

## **CHAPTER 16**

# **TECHNICAL SUPPORT TO OTRACO**



## CHAPTER 16 TECHNICAL SUPPORT TO OTRACO

### 16-1 PRESENT CONDITION

#### 16-1-1 Bus Operation

##### (1) Introduction

OTRACO provides the public transportation services which includes the non-profitable bus routes as a public transport agency, because of the provision of the social services for all Burundians.

68 units of large buses in 1983-1984 and 67 units of large buses in 1989 were procured to OTRACO by the Japanese Grant Aid Project. The number of large buses owned by OTRACO exceeded approximately 100 units before the civil conflict in 1994. However, most of those large buses and equipments have been damaged, and skilled workers have also been lost due to civil conflict which continued for almost 13 years since 1994. Only 42 buses are currently in operation, that is to say OTRACO has not yet recovered the condition of the level of its bus operation network and system achieved before the civil conflict.

**Table 16.1.1 Bus Operation Situation from 1991 to 2006**

	1991	1992	1993	2003	2004	2005	2006
Number of buses holding of buses in operation	51	60	50	31	36	43	42
Total mileage (km)	2,287,439	2,409,611	2,226,735	898,616	815,652	660,936	813,058
Total of passengers	5,422,033	4,992,597	No records	No records	No records	No records	No records
No. of Bus routes					57	42	49
Annual Revenue (Fbu)				489,949,314	517,346,307	483,632,416	576,585,716
No of Staffs	238	248	210	237	98	96	98
source	Annual report						

##### (2) Category of bus operation services

Type of bus operation services consist of 5 categories;

Category 1: Urban Bus Service in Bujumbura City (5 routes)

- Category 2: Sub-urban Service surrounding Bujumbura City (4 routes)
- Category 3: School bus service for the students in Bujumbura (11 routes)
- Category 4: Inter-urban service from Bujumbura City (18 routes)
- Category 5: International bus service between Bujumbura and Kigali/Rwanda (1 route)

39 bus routes in total are operated by OTRACO currently. Existing operated bus routes and bus route map are shown in Table 16.1.2 and Figure 16.1.1.

#### 1) Urban Bus Service in Bujumbura

Urban bus services are operated from 6:00hrs to 19:00hrs as a weekday service. Number of operation frequency for urban bus services is from 2 to 4 round trips per weekdays. (Normally 4 times roundtrips: Going to the office in the morning, going home at lunch time, going to the office after lunch, going home at evening)

Almost bus passengers for urban bus services are workers from the industrial area as well as from hospitals.

##### - Other information

Operated Bus Type:	Large Bus (100 passengers capacity)
Bus fare:	220 FBu/one trip
Bus route condition:	Paved road

#### 2) Sub-urban Bus Service surrounding Bujumbura city

There are 4 sub-urban bus routes those destinations are at Gatumba and Ruziba located approximately 20km away from Bujumbura City. Number of operation frequency for sub-urban bus services is from 2 to 4 round trips per weekdays.

##### - Other information

Operated Bus Type:	Large Bus (100 and 60 passengers capacity)/Medium Bus (40 passengers capacity)
Bus fare:	300 - 350 FBu/one trip
Bus route condition:	Paved road

### 3) School bus for students in Bujumbura city

There are 11 school bus routes which connect between major commune and Schools. Number of operation frequency for school bus services is from 2 to 4 round trips per weekdays.

- Other information

Operated Bus Type:	Large Bus (100 and 60 passengers capacity)/ Medium Bus (40 passengers capacity)
Bus fare:	9,000 – 20,000 FBu/month/student
Bus route condition:	Paved road

### 4) Inter-urban Bus route

There are 18 inter-urban bus routes which connect between Bujumbura and major rural towns. Number of operation frequency is from 1 to 3 round trips per weekdays. And on Saturday and Sunday inter-urban bus routes are operated by the private vehicles when people are going at their home town for weekend.

- Other information

Operated Bus Type:	Large Bus (60 passengers capacity)/Medium Bus (40 passengers capacity)
Bus fare:	500-6,500 FBu/one trip
Bus route condition:	Paved road and unpaved road

### 5) International Bus route

There is one international bus routes which connect between Bujumbura and Kigali (the capital city of Rwanda). This bus service route is shared between OTRACO and ONATRACOM which is the public transport corporation in Rwanda. Number of operation frequency is 3 round trips per week by OTRACO.

- Other information

Operated Bus Type:	Medium Bus (40 passengers capacity)
Bus fare:	8,000 FBu/one trip
Bus route condition:	Paved trunk road

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Table 16.1.2 Existing Bus Operation

No.	Type of Bus Service	Origin	Destination	Bus Fare (FBU)	Operation Hour	Route Length (km/round trip)	Trip Hours (hours/round trip)	No. of Bus Operation	Total No. of Weekly	Total Number of Passenger	Total Trip Hours (52 weeks /year)	Bus Type	Bus fare revenue (FBU) per year
								Weekday	Saturday	Sunday	per day	100/60/40	
1	Inter-urban	Bujumbura	Munini	500-3,500Fbu		275	9	1 x 2	0	0	2	40	80
2	Inter-urban	Bujumbura	Biziracanda	500-3,000Fbu		175	6	1 x 3	1	1	5	40	80
3	Inter-urban	Bujumbura	Cankuzo-Camaz	500-6,500Fbu		556	20	1 x 2	1	1	4	100	400
4	Inter-urban	Bujumbura	Gishuha	500-4,000Fbu		259	9	1 x 3	1	1	5	40	80
5	Inter-urban	Bujumbura	Gishubi	500-3,500Fbu		298	9	1 x 3	1	1	5	40	80
6	Inter-urban	Bujumbura	Gisozi	500-2,500Fbu		172	4	1 x 3	1	1	5	30	60
7	Inter-urban	Bujumbura	Gitega	500-4,000Fbu		250	10	1 x 3	1	1	5	30	60
8	Inter-urban	Bujumbura	Mayuyu	500-2,500Fbu		116	4	1 x 3	1	1	5	40	80
9	Inter-urban	Bujumbura	Mugongo	500-2,500Fbu		148	4	1 x 3	1	1	5	40	80
10	Inter-urban	Bujumbura	Musenyi/Ruhororo	500-4,500Fbu		400	10	1 x 2	1	1	4	100	400
11	Inter-urban	Bujumbura	Buhiga	500-5,000Fbu		365	9	1 x 2	1	1	4	40	160
12	Inter-urban	Bujumbura	Nyabihanga	500-3,000Fbu		197	7	1 x 1	1	1	3	40	160
13	Inter-urban	Bujumbura	Rango	500-3,300Fbu		221	6	1 x 2	1	1	4	40	160
14	Inter-urban	Bujumbura	Mpiga(Rulana)	500-5,000Fbu		382	18	1 x 2	1	1	4	40	160
15	Inter-urban	Bujumbura	Ryansoro	500-3,200Fbu		260	8	1 x 3	1	1	5	30	60
16	Inter-urban	Bujumbura	Vyanda	500-4,000Fbu		303	12	1 x 2	1	1	4	100	400
17	Inter-urban	Bujumbura	Marangara	500-5,500Fbu		420	12	1 x 1	1	1	3	20	80
18	Inter-urban	Bujumbura	Kinyinya	500-5,500Fbu		398	10	1 x 3	1	0	4	40	160
19	Urban	1 Ngagara	Chanic	220FBU	6:00 - 19:00	10	2	1 x 5	0	0	5	80	400
20	Urban	2 Gikungu	Chanic	220FBU	6:00 - 19:00	8	2	4 x 5	0	0	20	320	6,400
21	Urban	3 Msaga	Chuk	220FBU	6:00 - 19:00	15	2	4 x 5	0	0	20	400	8,000
22	Urban	4 Msaga	Chanic	220FBU	6:00 - 19:00	15	2	4 x 5	0	0	20	400	8,000
23	Urban	5 Kanyosha	Chanic	220FBU	6:00 - 19:00	15	2	4 x 5	0	0	20	400	8,000
24	Sub-Urban	1 Gatumba	Grand Bureau	350FBU		22	2	4 x 5	0	0	20	400	8,000
25	Sub-Urban	2 Gatumba	Gasenyi	350FBU		22	2	4 x 5	0	0	10	80	8,000
26	Sub-Urban	3 Ruziba	Marche Central(Ville)	300FBU		15	9	1 x 5	0	0	5	340	1,700
27	Sub-Urban	4 Gatumba	Marche Central(Ville)	350FBU		18	9	1 x 5	0	0	5	400	2,000
28	for Students	1 Kinindo	Lycee Vugizo	9,000FBU/month/student		10	2	2 x 5	0	0	10	200	2,000
29	for Students	2 Musaga	Kinindo-LY. Kamenge	10,000FBU/month/student		15	2	2 x 5	0	0	10	200	2,000
30	for Students	3 Kinindo	EIB(Ecole Indep.)	10,000FBU/month/student		6	2	4 x 3	2	0	14	80	1,120
31	for Students	4 Kinindo	Lyc. SOS	10,000FBU/month/student		18	2	4 x 3	2	0	14	160	2,240
32	for Students	5 Ngagara	Vugizo	9,000FBU/month/student		6	2	4 x 3	2	0	14	80	1,120
33	for Students	6 Ngagara	EIB(Ecole Indep.)	10,000FBU/month/student		20	2	4 x 3	2	0	14	200	2,800
34	for Students	7 Musaga	Lyc. Vugizo	9,000FBU/month/student		10	2	2 x 5	0	0	10	80	8,000
35	for Students	8 Kinindo	LA Colombiere	9,000FBU/month/student		20	2	4 x 5	0	0	20	160	2,240
36	for Students	9 Kinindo	Sem. St. Joseph	10,000FBU/month/student		15	2	4 x 3	2	0	14	80	1,120
37	for Students	10 Kinindo	Michel Archange	10,000FBU/month/student		6	2	4 x 5	0	0	20	400	8,000
38	for Students	11 Kinindo	Universite Lumiere	20,000FBU/month/student		20	2	2 x 5	0	0	10	80	1,120
39	International	1 Bujumbura	Kigali	8,000FBU/oneway		598	8	0.5 x 6	0	0	3	25	150
Total											5,415	85,150	46,956

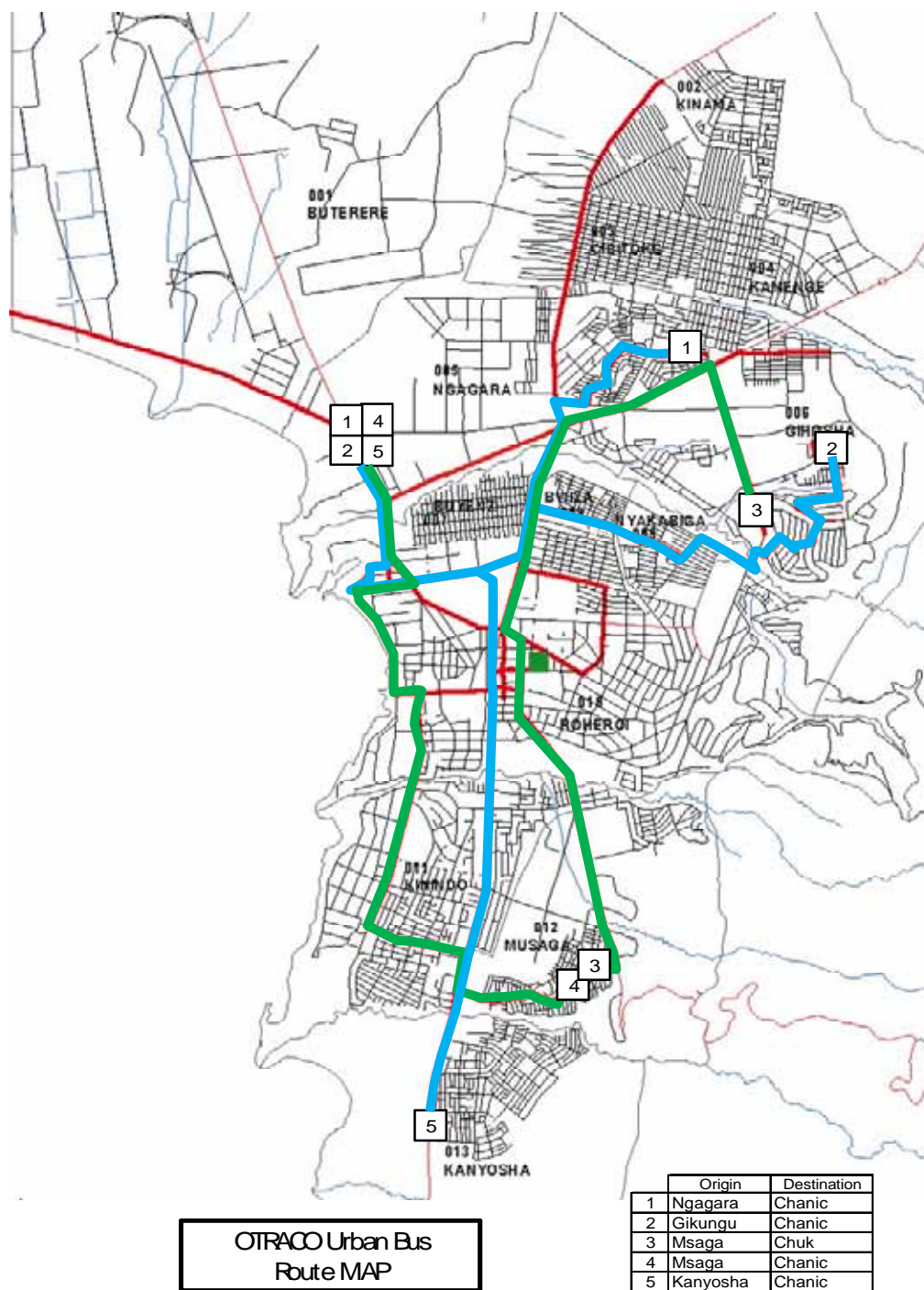


Figure 16.1.1(a) Current Bus Operation Route (Bujumbura City)

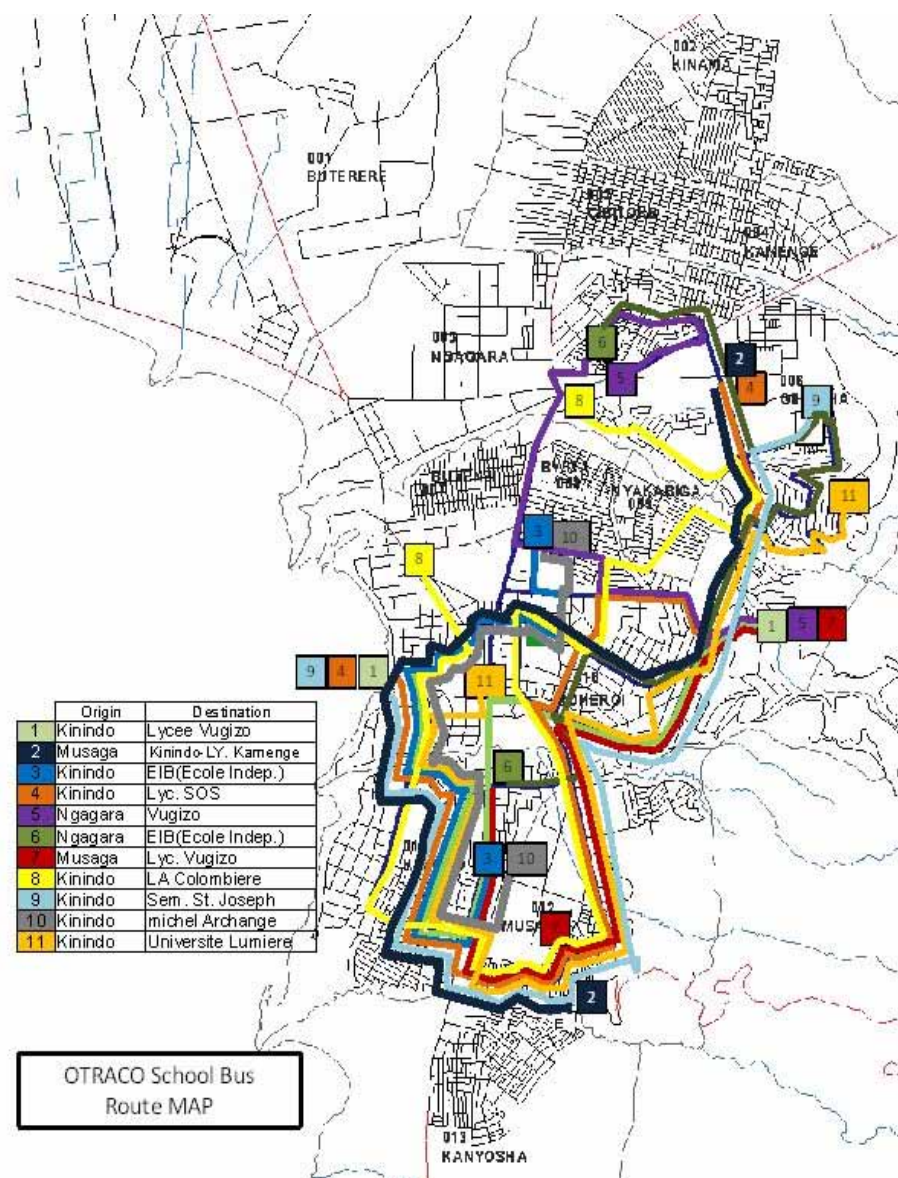


Figure 16.1.1(b) Current Bus Operation Route/School Bus route (Bujumbura City)



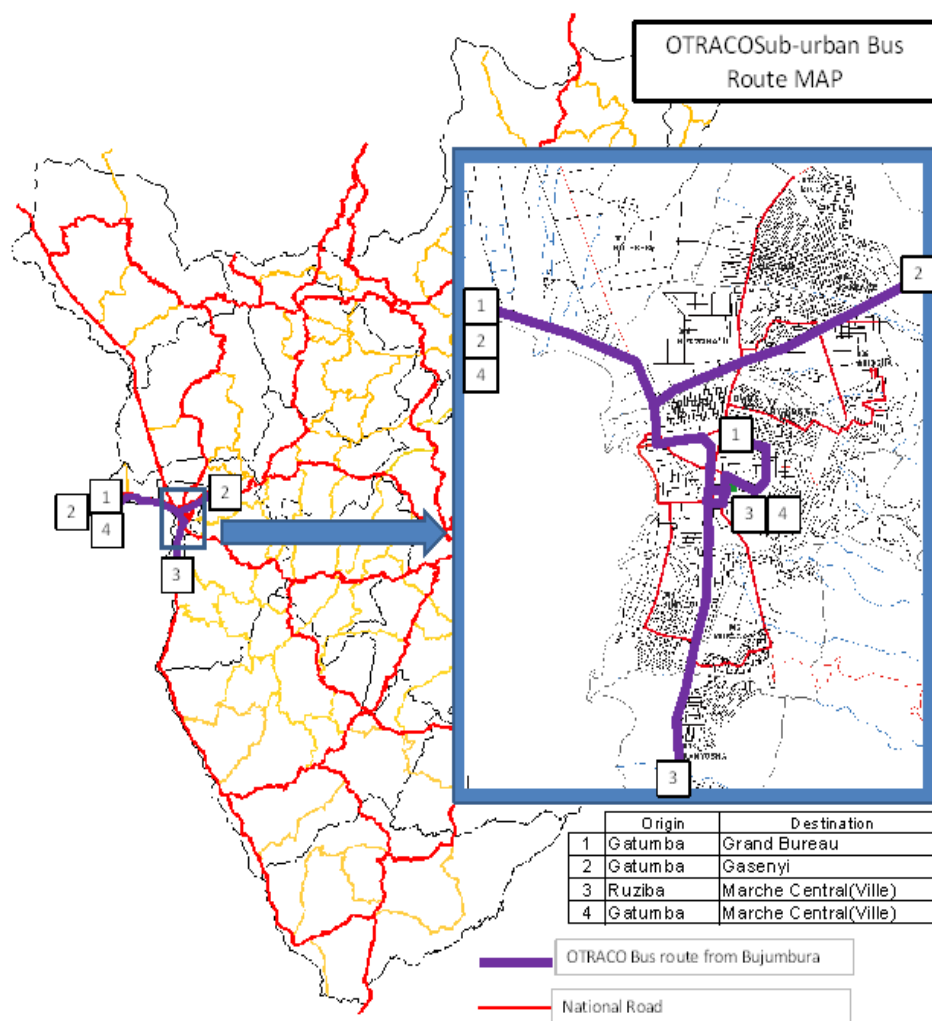


Figure 16.1.1(c) Current Bus Operation Route (Interurban Bus route from Bujumbura)

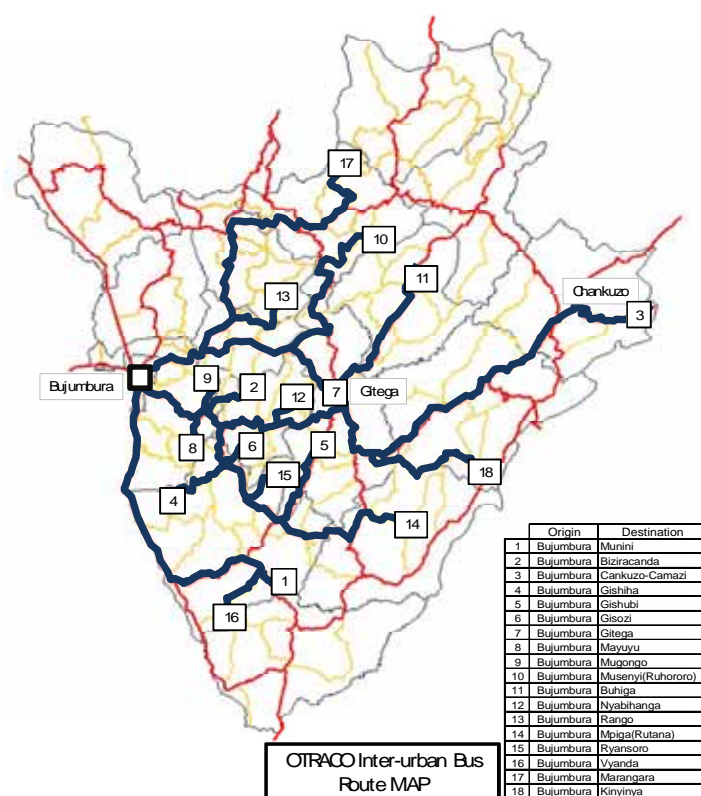


Figure 16.1.2(a) Current Bus Operation Route (Rural Bus Service)

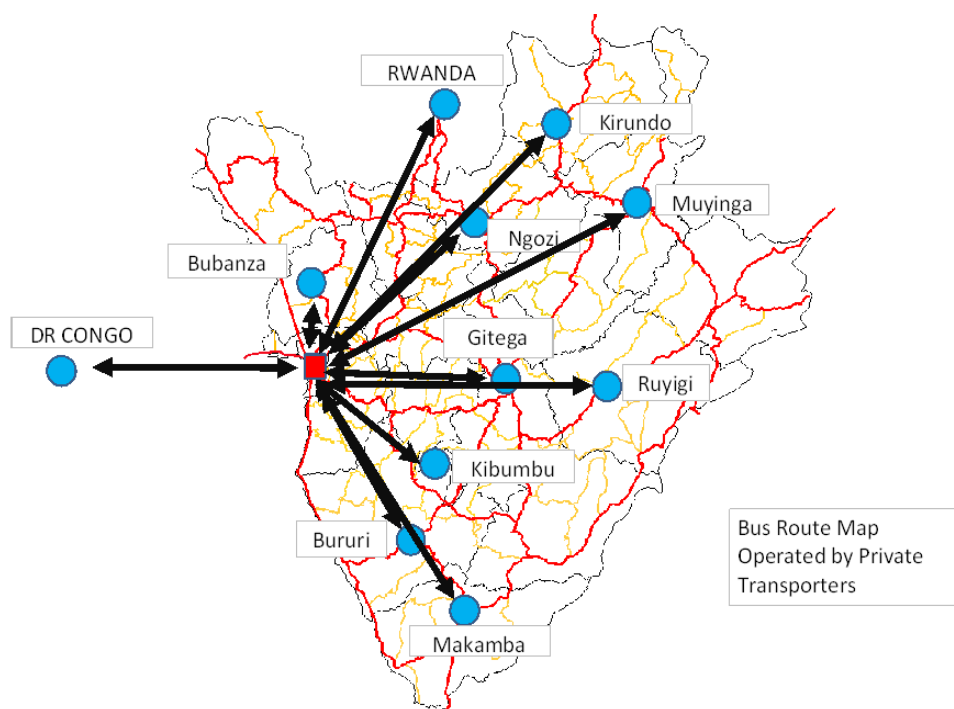


Figure 16.1.2(b) Current Private Bus Operation Route (Rural Bus Service)

### (3) Bus operation system for Bujumbura city bus operation service

The services on each particular route are normally started in the morning whereby all buses depart from the OTRACO garage to their respective routes. Mostly the Bujumbura city bus services are operated approximately 4 round trips particularly at the time of going to business in the morning, going home at lunch time, going to business after lunch and going home in the evening.

Beyond the above-mentioned time, all buses return without passengers to OTRACO.

Cost of fuel consumption for empty operated buses should be minimized to reduce the deficit. Advice should be given to OTRACO drivers that when going to work in the morning they should walk or use minibuses from their home to OTRACO garage.

There are 3 OTRACO bus stations located at Kamenge, Nyagabiga and Musaga in Bujumbura city. However, these bus stations are not organized to cope with the current situation.

Current bus operation system of one starting/ending point (OTRACO garage) should be changed. Buses should be distributed and parked at 3 bus stations. By changing the current single starting point (OTRACO garage) to 3 bus stations, drivers can minimize the time spent to go to work; in that case the stable bus operation can be secured. Along with that the fuel consumption will be reduced, because of the decrease of the driving distance without passengers from the origin of starting stations to the destination.

### (4) Task of the Bus Transport Operation Department

Bus transport operation department consists of 2 sections. These sections are bus operation and management section and inspection section. The section's management consists of only 1 manager, 1 assistant manager and 5 staffs. Task for each section is as shown below;

The daily records of bus operation are recorded manually.

**Table 16.1.3 Task of the Bus Operation and Inspection sections**

<b>Organisation</b>	<b>Task</b>
Bus Operation and Management section	<ul style="list-style-type: none"> <li>- Preparation of Bus operation plan</li> <li>- Newly opened bus route plan</li> </ul>
Inspection section	<ul style="list-style-type: none"> <li>- Check of the collected tickets</li> <li>- Check of bus operation situation</li> <li>- Check of bus route condition</li> <li>- Check and control of driver's performance</li> </ul>

**(5) Management system for bus operation**

Bus transport operation department coordinates with technical Service department to make bus operation plan.

Bus operation plan is revised in consideration of the bus maintenance condition prepared by the technical Service.

**16-1-2 Bus Maintenance****(1) General Condition****1) Condition of Buses**

At present, OTRACO owns only 68 vehicles (the administrative vehicles are not included), of which about 60 % is in operation naming and among the operational vehicles the majority are 40 passenger buses (70% of running buses). All bus conditions are as follow (Details are presented in Appendix-2);

Table 16.1.4 Current Bus Condition

Condition Capacity	Running	Grounded* <sub>1</sub>	Scrapped	Total	Ratio (%)
100	8	3	3	14	20.6
60	4	2	9	15	22.1
40	30	6	2	38	55.9
26	0	0	1	1	1.5
Total	42	11	15	68	100.0
Ratio (%)	61.8	16.2	22.1	100.0	

\*1; for waiting repair

The ratio of vehicles older than 15 years or more is about 37 %. It can be mentioned here that these vehicles are still able to operate because of these strong and durable bodies compared with standard models in those days. However, it seems that the operation of these vehicles will decrease extremely in near future and the maintenance will become uneconomical and inefficient because of difficulty in procurement of spare parts and increasing maintenance time.

Table 16.1.5 Bus Condition by Manufactures Year

Capacity	100		60		40		26		Total	Ratio (%)
Condition Man. Year	Running	Repair/ Scrapped	Running	Repair/ Scrapped	Running	Repair/ Scrapped	Running	Repair/ Scrapped		
1983	0	0	2	1	0	0	0	0	3	4.4
1984	2	2	0	0	0	0	0	0	4	5.9
1989	2	3	2	10	0	0	1	1	19	26.5
1999	0	0	0	0	1	1	0	0	2	2.9
2000	0	0	0	0	6	3	0	0	9	13.2
2002	1	1	0	0	4	3	0	0	9	14.7
2003	2	0	0	0	6	0	0	0	8	11.8
2005	1	0	0	0	8	0	0	0	9	13.2

The causes of low availability (utilization rates) are as follows;

1. There are comparatively a lot of old model vehicles.
2. Due to the bad road condition, there are a lot of body breakdowns which require long time to repair.
3. Procurement period takes a long time.

4. Procurement of genuine parts is difficult. The frequent occurrence of the breakdown is inevitably caused by procurement of imitation parts which lead to other breakdowns and ending up in grounded situation.
5. Preventive maintenance is not done as scheduled.

The breakdown causes of vehicles still in operable condition and waiting for repair are as follows:

**Table 16.1.6 Cause of breakdown**

ID No.	MODEL	CAUSE OF BREAKDOWN
A18	CHR-680	Engine, Clutch, Transmission
A20	CHR-681	Engine
B07	JCR 500	Suspension
B47	MT112	Engine, Transmission
C39	NPR66	Engine, Suspencion, Brake, Clutch
C42	NPR66	Engine
C44	NPR66	Body
C46	NPR66	Engine
C51	NPR66	Engine
C58	NPR66	Engine, Transmission
98490	MV-118	Spring

There are a lot of break downed vehicles which are of old aged type (CHR-680, MT112, and JCR500) and medium-size buses (NPR66). The causes are;

Old aged type (CHR-680, MT112)

- Breakdown of engine; 18-23 years passed since produced
- Body breakdown due to bad road condition
- Spare parts are hard to get (out of production )

Medium-size buses (NPR66)

- Body breakdown due to bad road condition
- Engine failure due to overloading during high altitude operation

## 2) Repair Frequency

Repair frequency and spare parts consumption for last four years were as follows:

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Table 16.1.7 Breakdown components and frequency in last 4 years

Section	Year & Model Type of Brake.	2004						2005						2006						2007(Jan. to Aug.)					
		NPR	MT	CHR	MV	Total	(%)	NPR	MT	CHR	MV	Total	(%)	NPR	MT	CHR	MV	Total	(%)	NPR	MT	CHR	MV	Total	(%)
H	1 Engine	1	2	2	0	5	1.1	3	0	1	0	4	0.7	2	0	0	0	2	0.3	4	2	1	0	7	1.2
E	2 Transmission	0	1	0	0	1	0.2	1	2	0	0	3	0.5	1	0	0	0	1	0.2	1	0	0	0	1	0.2
A	3 Differential	3	0	0	0	3	0.7	5	1	0	0	6	1.1	7	0	0	0	7	1.2	4	1	0	0	5	0.9
V	4 Brake	48	3	5	3	59	13.4	73	3	2	7	85	15.5	74	2	0	7	83	13.8	100	2	2	10	114	20.1
W	5 Clutch	4	1	1	0	6	1.4	4	0	1	0	5	0.9	3	1	0	2	6	1.0	7	1	6	1	15	2.6
O	6 Shock absorber FRT	0	2	0	0	2	0.5	3	1	0	0	4	0.7	0	0	0	0	0	0.0	6	1	2	0	9	1.6
R	7 Shock absorber RR	0	1	0	0	1	0.2	3	2	0	0	5	0.9	0	0	0	0	0	0.0	4	1	0	2	7	1.2
K	8 Spring	10	2	6	1	19	4.3	15	4	4	5	28	5.1	24	4	4	21	53	8.8	10	1	3	15	29	5.1
VI	9 Periodical Service	98	12	16	10	136	31.0	101	10	11	16	138	25.1	113	11	7	5	136	22.7	79	2	6	14	101	17.8
EL	10 Electrical	51	11	13	5	80	18.2	57	15	8	15	95	17.3	54	14	13	18	99	16.5	70	10	21	9	110	19.4
TR	11 Tire	70	6	3	3	82	18.7	100	8	2	15	125	22.8	126	8	1	10	145	24.2	90	0	0	20	110	19.4
BD	12 Body	31	9	5	0	45	10.3	37	8	6	0	51	9.3	54	10	2	2	68	11.3	42	6	6	5	59	10.4
	TOTAL	316	50	51	22	439	100	402	54	35	58	549	100	458	50	27	65	600	100	417	27	47	76	567	100
	(%)	72.0	11.4	11.6	5.0	100		73.2	9.8	6.4	10.6	100		76.3	8.3	4.5	10.8	100		73.5	4.8	8.3	13.4	100	

VI: Vehicle Inspection, EL:Electrical, TR:Tire, BD:Body

Table 16.1.8 Spare parts consumption in last 4 years

Parts name	Type	2004	2005	2006	2007	Parts name	Type	2004	2005	2006	2007
	MV123	6	3	7	5		MV123	0	0	1	0
Oil Filter	MV118	6	3	7	2	Clutch Plate	MV118	0	0	1	0
	NPR66	70	61	51	38		NPR66	5	2	2	4
	MV123	0	0	0	6		MV123	0	0	0	2
Fuel Filter	MV118	1	2	3	6	Leaf Spring	MV118	0	0	0	2
	NPR66	25	30	19	27	(FRT)	NPR66	2	4	7	1
	MV123	0	0	0	0		MV123	0	0	0	3
Air Cleaner	MV118	0	0	0	0	Leaf Spring	MV118	0	0	0	2
	NPR66	4	2	1	1	(RR)	NPR66	0	0	1	2
	MV123	0	0	0	0		MV123	0	0	2	1
Fan Belt	MV118	0	0	0	0	Center Bolt	MV118	0	0	0	4
	NPR66	0	0	4	1	(FRT)	NPR66	0	0	6	0
	MV123	1	4	3.5	2.5		MV123	0	0	4	5
Brake Lining	MV118	1	2	1	1	Center Bolt	MV118	0	0	4	3
(FRT)	NPR66	41	38	44	47	(RR)	NPR66	0	0	0	0
	MV123	1	7	5	4.5		MV123	0	0	20	4
Brake Lining	MV118	2	0	1	1	Whell Nut	MV118	0	94	71	4
(RR)	NPR66	41	38	44	47.5	(FRT)	NPR66	52	105	31	8
	MV123	0	0	0	1		MV123	0	0	20	8
Hub Bearing	MV118	0	0	0	1	Whell Nut	MV118	0	94	71	3
(FRT)	NPR66	2	0	7	2	(RR)	NPR66	52	105	31	17
	MV123	0	0	0	0		MV123	0	0	4	0
Hub Bearing	MV118	0	0	0	2	Battery	MV118	2	0	0	0
(RR)	NPR66	0	0	4	3		NPR66	23	14	11	12
	MV123	0	0	0	0		MV123	18	12	0	3
Hub oil Seal	MV118	0	0	0	1	Tire	MV118	22	14	22	5
(FRT)	NPR66	0	4	6	10		NPR66	180	170	227	42
	MV123	0	0	0	2						
Hub oil Seal	MV118	0	0	0	2						
(RR)	NPR66	30	34	30	27						
	MV123	0	0	2	1						
Clutch Disk	MV118	0	0	1	1						
	NPR66	10	3	9	9						

The total breakdown number has risen up to 37% in last two years. Repaired parts or components were mainly related to brake, tyre, electricity or the body. And the main causes of these damages are:

1. Vibration and frequent braking due to bad road condition and high attitude operation.
2. Body breakdown for few error margins between Gross vehicle weight and actual passenger weight.
3. Use of inferior parts
4. Lack of preventive inspection
5. Improper operational management and technology (including the inspection before starting work).

It is to some extent possible to prevent those damages through regular preventive inspection and replacement in advance of the frequently damaged parts. However, as the consumption of periodical maintenance parts are less than the check frequency, and because the periodical check is the calculated normal check, it is necessary to clarify the reason.

### 3) Cause of Trouble

- General

During the 5-week survey in the garage, 42 buses were brought into the heavy repair section without battery charging, and there were 50 problems found in those buses. 37 among 50 problems were on the chassis system. (Table 16.1.9)

**Table 16.1.9 Numbers of trouble**

	Chassis	Electric	Engine	Fuel	Total
Numbers	37	6	4	3	<b>50</b>

Among the 37 problems on the chassis system, 16 were brake lining changing, 3 brake dragging, 1 brake oil leaking, 2 wheel hub seal leaking, and 2 wheel clip bolt changing. This shows that 64 percent of the total chassis system problems are brake problems (Table 16.1.10). Therefore, almost half of work done by the heavy mechanics involves the brake overhaul maintenance in which the causes realized were mechanical and some managed problem. It was also found out that their overhaul procedure and adjustment were not correct and thus they may induce many other problems. In order to reduce brake problems and personnel's labour, a proper brake overhauling system is required and any wrong indication should not be overlooked when overhauling. On the other hand, lack of data management are also seen in the both mechanical and store section, as a result, some buses are seemed to be given new delivery of spare parts for the exchange work, because of no inquiry and record of an original



failure cause.

**Table 16.1.10 Number of chassis trouble (including Brake overhaul works)**

	Rear Brake lining changing	Front Brake lining changing	Brake dragging	Brake oil leaking	Wheel hub seal leaking	Clip bolts changing	Total
Numbers	13	3	3	1	2	2	24

**Table 16.1.11 Number of chassis trouble (except Brake overhaul works)**

	Kingpin changing	Cross joint changing	Rear Leaf spring changing	Front Leaf spring changing	Power steering oil leaking	Clutch overhauling	Total
Numbers	2	1	3	3	3	1	13

- Vehicle weight

It appeared that many troubles of brake system and chassis system may be related with the weight of buses themselves. The weight of buses were as following; medium size buses weighed between 4,000kg and 4,500kg, large size buses weighed between 11,000kg and 12,000kg. The gross vehicle weight of medium size bus is 7,000kg and that of large bus is 16,000kg. The vehicle net weight is defined as the total weight of bus and its passengers. While the vehicle net weight of small size bus is less than the vehicle gross weight, the vehicle net weight of large size bus is more than the vehicle gross weight (Table 16.1.12). It was also observed that bus weight (both large size buses and medium size buses) tend to increase as a result of adding stronger frames and large sized window shield on buses.

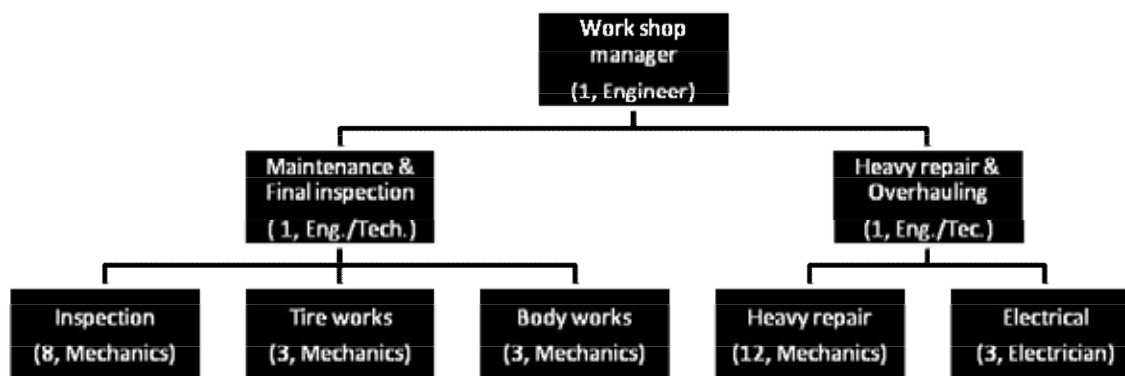
As some small size buses are used on routes with rough road surfaces, their brake system and chassis system seemed to be seriously damaged due to the effect of weight. Many troubles relating to chassis may arise after using buses on the type of roads aforementioned for the period of 1 to 2 years.

**Table 16.1.12 Relation with Vehicle weight and Gross vehicle weight**

Reg. No.	Model	Year	Vehicle gross weight	Vehicle weight	sheets	Unit Passenger weight	(A) - (B) - (C×D)
			(A)	(B)	(C)	(D)	
98460	NPR68	2000	7,000	4,090	30	70	<b>810</b>
98501	NPR69	2003	7,000	4,290	30	70	<b>610</b>
98534	NPR67	2005	7,000	4,195	30	70	<b>705</b>
98591	NPR66	2006	7,000	4,500	30	70	<b>400</b>
98489	MV118	2002	16,000	11,600	63	70	<b>-10</b>
98499	MV-123	2003	16,000	11,730	63	70	<b>-140</b>
98561	MV-123	2005	16,000	12,090	63	70	<b>-500</b>
98593	MV-123	2006	16,000	11,490	63	70	<b>100</b>

**(2) Maintenance Organization**

The maintenance management section is comprised of 32 employees in total of which 29 are site mechanics and 3 are management personnel. Eight (8) mechanics are in charge of vehicle inspection (the final inspection of OTRACO buses is also included), and sometimes they are also engaged in general maintenance works depending on their workload. Two mechanics are also arranged to keep maintenance and inspection record. Maintenance section organization chart is shown below;

**Figure 16.1.3 Maintenance section organization chart**

### (3) Maintenance Facilities

The main maintenance duties are done in Bujumbura headquarters facilities. There exist two type of facilities namely facility for heavy maintenance work (where 10-15 vehicles can be repaired) and car inspection facility which located in a part of administration buildings. The parking lot for these facilities has the capacity of parking about 200 large-scale bus vehicles. The headquarters facilities have equivalent capacity with those found at Gitega facilities established through grant aid in 1991, which is currently not in use because of the civil conflict.

Moreover, facilities where smooth operation can be provided (platform and carwash) with a small-scale management to three places (northern part at Kamenge, centre part at Nyakabiga, and southern part at Musaga) in the city are being repaired now.

### (4) Maintenance Budget

Since the maintenance budget as well as fuel and personnel expenses takes greater part of whole budget, proper management of maintenance budget is important to reduce the expenditure. The maintenance expenditure ratio (maintenance ratio) with in last three year's whole expenditure is 15-20%. So far as revenue includes government subsidy, revenue and expenditure ratio is more or less appropriate. However, were not for the subsidy, the figure becomes 19-26% and will continue to rise. The subsidy will be needed for several years in the future. Transitions of the maintenance management expenditure ratio for last three years with and without government subsidy are as follows:

**Table 16.1.13 Maintenance ratio**

Year	TOTAL INCOME( I )	TOTAL EXPENSES( E )	BALANCE	MAINTENANCE(ME)	MR(%)
2006	1,035,678,701	1,003,953,656	31,725,045	148,278,238	14.8
2005	805,292,527	734,331,659	70,960,868	123,750,349	16.9
2004	742,260,585	746,854,684	-4,594,099	158,248,802	21.2

**Table 16.1.14 Maintenance ratio (without Government subsidy)**

Year	TOTAL INCOME ( I )	TOTAL EXPENSES ( E )	GOV. SUBSIDY	BALANCE	ACTUAL INCOME (AI)	MAINTENANCE (ME)	ME/AI(%)
2006	1,035,678,701	1,003,953,656	267,944,044	-236,218,999	767,734,657	148,278,238	19.3
2005	805,292,527	734,331,659	201,799,997	-130,839,129	603,492,530	123,750,349	20.5
2004	742,260,585	746,854,684	135,520,000	-140,114,099	606,740,585	158,248,802	26.1

**Table 16.1.15 Total maintenance cost**

	Tire	Battery	Spareparts	Total
100	3,000,000	960,000	5,500,000	9,460,000
60	3,360,000	280,000	3,300,000	6,940,000
40	37,800,000	1,200,000	17,600,000	56,600,000
Total	44,160,000	2,440,000	26,400,000	73,000,000

To calculate the reserve fund, 40% is to be added to this total assumption.

Reserve fund (numbers of vehicles other than average operation vehicle were considered) is to be  $73,000,000 \times 1.4 = 102,200,000$ FBu.

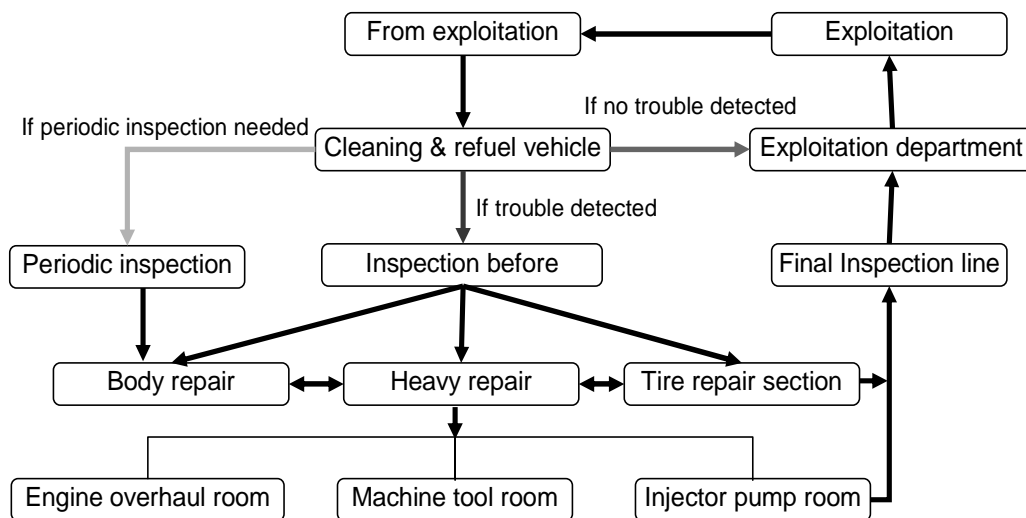
This is 12-15% when calculating by the ratio of income and expenses without the government subsidy.

#### (5) Maintenance Procedure

Buses are washed and refuelled after operation. The maintenance is started in the following procedure;

- If a driver reports that no problem happened, the bus is not inspected and is used again.
- When a driver reports a problem; the bus is checked by an inspector. After the inspector confirms a problem and makes an instruction paper, the bus is sent to the proper section for maintenance.
- A periodic inspection is done by an inspector after the bus ran for certain mileage. During a periodic inspection, an inspector usually changes engine oil and other oils such as differential oil, but there is no proper periodic inspection check list.
- Most OTRACO buses are used for local routes on every Wednesday, Saturday and Sunday and so buses are inspected beforehand on Tuesday, Thursday and Friday by the inspectors

After the necessary maintenance has been finished, buses are sent back for re-inspection. Buses become ready for use only after an inspector submits a report to the Transport operation Department. The main tasks of the inspectors are to find the problems and the heavy repair mechanics detect the cause of the problems.



**Figure 16.1.4 The Service structure of OTRACO garage**

#### (6) Staff Condition

##### 1) Capacity of Staff

Investigation was done using questionnaire to confirm and evaluate the maintenance personnel's (mechanic) qualification and technical knowledge. The questionnaire details were as follows (Detail assessment check sheet are shown in Appendix-3);

- Academic background
- Experience and its detail
- Basic knowledge (Periodical check / Difference between 2 and 4-wheel drive etc.)
- Applied knowledge (operation for emergency of breakdown etc.)

And the questionnaire details for the management workers (engineer, technician) were

- Academic background
- Experience and its detail
- Administrative ability (Personnel arrangement/ processing a problem etc.)
- Management ability (vehicle confirmation and capital machine parts management, etc.)

The following are the results. (10 is the full mark)

**Table 16.1.16 Evaluation for maintenance management section**

Section \ Evaluation	Experience (year)	Basic Knowledge	Advanced Knowledge	Management	Total
Mechanical Management	17	7.5	8	6	7.5
Mechanic	23	6	7		6.5

The mechanics' experience is evaluated to be enough to deal with the OTRACO buses because 60% of the mechanics have experience of ten years or more and the models of the operating vehicles, which are grouped into four models and of a single manufacturer, are limited. However, since the shortage of equipments and tools, insufficient manuals and little opportunity of training are making it hard to attain advanced techniques, the required time for troubleshooting and repair shows the tendency to increase. In the same way, better performance might be difficult though both of management and the technical staff have enough experience and knowledge. For example, workers try to perform an advanced troubleshooting work without a required comprehension of basic methods.

Since 18 out of 26 mechanics have qualification of technical junior school graduates and 4 other of technical high school graduates (Table 16.1.7), many of them have sufficient knowledge about automobile structure and function of each device. Though they are able to use maintenance tools and equipment, their abilities to adjust each device properly and safely are not in the same level.

**Table 16.1.17 Academic Background of OTRACO Mechanics**

Academic Background Section	Degree (4 years)	Technical high school (3 years)	Technical junior school (4 years)	Primary school (7 years)
Engineer, Eng/Technician	2	1	0	0
Inspection Mechanic	0	2	6	0
Heavy repair mechanics	0	1	9	2
Electrical mechanics	0	0	3	0
Total	2	4	18	2

More than half of mechanics have been working for more than 11 years in OTRACO. (Table 16.1.8) Therefore, they are rather quick to deal with the jobs which they are used to but they are not very careful. They tend to depend too much on their experience so they are not able to work systematically and they face difficulties to detect the cause of the problem which they did not have experience of.

**Table 16.1.18 Length of service of OTRACO Mechanics**

Length of service Section	Less than 5 years	6-10 years	11-15 years	16-20 years	More than 20 years
Engineer, Eng/Technician	0	0	1	2	0
Inspection Mechanic	2	2	1	1	2
Heavy repair mechanics	5	2	1	3	1
Electrical mechanics	1	0	0	2	0
Total	8	4	3	8	3

2) Validities of number of staff arrangement to the number of buses (Working hours and Work efficiency)

An appropriate arrangement of the personnel will not only reduces maintenance cost but also will improve work efficiency. Conditions and results of verification of the present personnel arrangement (work efficiency) are as follows:

1. Working hours is 7.5 hours a day.
2. Work days are 250 days a year.
3. Break within the work is 20% of total working hours.
4. Working hours are set according to the working hour's table that OTRACO uses.
5. It doesn't include the management workers (persons in charge of the section) either.
6. It multiplied by the existing work recorded

The values of overall mean and by each section are as follows. (Refer to attached material for total working hours and the calculating formula for each breakdown, Appendix-4.)

Last year's work efficiency and the working hours for three years were as follows;

**Table 16.1.19 Work efficiency**

	2004	2005	2006	Section	Efficiency ratio
Total working hours	1,614	1,962	2,118	Heavy Repair	6.1
Increasing rate(%)	100	121.5613	131.2268	Inspection	13.7
				Electrical	4.6
				Body	4.0
				Tyre	10.3
				Avarage	6.8

The validity of the staff assignment of the heavy maintenance section is as follows.

**Table 16.1.20 Work efficiency reference value**

No. of appropriate arrangement	+4	+2	-2	-4
Work efficiency ratio	-6 ~ -4	-3 ~ 1	2 ~ 3	4 ~ 6

Note:

- 4 ~ -6      Need 4 mechanics replenishment.
- 1 ~ -3      Need 2 mechanics replenishment.
- 2 ~ 3       Capacity is excessive by about 2 mechanics.
- 4 ~ 6       Capacity is excessive by about 4 mechanics.

From the calculation of work efficiency, it is understood that there is room in the staff arrangements (There is room of about 4 mechanics). Moreover, special departments such as body, tyre and electricity are arranged with minimum necessary number of staff (each section should have 3 mechanics and Inspection section which will work on public car inspection).

A further verification might be necessary because work efficiency becomes 4.1 as a whole in comparison with the average value of 4.0, as the heavy repair section does not include the personnel who were recruited at the end of last year (4 mechanics). Moreover, after the maintenance record is introduced, a repeated verification might be necessary for proper personnel arrangement.

### 3) Maintenance management and Operation management

Validity of maintenance management to the operation management was vilified according to the necessary working hours per duty, breakdown frequency per day and operation hours per day.

- Breakdown frequency per day;  
 $600 \text{ (total entry number)} \div 250 \text{ (net working days)} = 2.4 \text{ (times/day)}$
- Average working hours per vehicle;  
 $2,118 \text{ (total working hours)} \div 600 \text{ (total entry number)} = 3.6 \text{ (hours/vehicle)}$
- Ratio of repair entry number to the average number of operational buses;  
 $2.4 \text{ (times/day)} \div 42 \text{ (number of operational buses)} \times 100 = 6\%$
- Ratio of repair hours to the total operating hours per day;  
 $3.6 \text{ (repair work hours/vehicle)} \times 2.4 \text{ (daily breakdown frequency)} \div (46,956 \div 365) \text{ (daily operating hours)} = 7 (\%)$



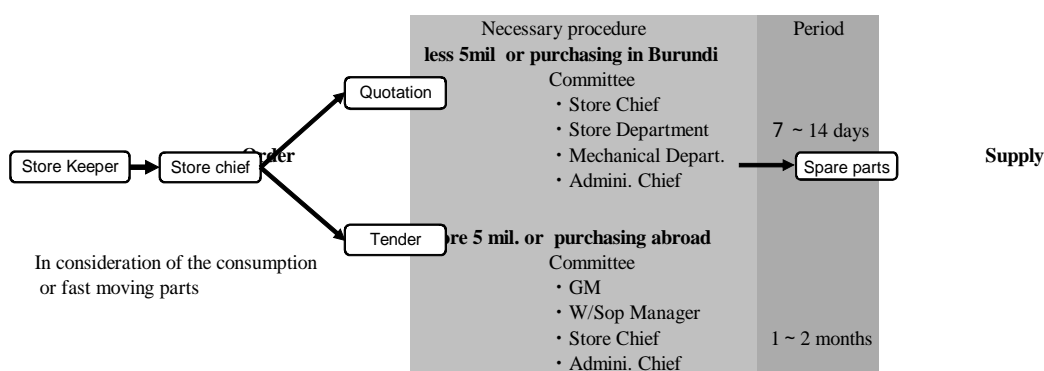
According to the above result the ratio of number of breakdown against the operating buses is 6% while 7% is the ratio of repairing hours against the operating hours. It seems that the total influence of maintenance management to the operation management is little, considering the current equipment condition (availability), the repair equipment (tool) and spare parts availability.

#### (7) Equipment (Tools) Condition

Most of the equipments at the OTRACO garage were donated by the Government of Japan at the time when the garage was established in 1987. Air compressor, one of the very important equipments, has been broken down two years ago and so no air tools are being used now in the garage. Two large oil press tools are also broken. Furthermore, all the pit jacks and grease guns are broken through frequent use. After the JICA study team expert explained about the usefulness of grease guns, OTRACO decided to ask for some grease guns for free of charge from the company which they buy grease from. 20 years have passed since the equipments were donated, so they need to be replaced. (Detail tools and equipment are shown in Appendix.-5)

#### (8) Stock control (Spare parts) condition

The technical capability of maintenance is important for appropriate maintenance including the stock and order management of spare parts for the repair. The present spare parts procurement procedure and organization of the procurement (outline) are as follows.



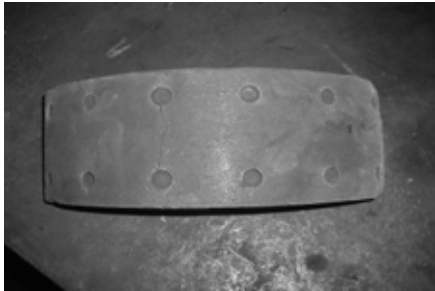
**Figure 16.1.5 Procurement Procedure**

At Present, problem in procurement of the spare parts arises at the time of delivery to judge whether they are appropriate parts (genuine parts) or not. Especially, there are inferior quality brake parts which may cause the increase of the breakdowns. Differences of regular

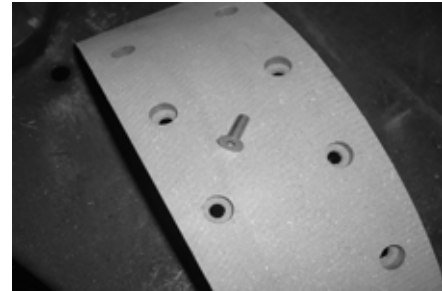
and non-regular goods related to some typical brake parts are as follows:

- Brake Lining

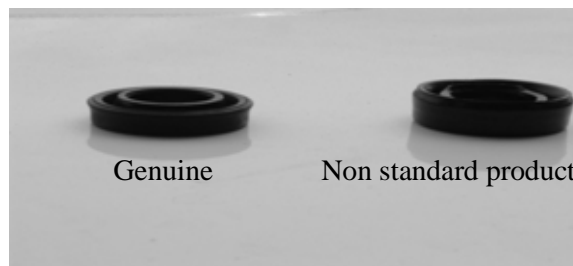
Genuine



Non standard product



- Wheel cylinder cup



Though the parts management is performed comparatively well, the parts ledger management has become complex because there are as many as four different model vehicles managed basically by the part's number, and management is not done by the names of parts. The main causes of that may be due to the computer system of the dealer, to whom the parts are ordered, which they have not yet been accustomed with and uncommonly different parts are procured.

#### (9) Public Vehicle Inspection Service

The car inspection system has been introduced since 1984 for the safety driving. As the contents of the inspection, side slip, lighting devices, brake and speed meter are the main check items. Total number of inspected vehicles or motorcycle has been increasing year by year and compared with 2004 and 2006 the inspection had become almost 4-5 times (7,000 to 29,000) and there is an income of 15-200,000 FBu every month.

**Table 16.1.21 Numbers of Inspected Vehicles**

Year	2004	2005	2006	2007
Inspected Vehicle Number	6,712	20,166	28,665	16,915* <sub>1</sub>

\*1; Jan.toJune

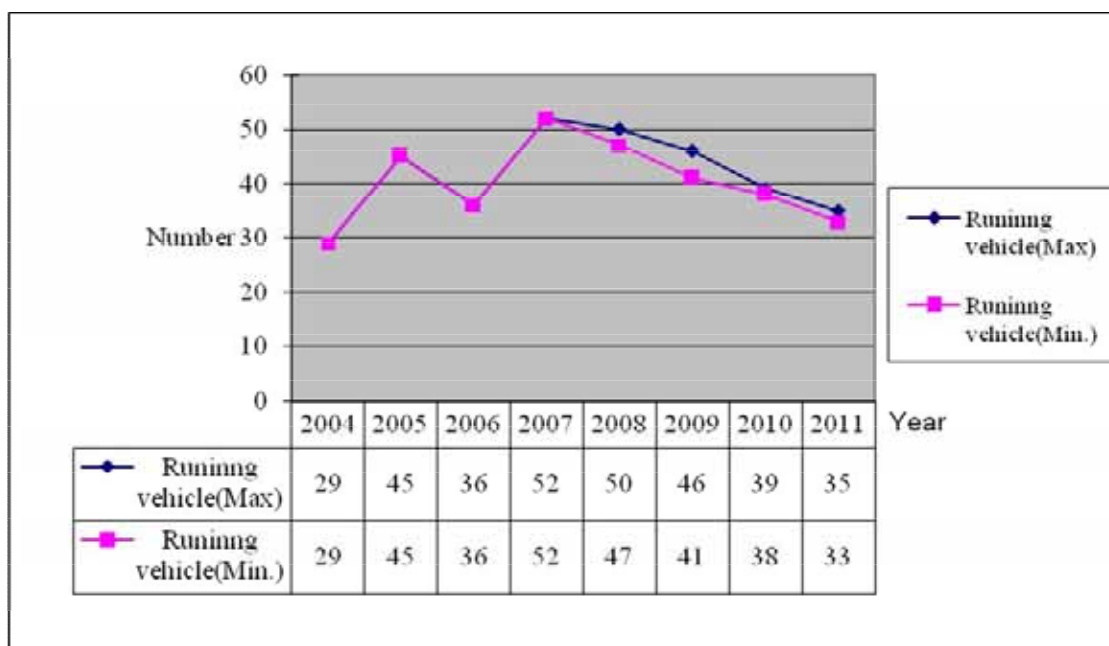
## (10) Forecast number of Buses in the future

The number of vehicle in the future is forecasted after the clarification of current condition and problem. The results of the forecast number of vehicles are tabulated in table 16.1.22. based on the under mentioned vehicle arrangement, replacement in the future and vehicle condition.

1. Interurban operation should be maintained at 1-2 trips a week.
2. When a vehicle's availability is 30% or less, it is to be a grounded vehicle.
3. Permissible years are assumed to be 22-23 years for 1983 or 1984 model vehicles in which the bodies are relatively in good condition.
4. Permissible years of 1989 model vehicles are to be 17-20 years and 15 years for large size (MV) buses and 10-12 years for medium size (NPR) of the models up to 1999, respectively depending on the body condition.
5. The present operating situation may be continued (in the city)
6. The unwanted situations (relating traffic accident, repair, and parts, etc.) also shall be considered (especially for the models after 1999 years).

**Table 16.1.22 Numbers of buses in the future**

Capacity	Current	2007	2008	2009	2010	2011
100	11	10	10 ~ 8	8 ~ 6	5	5
		50% of 1984 model completely grounded.	Continue with 2007 model or the half of 1989 model grounded.	1984 model completely grounded and 70% of 1989 model grounded.	1984 model and 1989 model completely grounded.	Continue with 2010 model because still new age.
60	7	6	5 ~ 4	4 ~ 3	2	2 ~ 1
		Availability of 1983 model become 70%	Availability of 1983 model and/or 1989 model become 35% & 75% respectively	100% ~ 75% of 1989 model available.	50% of 1989 model available	25%-50% of 1989 model available
40	36	36	35	34 ~ 32	32 ~ 31	28 ~ 27
		100% of availability	50% of 1999 model available, the rest grounded by accidental cause.	100% of 1999 model and/or 20% of 2000 model grounded due to accidental cause	50% of 2000 model availability.	30% of 2000 model and 25% of 2002 model available, the rest grounded due to accident



**Figure 16.1.6 Numbers of buses in the future**

It is observed that vehicle number decreased gradually every year by 4-15%, and based on the above data up to year 2007 it is expected that about 30% of the vehicles will be decreased in next five years.

## 16-2 IMPROVEMENT PLAN

### 16-2-1 Bus Operation

OTRACO has future plan for strengthening bus operation. The contents of the future plan are as shown below;

- Reopening of Gitega branch office
- Opening of new branch offices at Ngozi and Bururi
- Increasing number of bus routes to cover the whole of Burundi

The main objective of the above-mentioned future plans is to recover the condition of the bus operation network and system before civil conflict.

The future bus operation plan is as shown in the figures below;

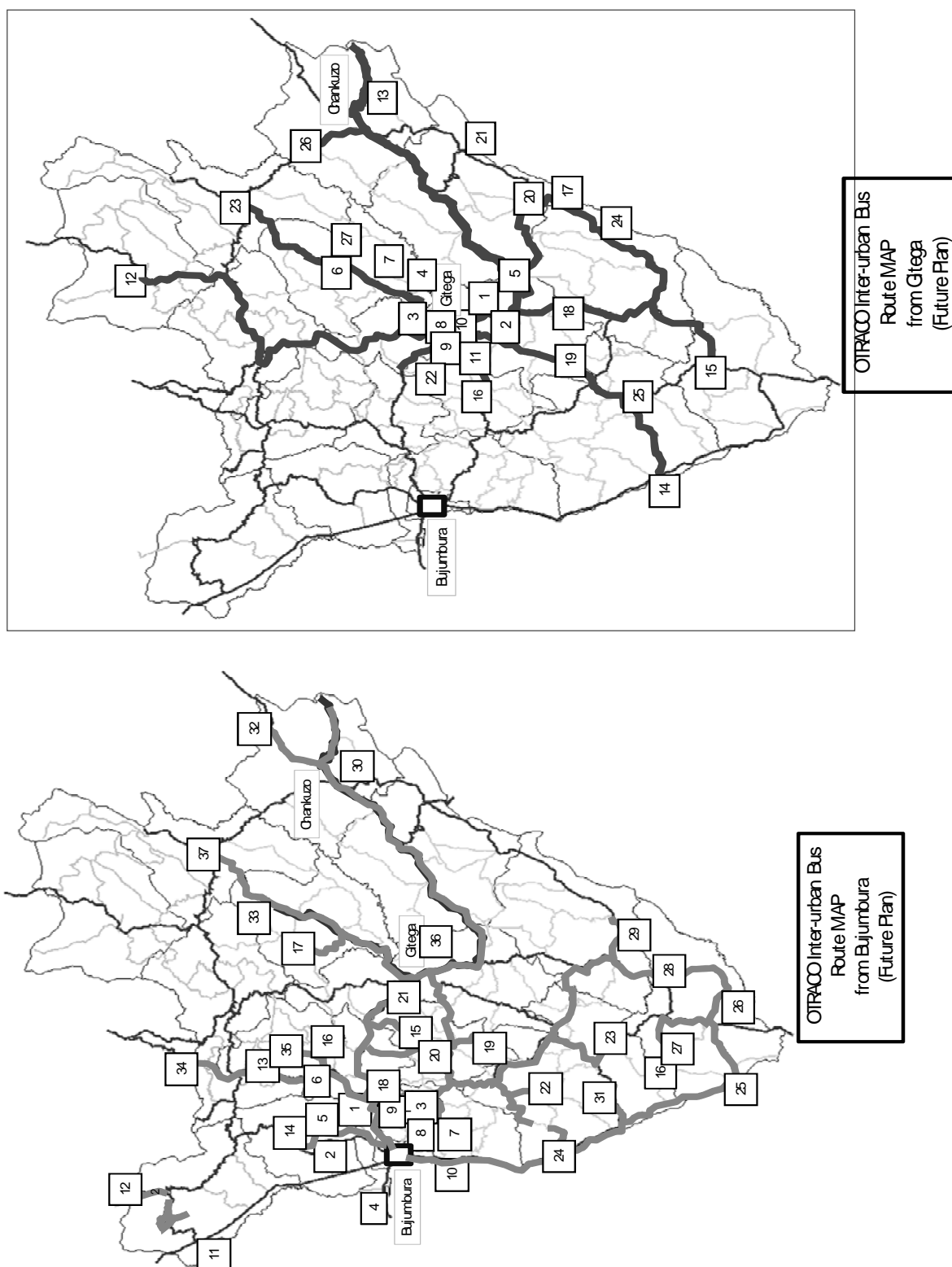


Figure 16.2.1 (a) OTRACO Future Bus Operation Plan in Burundi

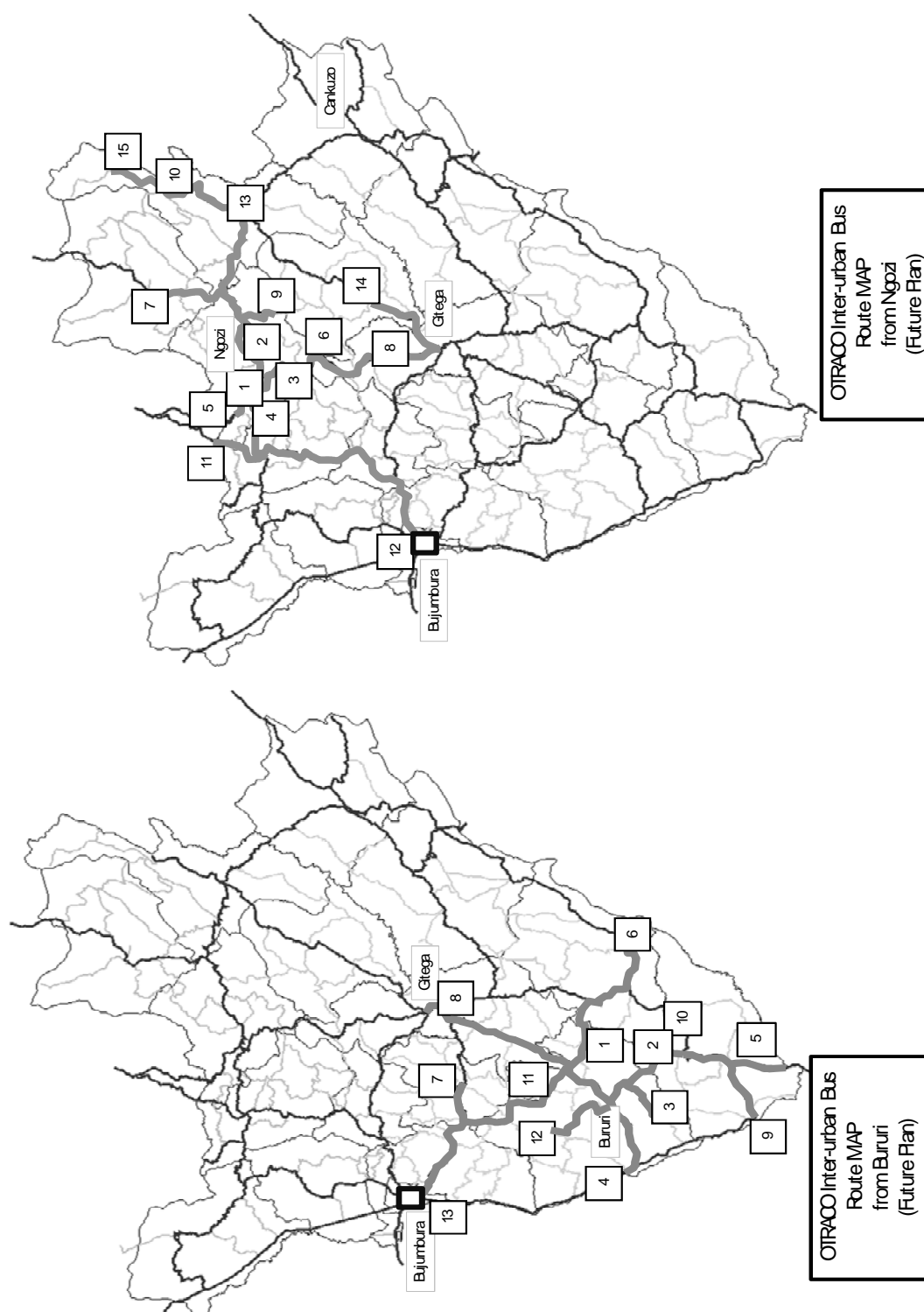


Figure 16.2.1 (b) OTRACO Future Bus Operation Plan in Burundi

Table 16.2.1 Future Bus Route

## Bujumbura Headquarter(Inter-urban Bus route)

	Origin	Destination
1	Bujumbura	RUGOMBO - (BORDER OF RWANDA)
2	Bujumbura	RUGOMBO - MABAYI
3	Bujumbura	RUGOMBO - KAYANZA
4	Bujumbura	BUBANZA - MUSIGATI
5	Bujumbura	KIGANDA- FOTA
6	Bujumbura	BUKEYE
7	Bujumbura	GITONGO - GIHOZAZI
8	Bujumbura	BUGARAMA - RYARUSERA
9	Bujumbura	BISORO
10	Bujumbura	NDAVA
11	Bujumbura	BUJUMBURA -
12	Bujumbura	BUYENGERO
13	Bujumbura	MUNINI
14	Bujumbura	MURAGO
15	Bujumbura	NYANZA LAC
16	Bujumbura	KIBAGO -(BORDER OF TANZANIA)
17	Bujumbura	VUGIZO
18	Bujumbura	KAYOGORO
19	Bujumbura	GIHOZI- (BORDER OF TANZANIA)
20	Bujumbura	CANKUZO - GASENYI(BORDER OF TANZANIA)
21	Bujumbura	KIGANDA
22	Bujumbura	MISHIHA
23	Bujumbura	BUGENYUZI
24	Bujumbura	KANYARU HAUT (BORDER OF RWANDA)
25	Bujumbura	BUTAGANZWA - MUSEMA
26	Bujumbura	GITEGA
27	Bujumbura	MUYINGA

## Bujumbura Headquarter(Sub-urban Bus route)

	Origin	Destination
1	Bujumbura	MUBIMBI
2	Bujumbura	GIHANGA
3	Bujumbura	MUYIRA
4	Bujumbura	GATUMBA (BORDER OF CONGO)
5	Bujumbura	MUZINDA-MUSENYI
6	Bujumbura	RUGAZI
7	Bujumbura	BUHONGA
8	Bujumbura	SOROREZO
9	Bujumbura	ISALE
10	Bujumbura	GITAZA

## Bujumbura Headquarter(School Bus route)

1	KAMENGE-CITY CENTER
2	MUSAGA - CITY CENTER
3	KINAMA-CIBITOKE-CITY CENTER
4	KIBENGA - KININDO - CITY CENTER
5	NGAGARA-CITY CENTER
6	NYAKABIGA-CITY CENTER
7	RUZIBA - CITY CENTER
8	KANYOSHA-CITY CENTER

## Gitega Branch Office(Inter-urban Bus route)

	Origin	Destination
1	Gitega	MUTAHU- NGOZI-KIRUNDO
2	Gitega	CANKUZO- GISAGARA
3	Gitega	BURURI - RUMONGE
4	Gitega	RUTANA - KAYOGORO -MAKAMBA
5	Gitega	MWARO
6	Gitega	RUTANA - GIHOZI - GIHARO
7	Gitega	BUKIRASAZI - BURAZA
8	Gitega	GISHUBI - RYANSORO
9	Gitega	KINYINYA
10	Gitega	GISURU
11	Gitega	GIHETA - NYABIHANGA
12	Gitega	MUYINGA
13	Gitega	MPINGA - KAYOVE
14	Gitega	KIGANDA
15	Gitega	KIGAMBA
16	Gitega	KARUZI

## Gitega Branch Office(Sub-urban Bus route)

	Origin	Destination
1	Gitega	SONGA-GRAND SEMINAIRE-MWEYA
2	Gitega	MUSHASHA
3	Gitega	GIHETA - KIBIMBA
4	Gitega	MUGERA
5	Gitega	MAKEBUKO
6	Gitega	MUTOYI
7	Gitega	MUBUGA

## Gitega Branch Office(School Bus route)

1	CITY CENTER - INSTITUT SUPERIEUR
2	CITY CENTER - LYCEE NYABIHARAGE -
3	MUSHASHA - LYCEE MUSINZIRA
4	CITY CENTER- MAGARAMA - MUSHASHA

## Bururi Branch Office(Inter-urban Bus Route)

	Origin	Destination
1	Bururi	RUMONGE
2	Bururi	MAKAMBA-MABANDA-(BORDER OF TANZANIA)
3	Bururi	RUTANA-GIHOZI
4	Bururi	MWARO
5	Bururi	GITEGA
6	Bururi	MAKAMBA-NYANZA-LAC
7	Bururi	KIRYAMA-RUTOVU
8	Bururi	MATANA
9	Bururi	RUMEZA-BUYENGERO
10	Bururi	BUJUMBURA

## Bururi Branch Office(Sub-urban Bus Route)

	Origin	Destination
1	Bururi	KIREMBA
2	Bururi	MUNINI
3	Bururi	YVANDA

## Ngozi Branch Office(Inter-urban Bus Rote)

	Origin	Destination
1	Ngozi	KIRUNDO (BORDER OF RWANDA)
2	Ngozi	MUTAHU-GITEGA
3	Ngozi	MUSENYI
4	Ngozi	MUYINGA-KOBERO
5	Ngozi	KAYANZA-KANYARU-HAUT
6	Ngozi	KAYANZA-BUJUMBURA
7	Ngozi	MUYINGA
8	Ngozi	KARUZI
9	Ngozi	MUYINGA-GITERANYI

## Ngozi Branch Office(Inter-urban Bus Rote)

	Origin	Destination
1	Ngozi	KIRUNDO (BORDER OF RWANDA)
2	Ngozi	MUTAHU-GITEGA
3	Ngozi	MUSENYI
4	Ngozi	MUYINGA-KOBERO
5	Ngozi	KAYANZA-KANYARU-HAUT
6	Ngozi	KAYANZA-BUJUMBURA
7	Ngozi	MUYINGA
8	Ngozi	KARUZI
9	Ngozi	MUYINGA-GITERANYI

## (1) Comparison of current operation situation between OTRACO and ONATRACOM

There is the public transport corporation which is called ONATRACOM (Office National des Transport en Commun) in Rwanda. The buses owned by ONATRACOM were also decreased after civil conflict as same as Burundi.

Recently the Japanese Government supported the Rwanda Government by giving the Grant aid and technical cooperation to the project to recover the situation before civil conflict. The Comparison of bus operation situation between OTRACO and ONATRACOM is shown as below;

**Table 16.2.2 Comparison of bus operation situation between OTRACO and ONATRACOM**

	OTRACO in Burundi	ONATRACOM in Rwanda	Ratio between OTRACO and ONATRACOM
No. of Buses	68	169	0.40
No. of operated buses	42	151	0.28
No. of Bus Routes	39 (1.08 bus route/bus)	115 (0.68 bus route/bus)	0.33
Total Mileage	816,053km (22,668km/bus)	4,463,396km (26,410km/bus)	0.18
No. of staffs	98 2.72staffs/bus	236 1.39staffs/bus	0.41
Population	7,211,362 (in 2003)	8,128,553(in 2002)	0.88
Population Density	278/km <sup>2</sup>	303/km <sup>2</sup>	0.91

Population situation between above the 2 countries is so similar. However number of owned and operated buses by OTRACO is approximately 30% of ONATRACOM.

On the other hand, population increase ratio for 10 years after 1993 is approximately 10% for the entire Burundi.

To recover the situation existing before 1993, the total number of buses in OTRACO should be increased by around 100 vehicles to reach the same level as Rwanda.



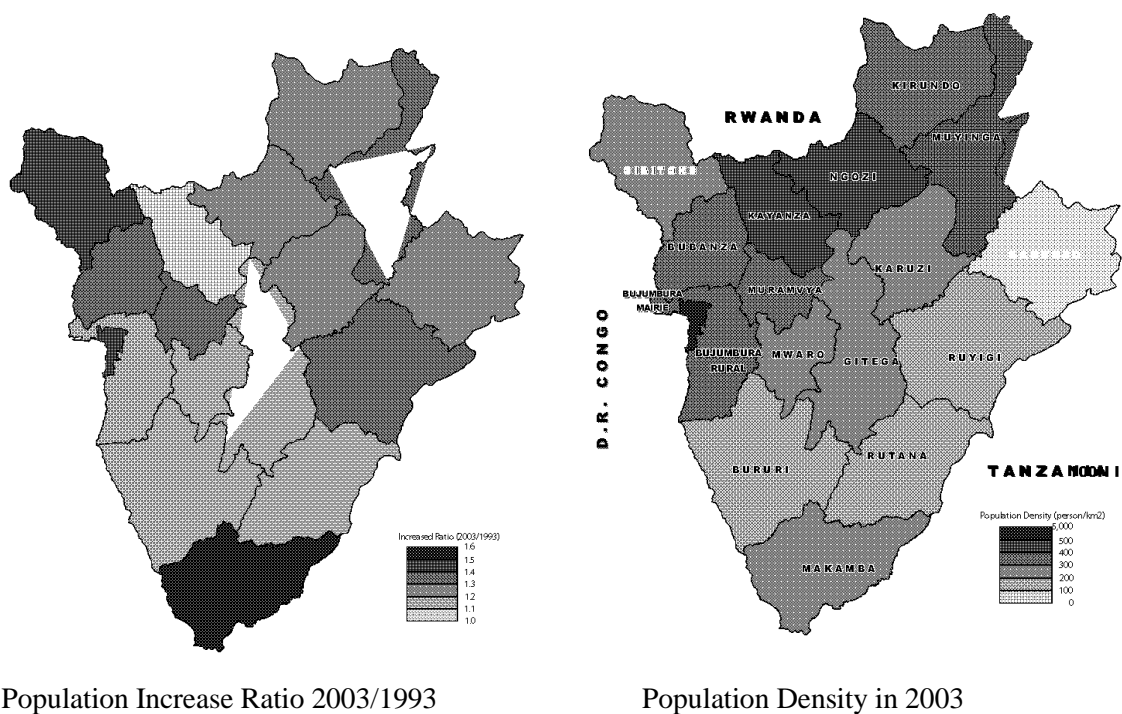


Figure 16.2.2 Population in Burundi

Table 16.2.3 Population in each province in Burundi

	Province	Area(km2)	in 1990	in 1993	Population	in 2003	in 1990	Population Decsity/(km2)	in 1993	Population Decsity/(km2)	in 2003	1993/1990	2003/1993
1	Bubanza	1,089.0	222,953	248,675	329,528	205	228	303	1.12	1.33	1.18	1.08	1.18
2	Bujumbura Rural	1,232.6	373,491	402,366	476,350	303	326	386	1.11	1.40	1.40	1.07	1.14
3	Bujumbura City	86.5	235,440	261,377	365,380	2,721	3,021	4,223	1.09	1.23	1.41	1.06	1.12
4	Bururi	2,465.1	385,490	411,416	471,010	156	167	191	1.10	1.21	1.26	1.05	1.08
5	Cankuzo	1,964.5	142,797	155,470	190,816	73	79	97	1.10	1.21	1.26	1.05	1.08
6	Cibitoke	1,635.5	279,843	318,923	449,768	171	195	275	1.10	1.21	1.26	1.05	1.08
7	Gitega	1,979.0	565,174	599,191	669,283	286	303	338	1.10	1.21	1.26	1.05	1.08
8	Karuzi	1,457.4	287,905	315,996	398,220	198	217	273	1.10	1.21	1.26	1.05	1.08
9	Kayanza	1,233.2	443,116	465,507	501,973	359	377	407	1.10	1.21	1.26	1.05	1.08
10	Kirundo	1,703.3	401,103	442,023	564,279	235	260	331	1.10	1.21	1.26	1.05	1.08
11	Makamba	1,959.6	223,799	270,430	438,410	114	138	224	1.10	1.21	1.26	1.05	1.08
12	Muramvya	1536.12	441,653	461,467		288	300		1.10	1.21	1.26	1.05	1.08
12'	Muramvya(*1)	695.5	231,744	242,119	266,396	333	348	383	1.04	1.10	1.10	1.04	1.10
13	Muyibnga	1,836.3	373,382	413,609	553,867	203	225	302	1.11	1.34	1.34	1.11	1.34
14	Mwaro(*1)	839.6	209,909	219,348	241,296	250	261	287	1.04	1.10	1.10	1.04	1.10
15	Ngozi	1,473.9	482,246	526,577	674,633	327	357	458	1.09	1.28	1.28	1.09	1.28
16	Rutana	1,959.5	195,834	214,056	275,121	100	109	140	1.09	1.29	1.29	1.09	1.29
17	Ruyigi	2,338.9	238,567	262,614	345,032	102	112	148	1.10	1.31	1.31	1.10	1.31
	Total	25,949.5	5,292,793	5,769,697	7,211,362	204	222	278	1.09	1.25	1.25	1.09	1.25

(\*1) Mwaro province is one of two provinces that were created in 2002 as a result of splitting the Muramvya province; the other province retained the name of Muramvya.

Data Resource: Annuaire Statistique du Burundi 2003, ISTEERU

Table 16.2.4 Existing Route Information for Buses to be installed

.OTRACO HEADQUARTERS OF BUJUMBURA : 45 Buses  
 .URBAN TRANSPORT : 08 Buses

No.	Bus capacity (Nos. of)	Bus quantity	Bus route	Rate of average passenger per bus (%)	Journey distance (km)	Bus service frequency a day	Number of bus route residents	Bus fares for the route (Max. &)		
								Adult	Student	Infant
1	62	1	KAMENGE-CITY CENTER	90	8	14	7500	220	150	150
2	62	1	MUSAGA - CITY CENTER	85	8	12	6000	220	150	150
3	62	1	KINAMA-CIBITOKE-CITY CENTER	90	9	12	6500	220	150	150
4	62	1	KIBENGA - KININDO - CITY CENTER	90	9	14	4000	220	150	150
5	62	1	NGAGARA-CITY CENTER	90	7	12	5000	220	150	150
6	62	1	NYAKABIGA-CITY CENTER	85	5	12	2500	220	150	150
7	62	1	RUZIBA - CITY CENTER	95	12	16	4000	220	150	150
8	62	1	KANYOSHA-CITY CENTER	90	10	12	5000	220	150	150
TOTAL		8	8	90	68		40500			

## -2. SURBUB ROUTES TRANSPORT :10 BUSES

No.	Bus capacity (Nos. of)	Bus quantity	Bus route	Rate of average passenger per bus (%)	Journey distance (km)	Bus service frequency a day	Number of bus route residents	Bus fares for the route (Max. &)		
								Adult	Student	Infant
1	29	1	BUJUMBURA-MUBIMBI	90	15	4	5000	500	350	350
2	62	1	BUJUMBURA-GIHANGA	80	25	2	4500	700	450	450
3	29	1	BUJUMBURA-MUYIRA	80	16	6	3800	400	250	250
4	62	1	BUJUMBURA- GATUMBA (BORDER OF CONG	90	26	4	6500	500	350	350
5	62	1	BUJUMBURA-MUZINDA-MUSENYI	80	17	2	5000	600	350	350
6	29	1	BUJUMBURA-RUGAZI	80	30	3	4500	1200	400	400
7	29	1	BUJUMBURA-BUHONGA	85	12	4	7500	500	800	800
8	29	1	BUJUMBURA-SOROREZO	80	10	6	3000	300	350	350
9	29	1	BUJUMBURA-ISALE	80	17	3	7000	600	200	200
10	62	1	BUJUMBURA-GITAZA	90	20	2	5000	500	350	350
TOTAL		10	10		188		51800			

Source:

I-3 INTERURBAN TRANSPORT : 27 buses FROM BUJUMBURA (CAPITALE)

No.	Bus capacity (Nos. of seats)	Bus quantity	Bus route	Rate of average passenger per bus (%)	Journey distance (km)	Bus service frequency a day	Number of bus route residents	Bus fares for the route (Max. & Min.)		
								Adult	Student	Infant
1	45	1	BUJUMBURA - RUGOMBO - (BORDER OF RWANDA)	85	90	1	8000	2200	1400	1400 0
2	45	1	BUJUMBURA - RUGOMBO - MABAYI	80	105	1	9000	2600	1700	1700 0
3	45	1	BUJUMBURA - RUGOMBO - KAYANZA	80	136	1	11000	3400	2200	2200 0
4	45	1	BUJUMBURA - BUBANZA - MUSIGATI	75	113	1	9500	2800	1800	1800 0
5	45	1	BUJUMBURA - KIGANDA - FOTA	80	91	1	8000	2200	1400	1400 0
6	62	1	BUJUMBURA - BUKEYE	80	56	1	6000	1500	1000	1000 0
7	45	1	BUJUMBURA - GITONGO - GIHOGAZI	90	115	1	9500	2800	1800	1800 0
8	45	1	BUJUMBURA - BUGARAMA - RYARUSERA	85	45	1	5000	1200	800	800 0
9	45	1	BUJUMBURA - BISORO	80	90	1	8000	2200	1400	1400 0
10	45	1	BUJUMBURA - NDAVA	80	85	1	7500	2200	1400	1400 0
11	45	1	BUJUMBURA - MBOGORA - KIBUNGERE	75	95	1	8000	2400	1600	1600 0
12	45	1	BUJUMBURA - BUYENGERO	80	93	1	7500	2300	1500	1500 0
13	45	1	BUJUMBURA - MUNINI	80	130	1	9500	3200	2100	2100 0
14	45	1	BUJUMBURA - MURAGO	75	65	1	7000	1600	1000	1000 0
15	62	1	BUJUMBURA - NYANZA LAC	80	123	1	9000	3000	2000	2000 0
16	45	1	BUJUMBURA - KIBAGO - (BORDER OF TANZANIA)	90	180	1	12000	4500	3000	3000 0
17	45	1	BUJUMBURA - VUGIZO	80	170	1	11500	4200	2700	2700 0
18	45	1	BUJUMBURA - KAYOGORO	90	188	1	12000	4700	3100	3100 0
19	62	1	BUJUMBURA - GIHOFL - (BORDER OF TANZANIA)	80	168	1	12000	4200	2700	2700 0
20	45	1	BUJUMBURA - CANKUZO - GASENYI (BORDER OF TANZANIA)	75	268	1	15000	6500	4300	4300 0
21	45	1	BUJUMBURA - KIGANDA	85	79	1	8000	2000	1300	1300 0
22	45	1	BUJUMBURA - MISHIHA	80	250	1	13000	6200	4100	4100 0
23	45	1	BUJUMBURA - BUGENYUZI	80	145	1	9500	3600	2400	2400 0
24	62	1	BUJUMBURA - KANYARU HAUT (BORDER OF RWANDA)	80	118	1	11000	3000	2000	2000 0
25	45	1	BUJUMBURA - BUTAGANZWA - MUSEMA	75	74	1	9000	2000	1300	1300 0
26	45	1	BUJUMBURA - GITEGA	85	110	1	10000	2800	1800	1800 0
27	45	1	BUJUMBURA - MUYINGA	80	210	1	13000	5200	3400	3400 0
TOTAL		27	27		3392		258500			

Source:

**II. GITEGA AGENCY (2nd city) : 27 buses**  
**II 1. SURBUB ROUTES TRANSPORT : 7 buses**

No.	Bus capacity (Nos. of seats)	Bus quantity	Bus route	Rate of average passenger per bus	Journey distance (km)	Bus service frequency a day	Number of bus route residents	Bus fares for the route (Max. &		
								Adult	Student	Child
1	62	1	GITEGA - SONGA-GRAND SEMINAIRE-MWEYA	80	12	3	5000	400	250	250
2	62	1	GITEGA - MUSHASHA	85	6	5	2500	220	150	150
3	45	1	GITEGA - GIHETA - KIBIMBA	80	29	3	6000	900	600	600
4	45	1	GITEGA - MUGERA	80	15	2	5700	500	350	350
5	62	1	GITEGA - MAKEBUKO	80	23	2	6000	700	450	450
6	29	1	GITEGA - MUTOYI	85	30	2	6200	1000	650	650
7	45	1	GITEGA - MUBUGA	80	12	4	4000	400	250	250
<b>TOTAL</b>		<b>7</b>	<b>7</b>		<b>127</b>		<b>35400</b>			

**II 2. SCHOOL BUS : 4 Buses**

No.	Bus capacity (Nos. of seats)	Bus quantity	Bus route	Rate of average passenger per bus	Journey distance (km)	Bus service frequency a day	Number of bus route residents	Bus fares for the route (Max. &		
								Adult	Student	Child
1	62	1	CITY CENTER - INSTITUT SUPERIEUR AGRONOMIQUE	80	7	4	3000	220	150	150
2	62	1	CITY CENTER - LYCEE NYABIHARAGE - LYCEE MUSHASHA-LYCEE GITEGA	90	6	4	2800	220	150	150
3	62	1	MUSHASHA - LYCEE MUSINZIRA	85	6	4	2500	220	150	150
4	62	1	CITY CENTER- MAGARAMA - MUSHASHA	90	8	4	3000	220	150	150
<b>TOTAL</b>		<b>4</b>	<b>4</b>		<b>27</b>		<b>11300</b>			

Source:

## II 3. INTERURBAN TRANSPORT : 16 buses

No.	Bus capacity (Nos. of seats)	Bus quantity	Bus route	Rate of average passenger per bus (%)	Journey distance (km)	Bus service frequency a day	Number of bus route residents	Bus fares for the route (Max. & Min.)			
								Adult	Student	Child	Infant
1	45	1	GITEGA - MUTAHO- NGOZI-KIRUNDO	85	160	1	12000	4000	2600	2600	0
2	45	1	GITEGA - CANKUZO- GISAGARA	80	158	1	11000	4000	2600	2600	0
3	45	1	GITEGA - BURURI - RUMONGE	85	125	1	9000	3000	2000	2000	0
4	62	1	GITEGA - RUTANA - KAYOGORO - MAKAMBA	75	147	1	9000	3600	2400	2400	0
5	62	1	GITEGA - MWARO	80	45	1	6000	1200	800	800	0
6	29	1	GITEGA - RUTANA - GIHOFI - GIHARO	90	113	1	8000	2800	1800	1800	0
7	45	1	GITEGA - BUKIRASAZI - BURAZA	85	56	1	6000	1500	1000	1000	0
8	29	1	GITEGA - GISHUBI - RYANSORO	85	64	1	6500	1600	1000	1000	0
9	45	1	GITEGA - KINYINYA	80	80	1	6500	2000	1300	1300	0
10	29	1	GITEGA - GISURU	90	115	1	8300	2800	1800	1800	0
11	29	1	GITEGA - GIHETA - NYABIHANGA	85	45	1	5000	1200	800	800	0
12	45	1	GITEGA - MUYINGA	80	95	1	8500	2400	1600	1600	0
13	29	1	GITEGA - MPINGA - KAYOVE	85	75	1	7000	2000	1300	1300	0
14	45	1	GITEGA - KIGANDA	75	48	1	6000	1200	800	800	0
15	29	1	GITEGA - KIGAMBA	75	140	1	8000	3500	2300	2300	0
16	45	1	GITEGA-KARUZI	80	60	1	6500	1500	1000	1000	0
TOTAL		16	16		1526		123300				

. NGOZI AGENCY : 15 buses  
1 .SURBUB ROUTES TRANSPORT : 6 buses

No.	Bus capacity (Nos. of seats)	Bus quantity	Bus route	Rate of average passenger per bus (%)	Journey distance (km)	Bus service frequency a day	Number of bus route residents	Bus fares for the route (Max. & Min.)			
								Adult	Student	Child	Infant
1	29	1	NGOZI - MWUMBA	85	12	4	3500	400	250	250	0
2	29	1	NGOZI - GASHIKANWA	85	12	4	3000	400	250	250	0
3	29	1	NGOZI - MIVO	85	10	4	2500	400	250	250	0
4	29	1	NGOZI - VYERWA	85	6	4	2000	220	150	150	0
5	45	1	NGOZI - BUSIGA	85	15	3	3500	500	350	350	0
6	45	1	NGOZI - BURASIRA	85	25	3	4000	800	500	500	0
TOTAL		6	6		80		18500				

Source:

## III 2. INTERURBAN TRANSPORT: 11 buses

No.	Bus capacity (Nos. of seats)	Bus quantity	Bus route	Rate of average passenger per bus (%)	Journey distance (km)	Bus service frequency a day	Number of bus route residents	Bus fares for the route (Max. &)		
								Adult	Student	Child
1	45	1	NGOZI- KIRUNDO (BORDER OF RWAND	80	74	1	12000	2000	1300	1300
2	45	1	NGOZI-MUTAHU-GITEGA	85	85	1	10000	2200	1400	1400
3	29	1	NGOZI-MUSENYI	75	25	3	6000	300	190	190
4	45	1	NGOZI-MUYINGA-KOBERO	85	109	1	13000	2800	1800	1800
5	45	1	NGOZI-KAYANZA-KANYARU-HAUT	90	52	2	6500	1300	850	850
6	45	1	NGOZI-KAYANZA-BUJUMBURA	90	125	1	12000	3000	2000	2000
7	45	1	NGOZI-MUYINGA	80	81	1	9000	2000	1300	1300
8	45	1	NGOZI-KARUZI	80	81	1	8500	2000	1300	1300
9	45	1	NGOZI-MUYINGA-GITERANYI	75	121	1	11000	3000	2000	2000
TOTAL		9	9		753		88000			

IV. BURURI AGENCY : 13 buses  
1. SURBUB ROUTES TRANSPORT : 3 buses

No.	Bus capacity (Nos. of seats)	Bus quantity	Bus route	Rate of average passenger per bus (%)	Journey distance (km)	Bus service frequency a day	Number of bus route residents	Bus fares for the route (Max. &)		
								Adult	Student	Child
1	29	1	BURURI-KIREMBA	90	8	3	2500	300	200	200
2	29	1	BURURI-MUNINI	90	15	3	3500	500	350	350
3	45	1	BURURI-VYANDA	85	35	2	4000	1200	800	800
TOTAL		3	3		58		10000			

Source:

## -2. INTERURBAN TRANSPORT: 10 buses

No.	Bus capacity (Nos. of seats)	Bus quantity	Bus route	Rate of average passenger per bus	Journey distance (km)	Bus service frequency a day	Number of bus route residents	Bus fares for the route (Max. & Min.)			
								Adult	Student	Child	Infant
1	45	1	BURURI-RUMONGE	90	34	3	3000	600	400	400	0
2	45	1	BURURI-MAKAMBA-MABANDA-(BORDER OF TANZANIA)	90	106	1	8000	2600	1700	1700	0
3	45	1	BURURI-RUTANA-GIHOFI	80	85	1	7500	2200	1400	1400	0
4	45	1	BURURI-MWARO	80	86	1	7500	2200	1400	1400	0
5	45	1	BURURI-GITEGA	85	91	1	7700	2200	1400	1400	0
6	45	1	BURURI-MAKAMBA-NYANZA-LAC	90	74	1	6800	2000	1300	1300	0
7	45	1	BURURI-KIRYAMA-RUTOVU	80	40	2	2800	1000	700	700	0
8	45	1	BURURI-MATANA	80	30	2	2000	800	500	500	0
9	45	1	BURURI-RUMEZA-BUYENGERO	80	30	2	2000	800	500	500	0
10	45	1	BURURI-BUJUMBURA	90	107	1	8500	2600	1700	1700	0
TOTAL		10	10		683		55800				

Source:



## (2) Improvement of Bus operation in OTRACO

### 1) Improvement of Bus operation system for Bujumbura city bus operation service

The services on each particular route are normally started in the morning whereby all buses depart from the OTRACO garage to their respective routes. Mostly the Bujumbura city bus services are operated approximately 4 round trips particularly at the time of going to business in the morning, going home at lunch time, going to business after lunch and going home in the evening.

Beyond the above-mentioned time, all buses return without passengers to OTRACO.

Cost of fuel consumption for empty operated buses should be minimized to reduce the deficit. Advice should be given to OTRACO drivers that when going to work in the morning they should walk or use minibuses from their home to OTRACO garage.

There are 3 OTRACO bus stations located at Kamenge, Nyagabiga and Musaga in Bujumbura city. However, these bus stations are not organized to cope with the current situation.

Current bus operation system of one starting/ending point (OTRACO garage) should be changed. Buses should be distributed and parked at 3 bus stations. By changing the current single starting point (OTRACO garage) to 3 bus stations, drivers can minimize the time spent to go to work; in that case the stable bus operation can be secured. Along with that the fuel consumption will be reduced, because of the decrease of the driving distance without passengers from the origin of starting stations to the destination.

### 2) Improvement of data processing systems in OTRACO

Information of bus operation in current situation is recorded manually on paper-based record. Improvement of processing bus operation data should be made necessary to obtain efficient data analysis.

Required items for data processing are as shown below;

- Number of owned bus
- Number of operated bus
- List of operated bus route
- Bus operation record by each bus route

- Number of bus passengers by each bus route: This information is currently not recorded since 1993, according to the annual report of 1993. Only total amount of ticket sales are recorded. This information is the useful data for the analysis of the transport demand and making the bus operation plan.
- Total mileage by each bus route
- Number of staffs

Data processing system should be improved by the installation of necessary computers at OTRACO's transport department.

### (3) Future OTRACO staff arrangement Plan

No. of OTRACO buses will be increased from 52 units in 2007 to 199 units in 2017 for the future bus operation plan. OTRACO staffs also must be increased in consideration of the no. of buses and newly opened branch office and ticket sales at the newly opened bus terminal in Bujumbura.

Required no. of OTRACO staffs in future is shown as Table 16.2.5.

299 staffs are required in Bujumbura head quarter in future from existing 98 staffs. 80 staffs are required for newly opened of 3 branch offices.

OTRACO should make the recruitment plan based on this future staffs arrangement plan.

Table 16.2.5 Future OTRACO staffs arrangement Plan

OTRACO Staff (Future Plan)	
Bujumbura Head Office	292
Gitega branch Office	38
Ngozi branch office	22
Bururi branch office	20
Total	372

Bujumbura head Quarter	
Number of bus	144
General Director	1
Director	1
Internal Control Unit	5
Executive / Administration	4
Staff office	2
Secretary	2
Boy office	1
Watchman	1
Health service	1
Supplies office	4
Accounting	8
Store	4
Executive/Operating Service	1
Control office	7
Drivers	135
Conductor	73
Executive/Technical Service	1
Technical Service	35
Busterminal Ticket Sales	4
Busterminal Information	2
Total No. of Staffs	292

Branch Office	Gitega	Ngozi	Bururi	Total
Number of Bus	27	15	13	55
Branch Office Manager	1	1	1	3
Cashier	1	1	1	3
Garage	8	4	4	16
Driver	27	15	13	55
Watchman	1	1	1	3
Total No. of Staffs	38	22	20	80

### 16-2-2 Bus Maintenance

#### (1) Organization

##### 1) To set up the data section

As a whole, organization of OTRACO is functioning properly. However, currently only the rough intonations on maintenance and repair works are recorded while details intonations such as mileage of each buses, parts or components replaced or whereabouts of repair works, have not been recorded. These data should be recorded not only the information for the further maintenances but also for the management of working staff, and so the setting up of a data section is necessary.

##### 2) Establishment of Branch organization

The organization reformation to establish the system of the maintenance management is important. In that regard the reopening of the local office (branch) will be needed in the future because of an increase in the operation frequency and the expected increase of bus routes.

#### (2) Budget

- To continue the government subsidy

While maintenance cost will exceed year by year due to the bus conditions, and since OTRACO's financial account balance depends on subsidy to a greater extent. Therefore, the government subsidy must continue for the effective maintenance work.

#### (3) Maintenance Procedure

##### 1) Establishment of Maintenance Management System

Though, three management staffs including the workshop manager are stationed, data management is hardly done and thus results in increasing maintenance time and decreasing vehicle availability. So it is necessary to re-construct the management system immediately.

- Vehicle ledger (maintenance ledger - Appendix-6 )

The equipment ledger should be introduced (and managed by drivers). Its contents should content the repair details, mileage, spare parts etc. for each vehicle service. This ledger will

make it easier to identify the conditions of the vehicles and monitoring driver's vehicle handling or ability (behaviours). This ledger will be collected and recorded in the mechanical section (transport section).

- Vehicle maintenance check sheet (Appendix-7)

Vehicle maintenance check sheet will help to identify the record of normal services (same as repairing order sheet); since there is no periodical maintenance details records at all. In view of this, periodical maintenance sheet to be introduced will help to preserve the data file for each vehicle. (Refer to details of the ledger attached, material-4)

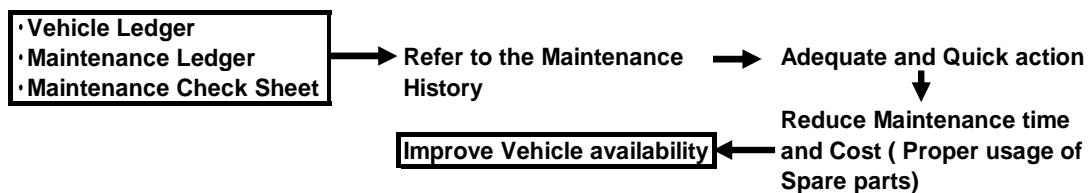


Figure 16.2.3 Effectiveness of each ledger

## 2) Preventive Maintenance

In OTRACO, the periodic check of each vehicle is done at the interval of certain distance (mileage) it ran. This cycle can be said to be appropriate. However, the periodic check only consists of simple oil change and a brake confirmation for two hours. The required time interval for the periodic check has been set by OTRACO standard. The periodic check conducted in OTRACO is too simple so that it is not possible to avoid immediate breakdown of vehicles. As a result, overall time for repair increases and consequently vehicle availability decreases.

Many breakdowns can be prevented by performing a preventive maintenance (prediction of certain breakdowns by way of precautionary measures before it may occur). The records of repair or periodical check are to be maintained in details by each section and to be renewed by latest information.

Moreover, recommended periodical check items for the basic consumable parts and lubricant corresponding to the mileage are shown below.

**Table 16.2.6 Basic periodical check item by mileage (MV123. MV118)**

(MV123. MV118)

Mileage(km)	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000	45,000	50,000	55,000	60,000
Material (parts)												
Engine oil		A		A		A		○		○		○
Oil filter				A				○				○
Fuel filter			A			A					○	○
T/M oil						A						○
D/F oil						A						○
Air cleaner						B						△
Grease	A	A	A	A	A	A	○	○	○	○	○	○

**Table 16.2.7 Basic periodical check item by mileage (MT112)**

Mileage(km)	5,000	10,000	15,000	20,000	25,000	30,000
Material (parts)						
Engine oil	A	A	A	A	A	A
Oil filter		A		A		A
Fuel filter			A			A
T/M oil				A		
D/F oil				A		
Air cleaner						B

**Table 16.2.8 Basic periodical check item by mileage (NPR66)**

Mileage(km)	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000	45,000	50,000	55,000	60,000	65,000	70,000	75,000
Material (parts)															
Engine oil	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Oil filter		A		A		A		A		A		A		A	
Fuel filter			A			A		A				A			A
T/M oil				A				A				A			
D/F oil				A				A				A			
Air cleaner						B						B			
Grease	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A

The recommended checks other than the above are as follows.

**Table 16.2.9 Recommended periodical maintenance work**

	Contents of Work
Engine	Check water, oils and leaking, tightening of each component etc.
Suspension	Check loosening and tightening of each suspension bolt & nuts, oils etc.
Transmission	Check leaking oil, abnormal sound, functioning etc.
Differential	Check leaking oil, abnormal sound, functioning etc.
Brake	Check condition of lining and drum, leaking of w/cylinder, and functioning
Tire	Check Nut & Bolt, Tightening, Air pressure etc.
Electrical	Functioning etc.
Body	Check loosening and spray etc.

To do the above periodic maintenance effectively, the following are needed.

- The driver is made to recognize the importance of the periodic check.

- The mileage data of Bus Inspection Section is effectively used.
- Close cooperation of Inspection section and Bus Inspection Section per day and instruction of periodical check.

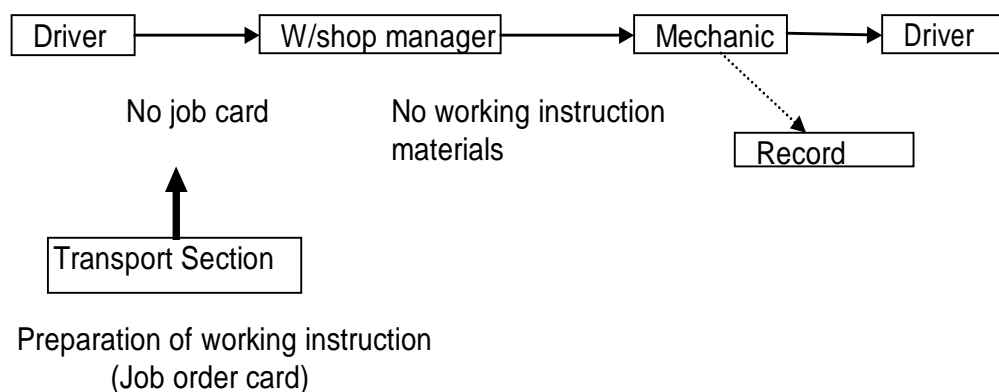
### 3) To establish a proper inspection system

One of the causes of increasing breakdown such as in brake system is overlooking or delay of finding the signs of the breakdown. OTRACO should restructure the system of checking so that each section should take the responsibility to solve those problems. The following one recommendation to each section.

- Inspection Section - Confirmation of accurate work procedure for inspection.
- Heavy repair section - To evaluate mechanics technical skill and the proper repair guidance if necessary.
- Store section - Enough stock of consumable parts for brake and engine.
- Transport section - To evaluate driving skills of drivers, route condition survey and bus arrangement for reduction of breakdown.

### (4) Participation of Transport Section

The participation of the transport section to the vehicle maintenance is important. The directives from a driver to the maintenance section should be made through an instruction sheet from the departments of transport clarifying the current condition.



**Figure 16.2.4 Proposed work flow 1**

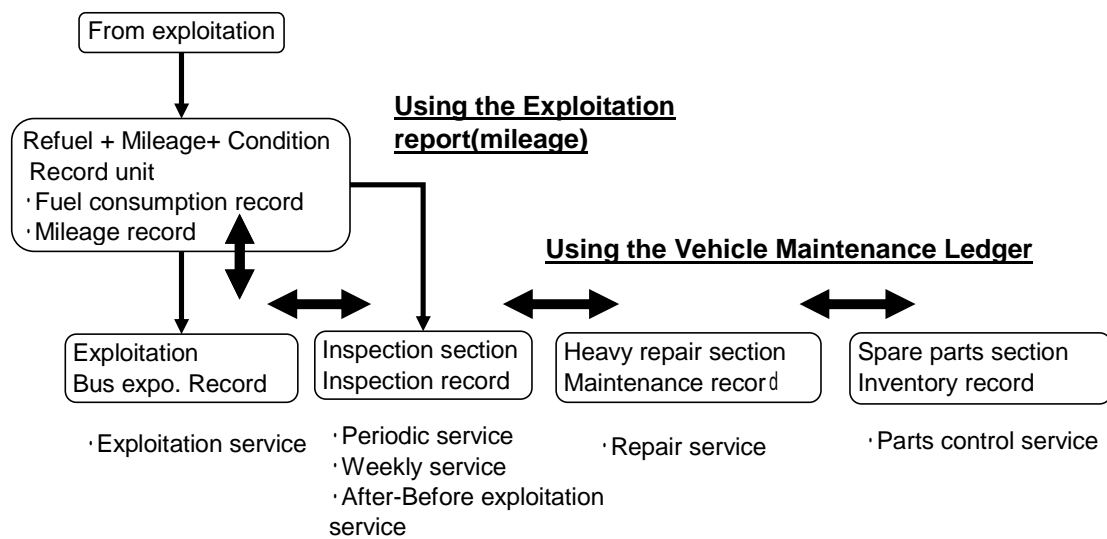


Figure 16.2.5 Proposed work flow 2

## (5) Capacity of Staff

## 1) Increase in Training Opportunity by various means

Due to lack of equipments (tools) and teaching materials (text) as well as little understanding of the other training method, the common training method conducted by OTRACO is on-job training or apprentice. And also a step-by-step search technique for troubleshooting is not understood. Considering this situation, the maintenance staffs need field training as well as some theoretical training. It would be very effective and helpful in this situation if seminars can be arranged by the vehicle dealer or Engineer/Technician using some teaching materials to train up the staffs. Moreover, some training on the body repairing by the producing company will be more effective.

## 2) Improvement of data management ability

Equipment management is by computing data important not only to improve the personnel technical skills but also to compile data so as to be able to analyze the problem and to take necessary action. The result of data management shall be reflected in the daily maintenance activities in order to reduce maintenance time and cost (avoid unnecessary use of spare parts) through the improvement the maintenance management capacity. In the improvement of data management the following ledgers are suggested to be maintained:

- Vehicle ledger



- Vehicle maintenance ledger

(Details will be described in the Maintenance management)

(6) Preparation of Equipment and facilities

1) Preparation to procure the basic Tools (capital machine parts)

Procurement of basic equipment is urgent. Especially, the basic maintenance equipments and tools such as air compressor, vehicle washing machine, parts cleaning machine and grease gun. Recommendable Tools are as follow;

**Table 16.2.10 Recommendable Tools and Equipment**

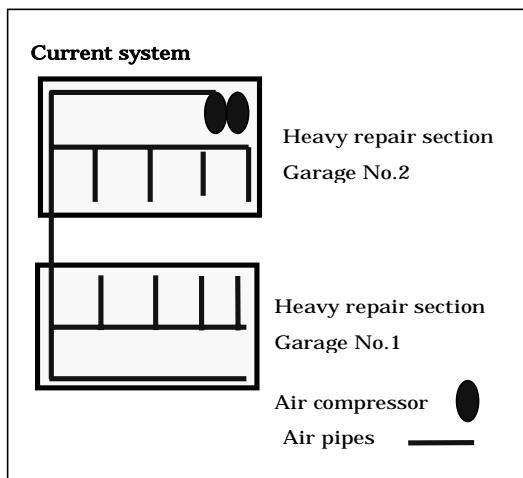
No.	Equipment Name	Specification	Q'ty	Location	Priority
1	Compressor	400 lt or more capacity	2	General Maintenance	A'
		250 lt or more capacity	2	Inspection & General Maintenance	A'
2	Air circulation tool set	System improvement	2	Inspection & General Maintenance	A'
3	Diesel injection tester	Standard	1	Diesel pump section	A'
4	Fork lift	2.5ton	1	General Maintenance	A'
5	Inspection line(Existing)	Renovation (Standard)	1	Inspection	A'
	Inspection line(New)	New installation (Standard)	1	Inspection	A'
6	Lubricant line for Inspection line	Renovation	1	Inspection	A'
7	General hand tool set	Cabinet type	10	Inspection & General Maintenance	A'
8	Pit juck	10 ton capacity	14	Inspection & General Maintenance	A'
9	Garage Jack	10 ton capacity	22	All Section	A'
10	Legit rack	for Large vehicle	20	General Maintenance	A'
		for Medium vehicle	40	General Maintenance	A'
11	Garage Lift	Renovation & Installation	1	General Maintenance	A'
12	Hydraulic press	10 ton capacity	3	Inspection & General Maintenance	A'
13	Air tool	Air Impact wrench	3	General Maintenance	A'
14	Distilled water manufact. Device	Standard	1	General Maintenance	A'
15	Battery charger	for Large vehicle	4	General Maintenance	A
16	Arc & Gass welding set	Standard	1	General Maintenance	A
17	Panel Beating tools	Standard	1	General Maintenance	A
18	Tyre replacement tool	for Large vehicle	1	General Maintenance	A
	Tyre replacement tool	for Medium vehicle	1	General Maintenance	A
19	Tyre repair tool set	Standard	1	General Maintenance	A
20	Lathe machine	for spare manufacturing	1	General Maintenance	A
21	Filling station	Installation	1	General	B

## 2) Renovation of the facilities

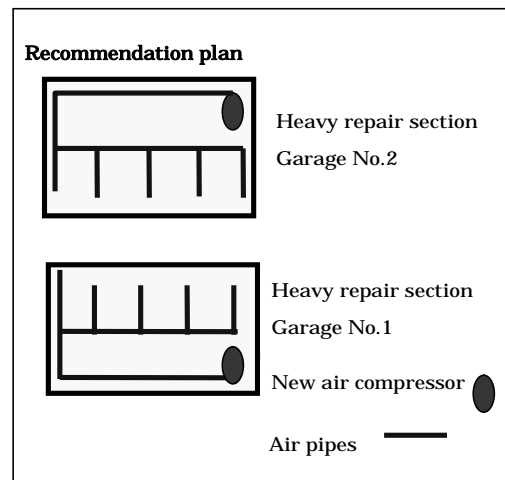
For improving work efficiency workshop facilities such as air supply arrangement, are recommended to restructure the existing setup or rather to split and relocate one of the existing locations of air supply facilities. Renovation of the facilities (air supply) plan is as follow;

- Heavy repair garage

Existing air supply system

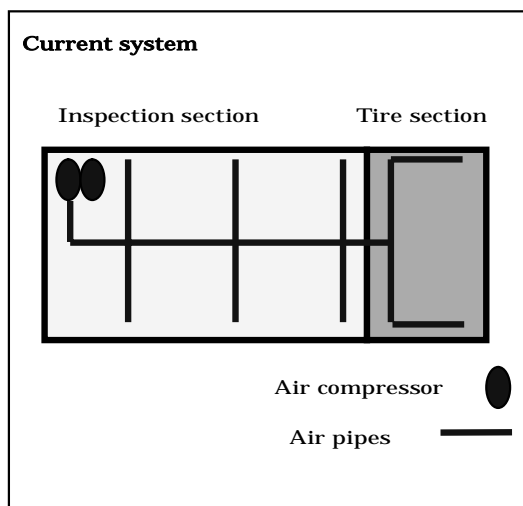


Recommendable air supply

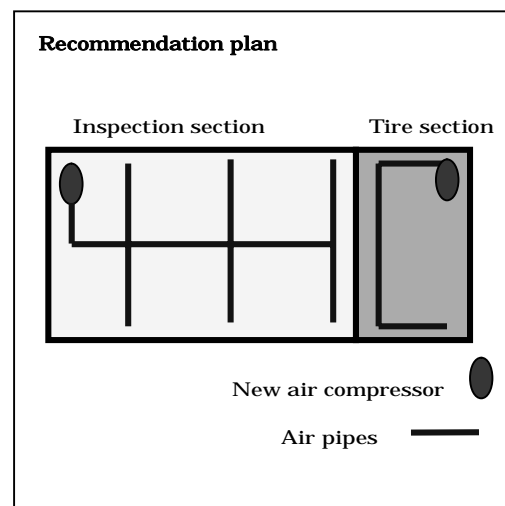


- Inspection yard

Existing air supply system



Recommendable air supply



## 3) Appropriate management of tool and material

The tool ledger will be prepared if necessary and the present condition of the tools and materials are to be confirmed.

## (7) Spare parts

## 1) Appropriate time procurement

The appropriate time for procurement (reorder time) depends upon the kinds of parts to be procured such as slow (Engine, Transmission or Differential parts etc.) or first (Oil, Fuel, Air filter or brake lining etc.) consumed parts. Hence, orders are placed at a stage when the remaining number of parts reaches at a certain reserve level. The example of calculation of the forecasted level in which the purchase should be considered is as shown below:

Let: (A) be the consumption of one month

(B) be the duration of procurement

Therefore the number of forecasts in which purchase is to be considered is

$$A \times B + \frac{1}{2}A^{*}: \text{which is equal to reserve number}$$

Example: Monthly average consumption quantity (A) = 24

Duration of procurement (B) = 2months

Therefore  $24 \times 2 + \frac{1}{2} \times 24 = 60,$

In that regard at the time of 60 pieces the Inventory figures have to be ordered.

And also shortening of the tender process can be expected to reduce equipment standby and maintenance time, and also improve vehicle availability. However, OTRACO should follow the procedure set by the government (however this procedure sometimes leads to complexity). It is necessary to set up an appropriate plan according to the reorder time.

For slow consumed parts that needs sudden counter measure

- Strengthening coordination with the dealer.
- Confirming with the vehicle maintenance ledger or the parts ledger.

## 2) Securing of parts quality

High vehicle availability (both number and frequency) and safety service to the customers are the main tasks of the public bus service company. From this point of view, not only the prevention of breakdowns or a decrease in the maintenance time, but at the same time the procurement of appropriate parts is also very important. There is a possibility of the cause of some other breakdowns because of use of inferior quality parts as described before. Therefore, it is necessary to take technical suggestion during the order and the delivery process of parts.

- To obligate submitting the samples at the tender process.
- A dealer or an affiliated trader is to be selected as much as possible.
- A technical staff should take part in the tender process.

### 3) Appropriate parts data management

The part management is mainly done by its part numbers; therefore, confirmation of this could be difficult for a person, others than the person who is in charge. So the parts ledger that contains the names of the parts clearly are recommended.

### (8) Personnel arrangement

#### 1) Appropriate number of personnel

An increase of 20-25% on the annual rate average is expected about the repair frequency in consideration of the work frequency during of past three years and the superannuation of buses ( In 2005-2006 work number was suppressed by introduction of new vehicles).

Keeping things as they are appropriate to the number of mechanics though it becomes 4.0 if the work efficiency in 2006 is compared as explained above, because 1000 is forecasted to reach 50% increase by 2008.

**Table 16.2.11 The Rate of Repair Works**

Year	2004	2005	2006	2007(estimate)	2008(estimate)
Number of breakdown	439	549	600	800	960
Transition ( % )	0	+20	+8	+36	+20

However, it seems that the staff increase is needed according to the change in the situation in the future. as follows:

- 1) An increase in the number of vehicle
- 2) To set up branches

As proper arrangement in that case reference value are as shown below;

**Table 16.2.12 An increase in the number of vehicle**

Increasing number	10-20	30-40	50-60	70-80	90-100
Appropriate additional number of staff	2	3	4	5	6

**Table 16.2.13 To set up branches**

Number of buses per branch	1-6	7-10	10-15
Appropriate number of staffs per branch	2	3	4

The situation in present number of arrangement and amount of work increase compared to the neighbouring country (such as Rwanda) was considered to be on same grounds.

#### (9) Public Vehicle Inspection

- Strengthening of car inspection

The number of monthly public car inspection has been increased almost six times compared with the year 2004 (where 500 vehicles to 3,000 vehicles were inspected). The expansion or renovation of the vehicle inspection services will help not only OTRACO sustainable management but also help to public safety awareness.

### 16-3 TECHNICAL TRANSFER TO OTRACO

#### 16-3-1 Seminars

Seminar on improvement of surroundings and safety of the garage were held three times at OTRACO premises. Summary of technical seminars are shown as follows:

##### Seminar 1

Subject:	Seminar on improvement of environment and safety of the garage
Date:	April 19, 2007
Venue:	OTRACO seminar room
Participants:	11 mechanics for heavy repair and 1 Engineer

##### Contents

The seminar was arranged on improvement of environment and safety of the garage. The problems found, which should be solved urgently, were explained to the mechanics. They were able to realize that it is important for them to understand those problems and they must try to solve those problems for their safety. Some photographs of an accident which happened at the garage in the past were used to make them realize the current

situation and they were told that the present environment at the garage is very dangerous and they must need to protect themselves.

### Conclusion

All the participants understood the importance of safety.

### Seminar 2

Subject: Seminar on brake overhauling  
 Date: May 2, 2007  
 Venue: OTRACO seminar room  
 Participants: 12 mechanics for heavy repair and 2 engineers

### Contents:

A proper procedure of brake maintenance was explained by dividing it into 16 processes for their easy understanding (Table 16.3.1). The explanation was made on the way of proper maintenance on each process and how to avoid mistakes as well as the necessity to check the whole brake system. On top of that they were also told the necessity of adjusting a wheel hub and bearing when doing brake overhauling.

### Conclusion

All the participants understood the proper way of brake overhauling.

**Table 16.3.1 16 Processes of Brake Overhauling**

Contents		
Before removing brake lining	Before removing brake lining	Before removing brake lining
1. Use the rigid rack	7. Diagnostic brake system breakdown	13. Method of adjustment of wheel hub bearing
2. Remove the axle shaft and rear hub	8. Inspection method of vacuum booster	14. Procedure of releasing air from brake fluid
3. Cleaning method of drum and brake	9. Replacement method of wheel cylinder cup	15. Adjustment method of brake
4. Change the bearing grease	10. Role of brake adjuster lock plate	16. Adjustment method of axle and shaft
5. Change the hub seal	11. Method of filling brake fluid on break adjuster back plate	
6. Change the brake lining	12. Installation method of brake shoe	

### Seminar 3

Subject: Seminar on periodic inspection

Date: May 10, 2007  
Venue: OTRACO seminar room and heavy repair garage  
Participants: 9 mechanics for heavy repair, 5 inspection mechanics and 3 Engineers

#### Contents:

The periodic inspection check list which was made with the help of the Workshop Manager and the Engineering Technicians was explained in the seminar. The mechanics were later shown how to do an inspection according to the check list.

#### Conclusion

All the participants understood how to do a Periodical inspection according to the check list.

#### Seminar 4

Subject: First OTRACO seminar on bus maintenance and management  
Date: July 12, 2007  
Time: 4:00pm-5:00pm  
Venue: OTRACO meeting room  
Participants: Bus exploitation section chief, heavy repair section sub chief, Bus inspection section chief, spare part section chief

##### 1. Objective

The objective of this seminar was to explain the present situation of bus management system and expected problems in future.

##### 2. Summary

OTRACO requested the government of Japan the grand aid and if the request will be accepted, about 100 buses are required to be donated. On the other hand the number of private vehicle inspections has increased significantly. Considering this situation it is essential for OTRACO to improve the system of bus maintenance and management before buses are donated.

At present the 4 sections are functioning independently. For example it has happened that a bus has been repaired without thinking why the trouble occurred and how to prevent the same trouble from happening again. All sections were needed to cooperate so that buses can be used for as long as possible.

##### 3. Review

For proper bus management it is necessary to detect the cause of troubles and accidents, and precautionary maintenance should be taken immediately. One of the important

factors of precautionary maintenance is to conduct a proper periodic inspection.

On the next day of the seminar, the exploitation section chief told the bus condition record unit staffs to check the mileage of each bus and if there was any bus which was due for the inspection. It seemed that they are willing to improve the present situation.

As the problem of present bus management system was explained at this seminar, a solution of this problem should be discussed at the next seminar.

#### Seminar 5

Subject:	Second OTRACO seminar on bus maintenance and management
Date:	July 26, 2007
Time:	3:30pm-5:00pm
Venue:	OTRACO meeting room
Participants:	Bus exploitation section chief, heavy repair section chief, heavy repair section sub chief, bus inspection section chief, spare part section chief

##### 1. Objective

The objective of this seminar was to present some problems caused by the lack of cooperation between 4 sections and discuss how to solve the problem.

##### 2. Summary

- It has been found that many brake linings had been changed for the specific bus by examining the spare parts record. Although the cause of the problem was apparent no measure was taken due to the lack of communication between the 4 sections.
- It was pointed out that periodic inspection has not been performed at the regulated mileage. The discussion was conducted on how to solve this problem.
- It was explained that although the data management by computer is necessary, how to utilize the data is important as well.

##### 3. Review

At this seminar there was a suggestion that the present situation of OTRACO bus management should be improved regardless of the number of buses. There was another suggestion that the problem of periodic inspection should be informed to the inspection staff engaged in inspection work. Those suggestions show that their enthusiasm of improving the situation.



### Seminar 6

Subject: OTRACO periodic service seminar  
Date: August 7, 2007  
Time: 4:00pm-5:00pm  
Venue: OTRACO meeting room  
Participants: Heavy repair section sub chief, 8 bus inspection section inspectors

#### 1. Objective

The object of this seminar was to explain the problem of periodic inspection to inspection staff and discuss how to solve the problem

#### 2. Summary

As a result of cross checking of the data of 6 buses chosen at random, it was found out that periodic inspection was not conducted regularly. It is therefore necessary to take some measures to solve this problem before the buses are donated.

The number of buses and mechanics has not changed recently. However the number of private vehicles brought for inspection has been increased significantly, which may have had mechanics occupied and left them with less time for bus inspection.

Inspection section staff should check the sticker indicating next inspection attached to each bus at least once a week. At the same time, when entering a bus inspection record into the computer the mileage or date of the next inspection must be entered as well so that anyone can check the next inspection.

#### 3. Review

It was pointed out in the seminar that, the improvement of the technique of periodic inspection will be meaningless if buses are not going to be brought into the garage for inspection at the specified time without delay. Therefore the present system of bringing buses according to the stickers by drivers alone is not enough. Inspection staff should also have responsibility to conduct inspection without delay.

### Seminar 7

Subject: OTRACO brake overhauling seminar  
Date: August 11, 2007  
Time: 3:30pm-4:00pm  
Venue: OTRACO meeting room

Participants: Heavy repair section chief, heavy repair section sub chief, 10  
Heavy repair mechanics, 8 Bus inspection section inspectors

### 1. Objective

The objective of this seminar was to show how to do a proper brake overhaul by following the manual.

### 2. Summary

The OTRACO mechanics have long experience on the same kind of vehicles and thus they tend to depend on their experience rather than technique. As a result mistakes often happen when it comes to brake overhaul. The brake overhauling work normally requires the at most care in order to avoid causing further troubles such as damaging brakes.

It was explained that brake overhaul is not just changing spare parts but includes checking and adjustment of brake system, which is the most important part of brake overhaul. Then the manual containing the explanation on brake overhaul in the seminar held in May 2007 was distributed to all the participants and a supplementary explanation was given.

### 3. Review

In this seminar overhaul procedure was mainly explained. It will also be necessary to teach them the technique of brake trouble shooting.

## 16-3-2 Garage Environment and Safety Works

Several problems concerning environment and safety of the garage were found during the preliminary inspection. Some parts and devices removed from vehicles were scattered on the floor while some were lost or damaged. Most mechanics don't wear working boots (shoes) and welding gloves due to their lack of safety awareness. Besides some of the mechanics don't know the proper way to use a rigid rack or sometimes use only a jack, when they lift a vehicle, the situation which might cause an accident.



Photo 1: Brake overhauling without using a rigid rack.



Photo 2: He got injured on his thumb of the foot due to wearing sandals.

#### Attached Materials

- |            |                                   |
|------------|-----------------------------------|
| Appendix-2 | Vehicle list and Condition        |
| Appendix-3 | Capacity assessment questionnaire |
| Appendix-4 | Breakdown detail and working hour |
| Appendix-5 | Tool and Equipment list           |
| Appendix-6 | Vehicle Ledger                    |
| Appendix-7 | Maintenance check sheet           |
| Appendix-8 | Maintenance manual (Brake)        |



# **CHAPTER 17**

## **CONCLUSIONS AND RECOMMENDATIONS**



## CHAPTER 17 CONCLUSIONS AND RECOMMENDATIONS

### 17-1 Conclusions

#### (1) Plan Justification

The Emergency Study on Urban Transport in Bujumbura is conducted to improve the situation of urban transport in the City of Bujumbura thorough analysing present conditions and forecasting future traffic conditions comprehensively.

The investment by the plan in three terms of execution requires following amounts;

- Short Term (2008-2010)	:	7,3 BFBu
- Medium Term (2011-2013)	:	55,6 BFBu
- Long Term (2014-2017)	:	85.1 BFBu
Total	:	148.0 BFBu

The plan is justified as viable by the economic evaluation and acceptable by the initial environmental evaluation. Outline of economic evaluation are as follows:

- NPV	:	47.7 BFBu
- BCR	:	1.60
- EIRR	:	16.7%

#### (2) Plan Components

The major components in the plan are as follows;

##### ➤ Road Improvement

- North-south Axis Strengthening Projects (3 Roads)
- Ring road Developing Projects (2 Roads)
- Missing Link Development Projects (3 Roads)
- City Plan Development Projects - Northern Area (7 Roads)
- City Plan Development Projects – Southern Area (5 Roads)
- Traffic Signal Installation (36 Intersections)

##### ➤ Public Transport Improvement

- Central Bus Terminal
- Northern Bus Terminal
- Southern Bus Terminal

- Introduction of New Bus System
  - Traffic Management
- Parking Control in CBD
- Introduction of Bus Exclusive Lane
- Restriction of passenger car boarding one person into CBD
- Traffic Institution
  - Establishment of Regulatory Authority as the regulatory body in public transport
- Financing
  - Mobilization of internal financial resources to routine maintenance work



## 17-2 Recommendations

### (1) Authorization of the plan

Based on the objective of the study to establish urgent improvement plan of urban transport in ten years as the emergency study, immediate implementation of the plan and substantiation of benefit are required. For that purpose, the plan should be authorised by relevant ministries and agencies, by which every effort should be integrated to execute the plan and achieve the target.

Plans established in the study should be included in superordinate plans of relevant organizations and be highly regarded by donors to prompt the implementation of the plan.

### (2) Progress management of the plan by the authority

The plan proposed in this study shall be the fundamental guideline for the development of urban transport in Bujumbura and therefore all the development of infrastructure for urban transportation should be performed under the intention of the plan. In order to vitalise the plan and to attain the target of the plan, organization which has authority and is responsible for the implementation of the plan shall be clarified and defined. This organization should administer the progress of the plan thorough promoting and monitoring constantly the execution of the plan as scheduled.

Ministry of Transport, Post and Telecommunication and Ministry of Public Works, the counterpart organizations on this study, shall be given authority and responsibility and take a role as the executor of the plan. These two organizations, under close cooperation and clear adjustment of each role, shall manage the implementation of plan in the fields of public transport and road development respectively. Two organizations conduct managements thorough following aspects;

- Establishment of organizations and institutions required for the execution of the plan which are proposed in this study.
- To secure budget for the implementation of the plan and, for this sake, to make the plan well-understood among the donors, to promote investments by donors.
- To adjust the urban development projects into coordinating condition with urban transport.  
New town should be developed in accordance with the road development
- To investigate and to approve or reject the projects those are not referred in the plan.

Furthermore, if the progress of the plan is not achieved properly as the schedule, the responsible organizations should inspect the reason and review and re-establish the plan if

necessary. This review and re-establishment includes reformation of organizations and institutions concerning the execution of the plan.

(3) Evolution program for public transport in Bujumbura

In this study, public transport plan is drawn up based on the following allocation of role between OTRACO and private bus enterprises.

OTRACO: To raise the status of public transport according to the high capacity and safe, comfortable, regular operation, and to promote the utilization of public transport by citizens of every social class.

Private bus enterprise: To provide safe, comfortable and regular public transport service under the profit purpose.

Public transport in Bujumbura shall evolve in following scenario following the assigned role by OTRACO and private enterprise.

Step 1: Introduction of OTRACO large buses into trunk route

Public transport is distinguished as safe, comfortable and stable mode in the city by the introduction of OTRACO large buses as well as introduction of bus exclusive lanes. Attributes of passengers extend gradually from low income class to every class.

Step 2: OTRACO takes the lead in mass transport

Public bus establishes the role as citizens' daily means of transport by expansion of large bus operation. Administrative balance of bus company becomes profitable and therefore bus enterprise acquires social credibility.

Step 3: Private bus companies enter into large bus operation

Improvement of administrative credibility enables financing to private bus companies. Private bus companies enter into enterprise by large buses due to the technical transfer on bus operation management from OTRACO in addition to the financial improvement. Institution for private bus companies is also improved to enhance entry of private buses.

Step 4 Coexistence of private bus companies and OTRACO

Private bus companies and OTRACO operates and compete in bus services in the city. As a result, bus network extends and increase in passenger cars levels off.

#### (4) Building a consensus among citizens on the improvement plan

To make a progress of the plan smoothly, it is essential to form the consensus by among the citizen on the plan, so responsible organizations should disclose sufficient information and obtain comprehension before commencement of each project. The study team conducted three stake holders meeting in the study period and strove for absorption of citizen opinion. In this manner, the government organization should offer information including the progress of the plan and ask for opinions of interested parties and individuals thorough discussion.

It is also of overriding importance to obtain consensus on the promotion of public transport to restrict the increase of vehicle traffic which is the most basic premise in this study. To arouse the citizen's concern for utilization of public transport, comprehension by the participants of education and mass media should be constituted. To this end, personnel of government circles are recommended to promote car pools and pick-up buses to represent the concept of vehicle reduction.

#### (5) Social consideration

Environmental impact assessment (EIA) is supposed to be conducted at the design stage in advance for the projects proposed in the study. Major impacts to be considered in EIA are indicated as follows.

##### - Involuntary resettlement and land acquisition by the road development project

As described in IEE (chapter 13), road planning engineer and road design engineer should analyze the alternative plan and consider the flexible cross-section and proper alignment.

##### - Future decrease in employment opportunities by the introduction of large buses

Introduction of large buses into trunk routes contributes to environmental improvement greatly, decreasing number of vehicles and air pollution by exhaust gas. On the other hand, employment opportunities of drivers of minibus enterprises are decreased, which result in social impact. To mitigate the impact, the study proposes to enlargement of employment of OTRACO and related companies, and leading this process, to encourage strengthening the management of private bus enterprises. The organization concerned should strongly take into consideration of this role.

##### - Green environment along the developed road

Well-grown roadside trees are one of the good scenery of Bujumbura city. To avoid the demolition of this excellent green environment, consultant of road design should take into the consideration the scenery of road sides.

#### (6) Utilization of Community Profile

In this study, practical survey in the communities is conducted to clarify the features and profile the communities. Many of items of profile are forming basic information for analyzing the urban transportation on the study, but many aspects of community lives are reflected in the profile. Therefore, community profile can be utilized in various field of technical cooperation as the tool for analyzing the basic need of fundamental lives.

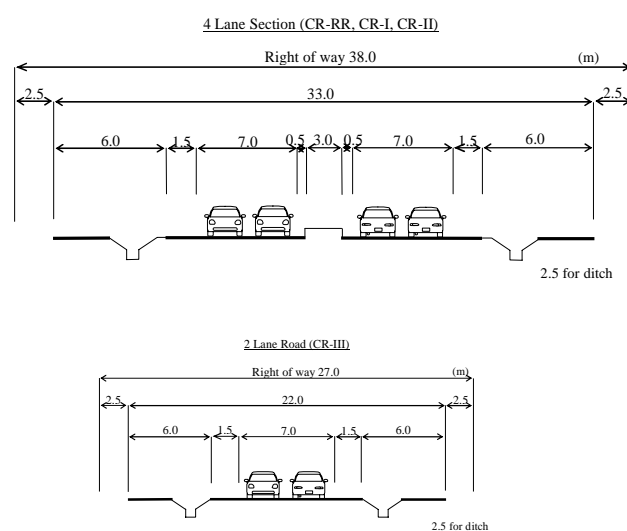
#### (7) Securement of maintenance budget

It is essential to maintain improved road in proper condition as well as to execute plan as scheduled. Periodic preventive maintenance enables to reduce maintenance costs of facilities over the long term. In this principle, the study proposes the scheme for road maintenance which deliberates on the efficiency and stability of maintenance. The World Bank also recommends that internal funds of the maintenance program shall cover at least 50% of routine maintenance need, and meanwhile, if needs be, periodic maintenance shall be submitted to partners, which is referred in chapter 14..

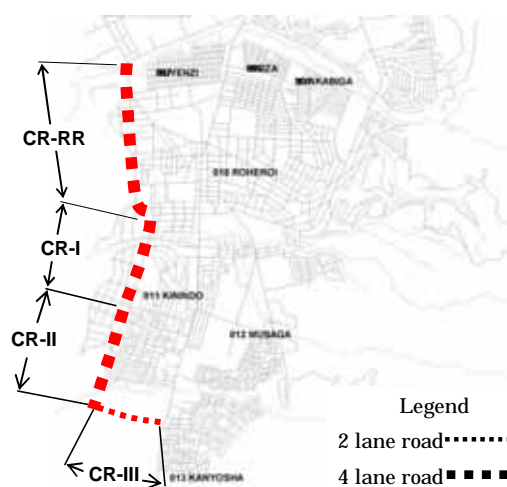
## PROJECT PROFILE SHEET (1)

Project Type	Road Development		
Project Name	New Construction of Coastal Alternative Route		
Project Objective	To reduce traffic volume to CBD area To enhance development in southern areas specifically for industrial functions To strengthen north-south corridor		
Executor	Ministry of Public Works and Equipments (MTPE)		
Location	Kinindo-Kanosha		
Beginning	RN No. 3	Ending	Ring Road
Length	7.4km	Width	27-38m
Lanes	2-4 lanes		
Present Traffic Volume in 2007		5,666/per 12 hour	
Traffic Volume Forecast in 2017		300 ~ 14,400 pcu/day	
Total Cost	19.1 billion Fbu	Cost per Length	2.5 billion Fbu

## Cross Section



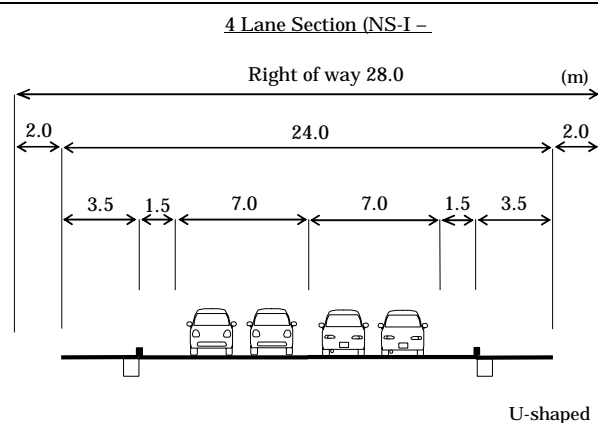
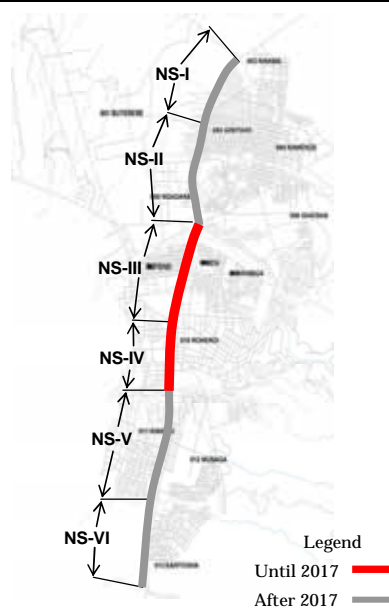
## Route Map



Notes: CR-RR is included in Ring

**PROJECT PROFILE SHEET (2)**

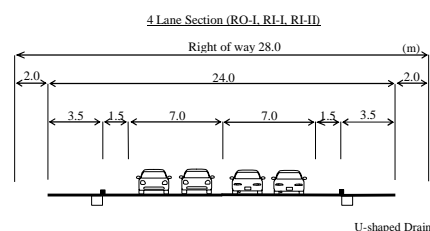
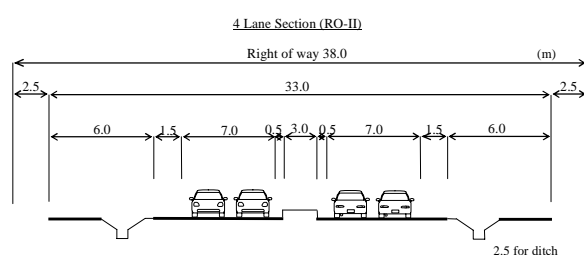
Project Type	Road Development		
Project Name	Improvement of North-South axis around CBD area		
Project Objective	To reduce traffic volume to CBD area To enhance development in southern areas specifically for industrial functions To strengthen north-south corridor		
Executor	Ministry of Public Works and Equipments (MTPE)		
Location	Rohero-Kinindo		
Beginning	Rohero	Ending	Kinindo
Length	4.6km	Width	28m
Lanes	4 lanes		
Present Traffic Volume in 2007	10,812/per 12 hour		
Traffic Volume Forecast in 2017	10,800 ~ 36,700 pcu/day		
Total Cost	10.6 billion Fbu	Cost per Length	2.5 billion/km

**Cross Section****Route Map**

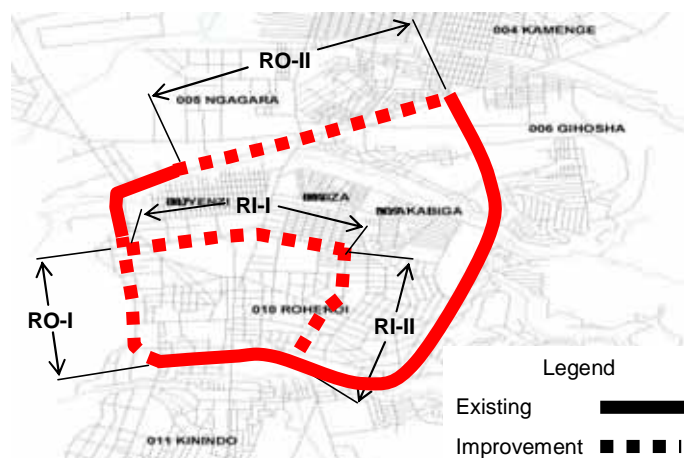
## PROJECT PROFILE SHEET (3)

Project Type	Road Development		
Project Name	Improvement of Ring Road		
Project Objective	To reduce traffic volume to CBD area Strengthen road network to future traffic demand		
Executor	Ministry of Public Works and Equipments (MTPE)		
Location	Ngagara-Rohero		
Beginning	Rohero	Ending	Kinindo
Length	6.9km	Width	28m
Lanes	4 lanes		
Present Traffic Volume in 2007	5,094-11,267/per 12 hour		
Traffic Volume Forecast in 2017	2,500 ~ 19,500 pcu/day		
Total Cost	17.2 billion Fbu	Cost per Length	2.5 billion/km

## Cross Section

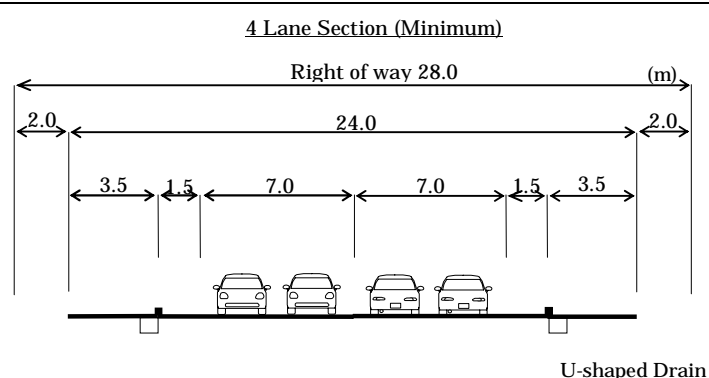
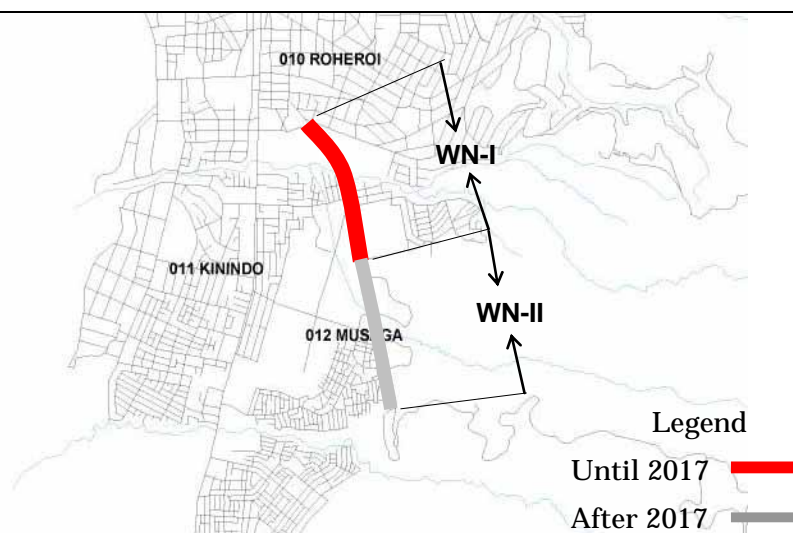


## Route Map



**PROJECT PROFILE SHEET (4)**

Project Type	Road Development		
Project Name	Widening of RN-7		
Project Objective	To reduce traffic volume to CBD area Strengthen road network to future traffic demand		
Executor	Ministry of Public Works and Equipments (MTPE)		
Location	Rohero-Musaga		
Beginning	Rohero	Ending	Musaga
Length	2.0km	Width	28m
Lanes	4 lanes		
Present Traffic Volume in 2007	11,267/per 12 hour		
Traffic Volume Forecast in 2017	14,000 pcu/day		
Total Cost	5.5 billion Fbu	Cost per Length	2.5 billion/km

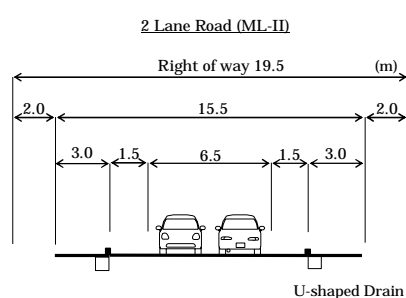
**Cross Section****Route Map**



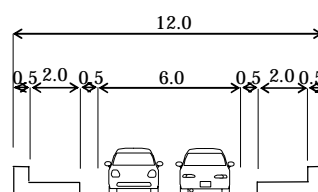
## PROJECT PROFILE SHEET (5)

Project Type	Road Development		
Project Name	New Construction of Missing Link		
Project Objective	Forming the Road network to traffic functions		
Executor	Ministry of Public Works and Equipments (MTPE)		
Location	Buyenzi-Ngagara, Bwiza-Gihosha, Rohero-Musaga		
Beginning		Ending	
Length	1.4km	Width	12-19.5m
Lanes	2 lanes		
Present Traffic Volume in 2007		/per 12 hour	
Traffic Volume Forecast in 2017		5,300-9,000 pcu/day	
Total Cost	4.9 billion Fbu	Cost per Length	3.5 billion/km

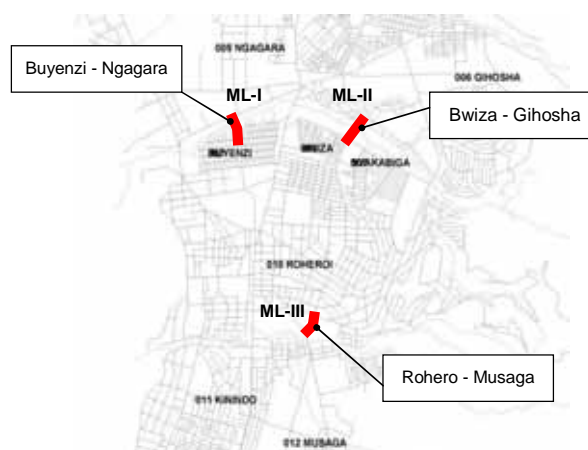
## Cross Section



## Bridge Section (ML-I, ML-II, ML-III)



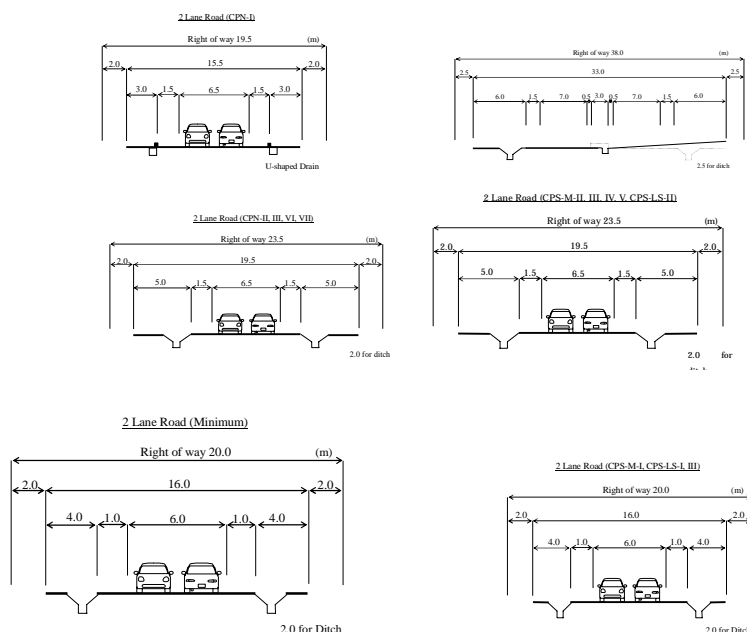
## Route Map



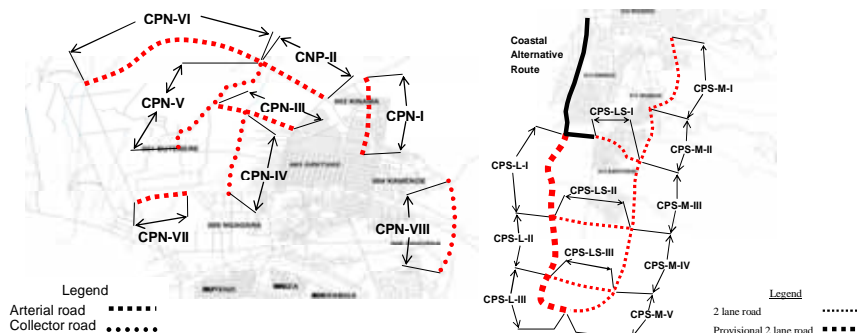
## PROJECT PROFILE SHEET (6)

Project Type	Road Development		
Project Name	City Plan Road Project at Northern and Southern Area		
Project Objective	Formulation of road network for the expansion of Bujumbura city		
Executor	Ministry of Public Works and Equipments (MTPE), Bujumbura City		
Location	Northern Area(Buterere, Kinama,, Ngagara, Gihosha) Southern Area(Kanosha, Musaga)		
Beginning		Ending	
Length	19.9km(Northern Area) 22.7km(Southern Area)	Width	22-23.5m(Northern area) 20-38.0m(Southern area)
Lanes	2 lanes		
Present Traffic Volume in 2007	/per 12 hour		
Traffic Volume Forecast in 2017	500-9,200 pcu/day(Northern area) 100-5,100 pcu/day(Southern area)		
Total Cost	39.0 billion Fbu(Northern area) 48.3 billion Fbu(Southern Area)	Cost per Length	2.0 billion/km(Northern Area) 2.1 billion/km(Southern Area)

## Cross Section



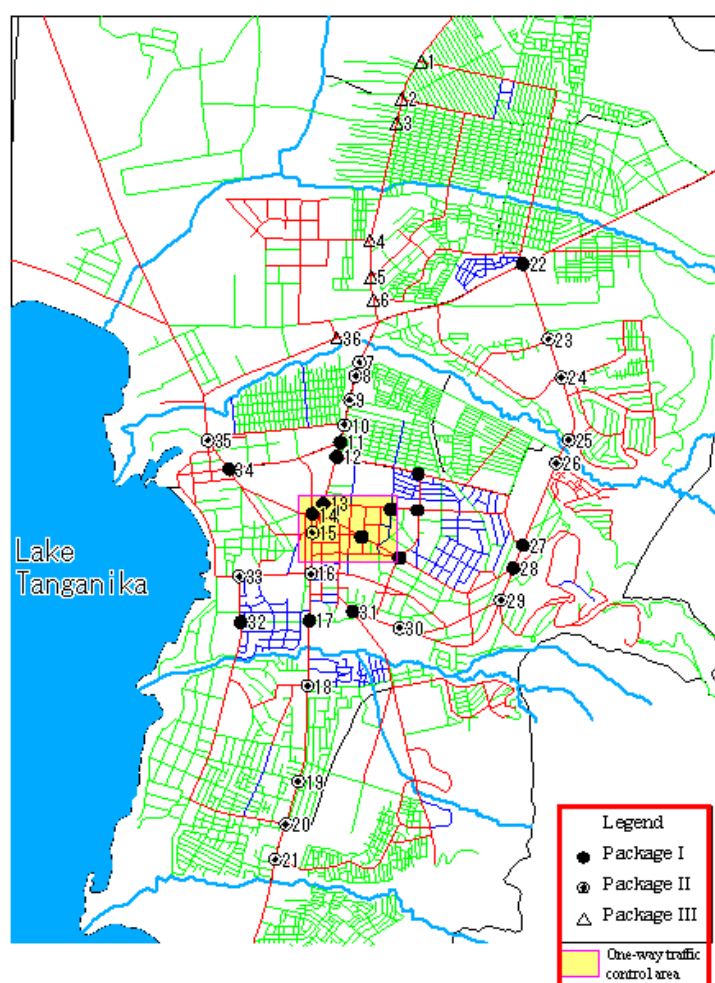
## Route Map



## PROJECT PROFILE SHEET (7)

Project Type	Road Development	
Project Name	Improvement of existing intersection	
Project Objective	Reduction of Traffic congestion Reduction of Traffic accident	
Executor	Ministry of Public Works and Equipments (MTPE), Bujumbura City	
Location	Bujumbura City	
Present Traffic Volume in 2007		/per 12 hour
Traffic Volume Forecast in 2017		pcu/day
Total Cost	0.83billion Fbu	

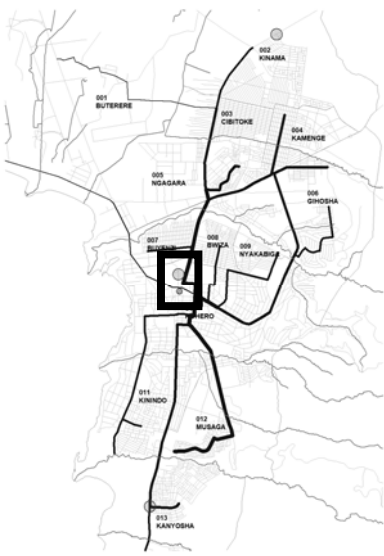

## Route Map



## PROJECT PROFILE SHEET (8)

Project Type	Road Development		
Project Name	Introduction of One-way Traffic control system in CBD area		
Project Objective	Reduction of Traffic congestion Reduction of Traffic accident		
Executor	Ministry of Public Works and Equipments (MTPE), Bujumbura City		
Location	Rohero		
Present Traffic Volume in 2007			/per 12 hour
Traffic Volume Forecast in 2017			pcu/day
Total Cost		Cost per Length	
Route Map			

**PROJECT PROFILE SHEET (9)**

Project Type	Bus Station
Project Name	New construction of City center busterminal
Project Objective	Reduction of traffic congestion Reduction of traffic accident Provision of easy and safety transfer at bus terminal
Executor	Ministry of Transport, Posts and Telecommunications, Bujumbura City
Location	Rohero
Area	30,600sq.m
Total Cost	2.4 billion Fbu
Location	
	
Design	
	

**PROJECT PROFILE SHEET (10)**

Project Type	Large Bus Operation		
Project Name	Introduction of New Bus operation System in Bujumbura city		
Project Objective	Reduction of Traffic congestion Reduction of traffic accident Provision of stable and comfortable bus operation		
Executor	OTRACO/Ministry of Transport, Posts and Telecommunications		
Location	Bujumbura City		
Total Cost	8.7 billion Fbu	Cost per Length	
Route Map			
