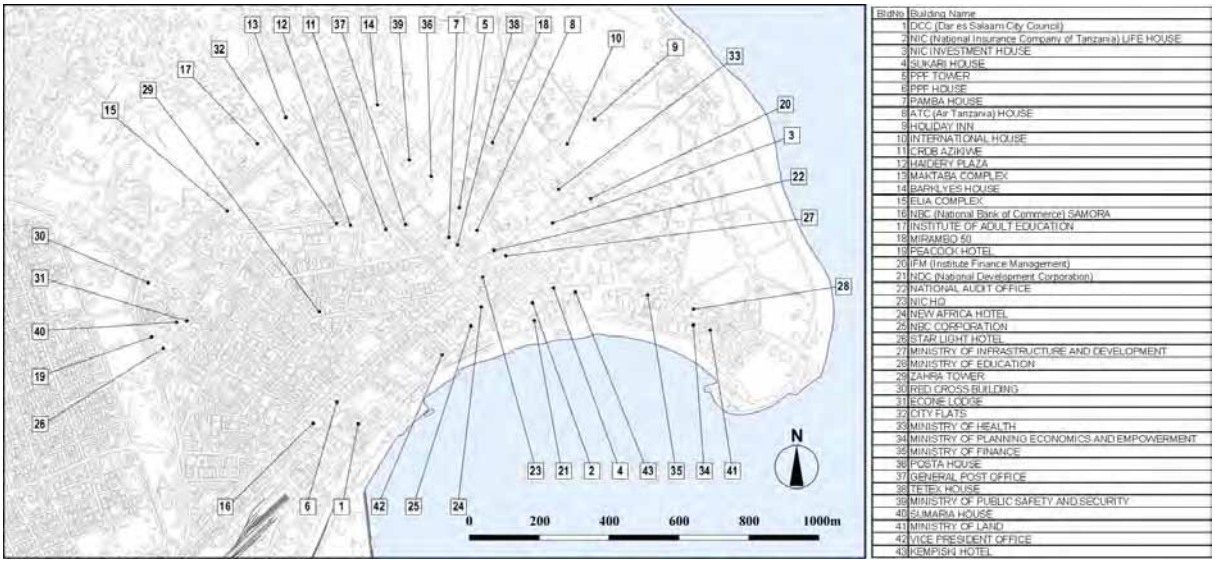


Note: excluding under construction buildings and vacant land
Source: JICA Study Team

Figure 6.2.1 Share of Gross Floor Area by Type of Use

6.2.2 Special Generator Attributes

Based on the land use inventory survey, following 43 buildings in the city center and its surrounding area were selected as target buildings to obtain more detailed generator attributes. The target buildings consist of 12 government office, 10 private office, 13 mixed (government and private office) use, 3 residential buildings, 5 hotels and one commercial use.



Source: JICA Study Team

Figure 6.2.2 Location of Target Buildings

6.2.3 Person Counts

Table 6.2.2 shows the total number of person entering / exiting by each building a day. The largest trip generators include PPF tower, General post office and Institute of Finance Management. At these three buildings, the number of entering or exiting exceeds more than five thousands a day.

Table 6.2.2 Total Number of Person Count

BldNo	Building Name	Type	In	Out
1	DCC (Dar es Salaam City Council)	GOVT	1,332	1,186
2	NIC (National Insurance Company of Tanzania) LIFE HOUSE	PRIVATE	3,657	3,623
3	NIC INVESTMENT HOUSE	MIX	3,003	2,855
4	SUKARI HOUSE	MIX	2,767	2,749
5	PPF TOWER	MIX	5,997	5,708
6	PPF HOUSE	MIX	2,308	2,260
7	PAMBA HOUSE	MIX	3,624	3,183
8	ATC (Air Tanzania) HOUSE	MIX	662	534
9	HOLIDAY INN	HOTEL	1,040	952
10	INTERNATIONAL HOUSE	PRIVATE	3,175	3,032
11	CRDB AZIKIWE	MIX	4,756	4,730
12	HAIDERY PLAZA	PRIVATE	3,590	3,495
13	MAKTABA COMPLEX	MIX	3,553	3,493
14	BARKLYES HOUSE	MIX	4,251	3,802
15	ELIA COMPLEX	PRIVATE	883	981
16	NBC (National Bank of Commerce) SAMORA	PRIVATE	1,720	1,762
17	INSTITUTE OF ADULT EDUCATION	GOVT	730	736
18	MIRAMBO 50	PRIVATE	833	620
19	PEACOCK HOTEL	HOTEL	937	906
20	IFM (Institute Finance Management)	GOVT	5,933	5,491
21	NDC (National Development Corporation)	MIX	1,197	1,114
22	NATIONAL AUDIT OFFICE	MIX	1,113	986
23	NIC HQ	PRIVATE	1,324	1,285
24	NEW AFRICA HOTEL	HOTEL	947	925
25	NBC CORPORATION	PRIVATE	3,697	3,508
26	STAR LIGHT HOTEL	HOTEL	189	217
27	MINISTRY OF INFRASTRUCTURE AND DEVELOPMENT	MIX	2,516	2,480
28	MINISTRY OF EDUCATION	GOVT	2,918	2,795
29	ZAHRA TOWER	PRIVATE	1,073	1,002
30	RED CROSS BUILDING	PRIVATE	1,522	1,521
31	ECONE LODGE	RESIDENCE	327	324
32	CITY FLATS	RESIDENCE	567	537
33	MINISTRY OF HEALTH	GOVT	2,016	1,870
34	MINISTRY OF PLANNING ECONOMICS AND EMPOWERMENT	GOVT	619	604
35	MINISTRY OF FINANCE	GOVT	1,583	1,460
36	POSTA HOUSE	GOVT	1,802	1,756
37	GENERAL POST OFFICE	GOVT	5,274	5,216
38	TETEX HOUSE	MIX	761	712
39	MINISTRY OF PUBLIC SAFETY AND SECURITY	GOVT	4,305	4,438
40	SUMARIA HOUSE	RESIDENCE	298	278
41	MINISTRY OF LAND	GOVT	2,640	2,448
42	VICE PRESIDENT OFFICE	GOVT	866	874
43	KEMPISKI HOTEL	HOTEL	2,041	1,866

Note: Mix means government office and private company etc.

Figure 6.2.3 and 6.2.4 shows the hourly person trip generation by type of building use. Concerning the office buildings including government, private and mixed use, the highest peak hour is observed around noon. At the hotel and residence, sharp fluctuation is not observed in the daytime.

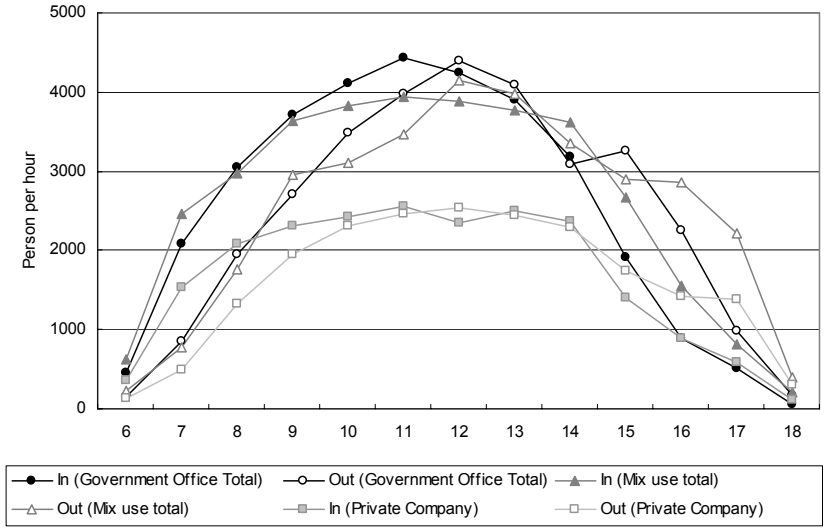


Figure 6.2.3 Hourly Fluctuation of Person Trip Generation (Office Building)

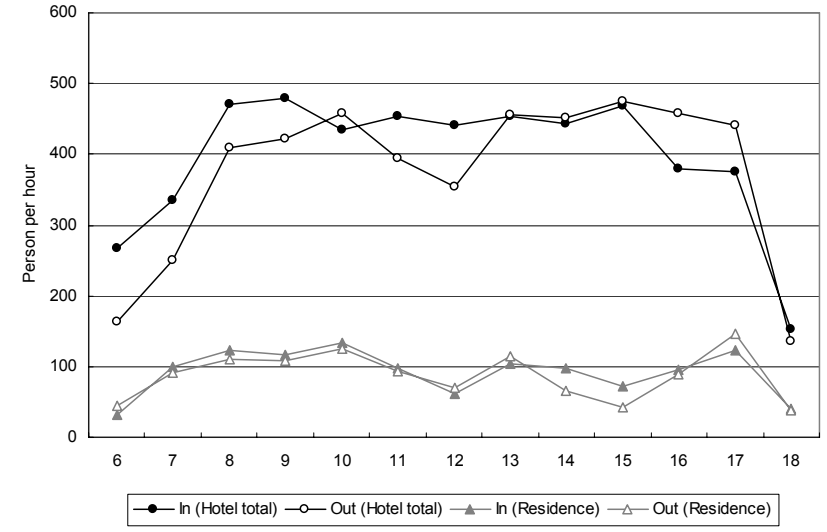


Figure 6.2.4 Hourly Fluctuation of Person Trip Generation (Hotel and Residence)

6.2.4 Person Interviews

Table 6.2.3 summarizes the sample rate by type of building. In morning peak period (6:30 – 9:30), almost more than 15% sample rate was achieved except mix use building.

Table 6.2.3 Person Interview Sample Ratio

Type	Interview		Person Count (In)		Sample Ratio	
	Morning	Day	Morning	Day	Morning	Day
GOVT	1,321	3,623	7,417	32,534	18%	11%
PRIVATE	862	2,240	5,030	21,474	17%	10%
MIX	909	2,497	7,845	33,992	12%	7%
RESIDENCE	50	163	315	1,192	16%	14%
HOTEL	226	678	1,317	5,154	17%	13%

Notes: morning peak period is 3 hours from 6:30 to 9:30

Based on the results of person count entering into building and interview survey, expansion factor for following analysis is calculated each building and survey hour.

(1) Hourly Estimated Trip Attraction by Status

Figure 6.2.5 shows the hourly trip attraction in total of office building by status. The upper figure is total of lower two figures which indicate incoming from outside or inside of city center respectively.

Commuter trip by employee in the city center is observed until 9 o'clock morning and it is dominated by the trip from outside of the city center.

The number of visitor increase from 8:00 to noon and visitor from outside of city center is almost twice of trip from inside of city center.

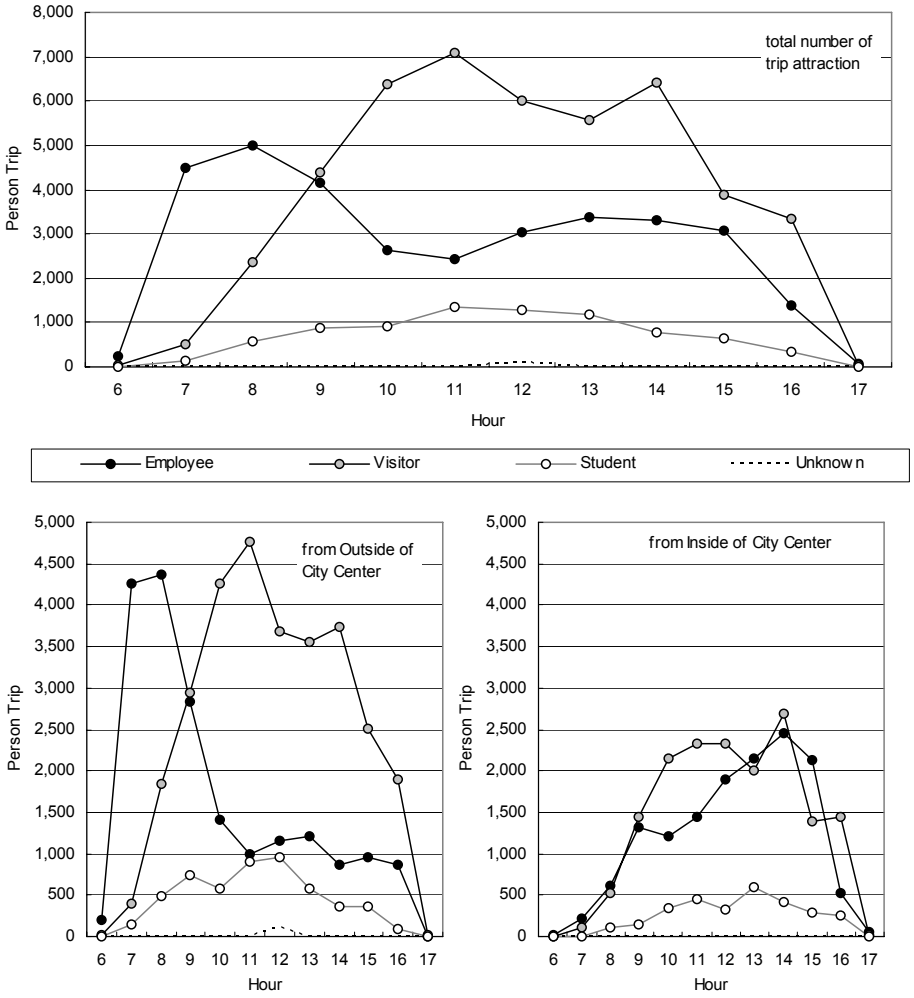


Figure 6.2.5 Hourly Trip Attraction by Status in Total of Office Building

(2) Hourly Estimated Trip Attraction by Purpose

Trip purpose has a relationship with status of interviewee as shown in Figure 6.2.6. It is observed that the fluctuation of internal 'business activities' and internal 'back to work place' are almost symmetrical at noon.

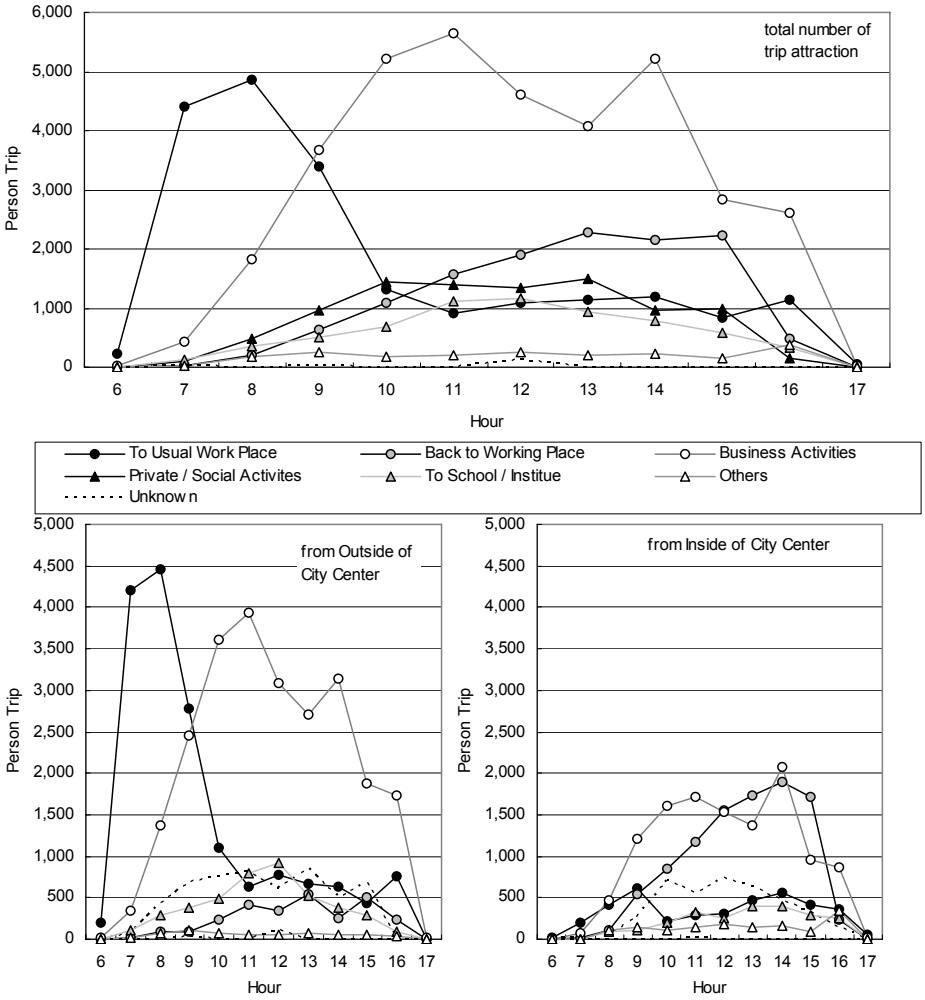


Figure 6.2.6 Hourly Trip Attraction by Purpose in Total of Office Building

(3) Hourly Estimated Trip Attraction by Mode

In the city center, major transport mode are dala dala (38%) , car (24%) and non-motorized (24%), which are mainly occupied walking as shown in Table 6.2.4. Non-motorized trip is used internal short trip, while a share of dala dala is lower than car.

Table 6.2.4 Modal Share in Total of Office Building

	Car	Dala dala	company bus	Taxi, Bhajaj	Motor-cycle	Non-Motorize	Others	Unknown	Total
External trip end	14,224	28,886	1,629	3,358	1,507	3,785	43	605	54,037
Modal share	26%	53%	3%	6%	3%	7%	0%	1%	100%
Excluding Non-motorized	28%	57%	3%	7%	3%	-	0%	1%	100%
Internal trip end	7,075	4,550	1,435	2,779	445	17,068	0	27	33,377
Modal share	21%	14%	4%	8%	1%	51%	0%	0%	100%
Excluding Non-motorized	43%	28%	9%	17%	3%	-	0%	0%	100%
Total trip end	21,299	33,436	3,064	6,137	1,952	20,852	43	632	87,414
Modal share	24%	38%	4%	7%	2%	24%	0%	1%	100%
Excluding Non-motorized	32%	50%	5%	9%	3%	-	0%	1%	100%

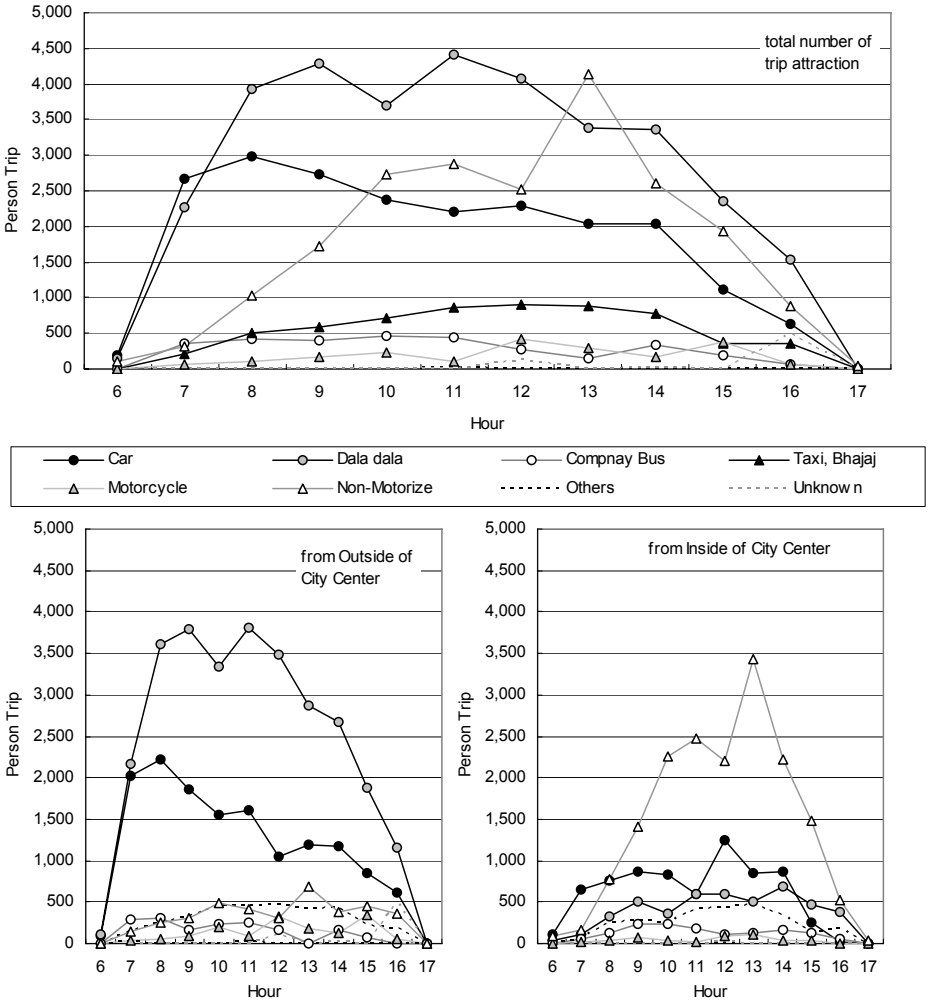


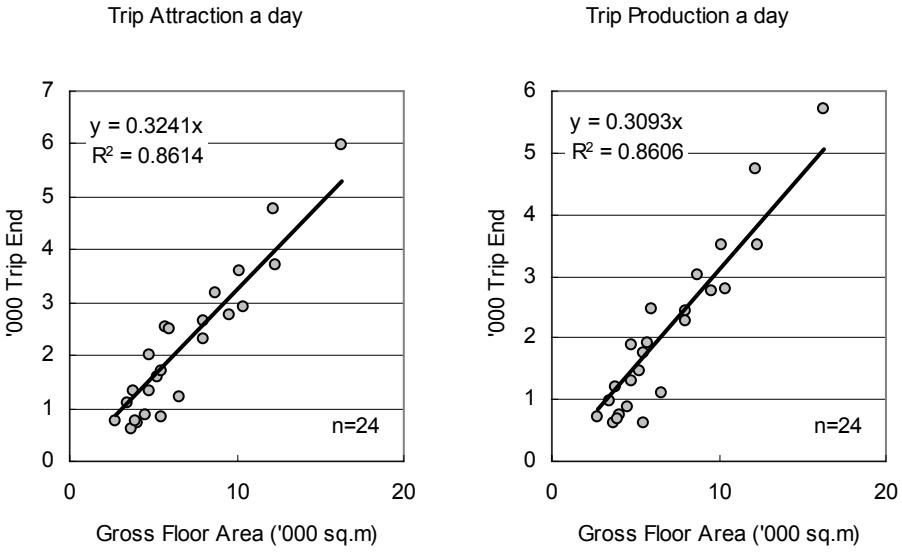
Figure 6.2.7 Hourly Trip Attraction by Mode in Total of Office

6.3 Estimation of Trip Generation in Survey Area

6.3.1 Trip Rate by Type of Building

(1) Office Use

Figure 6.3.1 shows the results of regression analysis on trip generation and gross floor area at office use excluding 10 special buildings such as Maktaba complex including national library, four buildings that is complex with office and residence, and several special case such as post office.



Source: JICA Study Team

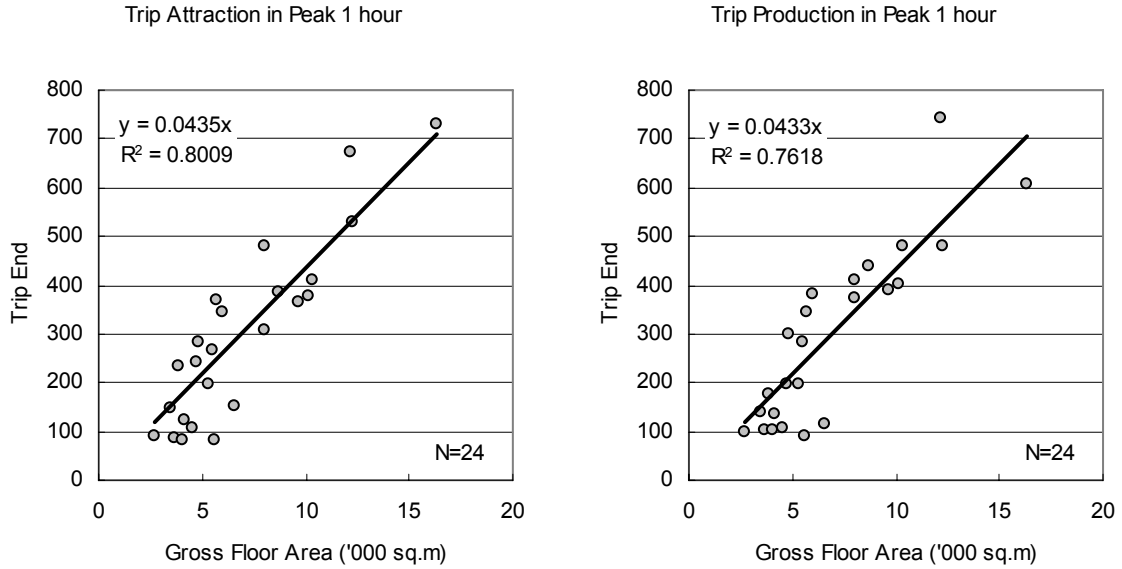
Figure 6.3.1 Estimated Daily Trip Rate by Gross Floor Area of Office Use

Daily trip generation at office use in the survey area is estimated by following formulas.

$$Ta = 0.324 \times GFA \qquad (r^2 = 0.86)$$
$$Tp = 0.309 \times GFA \qquad (r^2 = 0.86)$$
$$Tg = 0.633 \times GFA \qquad (r^2 = 0.86)$$

where, *Ta*: Trip Attraction at Office (trip end per day), *Tp*: Trip Production at Office (trip end per day), *Tg*: Trip Generation at Office (total of trip production and trip attraction), *GFA*: Gross Floor Area of Office use (sq. meters)

Average peak ratio is 12.6% of a day and peak hour is from 11:00 – 12:00. Figure 6.3.2 shows estimated trip rated in peak 1 hour.



Source: JICA Study Team

Figure 6.3.2 Estimated Trip Rate by Gross Floor Area of Office Use

Trip generation at office use in peak 1 hour is estimated by following formulas.

$$Ta = 0.044 \times GFA \qquad (r^2 = 0.80)$$
$$Tp = 0.043 \times GFA \qquad (r^2 = 0.76)$$
$$Tg = 0.087 \times GFA \qquad (r^2 = 0.80)$$

where, Ta: Trip Attraction at Office in peak 1 hour, Tp: Trip Production at Office in peak 1 hour, Tg: Trip Generation at Office in peak 1 hour, GFA: Gross Floor Area of Office use (sq. meters)

(2) Commercial Use

Table 6.3.1 shows the summary of trip generation at commercial floor such as supermarket and shops. Based on the result of survey, average trip rate is calculated as follows;

$$Ta = 1.404 \times GFA$$
$$Tp = 1.293 \times GFA$$
$$Tg = 2.697 \times GFA$$

where, Ta: Trip Attraction at Commercial use (trip end per day), Tp: Trip Production at Commercial use (trip end per day), Tg: Trip Generation at Commercial (total of trip attraction and trip production), GFA: Gross Floor Area of Commercial use (sq. meters)

In peak hour, 13:00 – 14:00, trip generation at commercial floor is estimated as follows;

$$Ta = 0.166 \times GFA$$
$$Tp = 0.171 \times GFA$$
$$Tg = 0.337 \times GFA$$

where, Ta: Trip Attraction at Commercial use in peak 1 hour, Tp: Trip Production at Commercial use in peak 1 hour, Tg: Trip Generation at Commercial use (total of trip attraction and trip production), GFA: Gross Floor Area of Commercial use (sq. meters)

Table 6.3.1 Summary of Trip Generation at Commercial Use

TGS	Name	GFA (sq. m)	Trip Attraction (day)	Trip Production (day)	Trip Attraction (peak 1 hour)	Trip Production (peak 1 hour)	Trip Generation (day)	Trip Generation (peak 1 hour)	Peak Ratio
30	RED CROSS (GF)	1871	1522	1521	172	193	3043	365	12.0%
7	PAMBA HOUSE (Supermarket	802	2880	2489	368	373	5369	741	13.8%
32	CITY FLATS (GF)	631	236	262	39	42	498	81	16.3%
Total		3304	4638	4272	549	566	8910	1115	12.5%

Source : JICA Study Team

(3) Hotel

Table 6.3.2 shows the summary of trip generation at five hotels in city center. Based on the result of survey, average trip rate is calculated as follows;

$$Ta = 11.96 \times Number\ of\ Occupied\ Rooms$$
$$Tp = 8.473 \times Number\ of\ Occupied\ Rooms$$
$$Tg = 23.166 \times Number\ of\ Occupied\ Rooms$$

where, Ta: Trip Attraction at Hotel (trip end per day), Tp: Trip Production at Hotel (trip end per day), Tg: Trip Generation (total of trip attraction and trip production).

Trip generation in peak 1 hour at hotel is estimated as follows;

$$Ta = 1.142 \times Number\ of\ Occupied\ Rooms$$
$$Tp = 1.106 \times Number\ of\ Occupied\ Rooms$$
$$Tg = 2.248 \times Number\ of\ Occupied\ Rooms$$

where, Ta: Trip Attraction at Hotel in peak 1 hour, Tp: Trip Production at Hotel in peak 1 hour, Tg: Trip Generation at Hotel (total of trip attraction and trip production).,

Table 6.3.2 Summary of Trip Generation at Hotel

TGS	Name	GFA (sq. m)	Num of Rooms	Ave. Occupancy	Occupied Rooms	Trip Attraction (day)	Trip Production (day)	Trip Attraction (peak 1 hour)	Trip Production (peak 1 hour)	Trip Generation (day)	Trip Generation (peak 1 hour)	Peak Ratio
9	HOLIDAY INN	6050	152	80%	122	1040	952	107	146	1992	253	12.7%
19	PEACOCK HOTEL	5328	93	75%	70	937	906	122	107	1843	229	12.4%
24	NEW AFRICA HOTEL	14298	126	70%	88	947	925	118	94	1872	212	11.3%
43	KEMPISKI HOTEL	19846	180	75%	135	2041	1866	194	227	3907	421	10.8%
26	STARLIGHT HOTEL	8405	154	75%	116	189	217	29	37	406	66	16.3%
Total (excl. STARLIGHT HOTEL)			551	75%	415	4965	4649	474	459	9614	933	9.7%

Note1: Occupancy rate at Peacock, Kempiski and Starlight hotel is assumption.
Note2: Interview survey was not allowed at Starlight hotel.
Source : JICA Study Team

(4) Residence

Table 6.3.3 shows the summary of trip generation at three residence buildings. Based on the result of survey, average trip rate is calculated as follows;

$$Ta = 0.159 \times GFA$$
$$Tp = 0.145 \times GFA$$
$$Tg = 0.304 \times GFA$$

where, *Ta*: Trip Attraction at Residence (trip end per day), *Tp*: Trip Production at Residence (trip end per day), *Tg*: Trip Generation at Residence (total of trip production and trip attraction), *GFA*: Gross Floor Area of Residential use (sq. meters)

Trip generation at residence in peak 1 hour is estimated from formulas as follows;

$$Ta = 0.016 \times GFA$$
$$Tp = 0.017 \times GFA$$
$$Tg = 0.033 \times GFA$$

where, *Ta*: Trip Attraction at Residence in peak 1 hour, *Tp*: Trip Production at Residence in peak 1 hour, *Tg*: Trip Generation ad Residence (total of trip attraction and trip production), *GFA*: Gross Floor Area of Residential use (sq. meters)

Table 6.3.3 Summary of Trip Generation at Residence Building

TGS	Name	GFA (sq. m)	Num of Rooms	Ave. Area per room (sq. m)	Occupancy Rate	Occupied Rooms	Trip Attraction (day)	Trip Production (day)	Trip Attraction (peak 1 hour)	Trip Production (peak 1 hour)	Trip Generation (day)	Trip Generation (peak 1 hour)	Peak Ratio
31	ECONE LODGE	1880	61	30.8	66%	40	327	324	46	36	651	82	12.6%
32	CITY FLATS	1893	48	39.4	100%	48	331	275	37	31	606	68	11.2%
40	SUMARIA HOUSE	2256	42	53.7	100%	42	298	278	50	53	576	103	17.9%
Total		6029	151	39.9	86%	130	956	877	94	103	1833	197	10.7%

Source: JICA Study Team

6.3.2 Estimation of Total Trip in CBD

Based on the gross floor area by type of use which is the result of land use inventory survey and estimated trip generation rate, trip generation in city center is estimated as shown in Table 6.3.4. Total daily trip end in the city center is about 1.15 million T.E. per day.

Table 6.3.4 Estimated Daily Trip Generation in City Center

	Gross Floor Area ('000 sq.m)	Daily Trip Generation ('000 T.E.)		
			Attraction	Production
Office	720	468	246	222
Commercial	193	519	270	249
Residence	495	151	79	72
Hotel	71	15	8	7
Total	1,478	1,153	603	550

Source: JICA Study Team

A 58% of daily trip attraction in city center comes from outside area and it is 350 thousands T.E. in a day. The modal share of dala dala and car from outside of city center are 25.6% and 16.7% of total trip attraction in city center respectively. Major mode of internal trip is non-motorize, namely working and bicycle occupy 29.6% of trip attraction in city center.

Table 6.3.5 Composition of Trip Attraction in City Center ('000 T.E. / day)

	Car	Dala dala	Others	Non-Motorize	Total
From outside of city center	101 16.7%	155 25.6%	62 10.3%	33 5.4%	350 58.1%
From inside of city center	36 6.0%	20 3.3%	18 3.0%	178 29.6%	253 41.9%
Total	137 22.7%	174 28.9%	81 13.4%	211 35.0%	603 100.0%

Source: JICA Study Team

Chapter 7 Bus Passenger Opinion Survey

7.1 Introduction

The Bus Passenger Opinion Survey aims to grasp the personal attributes of the bus passenger and awareness about the current bus service. It also aims to collect the stated preference for use of the new bus service : Bus Rapid Transit (BRT). Through analyzing these data obtained by the Bus Passenger Opinion Survey, the needs of the bus users can be identified and translated into the actual implementation plan to improve the current bus service and network, which is discussed in Technical Report 2. The detailed analysis on the stated preference data also provides such useful information as the future passenger demand of BRT.

7.2 Scope of Work

7.2.1 Survey Locations

The Bus Passenger Opinion Survey shall be carried out at the seven major bus terminals in Dar es Salaam, namely, Mwenge, Ubungo, Mbagala, Kigamboni Ferry, Kariakoo, Poata and Tandika. All are Dala Dala terminals, with exception of Ubungo and Tandika which are also used for the intercity bus terminal. The locations of the terminal are shown in the following figure.

7.2.2 Survey Hours

The survey shall extend over a total of six hours, three hours during the morning peak period (0600-0900) and three hours during the afternoon peak period (1600-1900).

7.2.3 Survey Days

The survey shall be performed on weekdays from Monday through Thursday excluding public holidays.

7.2.4 Sampling

The survey shall be administered to interview at least 1,750 passengers, or approximately 250 passengers per terminal.

Figure 7.2.1 Bus Terminal Locations

7.2.5 Survey Method

Surveyors shall randomly make interviews with the bus passengers at the said terminals. The number of interviewees at different terminals shall be determined based on the passenger volume at each terminal and should exceed 250 samples at each terminal. Information collected through the interview survey includes:

- Personal attribute (sex, age, occupation, social status, etc.);
- Trip information (trip purpose, origin-destination stations, waiting time, cost);
- Attitudinal information; and
- Stated preference for use of the BRT.

7.2.6 Survey Forms

A form for Bus Passenger Opinion Survey is illustrated in the Appendix.

7.3 Survey Performance

(1) Training

A training session for surveyors was held on 6th June under the supervision of the JICA Study Team. During the training session, technical terms such as trip purpose, origin and destination, and transport mode, were explained by the JICA Study Team. Following the training session, the surveyors carried out a pilot survey at Mwenge bus terminal on 7th in order to confirm the survey methodology and survey items.

(2) Survey Forms

The survey form was designed in English by JICA Study Team and amended based on the findings from the pilot survey. The survey form was then translated into Swahili language by the contractor. The questionnaire items include:

a. Individual attributes

- Sex, Age
- Occupation, industry, income level

b. Trip information

- Trip purpose
- Origin and destination
- Mode of transport

c. Opinion and preference

- Evaluation on the current bus service
- Reason for use of the bus
- Preference for use of BRT/Dala Dala by different service level

(3) Progress of the Field Survey

The field survey was conducted at the seven major bus terminals as summarized in the following table. The total number of 2,250 samples were interviewed throughout the survey period. The data was compiled into a database by using Microsoft Access, and the database was submitted to the JICA Study team on 10th July.

Table 7.3.1 Summary of the Survey

No.	Bus Terminal/Stop Name	Survey Date	Number of Samples Interviewed
1	Mwenge	11 June	291
2	Tandika	12 June	283
3	Mbagala	13 June	364
4	Posta	14 June	274
5	Ferry	14 June	285
6	Kariakoo	18 June	394
7	Ubungo	19 June	359
Total			2,250

7.4 Survey Result

7.4.1 Personal Attribute

(1) Sex

As indicated in Figure 7.4.1, the male passengers (interviewees) account for 66% of the total sample due to the random sampling at each survey location. The Household Interview Survey tells that the trip rate of female is estimated at only 0.75 trips/person/day, while that of male is 1.26 trips/person/day. Assuming that male population and female population are almost even, the number of trips made by male in Dar es Salaam can be estimated at 63% of the total trips from HIS, which is close to the 66% male sample f the bus passenger interview survey.

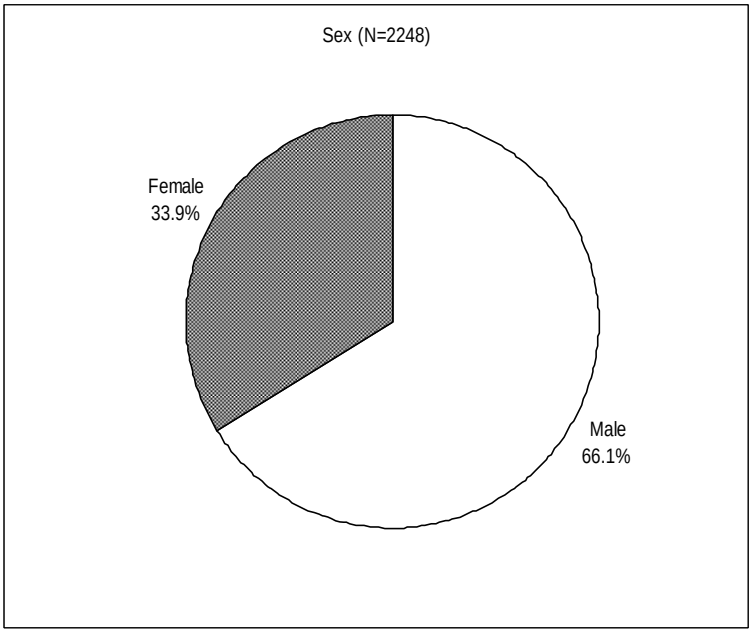


Figure 7.4.1 Sex

(2) Age

Age of majority of Dala Dala users ranges between 10 to 49 years old, accounting for 94% of the total. However, it should be noted that the survey was conducted during school holidays, the number (share) of students of age ranging from 10 to 19 might be small in comparison with the age structure of the population census.

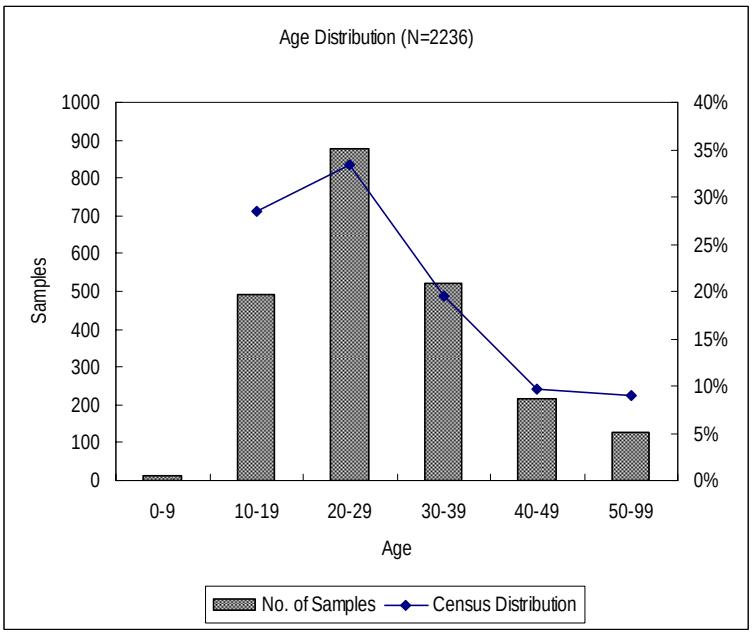


Figure 7.4.2 Age Group

(3) Activity and Occupation

As indicated in Figure 7.4.3, 73% of the sampled Dala Dala passengers are workers, followed by the student who accounts for 19% of the total. The Household Interview Survey identified that the workers in Dar es Salaam account for 38% of the population, while the students and housewives account for 29% and 19% respectively. Considering that the survey was conducted during the school holiday, the Dala Dala users might be dominated by the workers.

Various types of the occupation were observed in the interviewees: small business (31%), other work, including public workers (18%), technician (14%) , etc. HIS also suggests that small-scale businessman (24%) and other workers (26%).

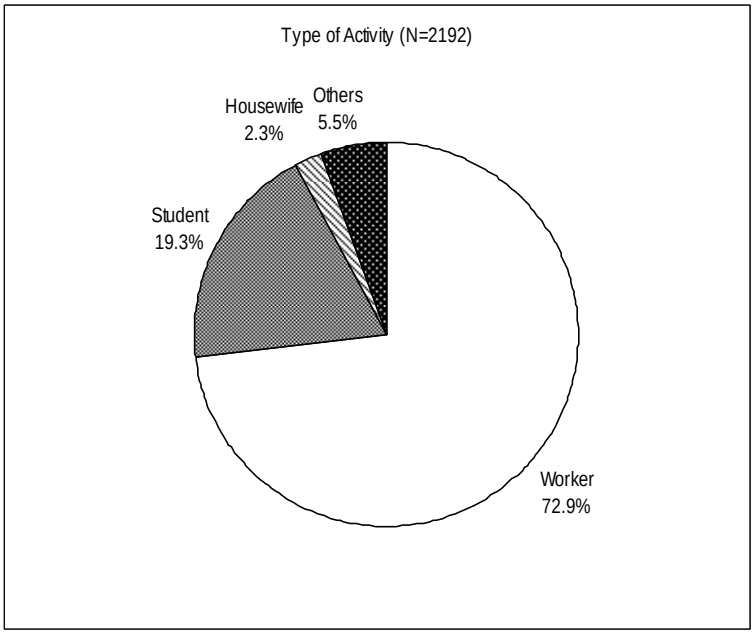


Figure 7.4.3 Activity

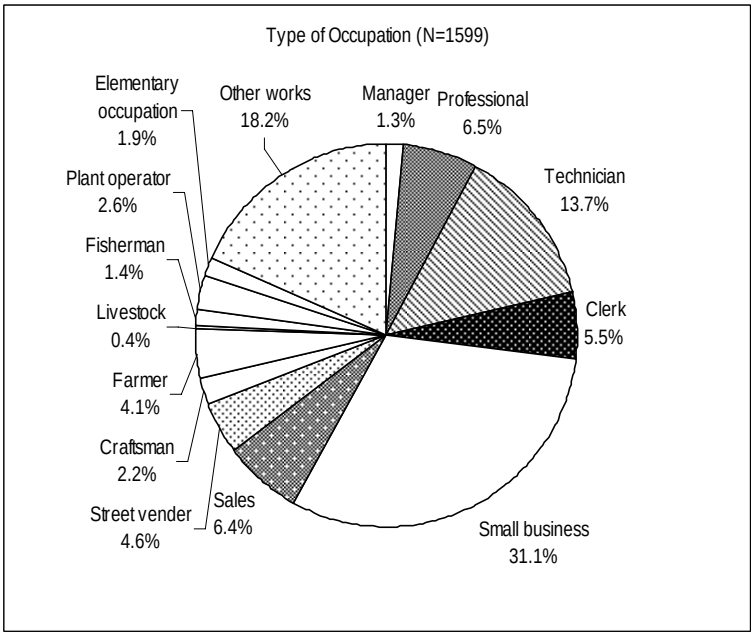


Figure 7.4.4 Occupation

(4) Income

The average monthly income of the interviewed Dala Dala passengers is rather high, reaching at 324,000 Tshs. per passenger, but majority of them fall in a range of less than 250,000 Tshs. The average household income estimated by HIS is 130,000 Tshs. that is, and the monthly income of the interviewees might be relatively high.

Figure 7.4.5 shows 50-percentile monthly income ranges between 75,000 and 100,000 Tshs. and 80-percentile monthly income ranges between 100,000 and 250,000 Tshs.

Assuming that the travel for Dala Dala users costs 350 Tshs per trip (17,500 Tshs per month[1]), the transportation costs account for 7 to 18% of the monthly income for most Dala Dala users.

[1] 350 Tshs/trip * 2 trips/day * 25 days

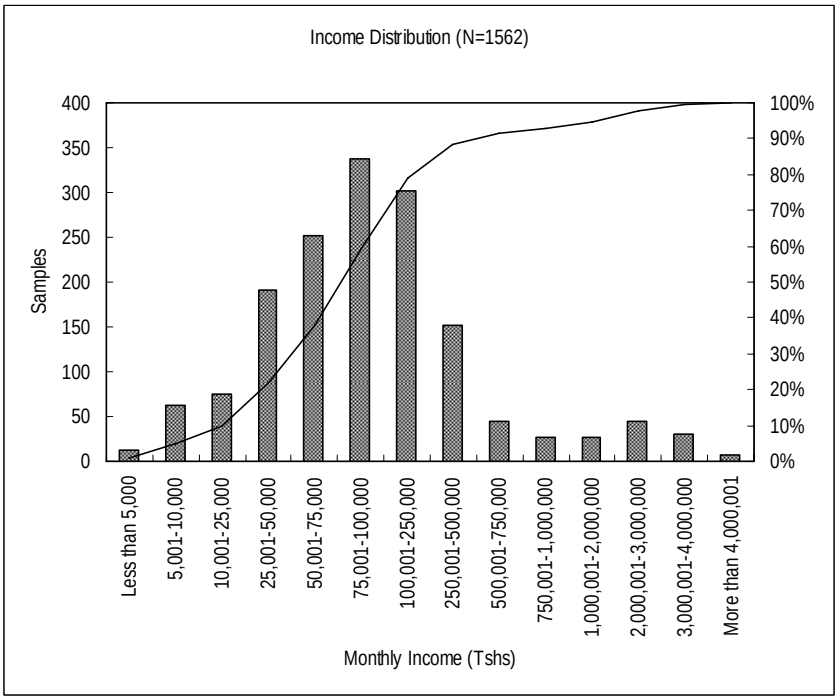


Figure 7.4.5 Income Rank

7.4.2 Trip Information

(1) Trip Purpose

A half of the interviewees answered either 'to go to work place' or 'to go to school' as their trip purpose. The composition of 'to go home' purpose is expected to account for a half of the sampled purposes. However, since the survey was conducted with the bus passengers in the morning and evening peak hours, only 23% of the trip purposes were observed as 'to go home'. Assuming a half of the trips are made for 'to go home' purpose, the composition of the rest of the trip purpose almost represents the result of HIS[2].

[2] The preliminary analysis of the Household Interview Survey shows the following trip purpose composition: to go home (48.7%), to go to work place (24.5%), to go to school (11.3%), business activities (3.2%), back to work place (0.4%), private activities (11.6%), pickup or send off (0.4%).

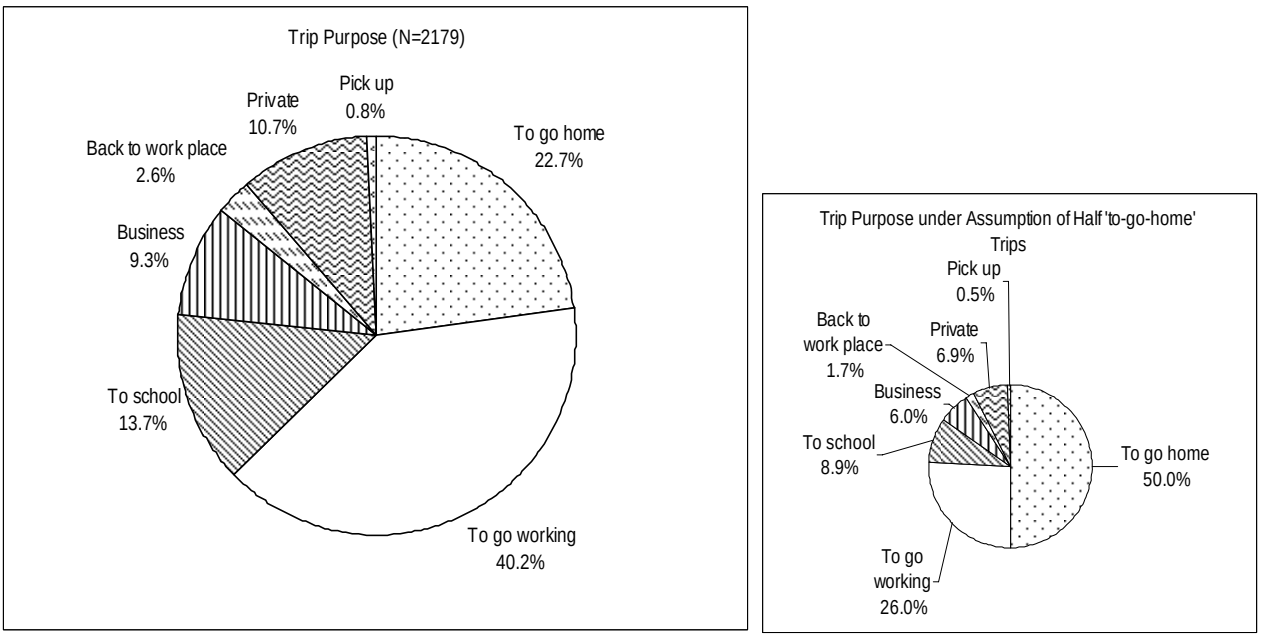


Figure 7.4.6 Trip Purpose

(2) Mode of Transport

As the following figures show, the share of walking and Dala Dala accounts for 56% and 41% of all the unlinked trips, respectively. The results of Bus Passenger Opinion Survey suggest most Dala Dala passengers, in their traveling, do not mix different modes of transport and tend to use solely Dala Dala. Also, the assess and egress modes of transport are limited to either 'walking' or 'Dala Dala'. Also, only 56% of Dala Dala passengers use one Dala Dala per trip and can make a trip without a transfer to their destination. The rest of 44% of the passengers use two or more Dala Dala per trip, which implies that the bus terminal users may access to the terminals by Dala Dala and transfer to another to travel to their destination.

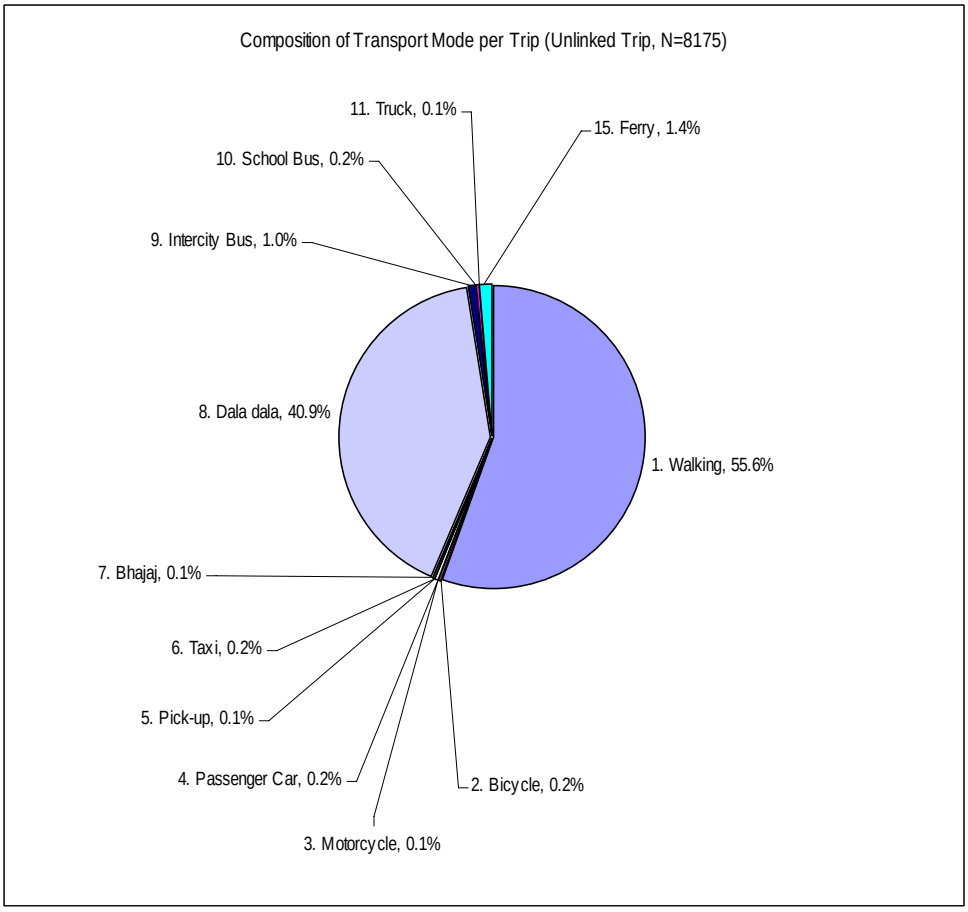


Figure 7.4.7 Transport Mode

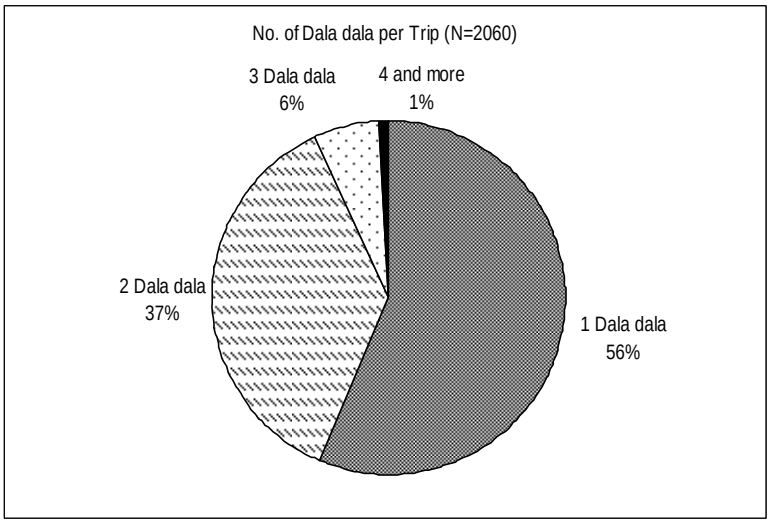


Figure 7.4.8 Number of Dala Dala per Trip

(3) Travel Time and Cost

Both travel time and waiting time made per trip are considered rather large, in traveling in Dar es Salaam. The average travel time per trip is estimated at 77 minutes and waiting time, mainly for transferring another mode of transport, is at 35 minutes. The total travel time is estimated to reach 112 minutes per trip. Amongst the travel time, the travel time by Dala Dala is estimated at 57 minutes. This implies that the average travel distance range between 10 to 20 km under the assumption that the average travel speed of Dala Dala is 10 to 20 km/h during the peak hours. Looking at terminal-wide figures, travel time at Ubungo, Kariakoo, Post and Ferry are relatively larger than that of the rest. This may be caused by the long-distance trip made via the said two bus terminals and the road congestion along the bus routes to/from the said terminals. The terminal-wide figures do not show any significant difference in the waiting time. The cost for traveling, mainly the fare for Dala Dala, is estimated at around 320 Tshs per trip.

Table 7.4.1 Travel Time and Cost

Survey Location	Travel Time per Trip (min)	(Travel Time by Dala Dala) (min)	Waiting Time (min)	Fare per Trip (Tshs)
Mwenge	74.8	(54.8)	35.4	314
Tandika	74.7	(53.7)	34.3	331
Mbagala	73.9	(52.5)	32.6	315
Posta	81.2	(61.9)	36.8	327
Ferry	80.4	(58.9)	34.1	316
Kariokoo	81.1	(58.9)	36.2	364
Ubungo	83.4	(65.9)	34.5	358
TOTAL	77.2	(56.7)	34.9	324

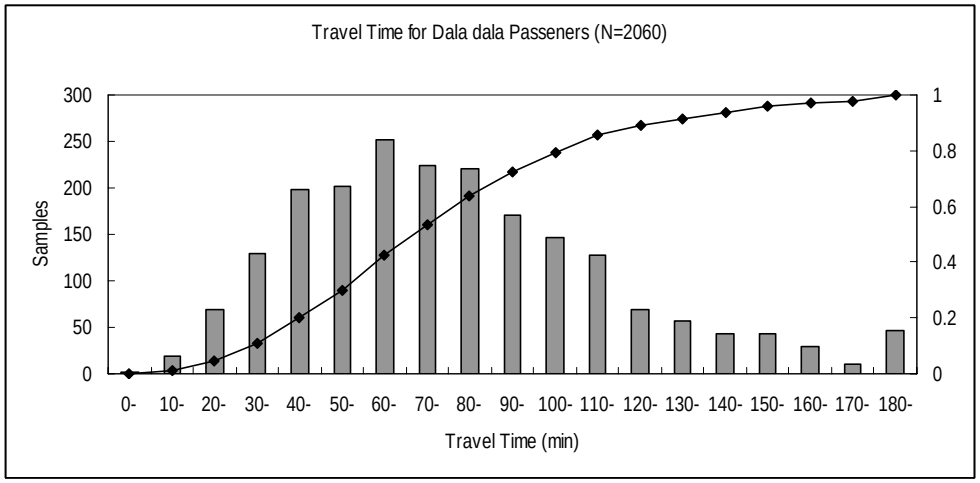


Figure 7.4.9 Distribution of Travel Time

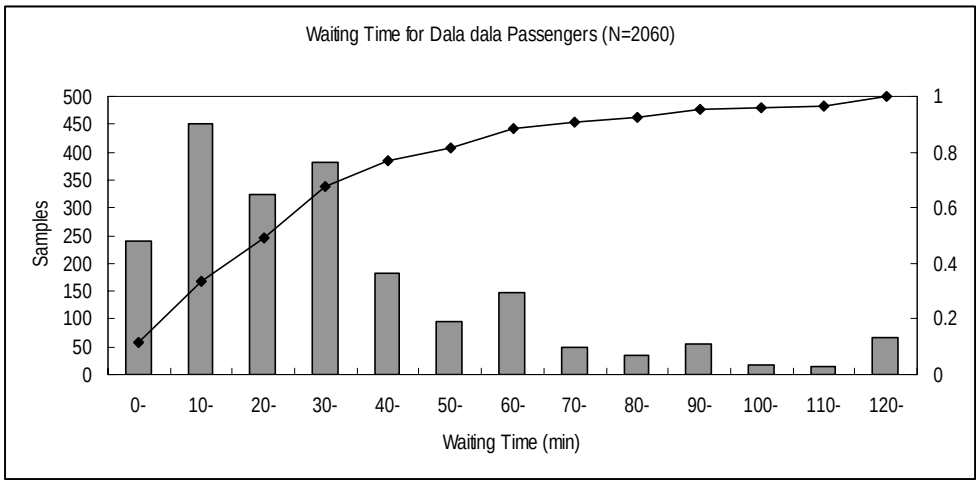


Figure 7.4.10 Distribution of Waiting Time

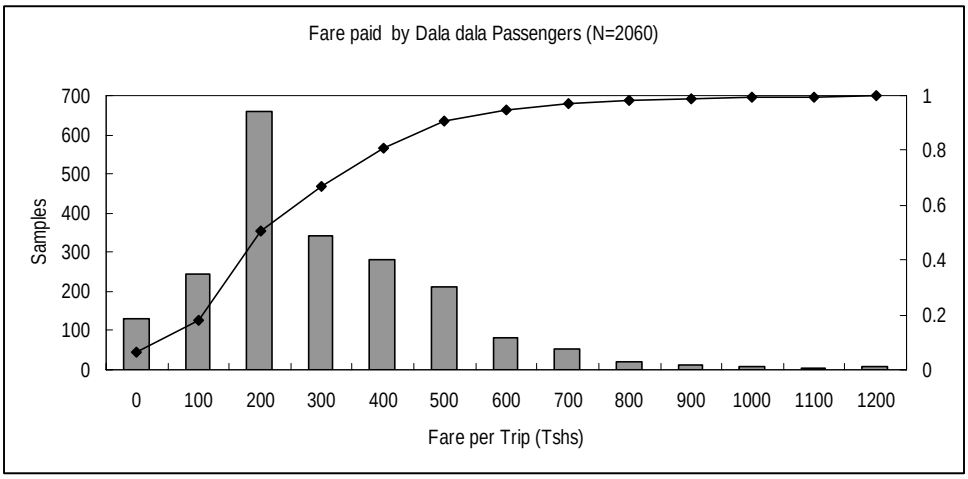


Figure 7.4.11 Distribution of Fare per Trip

(4) Reason for Use of Bus

Almost all the Dala Dala passengers use public transport because they have neither cars nor driving licenses. As the following figures shows, 98% of sampled Dala Dala passengers answered they have no choice other than buses. The preference to Dala Dala seems quite low among the Dala Dala passengers, since only 0.7% of sampled Dala Dala passengers answered they use Dala Dala because the Dala Dala is a more preferable transport than a car. The details of the preference to Dala Dala will be discussed in the following section.

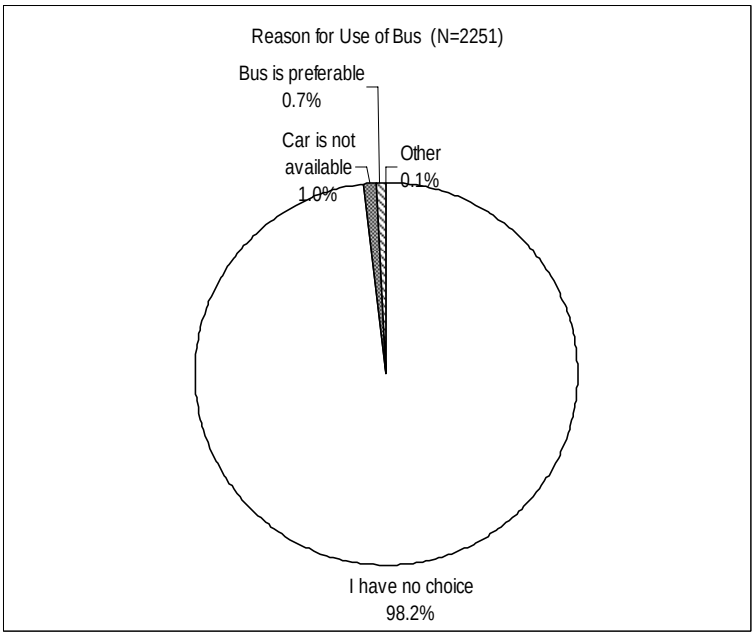


Figure 7.4.12 Reason for Use of Dala Dala

7.4.3 Awareness on Bus Services

(1) Evaluation by Bus Service

Overall, the Dala Dala users are unsatisfied with the current bus service. The following figure illustrates the evaluation on the current bus service, and shows more than 80% of the interviewees judged the current service either unacceptable or unsatisfied level. Looking at the evaluation result by different bus service, the critiques are raised toward routing of Dala Dala, and on board comfort, and nearly 90% of the interviewees evaluated them either unacceptable or unsatisfied level. Following them, waiting time at the bus stop, on board security and conductors' manner collected negative answers.

On the contrary, critiques towards operation hours and fare level and accessibility to the bus stop were observed relatively few, showing that nearly half of the Dala Dala passengers accepted or satisfied with the level of those services. It should be noted that the standard bus fare was increased from 200 Tshs. to 250 Tshs per trip due to the hike of the petrol price soon after the Bus Passenger Opinion Survey was completed, which may impact adversely the user's satisfaction on the fare level.

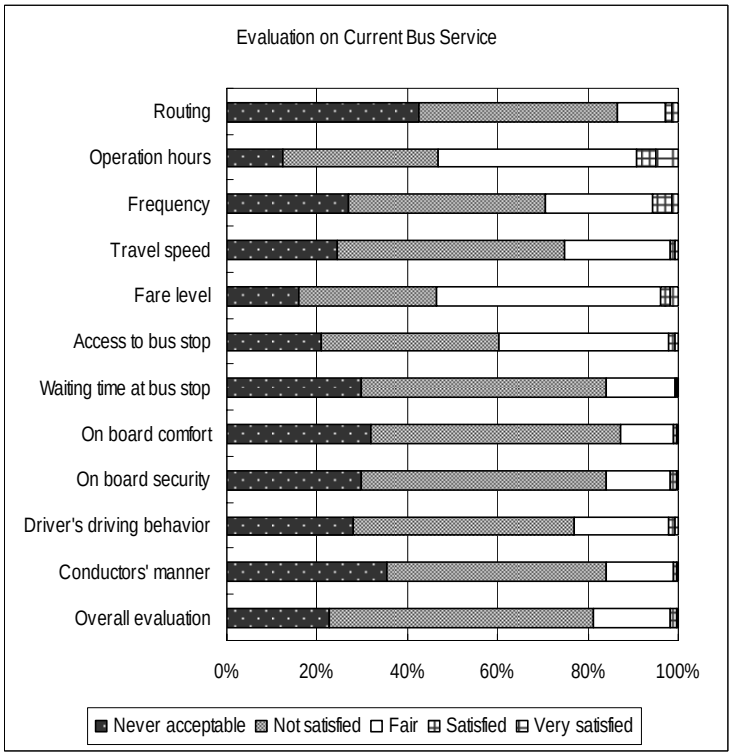


Figure 7.4.13 Evaluation on Current Bus Service

(2) Most Important/Critical Service

Next question is which bus service the Dala Dala users consider most important/critical. The answer can be drawn from the following figure and the most important/critical bus service is considered as routing. 56% of the interviewees answered routing of Dala Dala is the first important/critical bus service and 10% (4%) of the interviewees answered it as the second (third) important/critical bus service. Following the routing of Dala Dala, frequency is the second most important/critical bus service, since 7% and 21% and 6% of the interviewees answered frequency as first, second and third important/critical bus service, respectively.

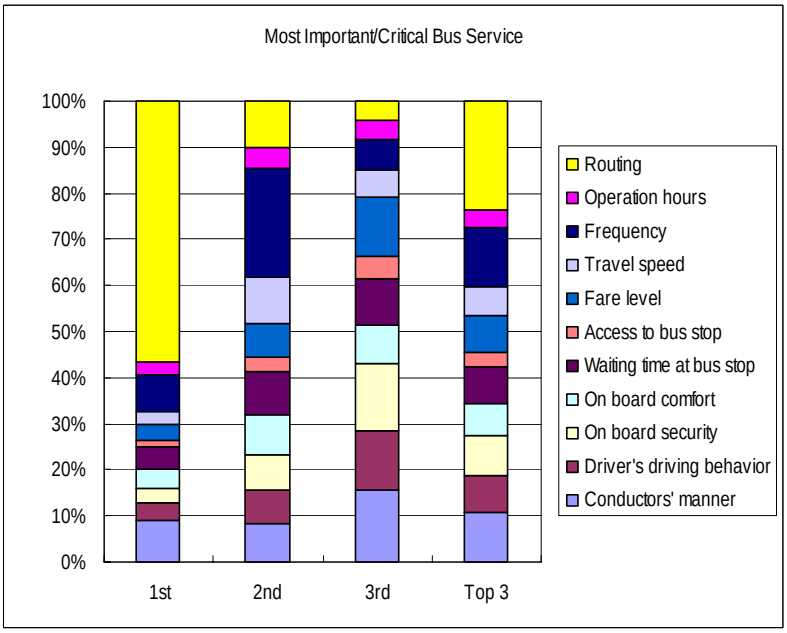


Figure 7.4.14 Most Important/Critical Bus Service

Taking examples of routing and frequency, the following figures show the evaluation on the current bus service by the different bus terminals. As discussed above, the overall evaluation shows most of the interviewees are unsatisfied with the routing of Dala Dala. More interviewees at Mbagala and Tandika evaluated the routing as unacceptable or unsatisfied level than those at the other bus terminals. Looking at the frequency, nealy 80% of the interviewees at Tandika answered frequency of Dala Dala is either unacceptable or unsatisfied, followed by those at Mwenge (73% say unacceptable or unsatisfied) and Posta (72% say unacceptable or unsatisfied).

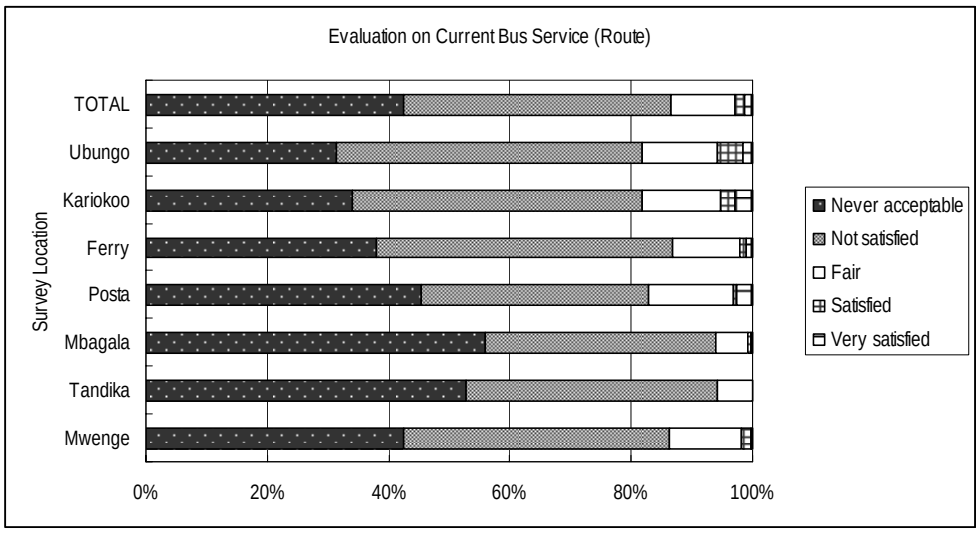


Figure 7.4.15 Most Important/Critical Bus Service (Route)

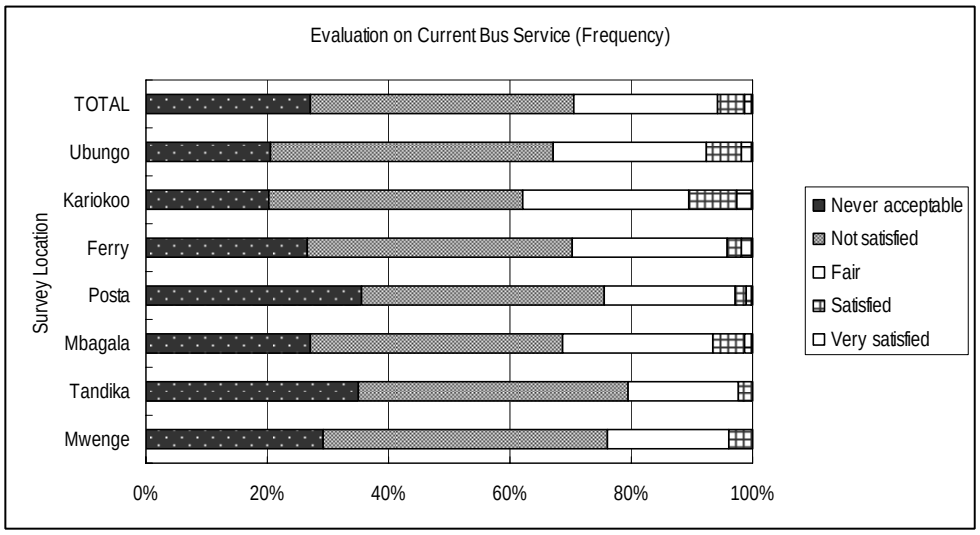


Figure 7.4.16 Most Important/Critical Bus Service (Frequency)

7.4.4 Preference to BRT/Dala Dala

(1) Preference by Bus Service

The Bus Passenger Opinion Survey also collects the stated preference for use of the new bus service – Bus Rapid Transit (BRT). The following figure shows the preference to BRT/Dala Dala by different time and cost. For instance, when the time difference is 20 minutes (60 minutes taken by Dala Dala and 40 minutes by BRT) and cost difference is zero (300 Tshs for both Dala Dala and BRT), 96% of the sampled Dala Dala passengers prefer to use BRT for their transport. The preference to BRT sharply decreases when the cost difference becomes large. In case the fare of BRT is 200 Tshs. larger than that of Dala Dala, only 27% of sampled Dala Dala passengers show their preference to BRT and any preference to BRT is not identified when the fare difference exceeds 500 Tshs.

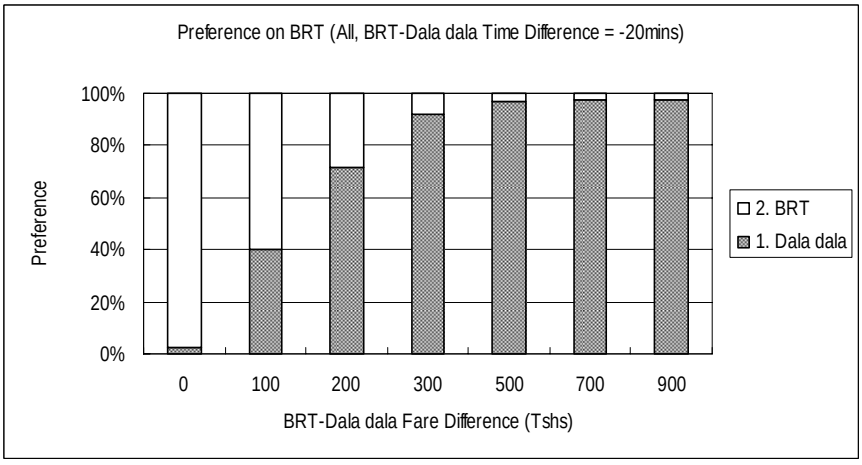


Figure 7.4.17 Preference to BRT/Dala Dala

(2) Preference by Personal Attribute

The preference to BRT/Dala Dala shows little change by the personal attributes. The following figures show the female, aged, and well-off Dala Dala passengers' preference to both transports. The preference of sampled female passengers is almost identical to that of the total. Slightly more passengers, when they are over 60 years old or when their monthly income exceeds 500,000 Tshs. tend to use BRT even when the cost difference becomes larger.

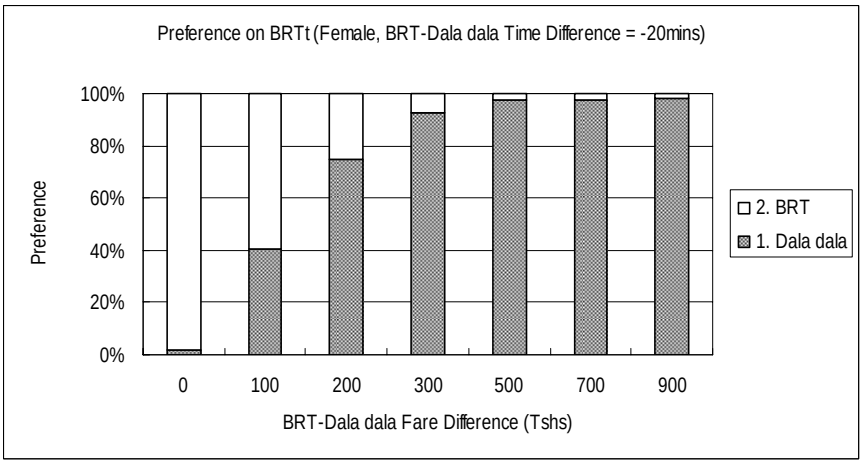


Figure 7.4.18 Preference to BRT/Dala Dala (Female)

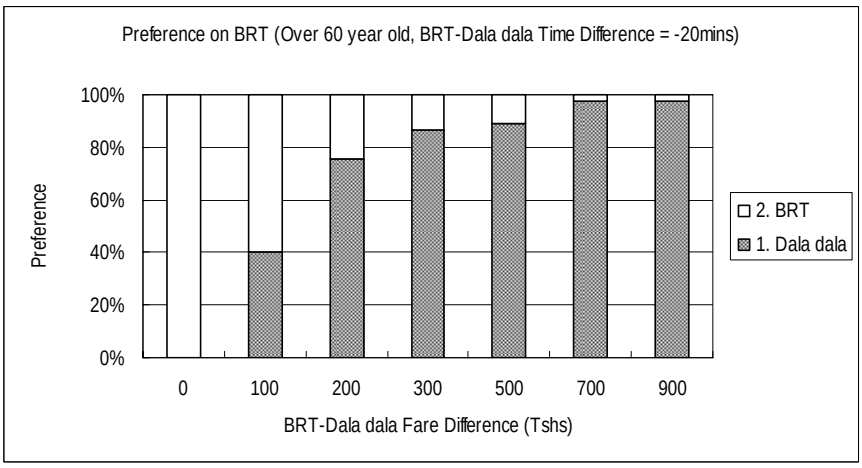


Figure 7.4.19 Preference to BRT/Dala Dala (Over-60-Years)

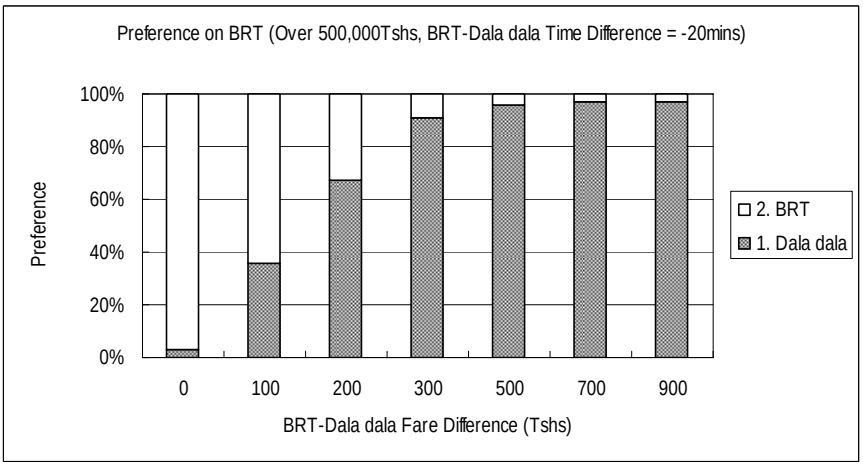


Figure 7.4.20 Preference to BRT/Dala Dala (Over 500,000 Tshs.)

7.4.5 Binary Choice Model

(1) General

The travel behaviour, in general, is explained by the utility maximization method, which determines the means of transport that generates the largest utility amongst the different means of transport, using the 'discrete choice data[3]'. The following formula describes probability utility function.

$$U_{in} = \beta_1 x_{1in} + \beta_2 x_{2in} + \cdots\cdots + \beta_K x_{Kin} + \varepsilon_{in} = V_{in} + \varepsilon_{in}$$

subject to; V_{in}: individual n's utility generated from the choice of $i(i=1,.....,J)$, x_{kin}: k-th dependent variable of individual n choosing mode i, β_k: k-th unknown parameter, ε_{in}: probability variable of utility.

In general, dependent variables include the level of service, such as travel time, costs, and the number of transfers, and also include personal attributes, such as sex, age, and income. When the number of alternative transport modes is only two, which are described alternative i and j, the probability of choosing alternative i by individual n $P_n(i)$ is expressed by the following formula.

$$\begin{aligned} P_n(i) &= \Pr[U_{in} \geq U_{jn}] \\ &= \Pr[V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn}] \\ &= \Pr[\varepsilon_{jn} - \varepsilon_{in} \geq V_{in} - V_{jn}] \\ &= F_{\varepsilon}(V_{in} - V_{jn}) \end{aligned}$$

subject to; F_{ε}: accumulation distribution function of ε_n.

A logit model is the most commonly used distribution pattern of the probability variable ε_n, when the

[3] A 'continuum' is, on the contrary of 'discrete', always explained by the numerous values, such as height and weight.

distribution of ε_n is assumed to be logistic. The probability of choosing alternative i by individual n $P_n(i)$, under the assumption of ε_n being a binary logit model, is expressed by the following formula.

$$P_n(i) = \frac{1}{1+\exp\{-\mu(V_{in} - V_{jn})\}}$$

subject to; μ : a scale parameter which explains the extent of a scattering of ε_n.

The following s-curve figure shows the probability of a binary logit model.

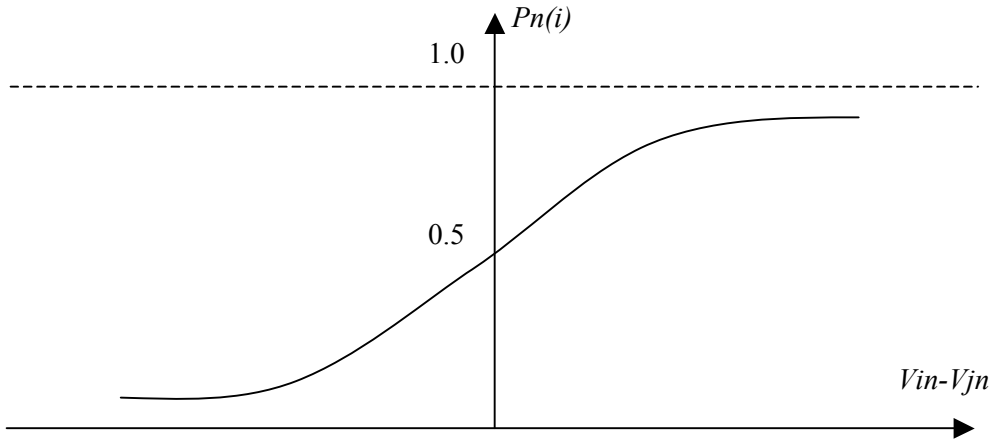


Figure 7.4.21 Probability of Binary Logid Model

In estimating the model of travel behavior, unknown parameters encompassed in the discrete choice model need to be calculated in order that they generate the best estimation of the observed data. When the probability of the mode choice follows a theoretical formula with unknown parameters, maximum likelihood estimation is the most commonly used as a method to calculate the unknown parameters. Under the assumption of discrete choice, the likelihood of data L is expressed in accordance with the following formula.

$$L = \prod_{n=1}^{N} \prod_{i=1}^{J} P_n(i)^{din}$$

subject to; d_{in}=1 when individual n chooses alternative mode i, otherwise d_{in}=0.

Several econometrics application software, including R[4], TSP[5] and Gauss[6], are available to estimate the model through maximum likelihood estimation. The model estimation, explored in the following section, is done by using R.

[4] Refer to the website of R-Project. (http://www.r-project.org/)
[5] Refer to the website of TSP International Corp. (http://www.tspintl.com/)
[6] Refer to the website of Aptech Corp. (http://www.aptech.com/)

(2) Model Estimation

This section explores binary choice modeling between BRT and Dala Dala. The binary choice model encompasses costs and travel time as its dependent variables and a structure of the model is shown in the following formula. Any dummy variables are not encompassed in the model since the significant difference in the preference to BRT/Dala Dala, in terms of their personal attributes, and that between the population of Dala Dala users and the sampled Dala Dala passengers are not identified as discussed above.

$$V_{BRT\_n} = Cont + \beta_1 \times Cost_{BRT\_n} + \beta_2 Time_{BRT\_n}$$
$$V_{DD\_n} = \beta_1 \times Cost_{DD\_n} + \beta_2 Time_{DD\_n}$$

subject to; *Cont*: constant included in the utility of BRT, *Cost*: fare of BRT/Dala Dala, *Time*: travel time of BRT/Dala Dala.

Assuming the logit model as the distribution pattern of the probability variable and applying the maximum likelihood estimation to calculate the parameters of the above-mentioned model, the result of the model estimation is tabulated in the following table.

Table 7.4.2 Summary of Model Estimation

Variables	Value	Standard Error	T-value
Constant	1.23	0.0643	19.07
Time (min)	-0.0198	0.00192	-10.26
Cost (Tsh)	-0.0109	0.000180	-60.20

The results of the model estimation can be summarized as follows:

- The parameters of both travel time and costs are minus and t-value of both parameters exceeds 1.96 (95% validity). Accordingly, the result of the model estimation is concluded acceptable.
- A constant encompassed in the utility of BRT is plus and its value is estimated at 1.23, and accordingly, the preference to BRT is relatively large when the level of service of BRT and that of Dala Dala are similar. When the level of service of BRT and that of Dala Dala are equal, 77% of the bus passengers is estimated to use BRT.
- The time value is estimated at 1.82 Tshs per minute (109 Tshs per hour and 22,000 Tsh per month[7]) and differs from 50-percentile monthly income, ranging between 75,000 and 100,000 Tshs.

The results of the model estimation can be illustrated in the following figure.

[7] It is estimated under the assumption that working time per day is 8 hours and working days per month are 25 days.

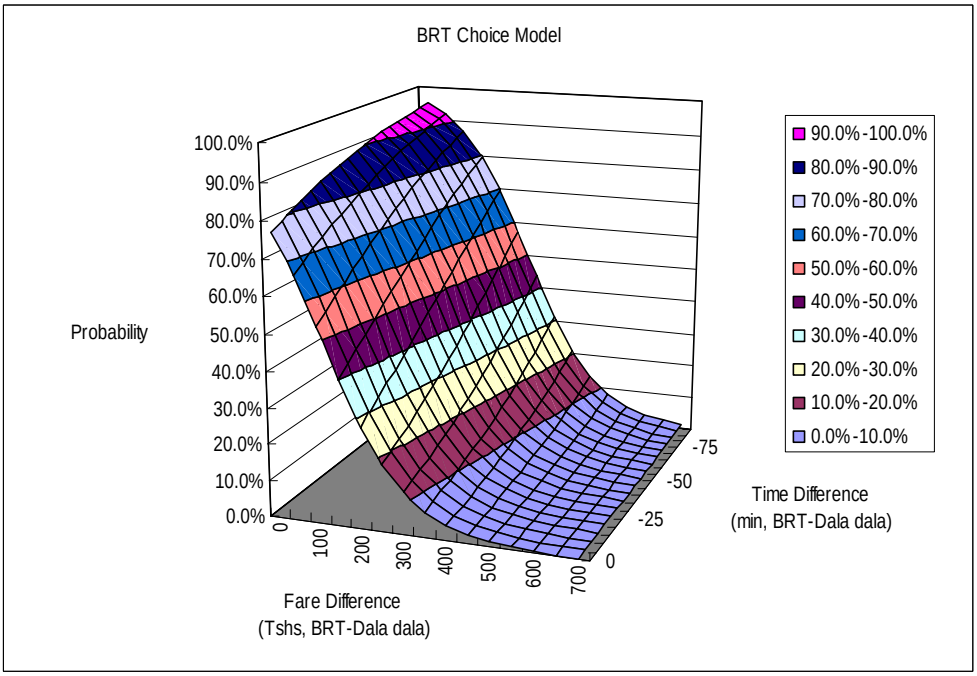


Figure 7.4.22 Result of BRT Choice Model

Appendix -7: Survey Forms

PTS-1 Public Transport Passenger Interview Survey Form

Code Table for Public Transport Passenger Interview Survey

CONFIDENTIAL | **PTS-1 : PUBLIC TRANSPORT PASSENGER INTERVIEW SURVEY** | **Dar es Salaam Transport Policy and System Development Master Plan Study**

Survey Location (1) ☐ Sheet No. (2) ☐ Interviewer (3) ☐ Supervisor (4) ☐

Sex	Age	Occupation	Occupation 1-14 only: Main Industry	Occupation 1-14 only: Monthly Income	Trip Purpose	Address of Your Residence	Code
(5) ☐ 1: Male 2: Female	(6) ☐	(7) ☐ Choose from Table-A	(8) ☐ Choose from Table-B	(9) ☐ Choose from Table-C	(10) ☐ Choose from Table-D	Region (11)	(16)
						District/ Municipality (12)	(17)
						Ward (13)	(18)
						Sub-Ward (14)	(19)
						Landmark (15)	

Origin Place (20) ☐ 1: Same as your residence 2: Not same (Please specify below)

Address of Origin Place		Code
Region	(21)	(26)
District/ Municipality	(22)	(27)
Ward	(23)	(28)
Sub-Ward	(24)	(29)
Landmark	(25)	

Destination Place (30) ☐ 1: Same as your residence 2: Not same (Please specify below)

Address of Destination Place		Code
Region	(31)	(36)
District/ Municipality	(32)	(37)
Ward	(33)	(38)
Sub-Ward	(34)	(39)
Landmark	(35)	

Total number of transfer you did and you will (40) ☐
(transfer includes walking to bus, bus to bus, bus to taxi, etc. and vice versa)

Trip Information form Origin to Destination

	Transport Mode (choose from Table-E)	Travel Time (min)	Public Transport Fare (Tshs)
1st	(41)	(42)	(43)
2nd	(46)	(47)	(48)
3rd	(51)	(52)	(53)
4th	(56)	(57)	(58)
5th	(61)	(62)	(63)
6th	(66)	(67)	(68)
7th	(71)	(72)	(73)

	Transfer Place (Name of bus stop, terminal etc.)	Waiting Time (min)
1st	(44)	(45)
2nd	(49)	(50)
3rd	(54)	(55)
4th	(59)	(60)
5th	(64)	(65)
6th	(69)	(70)

Evaluation on the Current Condition

Check one of the ☑ which apply

1. Never acceptable — 2. Not satisfied — 3. Fair — 4. Satisfied — 5. Very satisfied

1) Routing .... (74) ☐—☐—☐—☐—☐
2) Operation hours .... (75) ☐—☐—☐—☐—☐
3) Frequency .... (76) ☐—☐—☐—☐—☐
4) Travel speed (time) .... (77) ☐—☐—☐—☐—☐
5) Fare level .... (78) ☐—☐—☐—☐—☐
6) Access to bus stop .... (79) ☐—☐—☐—☐—☐
7) Waiting time at bus stop .... (80) ☐—☐—☐—☐—☐
8) On board comfort .... (81) ☐—☐—☐—☐—☐
9) On board security .... (82) ☐—☐—☐—☐—☐
10) Driver's driving behavior .... (83) ☐—☐—☐—☐—☐
11) Conductors' manner of services .... (84) ☐—☐—☐—☐—☐
12) Overall evaluation .... (85) ☐—☐—☐—☐—☐

Which elements do you think should be improved?
choose three element from "1) Routing" to 11) Conductors' manner of services" in above

The most important / critical element (86) ☐
Secondary important / critical element (87) ☐
Tertiary important / critical element (88) ☐

Why did you travel by bus? (87) ☐

1. I have no choice other than buses. (No driving license, no car, etc.)
2. A car was not available on today.
3. Bus is preferable than car.
4. Others (Please specify below)
(88) ☐

Preferences on Public Transport (Please refer "What is the Bus Rapid Transit System?")

Which do you prefer Bus Rapid Transit System (BRT) or Dala dala for each case given below?

Check one of the ☑ which apply

Case	1. Dala dala: Fare (Tshs)	1. Dala dala: Travel Time (min)	2. BRT: Fare (Tshs)	2. BRT: Travel Time (min)	Preference: 1 Dala dala or 2 BRT
1	300	60	300	40	(89) ☐ or ☐
2	300	60	400	40	(90) ☐ or ☐
3	300	60	500	40	(91) ☐ or ☐
4	300	60	600	40	(92) ☐ or ☐
5	300	60	800	40	(93) ☐ or ☐
6	300	60	1,000	40	(94) ☐ or ☐
7	300	60	1,200	40	(95) ☐ or ☐

*Travel time includes "waiting time", "riding time" and "access / egress time". "access / egress time" is fixed to 10 minutes
* Only 1 transfer (change bus) is assumed for every case.

Which do you prefer Bus Rapid Transit System (BRT) or Dala dala to make a same trip for each case given below?

Check one of the ☑ which apply

Case	1. Dala dala: Fare (Tshs)	1. Dala dala: Travel Time (min)	2. BRT: Fare (Tshs)	2. BRT: Travel Time (min)	Preference: 1 Dala dala or 2 BRT
1	600	90	600	45	(96) ☐ or ☐
2	600	90	800	45	(97) ☐ or ☐
3	600	90	1,000	45	(98) ☐ or ☐
4	600	90	1,300	45	(99) ☐ or ☐
5	600	90	1,500	45	(100) ☐ or ☐

CODE TABLE FOR PUBLIC TRANSPORT PASSENGER INTERVIEW SURVEY

Table-A : Occupation

Worker →
1. Legislators, Administrators, and Managers
2. Professionals
3. Tech. and Associate Professionals
4. Clerks
5. Small Business Managers
6. Service & Shop sales workers
7. Street Venders
8. Craftsmen
9. Farmers
10. Livestock Keepers
11. Fishermen
12. Plant Operators, Assemblers
13. Element. Occupations
14. Other working

Student →
15. Student (Elementary)
16. Student (Secondary)
17. Student (University / Institute)
18. Student (Others)

Non-worker →
19. Not working but looking for work
20. Not working but not looking for work
21. Home Maker, Housewife
22. Retired / Too old, pensioner
23. Unable to work
24. Others

Table-B : Main Industry

1. Agriculture
2. Forestry, Fishing & Other
3. Mining & Quarrying
4. Manufacturing
5. Electricity, Gas and Water
6. Construction
7. Raw food sales (Un-cooked)
8. Trade and Commerce
9. Transport and Communication
10. Finance & Insurance
11. Education
12. Public (Government)
13. Others

Table-C : Monthly Income

1. Less than 5,000	8. 250,001 - 500,000
2. 5,001 - 10,000	9. 500,001 - 750,000
3. 10,001 - 25,000	10. 750,001 - 1,000,000
4. 25,001 - 50,000	11. 1,000,001 - 2,000,000
5. 50,001 - 75,000	12. 2,000,001 - 3,000,000
6. 75,001 - 100,000	13. 3,000,001 - 4,000,000
7. 100,001 - 250,000	14. More than 4,000,001

Table-D : Trip Purpose

1. To go home
2. To go usual work place
3. To school/institute (student only)
4. Business activities
   (sale, delivering, meeting, etc.)
5. Back to working place
6. Private/social activities
   (eating, shopping etc.)
7. Pick up or send off
   (taking children to school and back etc.)

Table-E : Transport Mode

1. Walking
2. Bicycle
3. Motorcycle
4. Passenger Car
5. Pick-up, Van
6. Taxi
7. Bhajaj
8. Dala dala
9. Intercity bus
10. School/Company bus
11. 2 axles truck
12. 3 axles truck
13. Trailer truck, more than 3 axles truck
14. Railway
15. Ferry/boat

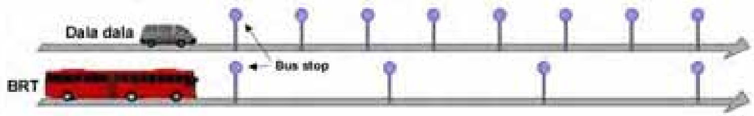
WHAT IS THE BUS RAPID TRANSIT SYSTEM (BRT)?

1. BRT runs on exclusive lane.

BRT is not affected by any other vehicles.

BRT is able to maintain it's speed and time table.

2. BRT is a kind of express bus.

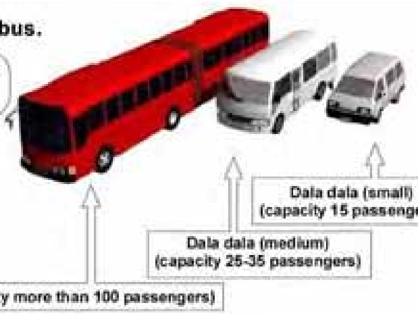


BRT is able to reduce number of stops.

3. BRT is an articulated long bus.

BRT can carry a lot of passengers more than any existing bus.

BRT will provide comfortable travel.



Chapter 8 Car User Opinion Survey

8.1 Introduction

The Car User Opinion Survey aims to grasp car users' attitudinal perception for the current bus service and the stated preference for use of the new bus service – Bus Rapid Transit (BRT). It also grasps the stated preference for use of the car when the area-pricing scheme is employed to the CBD area of Dar es Salaam. Through analyzing these data obtained by the Car User Opinion Survey, the needs of the car users can be identified and translated into the policy implications to improve the traffic circulation within the CBD area, which is discussed in the separate chapter. The detailed analysis on the stated preference data also provides such useful information as the future demand of the BRT passengers shifted from car users.

8.2 Scope of Work

8.2.1 Survey Locations

The Car User Opinion Survey was carried out at two off-street parking spaces at the CBD area (in front of the Dar es Salaam City Council) and at Mnaji Moja (near the Usirika Building). Most parking spaces in both the CBD and Mnaji Moja are reserved for the employees nearby the office buildings[1]. The locations of the two parking lots surveyed are shown in the following figure.

[1] According to the interview with the director of National Parking System, 100 parking lots are reserved for the company employees out of 180 parking lots in the off-street parking nearby the Dar es Salaam City Council.

Source: JICA Study Team

Figure 8.2.1 Locations of Car User Opinion Survey

8.2.2 Survey Hours

The survey extended over a total of four hours, two hours during the morning peak period (07:00-09:00) and two hours during the afternoon peak period (16:00-18:00).

8.2.3 Survey Days

The survey was performed on weekdays from 14th Dec through 19th Dec 2007 excluding Saturday and Sunday.

8.2.4 Sampling

The survey was initially administered to interview at least 150 car users in total, or approximately 15 car users per day per surveyor.

8.2.5 Survey Method

Surveyors randomly interviewed the car users at the said parking lots. The number of interviewees at two parking lots was determined based on the available samples at each parking. Information collected through the interview survey includes:

- Personal attribute (sex and home address);
- Trip information (travel time and cost);
- Attitudinal information (frequency of bus use and reason for not using the bus); and
- Stated preference for BRT and Area Pricing Scheme.

8.2.6 Survey Forms

Two different forms were prepared for Car User Opinion Survey. One form aims to obtain the willingness-to-pay for the BRT service and the other aims to obtain the stated preference between the BRT and car when the BRT and Area Pricing Scheme are both introduced. Those survey forms are illustrated in the Appendix.

8.3 Survey Performance

(1) Training

A training session of surveyors was held on 12th November 2007, under the supervision of the JICA Study Team. During the training session, the objectives of the survey and such technical terms as the BRT and Area Pricing Scheme, were explained by the JICA Study Team. Following the training session, surveyors carried out a pilot survey at the parking lots in the CBD on 13th November in order to confirm the survey methodology and survey items.

(2) Survey Forms

The survey form was designed in English by JICA Study Team and amended based on the findings of the pilot survey. The questionnaire items include:

a. Individual attributes

- Sex
- Home address

b. Trip information

- Travel time and cost

c. Opinion and preference

- Reason for using the car
- Reason for not using the bus
- Preference to use of BRT/car by different service level

(3) Progress of the Field Survey

The field survey was conducted at the two off-street parking as summarized in the following table. The total number of 155 samples were interviewed during the survey period. The data set was compiled by using Microsoft Excel, and the data set was submitted to the JICA Study team on 20th November.

Table 8.3.1 Summary of the Survey

No.	Parking	Survey Date	Number of Samples Interviewed
1	CBD (nearby DCC)	14, 15 November	96
2	Mnaji Moja (nearby Usirika Building)	16, 19 November	59
Total			155

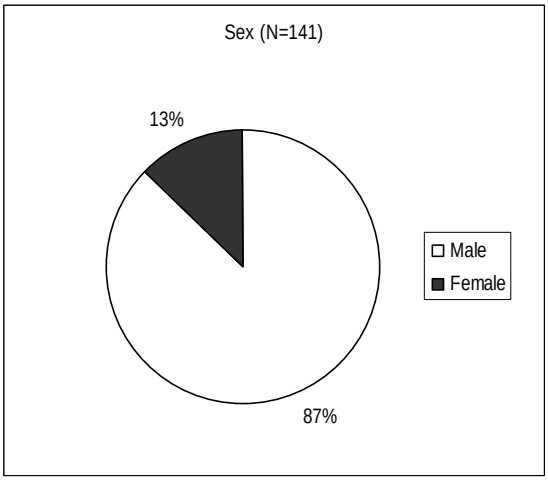
Source: JICA Study Team

8.4 Survey Result

8.4.1 Personal Attributes

Sex

The result of the random sampling applied to the Car User Opinion Survey indicates the majority of car users observed are male. As shown in the following figure, 87% of the total samples are male whereas remaining 13% are female. The preliminary result of the Household Interview Survey shows that the trip rate by male is estimated at 1.26 trips/person/day, whereas that by female remains 0.75 trips/person/day. Accordingly, this tendency also suggests more male car users travel to/from the CBD of Dar es Salaam than female does.



Source: JICA Study Team

Figure 8.4.1 Sex

8.4.2 Trip Information

Travel Time and Cost

Car users are prone to consume one hour in commuting to the city centre in Dar es Salaam. The

following table shows the average travel time and cost by the car users in CBD area and explains that sampled car users spend 59.8 minutes per trip and 5,551 Tshs per trip between their home and working places. This figure represents the result of the Home Interview Survey, which estimates at the average travel time of 55.1 minutes per trip made by car.

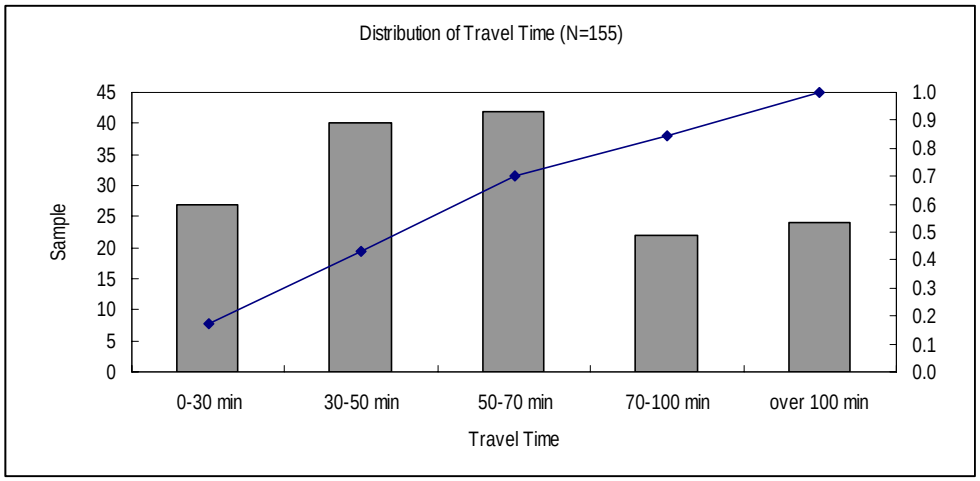
Comparing the level of service between car and Dala Dala, it shows far distorted. The following table also shows the average travel time and cost by Dala Dala passengers, and indicates that sampled car users consume less travel time, roughly by half, than Dala Dala passengers, who consume 112 minutes per trip. On the contrary, sampled Dala Dala passengers only pay 324 Tshs per trip and 17 times less than car users pay. This distorted level of service between car and Dala Dala implies that use of the car is limited only to the people who own the car and can afford to pay for the petrol and other charges, including parking fees.

Table 8.4.1 Travel Time and Cost

Mode of Transport	Travel Time per Trip(min)	Waiting Time(min)	Total Travel Time (min)	Fare/cost per Trip(Tshs)
Car	59.8	-	59.8	5,551
Dala Dala*	77.2(56.7**)	34.9	112.1	324

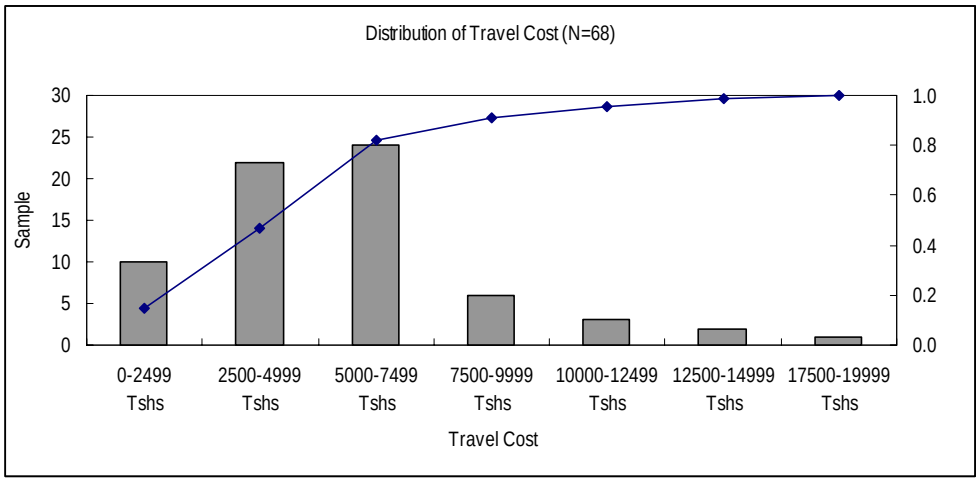
Note: *The above figures of Dala Dala are referred from the Bus Passenger Opinion Survey, conducted by JICA Study Team. **The figure shows travel time by Dala Dala, which excludes access/egress time.

Source: JICA Study Team



Source: JICA Study Team

Figure 8.4.2 Distribution of Travel Time



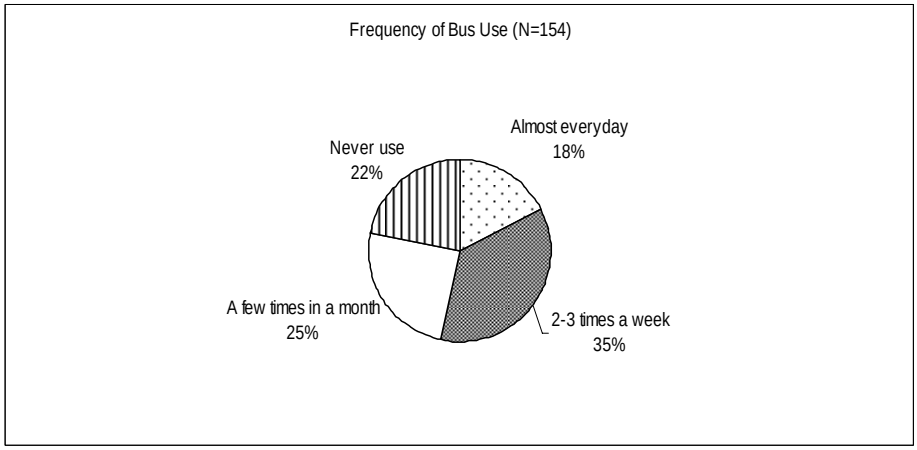
Source: JICA Study Team

Figure 8.4.3 Distribution of Cost per Trip

8.4.3 Awareness of Buses

(1) Frequency of Bus Use

Car users may consider Dala Dala as the alternative means of transport. The following figure shows the extent to how frequently car users in the CBD area use Dala Dala. It indicates that more than half of the sampled car users answered they use Dala Dala either almost every day (18% of the total samples) or two to three times a week (35%). And only 22% of the samples answered they never use Dala Dala.

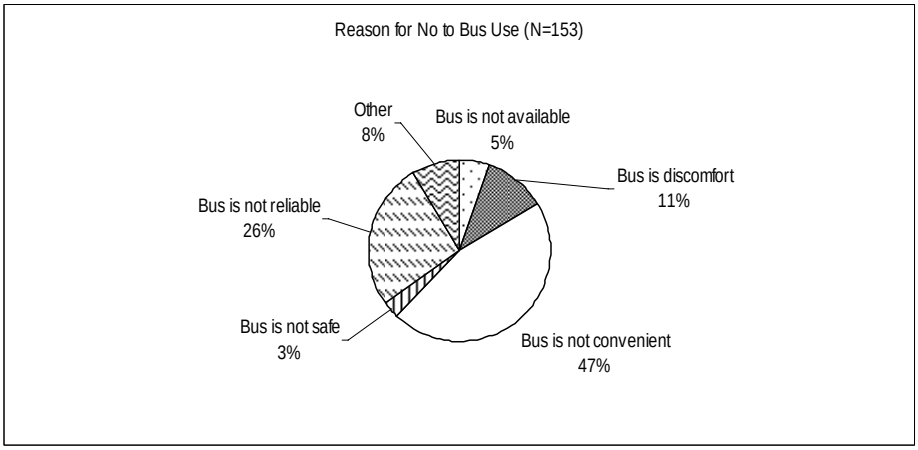


Source: JICA Study Team

Figure 8.4.4 Frequency of Bus Use

(2) Reason for Not Using Bus

However, most car users consider Dala Dala service less comfortable than the level of service by car they enjoy today. The following figure shows the reasons why car users do not use Dala Dala on the survey day, and indicates that inconvenient service by Dala Dala (47% of the samples), including long waiting hours at the bus stop, is the major deficit of the Dala Dala service, followed by unreliable service by Dala Dala (26%), such that Dala Dala is less punctual.

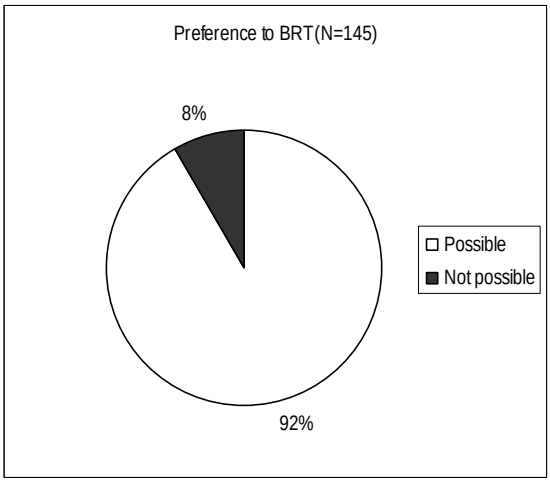


Source: JICA Study Team

Figure 8.4.5 Reason for Not Using Bus

(3) Possibility of BRT Use

The next question is how many car users can travel by new transport system, that is the BRT, when it is introduced as alternative means of public transport. The following figure shows preference of car users to use of the BRT and 92% of the sampled car users answered they can shift the car to the BRT in traveling to the CBD area in Dar es Salaam.



Source: JICA Study Team

Figure 8.4.6 Preference to BRT

Two approaches were applied to estimate the future demand of the BRT. One is the willingness-to-pay for the BRT service and the other is the stated preference between the BRT and car when the BRT and Area Pricing Scheme are both introduced. And the result of these approaches provides totally distorted answers. The following discussion will describe the analytical work on both approaches.

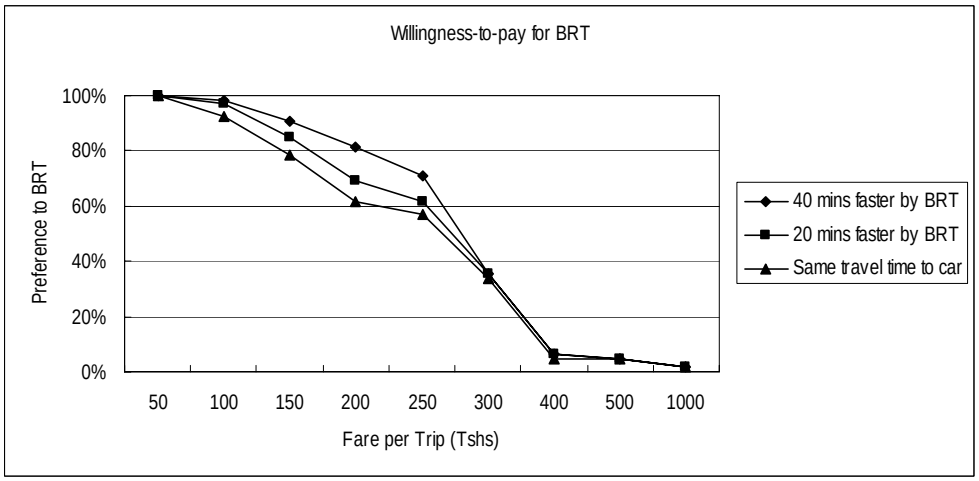
8.4.4 Preference to BRT/Car

(1) Willingness-to-Pay for BRT

Willingness-to-pay for use of the BRT was analyzed and estimated, using the Car Users Opinion Survey. The following figure shows the preference to BRT/car by different time sets. For instance, when the time difference is 40 minutes (the travel time by the BRT is 40 minutes faster than that by the car) and the fare of BRT per trip is 250 Tshs, 71% of the sampled car users prefer to use BRT for their means of transport. The preference to BRT sharply decreases when the fare becomes large. In case the fare of BRT increases to 400 Tshs per trip, only 6% of sampled car users show their preference to BRT and most of the sampled car users remain to use their cars.

Preference to BRT shows little change by travel time. Taking an example of 200 Tshs per trip by BRT, at which the distortion in their preference is large, preference to the BRT shows 82% of sampled car users when the travel time by the BRT is 40 minutes faster than by car and decreases to 62% of the

sample when the travel time by both transports is same. However, practically the fare of the BRT may exceed 400 Tshs per trip and preference to the BRT ranges 5 to 6% of the sampled car users and does not show significant difference when the travel time differs.



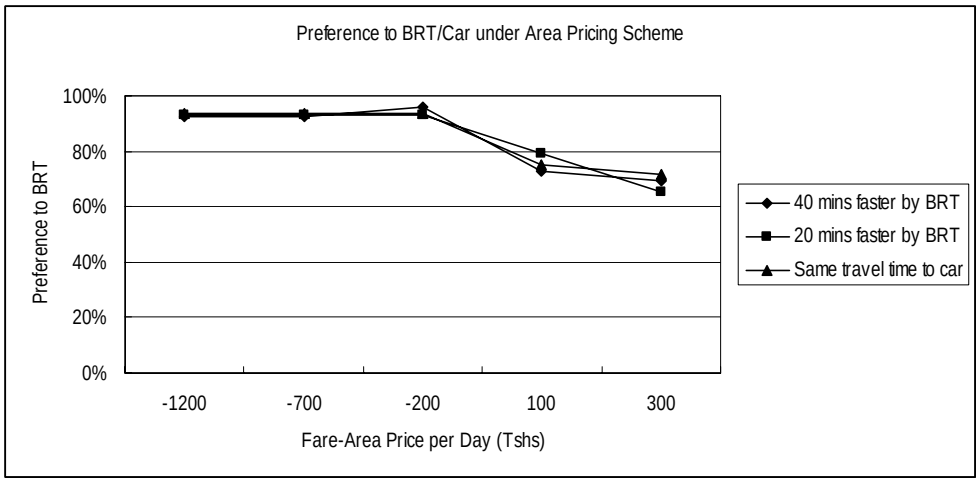
Source: JICA Study Team

Figure 8.4.7 Willingness-to-Pay for BRT

(2) Stated Preference under BRT and Area Pricing Scheme

On the contrary, the stated preference between the BRT and car was also estimated in case that the BRT and Area Pricing Scheme would be both introduced and its result is illustrated in the following figure. Taking an example when the travel time differs by 40 minutes (the travel time by the BRT is 40 minutes faster than that by the car) and travel cost differs by 1,200 Tshs (2,000 Tshs per day for car users and 800 Tshs per round trip for BRT passengers), 94% of the sampled car users prefer to shift from the car to the BRT. The preference to the BRT remains quite high even when the charge for car users becomes smaller. In case that the area charge to car users decreases to 500 Tshs per day and the fare for BRT passengers remains at 800 Tshs per round trip, 72% of sampled car users answered they would prefer to using the BRT.

These distorted results from the two surveys can be explained by existence of the bias always associated with the stated preference-type survey. The interviewees tend to show their appreciation to new policy implications – policy bias, to make the interviewer feel confirmable – interviewer bias, and/or to pretend themselves, for instance, as environmentally friendly persons – interviewee bias, by showing their exaggerated preference to the BRT in this survey. The following discussion will construct the modal choice model by eliminating these biases and foresee the BRT passenger/car user's demand.



Source: JICA Study Team

Figure 8.4.8 Preference to BRT/Car under Area Pricing Scheme

8.4.5 Binary Choice Model

(1) Model Estimation

This section explores binary choice modeling between BRT and car. Like the model between BRT and Dala Dala, the binary choice model encompasses costs and travel time as its dependent variables and a structure of the model is shown in the following formula. Any dummy variables are not encompassed in the model since the significant difference in the preference to BRT/car, in terms of their personal attributes, and that between the population of car users and the sampled car users are not identified as discussed above.

$$V_{BRT\_n} = \beta_1 \times Cost_{BRT\_n} + \beta_2 Time_{BRT\_n}$$
$$V_{Car\_n} = Cont + \beta_1 \times Cost_{Car\_n} + \beta_2 Time_{Car\_n}$$

subject to; *Cont*: constant included in the utility of car, *Cost*: fare of BRT/car, *Time*: travel time of BRT/car.

Assuming the logit model as the distribution pattern of the probability variable and applying the maximum likelihood estimation to calculate the parameters of the above-mentioned model, the result of the model estimation is tabulated in the following table.

Table 8.4.2 Summary of Model Estimation (Willingness-to-Pay)

Variables	Value	Standard Error	T-value
Constant	4.40	0.182	24.15
Time (min)	- 0.0135	0.00352	-3.82
Cost (Tsh)	- 0.00763	0.000301	-25.30

Source: JICA Study Team

Table 8.4.3 Summary of Model Estimation (Stated Preference)

Variables	Value	Standard Error	T-value
Constant	14.7*	(0.227)	(-6.15)
Time (min)	-0.00214	0.00850	-0.253
Cost (Tsh)	-0.00150	0.000326	-4.60

Note: *The constant value is initially estimated at -1.40 and adjusted based on the current share between Dala Dala and car.

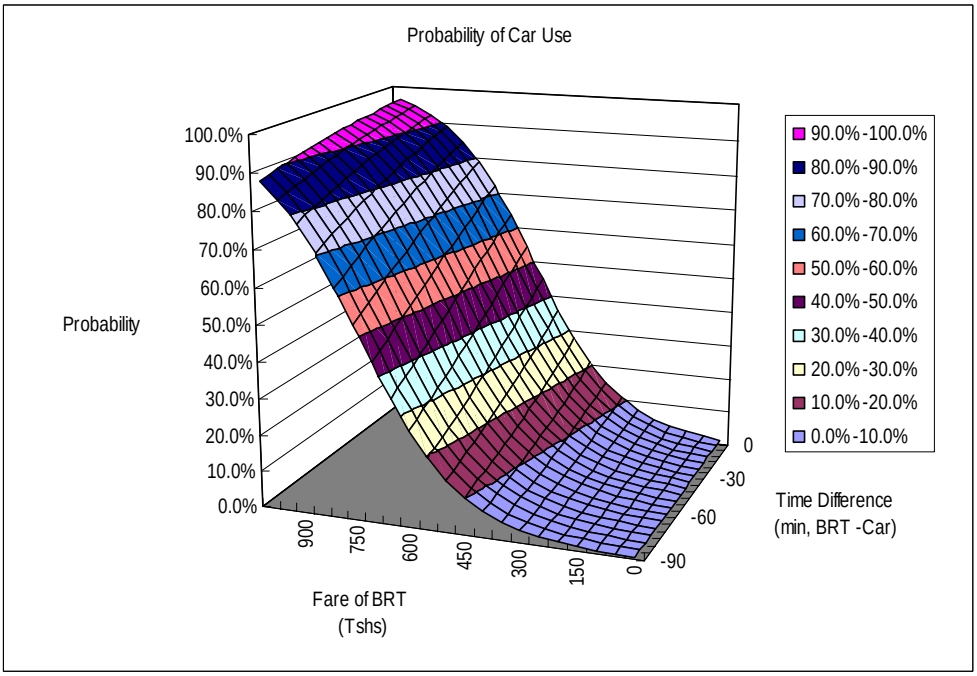
Source: JICA Study Team

The results of the model estimation can be summarized as follows:

- The parameters of both travel time and costs encompassed in the both models are minus. Except for the parameter of the time in the stated preference model, t-value of all parameters exceeds 1.96 (95% validity). Accordingly, the result of the model estimation is concluded acceptable.
- A constant of the utility function of car shows plus and its value is estimated at 4.40 in the willingness-to-pay model, and accordingly, the preference to car remains relatively large when the level of service of BRT and that of car are similar. When the travel time of BRT and that of the car are equal and the fare of BRT is 400 Tshs per trip, the majority of car users remain to user their car and only 15% of the car users are estimated to shift to the BRT.
- A constant of the utility function of car in the stated preference model is initially estimated at -1.40 and adjusted to 14.7 based on the based on the current modal share between Dala Dala and car[2].
- The time values in both model are considered relatively small and are estimated at 1.77 Tshs per minute (106 Tshs per hour and 21,184 Tsh per month[3]) and at 1.43 Tshs per minute (86 Tshs per hour and 17,148 Tsh per month) in willingness-to-pay model and stated preference model, respectively, and differs from 50-percentile monthly income, ranging between 75,000 and 100,000 Tshs.

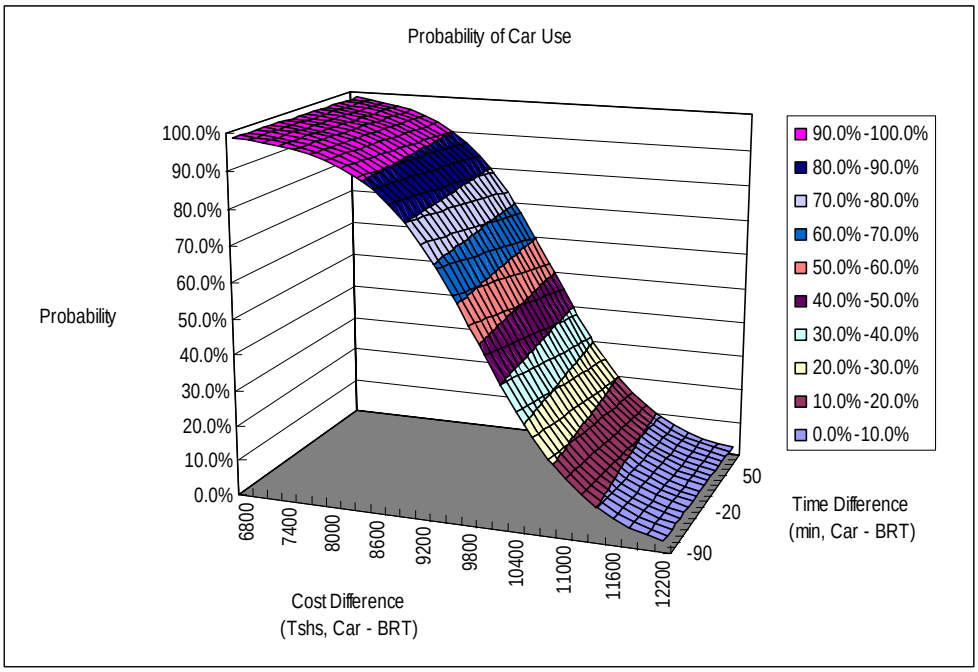
The results of the model estimation can be illustrated in the following figures.

[2] A constant value is adjusted under the assumption that the modal share is 86% (car) to 14% (Dala Dala) when the travel cost by car is 9300 Tshs per day and the fare by Dala Dala is 700 Tshs per round trip.
[3] It is estimated under the assumption that working time per day is 8 hours and working days per month are 25 days.



Source: JICA Study Team

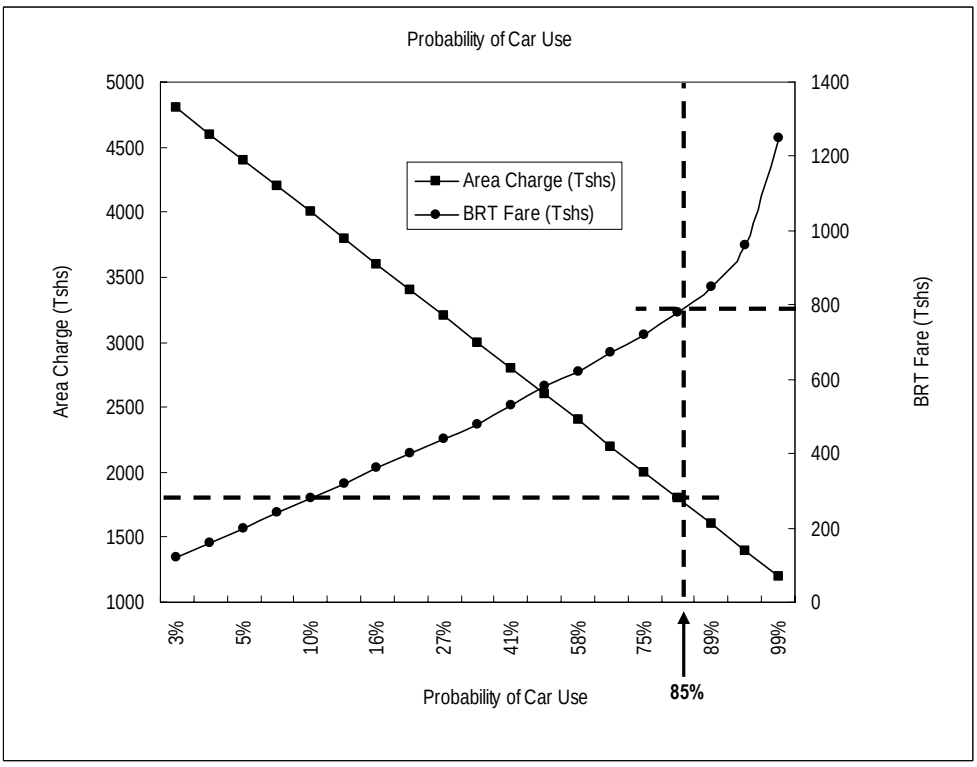
Figure 8.4.9 Result of BRT Choice Model



Source: JICA Study Team

Figure 8.4.10 Result of BRT Choice Model

(2) Application to Traffic Demand Management



Source: JICA Study Team

Figure 8.4.11 Application to Traffic Demand Management

APPENDIX - 8: Survey Forms

Car User Opinion Interview Survey Form (Willingness-to-Pay)

Car User Opinion Interview Survey Form (Stated Preference to BRT/Car)

Survey Location [ ] Sheet No [ ] Interviewer [ ]

Dar es Salaam Transport Policy and System Development Master Plan Study

Dar es Salaam City Council is now actively engaged to develop the urban transportation master plan with the target year of year 2030. This interview form is prepared in order to grasp trip characteristics of the car users and preference to Bus Rapid Transit (BRT). The result of this interview will provide the basis of traffic modeling to identify the potential users of the BRT. All the information collected will be strictly restricted to the model development purpose and will not be disclosed to the public.

Q0. How long does it take between your home and this parking? [ ]

Q1. How often do you use the bus? [ ]

Q2-1. Why did you do not travel by bus today? [ ]

Q2-2. Why did you do travel by car today? [ ]

Q3. How much does it cost for daily car transport? [ ] Tshs per day

Q4. Bus Rapid Transit (BRT) will be installed soon along the main trunk roads in Dar es Salaam.

- BRT runs on exclusive lane with high speed and no delay.
- **BRT is an articulated long bus which can carry more than 100 passengers.**
- **The future BRT network covers all over Dar and connect to the city centre.**

Is there any possibility that you will change your transport from car to BRT?

1. Possible
2. Impossible

Q5-3. If the travel time by BRT is 40 minutes faster, AT MOST how much you can afford to pay for BRT per trip?	Tshs per trip
Q5-2. If the travel time by BRT is 20 minutes faster, AT MOST how much you can afford to pay for BRT per trip?	Tshs per trip
Q5-1. If the travel time by BRT is same to now, AT MOST how much you can afford to pay for BRT per trip?	Tshs per trip

Q6. Please answer the following.

Sex: 1: Male / 2: Female   Home Address: (Ward) (Municipal)

Question 0.

1. 0-30 min
2. 30-50 min
3. 50-70 min
4. 70-100 min
5. Over 100 min

Question 1.

1. Almost every day
2. 2-3 times a week
3. A few times in a month
4. Never use

Question 2-1.

1. Bus is not available.
2. Bus is discomfort (dirty, smelling, etc.)
3. Bus is not convenient (long waiting)
4. Bus is not safe.
5. Bus is not reliable (no punctuality).
6. Other reason
( )

Question 2-2.

1. I need to drive for somebody. (e.g., sending my son to school)
2. I need to take some goods. (e.g., luggage, parcel, cargo)
3. I need to drive from one place to another.
4. I don't like the public transport.
5. Other reason
( )

Image Picture of Bus Rapid Transit

Survey Location | Sheet No | Interviewer

Dar es Salaam Transport Policy and System Development Master Plan Study *Form 120-1*

Dar es Salaam City Council is now actively engaged to develop the urban transportation master plan with the target year of year 2030. This interview form is prepared in order to grasp trip characteristics of the car users and preference to Bus Rapid Transit (BRT). The result of this interview will provide the basis of traffic modeling to identify the potential users of the BRT. All the information collected will be strictly restricted to the model development purpose and will not be disclosed to the public.

Q0. How long does it take between your home and this parking?

Q1. How often do you use the bus?

Q2. Why did you do not travel by bus today?

Q3. Bus Rapid Transit (BRT) will be installed soon along the main trunk roads in Dar es Salaam.

- **BRT runs on exclusive lane with high speed and no delay.**
- **BRT is an articulated long bus which can carry more than 100 passengers.**
- **The future BRT network covers all over Dar and connect to the city centre.**

At the same time, Area Pricing System will be introduced, that imposes the drivers who enter CBD to pay, *like, an entrance fee.*

Is there any possibility that you will change your transport from car to BRT?

1. Possible → Go to Q4.
2. Impossible → If answer 2, please specify the reason.

Q4. If BRT and Area Pricing System are installed and your travel by car between your home and city centre increases, which do you prefer, car or BRT, for each case given below?

	Car		BRT		Preference
	Area Pricing Charge (per day)	Travel Time (per trip)	Fare (per day)	Travel Time (per trip)	Car (1) or BRT (2)
Case 1	2,000 Tshs	120 min	800 Tshs	120 min	
2	1,500 Tshs	120 min	800 Tshs	120 min	
3	1,000 Tshs	120 min	800 Tshs	120 min	
4	700 Tshs	120 min	800 Tshs	120 min	
5	500 Tshs	120 min	800 Tshs	120 min	

Car is CHEAP and takes same time.

Car is EXPENSIVE and takes same time.

Q5. Please answer the following.

Sex: 1: Male 2: Female | Home Address (Ward) (Municipal)

Question 0.

1. 0-30 min > Use **Form 20**
2. 30-50 min > Use **Form 40**
3. 50-70 min > Use **Form 60**
4. 70-100 min > Use **Form 90**
5. Over 100 min > Use **Form 120**

Question 1.

1. Almost every day
2. 2-3 times a week
3. A few times in a month
4. Never use

Question 2.

1. Bus is not available.
2. Bus is discomfort (dirty, smelling, etc.)
3. Bus is not convenient (long waiting)
4. Bus is not safe.
5. Bus is not reliable (no punctuality).
6. Other reason
( )

Question 3.

1. I need to drive for somebody. (e.g., sending my son to school)
2. I need to take some goods. (e.g., luggage, parcel, cargo)
3. I need to drive from one place to another.
4. I don't need to pay for use of the car.
4. I don't like the public transport.
5. Other reason
( )

Image Picture of Bus Rapid Transit