(3) Necessary Equipment and Materials

Before and during the implementation of experiments, the equipment, materials and services (advertisement and survey) are necessary.

Table A20.2.2 Preliminary Estimate of Necessary Equipment and Materials for Public Experiment

Items				Unit	Qty.
Bus Operation	1	Rental Bus	Mini bus	bus/day	22
	2	Driver	Mini bus	man/day	22
	3	Conductor	Mini bus	man/day	22
	4	Dispatcher	Line 1	man/day	4
			Line 2	man/day	2
	5	Supervisor		man/day	1
	6	Walky Talky			22
	7	Miscellaneous	Conductor bag and Punch, etc.	set	22
Advertising Media	1	TV Spot	45 seconds Broadcasting from: May 25- May 31, 2001 Broadcasting Station: TVK, TV3, TV5 Times: weekend: 6:55, 11:55, 18:55, 20:45 Times: weekday: 11:55, 12:45, 18:55, 20:45	days times/day	7 4
	2	Radio	45 seconds Broadcasting from: May 25- May 31, 2001 Broadcasting Station: FM103/FM99/FM95 Times: 6:30, 7:30, 8:30, 11:30, 12:30, 17:30. 18:30, 19:30, 22:30	days times/day	7 9

	3	Newspaper	- Raksmei Kampuchea (Khmer) A3
			- Cambodia Daily (English)
			      May 26, and May 30, 2001
			      (Size: $^1/_2$ of A4 with Color)
				times	7
					1/w/d & 1/w/e
					1/w/d & 1/w/e

	4	Banners	Type 1: Bus Operation Experiment - Line 1: 40 days - Line 2: 40days		14 x 2 = 28 10 x 2 = 20
	6	Pamphlets	School Government Office Hotel Tourist Agencies Others Total	copy	20,000 5,000 5,000 5,000 65,000 100,000
	7	Poster		copy	2,000

	8	Tickets	- Line 1: Blue Ticket
			- Line 2: Green Ticket
			- Transfer Ticket
			      Blue - Green
			      Green - Blue
				copy	3,500 x 30 = 105,000
					1,500 x 30 = 45,000
					
					500 x 30 = 15,000
					500 x 30 = 15,000

	9	Shirt/ T-Shirt	Driver Conductor Surveyor / (T-Shirt)		100 100 2,000
Pedestrian Crossing				sq. m.	10 places
Traffic Control				man/day	30

Survey	1	Travel Speed Survey (Bus)	3 days MPeak x 2 x 2
			               MOff x 2 x 2
			               AOff x 2 x 2
			               APeak x 2 x 2
				man*day	48

	2	Traffic Volume	3 Routes x 2 sections x 3 days	set	18
	3	Bus Passenger Count	3 days 20 x 3 x 2 x 3	man*day	360
	4	Bus Passenger Interview	3 days 200 samples x 3/10	man*day	60
	5	Shop Owners, etc. Interview Survey	2 days 600/ 10 (Bus)	man*day	60

Appendix A20-2-2 Publicity Activities

Items		Unit	In-charge	Remarks	May	June	July
1	TV Spot — 50 seconds Broadcasting from: May 26- June 2, 2001 Broadcasting Station: TVK, TV3 Times: weekend: 6:55, 11:55, 18:55, 20:45 Times: weekday: 11:55, 12:45, 18:55, 20:45	8 days 4 times/day	TVK	①Welcome to the bus operation ②How to get the bus ③Fare system ④Don't stop in the bus stop marking ⑤Opening of PPCS Gallery ⑥Ending of experiment	■	■	
2	Radio — 75 seconds Broadcasting from: May 26- June 2, 2001 Broadcasting Station: FM103/FM99/FM95 Times: 6:30, 7:30, 8:30, 11:30, 12:30, 21:30, 22:30, 23:30	8 days 8 times/day	TVK	①Welcome to the bus operation ②How to get the bus ③Fare system ④Opening of PPCS Gallery ⑤Ending of experiment	■	■	
3	Newspaper — - Raksmei Kampuchea (Khmer) A3 - Cambodia Daily (English) A4 May 26, and May 30, 2001 Color	2 times/week 1/w/d & 1/w/e 1/w/d & 1/w/e	TVK	Using a poster	■		
4	Banners — Type 1: Bus Operation Experiment - Line 1: 10 days + 10 days - Line 2: 10 days + 10 days	6+6, 6+6 6+6, 6+6	TVK	①Let's take a bus, cheap..... ②Let's take a bus, safe..... ③Opening of PPCS Gallery ④Ending of experiment	■	■	
5	Pamphlets — School Government Office Hotel Tourist Agencies In the Bus Others Total	100,000 sets	PPML		■	■	
6	Poster — Same as Pamphlet	1,000	PPML				
7	Shirt/T-Shirt — Driver & Conductor (Polo Shirt) Surveyor / (T-Shirt)	Blue 100+G 100 1,000	TVK		■	■	

The CAMBODIA DAILY

Transit Test To Restrict Monivong Traffic

BY KAY KIMSONG
AND JODY McPHILLIPS
THE CAMBODIA DAILY

Two- and three-wheeled traffic will be banned from one of Phnom Penh's busiest streets for the month of June, as part of a public transit experiment.

Bicycles, cyclos and motorcycles, both motorbike taxis and private motorbikes, will not be allowed on a section of Monivong Boulevard, officials said.

Japanese aid officials and Phnom Penh Governor Chea Sophara signed the papers Tuesday authorizing the experiment, to be paid for by the Japan International Cooperation Agency.

"This is very much appreciated," Chea Sophara said of the project, which will send 22 air-conditioned buses over two routes from 5:30 am to 7:30 pm daily.

Transit experts say Phnom Penh's chaotic traffic, with vehicles of various kinds whizzing in all directions, sharply slows movement within the city.

Two bus routes are planned: the Blue Line, which will run from Chbar Ampao market to a stop just east of the Japanese Bridge; and the Green Line, a clockwise downtown loop on Norodom, Sihanouk, Nehru and Kampuchea Krom boulevards.

Cycle traffic will be banned on one segment of the Blue Line—Monivong between Sihanouk and Charles de Gaulle—while the buses are running.

They want to see whether the buses will run more efficiently on the cycle-free stretch. Officials estimate that the 9 km Blue Line route will take between 40 to 50 minutes, while the 7 km Green Line loop will take 30 to 40 minutes.

Fares will start at 500 riel to encourage ridership but will rise to 800 riel after a few days.

JICA officials would not say how much the project will cost, saying they are still negotiating with the Ho Wah Genting Transport Co Ltd for bus leases. If the experiment is a success, they said, a private company may continue the bus service.

The officials said the buses will run every 5 or 10 minutes, seat 29 passengers with no more than 6 standees, and that the 56 bus stops would be between 300 and 500 meters apart. There are no plans to rent additional buses during the experiment.

Several roads running parallel to Monivong have been resurfaced to handle the expected increase in two-wheel traffic, including streets 107, 182, 105, 63, and 51, JICA's Koto Masato said.

Chea Sophara said an existing ban on two-wheel traffic on Norodom will be enforced.

The governor also said he does not expect motorbike taxi drivers to protest against the experimental introduction of buses. "I think they will enjoy driving on these safer roads," he said.

Moto driver Tith Sokhom, 40, said he's glad smaller streets are being upgraded, but questions whether June rains will flood them.

"The buses will be good for people who have the time, but people in a hurry will prefer motos," he said.

Cyclo driver Moek Buot, 37, said, "If they think this plan is good for the people. I'll do it," while Long Vasna, 56, said cyclos have been banned in the past and will survive another ban

Monthlong Bus Experiment To Begin Friday

BY JODY MCPHILLIPS
AND PHANN ANA
THE CAMBODIA DAILY

Phnom Penh's experiment in mass transit will roll as planned Friday morning, with 22 air-conditioned buses covering two routes from 5:30 am to 7:30 pm daily.

The bus experiment, to run for the month of June, is funded by the Japan International Cooperation Agency as part of its ongoing efforts to tame the city's chaotic traffic.

The idea is to see how feasible a public transit system is for Phnom Penh. Traffic experts say the current jumble of vehicles, from oxcarts up to tractor-trailers, is inefficient and dangerous.

As part of the experiment, bicycles, cyclos, motorcycles and slow-moving vehicles will be banned during bus hours from the busiest stretch of road in the city: Monivong Boulevard between Sihanouk and Kampuchea Krom boulevards.

Engineers had hoped to determine whether banning smaller vehicles made a significant difference in bus performance.

But Tatsuyuki Sakurai, deputy team leader for JICA's road section, said Wednesday that ongoing Water Authority construction along Monivong Boulevard could complicate the situation.

He said the water project, intended to carry drinking water to the Chbar Ampao area, was supposed to be completed by June but is running behind schedule.

Municipal officials are racing to complete the water project before the heavy rains begin, he said.

"So we must compromise on this," he said. "The city officials are being very cooperative."

Most of Monivong is wide enough for the buses to pass without problem, he said. At two spots where construction is slowing traffic—the intersection of Russian Boulevard and Monivong—the city will assign 100 police officers to keep traffic moving.

Line 1 will run along Monivong Boulevard from the Chbar Ampao market, east of the Monivong Bridge, to just east of the Japanese Bridge. Line 2 will loop around downtown, running clockwise along Norodom, Sihanouk, Nehru

and Kampuchea Krom boulevards.

Tickets will cost 800 riel, regardless of distance, and passengers can transfer from one line to the other for free. For the first five days of June, tickets will cost 500 riel to encourage ridership.

The buses will run every five minutes between 6:30 and 8:30 am and 4:30 and 6:30 pm, and every 10 minutes the rest of the time. The buses, which seat 29, are leased from private companies and will carry logos that read "Phnom Penh City Shuttle."

Signs are posted at the approximately 36 stops along both routes. The number is inexact, said Sakurai, because one or two stops may be changed depending on demand.

He said there are no plans to continue service past June 30, although if ridership is high enough, the private companies may wish to inaugurate their own bus system.

Sakurai said JICA plans to issue a report on the experiment in late September or early October.

Buses a Novel Sight for Phnom Penh Residents

BY ANA NOV
AND MATT REED
THE CAMBODIA DAILY

With her three young grandsons, Kim Phum set out Friday morning to ride Phnom Penh's air conditioned buses, seeking to have a bit of "fun" and to satisfy her curiosity about what the Phnom Penh City Shuttle—Cambodia's first public transit system—is all about.

"I can't use it to commute to work, because my office is not on one of the lines," she said. "But tonight I will go to Prek Liep with family members to have dinner."

On the morning of its first day of operation, some buses on the shuttle's two lines were half-full with thrill-seekers like Kim Phum and children returning from various International Children's Day events. Whether people will use the buses to travel between office and home won't be known until next week, when work resumes after Friday's holiday.

For Malay, a woman in her 20s who lives at the end of the Monivong Boulevard route in the Chbar Ampou area, traveling to her job at the Sunway Hotel by bus is a possibility. But she worries that the buses' hours of operation—from 5:30 am to 7:30 pm every day—won't fit her work schedule. And she complained the bus stops didn't have shelters.

"I support Cambodia's development, but I am almost dying from

the heat," she said. "And what would I do if it rained?"

The municipality and the Japan International Cooperation Agency, which is funding the bus system, started the month-long experiment Friday to see if it is a feasible way to tame the city's chaotic traffic. Phnom Penh Governor Chea Sophara said the city hopes to reduce traffic accidents by 70 percent within three years.

"Cars, motorbikes and people have increased. But the amount of space has not," he said. "Bangkok is a good example for bringing Phnom Penh out of pollution."

Phnom Penh's roads have become increasingly dangerous as the number of people driving has risen. A recent study of driving habits fund that most motorbike operators do not wear helmets, and accidents are a major cause of debilitating head injuries.

As part of the experiment, bicycles, cyclos, motorcycles and slow-moving vehicles are banned from Monivong Boulevard between Kampuchea Krom and Sihanouk boulevards during the buses' operating hours.

That's fine with 60-year-old Tang Hoy. Aboard a bus Friday, she said she is scared of motorbike taxis, which she deemed too risky. And she recalled that the last time she rode a cyclo, it tipped over and caused a slash to her forehead.

At one bus stop at the corner of Kampuchea Krom and Monivong boulevards, a succession of motorbike taxi drivers stopped and asked prospective bus riders if they needed a lift. Some looked bewildered when people on the sidewalk replied they were waiting for a bus.

"In Phnom Penh, moto dops and cyclos are popular," said Japanese Ambassador Gotaro Ogawa. "So I am not clear on whether the bus operation will be successful or not."

At several stops Friday, buses came along every seven or eight minutes. Onboard, Cambodian pop music played at a comfortable volume as conductors walked up and down the narrow aisle, selling and checking tickets, explaining rules, answering questions and issuing transfer passes for riders wanting to switch from one route to another.

"Some people don't know how to use the bus," said conductor Sok Lyda. "I have to explain a lot."

There are 22 buses running in the system. One route goes both ways along Monivong Boulevard, while the second route rings the center of the city along Norodom, Sihanouk, Nehru and Kampuchea Krom boulevards. Fares are set at 800 riel, but will cost just 500 riel for the first five days of June. *(Additional reporting by Kay Kimsong)*

Residents Oppose Moto Ban on Monivong

BY SAING SOENTHIRITH
THE CAMBODIA DAILY

Hundreds of Phnom Penh residents plan today to protest the municipal government's recent decision to close off the busiest section of the city's busiest boulevard to motorcycles, said Boeng Prolit commune representative Teap Sokhoeun.

"For a long time, we have been living and running businesses along Monivong Boulevard," a petition signed by residents of Boeng Prolit commune in Prampi Makara district states. "All of our clients and residents travel by motorcycle or motor-taxi. It is the easiest way for them to travel."

The city began a monthlong experiment in public transit Friday when 22 buses started operating along two routes between 5:30 an and 7:30 pm daily. As part of the experiment,

however, bicycles, cyclos, motorcycles and slow-moving vehicles have been banned from Monivong Boulevard, the city's main artery, between Kampuchea Krom and Sihanouk boulevards during those hours.

The city hopes to ease increasingly congested traffic conditions by encouraging residents to take the bus on the city's main boulevards. Phnom Penh Governor Chea Sophara has said the city hopes to reduce traffic accidents by 70 percent within three years.

Phnom Penh traffic conditions have deteriorated greatly in recent years as more vehicles are using the streets. More than 80 percent of accidents in the capital involve motorcycles, according to a study conducted earlier this year by the NGO Handicap International Belgium. The petition signers are demanding that the

city immediately reopen the heavily traveled section of Monivong to all vehicles.

Chea Sophara said Tuesday he welcomes the petition. He promised to find a way to solve the residents' problems, but he can't say what that solution might be.

Teap Sokhoeun said residents will begin walking from their houses on Monivong at 8 am, and gather soon after that for a demonstration at the Municipal Government Building.

The bus experiment, which is being funded by the Japan International Cooperation Agency, is scheduled to end June 30.

One route goes both ways along Monivong Boulevard from Chbar Ampou to Prek Liep. The second route travels one way along Norodom, Sihanouk, Nehru and Kampuchea Krom Boulevards.

Despite A Few Hitches, City Bus Experiment Rolling On

BY JODY MCPHILLIPS
AND PHANN ANA
THE CAMBODIA DAILY

One week into the monthlong Phnom Penh City Shuttle bus experiment, ridership has dropped a bit but continues to be strong, according to Tatsuyuki Sakurai of the Japan International Cooperation Agency.

The 22 buses carried an average of 5,000 passengers daily the first five days of the experiment, when the fare was an introductory 500 riel per ride, he said.

At that rate, each bus earned about $28 for its day's work; the total for all buses was $625.

On Day 6, when the fare rose to 800 riel, ridership dropped to 3,600, dipping over the weekend to 3,300. But at the higher rate, each bus earned between $30 and nearly $33 per day, for a system-wide total of between $660 and $720.

Tatsuyuki Sakurai would not say how many riders will spell success for the JICA experiment, but he joked that engineers are laying bets on the daily ridership.

Engineers cannot say what the break-even point for a commercial bus system would be, since they rent the buses from private companies and don't know what the operating costs are.

Planners had hoped ridership would be as high as 8,300 per day during the first five days, dropping to 4,500 once the fare increased. "But that was a very, very optimistic projection, if everything had gone perfectly," Sakurai said.

There have been some complaints from riders, notably a lack of shelter at bus stops to ward off sun and rain. Some foreigners have also complained of rowdy students who eat on the bus.

But most people seem to like the system, and have mastered the intricacies of asking for transfers from one line to another. Parents in particular say they appreciate how much safer the bus is for their children, compared to motorbike taxis, the engineers say.

Line 1 runs up and down Monivong Boulevard from Chbar

Ampao to Prek Leap, while Line 2 circles clockwise around downtown on Norodom, Sihanouk, Nehru and Kampuchea Krom boulevards.

Line 2 posted the highest ridership on the first two days of the experiment, attracting mainly students and shoppers. The line passes near Psar Thmei, Psar Olympic and Psar Depot as well as many schools.

Line 1 is more of a commuters' line, carrying greater numbers of passengers during morning and evening rush hours, when buses run every six minutes. It is attracting more riders as the experiment continues, while Line 2 ridership has leveled off.

A few things aren't working out as planned. Cycle traffic was supposed to be banned from Monivong Boulevard between Sihanouk and Kampuchea Krom, but the ban has not been well enforced.

That same stretch of road—the busiest in the city—is also disrupted by a major water project, as workers rush to lay water pipe

before the heavy rains arrive.

But neither factor has been a big problem, engineers say. Buses on the Monivong line are actually averaging slightly higher speeds than expected, despite the congestion.

Passengers are being surveyed to see what changes they would like to see, but planners say it is already clear that 800 riel is a bit more than students want to pay.

Beginning Sunday, the buses will display student-drawn traffic safety posters for the next 10 days, and the student artists will ride for free in hopes they will encourage their friends to use the system.

The one-month experiment is designed to test the market for mass transit in Phnom Penh in the hopes of averting Bangkok-style traffic gridlock.

Without intervention, the current chaotic mix of bicycles, motorcycles, cars and trucks is expected to slow city traffic to a polluted crawl as more Cambodians can afford motorized transport.

Bus Experiment Continues With Municipality in Charge

By PHANN ANA
AND MATT REED
THE CAMBODIA DAILY

Phnom Penh's experiment in mass transit is continuing indefinitely, with the municipality earlier this week taking over operation of 17 buses that began running regularly through the city center June 1.

Nhem Saran, director of the municipality's Department of Public Works and Transportation, said the government has decided to continue the project with its own funds.

In June, the Japan International Cooperation Agency funded the month-long experiment as part of its ongoing effort to tame Phnom Penh's increasingly Bangkok-like traffic conditions.

Nhem Saran said the city is searching for private businesses to advertise on buses to offset operating losses. He said the city is losing up to $1,000 a day on the project. The city rents 17 buses—eight from Ho Wah Genting Transport Co for $50 a day and nine from APEX Tour Co for $60 a day. Currently, passengers are charged 500 riel, but that will soon rise to 800 riel for adults, Nhem Saran said. School children will continue to pay 500 riel.

"Of course, the income from the bus revenue is not enough to cover the rent of the buses," said Tatsuyuki Sakurai, JICA deputy team leader. "If the municipality wants to continue, it will have to subsidize."

More than 100,000 people rode the buses during the month of June, Sakurai said. During the first week of June, about 5,000 people rode the bus daily. That tapered off to 3,000 a day for the last three weeks of June.

There were 3,000 riders on Sunday and 4,000 on Monday, Nhem Saran said.

Planners had hoped ridership would be as high as 8,300 passengers per day during the first five days of June and more than 4,000 for the rest of the month. Most passengers were students and shoppers, JICA official Masato Koto said. Many riders thought the buses were safer than motorcycle taxis, he said.

Originally, 23 buses operated on the two routes, but only about 17 were found to be necessary, Nhem Saran said. The buses run from 5:30 am to 7:30 pm every day along two lines. There are about 36 stops on both lines.

Line 1 runs along Monivong Boulevard from Phsar Chbar Ampou east of the Monivong Bridge to Prek Liep east of the Japanese Bridge. During morning and evening rush hours, the buses run every six minutes.

Line 2 loops around downtown, running clockwise along Norodom, Sihanouk, Nehru and Kampuchea Krom boulevards and passing Phsar Thmei, Phsar Olympic and Phsar Depot.

As part of the experiment, the city banned bicycles, cyclos, motorcycles and slow-moving vehicles on Monivong Boulevard between Sihanouk and Kampuchea Krom boulevards.

The ban brought protests from residents and shop owners on Monivong. Police did not strictly enforce the ban, but Sakurai added that JICA found that there was 45 percent fewer motorcycles on Monivong Boulevard during June.

A JICA analysis of a June passenger survey will be finished in a few weeks, Koto said.

Municipal Mass Transit Experiment Falters

By PHANN ANA
AND MATT REED
THE CAMBODIA DAILY

Phnom Penh's experiment in mass transit has ended, with the city halting the 17 buses that have been running along two routes through the city's center since June 1.

The Japan International Cooperation Agency funded a month-long experiment in June, then handed the project over to the municipal government July 1.

Because the city lost $20,100 during July, the project has been canceled, although there is some possibility a public bus system could be revived in the future, said Nhem Saran, director of the Department of Public Works and Transportation.

Nhem Saran said construction along Monivong Boulevard, the city's busiest street and one of the bus routes, cut down on ridership and reliability. The July 4 bombings of two hotels on Monivong caused police to shut down a section of the boulevard, further complicating traffic and making the bus less convenient, he said.

JICA official Masato Koto said his organization will present a report on the feasibility of public transportation in Phnom Penh at the end of September.

Nhem Saran said a future system could include routes to areas outside of Phnom Penh, including Takhmau and Pochentong Airport.

student TIMES

A Special Supplement to *The* CAMBODIA DAILY

Wednesday, March 28, 2001

City Buses to End Chaos

BY AUNG SOE MOE
AND MEAS SOCHEA

A motorcycle zips across Monivong Boulevard as the traffic light turns yellow. A cyclo cuts through the same intersection even though the light is red.

Traffic seems to go in every direction. At least for now. Motocycles and cyclos will soon vanish from a major stretch of the boulevard.

Starting in mid-May, the Municipality of Phnom Penh will introduce a trial bus system as a part of a 15-year transportation plan. Only cars and buses will be allowed during the month-long test.

"If there is no plan like this, the traffic jams of Phnom Penh will look like Bangkok," said Koizumi Yukihiro, the assistant representative of Japan International Cooperation Agency, which is helping on the plan.

The experiment will include two bus lines. One will run along Monivong from the Japanese Bridge to Chbar Ampov Market. The second line will connect Norodom, Kampuchea Krom, Nerhu and Sihanouk boulevards.

During the trial, motorbikes, cyclos and bicycles will be banned from more than one kilometer of Monivong between Kampuchea Krom and Sihanouk.

More than 20 air-conditioned buses will run along the two lines from 5:30 a.m. to 7:30 p.m. daily. Buses will depart every five to 10 minutes. The bus fare will range from 500 to 800 riel. Ho Wah Genting Co., which runs buses from the capital to the provinces, will operate the system.

City Buses

"We have decided not to allow any motorbikes, cyclos and bicycles because this segment has the most serious traffic jams," Yukihiro said. Those vehicles can use three roads parallel to Monivong—Streets 105, 107 d 63. The streets will be upgraded to handle the increased traffic.

Kang Sovann, chief of the traffic police department, said the plan will cut down on traffic accidents, which increased nearly 40 percent last year.

Many residents also welcomed the bus plan.

Sok Khum, who walks along Monivong to take her daughter to school, said it is difficult to cross the road with so many motorbikes and cyclos.

Thyda, a receptionist who works near Sihanouk, said it's dusty when she takes a moto-taxi to work. She thinks an air-conditioned bus will be more convenient.
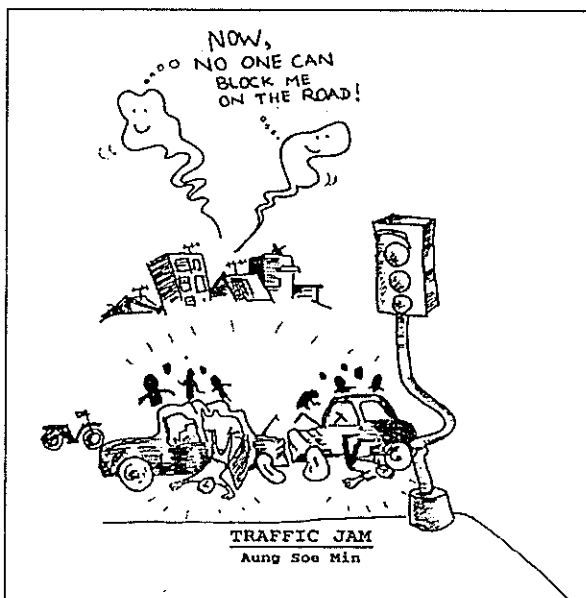
But some moto-taxi drivers and cyclo drivers are worried.

"If the government closes Monivong, we will lose cus-tomers," said Let Kim Om, a moto-dop from Kompong Cham province. "And if I can not find enough money for my family, I must go back to my home province and become a farmer again."

Khun Leng, 51, a cyclo driver, came to Phnom Penh from Kandal province 10 years ago. "If there is a plan like this, it will a big disad-vantage for us, such as losing customers and income, and it may be very hard to find a thousand riel." he said. "But we must obey the regula-tions."

About 5,000 passengers are expected to use the buses every day. JICA representa-tives, other experts from Japan and city officials will study the results of the trial bus system before deciding to make it permanent.

The long-term plan is to extend bus routes covering 71 km by 2005, 102 km by 2010 and 135 km by 2015.

There's only one thing wrong with the proposed buses, according to some would-be passengers.

"I like this plan," said Miss Socheata. "But a bus cannot take me to the front of my house like a motorbike can."

NOW, NO ONE CAN BLOCK ME ON THE ROAD!

TRAFFIC JAM
Aung Soe Min

By The Servant

Tour the city in air-conditioned comfort for just 800 Riels flat. There are currently only two routes, operating from early morning until evening.

Since the beginning of June, there has been a new bus service to take passengers around in the capital city as well. The Phnom Penh City Shuttle is a joint effort experiment between the Municipality of Phnom Penh and Japan International Cooperation Agency (JICA). The buses are quite new and comfortable. At least until June 30, 2001, there are two lines operating between 5.30 in the morning and 7.30 at night.

Line 1 takes passengers between operation through Preah Sihanouk Boulevard, Nerhu Boulevard, Kampuchea Krom Boulevard and Preah Norodom Boulevard. The fare is a flat 800 Riels regardless. There are 56 stops along the route and these buses will only stop at designated bus stops. Waiting time for these buses is between 5 to 10 minutes only. Although there are no running commentaries on board, these buses are a good and inexpensive way to see the city.

A20-18
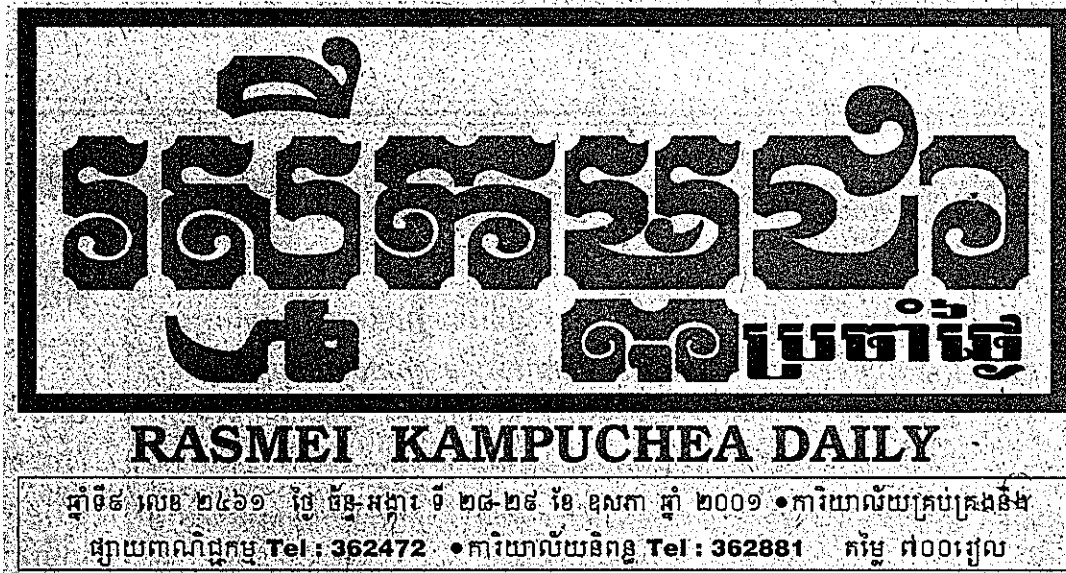
June 3, 2001
STARTING THE CITY BUS OPERATION EXPERIMENT: BUT FEW PASSENGERS
The bus operation experiment by the Municipality of Phnom Penh started on June 1, supported by JICA. Prior to the experiment, the opening ceremony was held in the afternoon of May 31. On the first day, the number of bus passengers was few, but the buses ran on schedule at 5 minutes interval.
Phnom Penh Governor Chea Sophara said "the bus operation brought a big merit to the city such as to maintain the urban environment and to reduce the traffic accidents." Moreover, he expressed hope that the citizens and students support this experiment because if it succeeds, "the bus will operate all over the city in the future." In the morning of June 1, many buses were observed queueing along Monivong Boulevard, and arriving buses stopped at the designated bus stops on either side of Monivong Boulevard every 5 minutes. The number of bus passengers seemed few, and motorcycles continued to traverse Monivong Boulevard, in spite of the prohibition of motorcycles along this road.
Meanwhile, according to Mr. Nhem Saran, director of the Department of Public Works and Transport, the bus operation experiment has mobilized a fleet of 22 buses in the morning of June 1, but the number of bus passengers was less than what was expected. He added that the Monivong route and Circular route plying the Kampuchea Krom-Norodom-Nerhu-Sihanouk corridor are served by 16 buses and 6 buses, respectively.

June 24, 2001
PHNOM PENH GOVERNOR CHEA SOPHARA: RENT BUSES FOR CONTINUATION OF BUS OPERATION

July 4, 2001
CONTINUATION OF BUS OPERATION WITH REDUCTION OF 4 BUSES AFTER BUS OPERATION EXPERIMENT BY JICA

July 30-31, 2001
CITY BUS OPERATION: 10 THOUSAND DOLLARS DEBT IN ONE MONTH

August 5, 2001
CITY BUS OPERATION ENDS

March 2 - 15, 2001

Last year traffic accidents in Phnom Penh killed more than twice the number of people claimed by land mines nationwide.

With the number of vehicles hitting the crumbling road surface of the city's streets increasing each year, Phelim Kyne and Vong Sokheng examine the present chaos and future for Phnom Penh's traffic system.

Koizumi Yukihiro looks at the future of Phnom Penh's traffic system with a mixture of dread and professional stoicism.

The Assistant Resident Representative for the Japan International Co-operation Agency (JICA), which is providing funds and expertise for the development of a city traffic master plan, Koizumi is blunt about the challenges that face planners in preventing Phnom Penh from following the traffic chaos model of development that has blighted capital cities across Asia.

With the number of registered vehicles in the city increasing 57% over the past five years to 150,000 competing for road space with an estimated 73,780 more that enter the city from the countryside and untold thousands of unregistered vehicles, Yukihiro says that unless drastic action is taken soon, the city will be unable to cope.

"As people have more money they're buying more cars, and if private vehicles increase in number without the development of any public transit system, the situation in Phnom Penh will become as severe as Bangkok's," Yukihiro said.

And in a direct challenge to the longtime *laissez-faire* attitude of government to the city's traffic woes, Yukihiro says effective, long-term strategies to alleviate congestion must be implemented in the short

term, or it will be too late.

While Phnom Penh's car-per-kilometer ratio of 34 cars per kilometer is a fraction of the 1,332 vehicles that clog each kilometer of Bangkok, Yukihiro warns things are changing fast. "Phnom Penh's traffic situation is currently better than that of other Asian cities because the roads are wider and the number of vehicles is still low compared to other cities," Yukihiro said. "But if there's no improvement and if economic gains continue, in five years the situation will be much more serious than now," he cautioned.

In an effort to save Phnom Penh from the traffic jams and pollution that have poisoned the quality of life in other parts of Asia, JICA is funding a three-part, 15-year plan designed to alleviate traffic congestion and provide alternatives to the vicious cycle of spiraling private vehicle ownership that has blighted the streets of Bangkok.

The first stages of the JICA plan involve the trial of a city bus system, a systematic upgrade of side street "collector roads" running parallel to main arteries such as Monivong and Sihanouk Boulevards along with a traffic safety education program.

"The small collector roads are of very poor quality so there is an over-concentration of traffic on main routes (such as Monivong Boulevard)," Yukihiro said. "Phnom Penh streets also have a mixture of motorbikes, cars and cyclos driving in every direction on all sides of the road, which is chaotic and also decreases road capacity."

JICA and counterparts in the Ministry of Public Works and Transport (MPWT) and the Phnom Penh Municipality will evaluate the success of these initial measures before deciding on the next plan of action.

Than Sina, Deputy Governor of Phnom Penh Municipality, is aware of the increasing threat that traffic problems pose to city development and the safety of its citizens.

"We're in the process of trying to resolve it, but we don't yet have an integrated plan," he said.

Sina said that the Municipality was upgrading a "beltway" system of perimeter roads to relieve stress on the city's core main arteries using funding derived from the sale of the old Youth Club property to the United States government.

Emphasis on stricter enforcement of traffic rules and driver education were also on Sina's checklist of measures for mitigating the worst excesses of local drivers.

But Sina warned that successfully addressing the city's traffic problems involved factors beyond the control of the Municipality.

"The city's traffic problem is a reflection of the effect that poverty has in spurring rural migration to the city, as we saw in the seventies and eighties in Bangkok and Jakarta," he explained. "Effective poverty alleviation measures must be implemented nationwide in order to stem migration to the city and reduce the number of people and vehicles on the city streets."

Funding and expertise was urgently needed to prevent Phnom Penh from replicating the traffic crises that now define life in other major Asian cities, he adds.

On the buses: A public transit solution

A fleet of more than 20 buses will hit the streets of central Phnom Penh in May in a one-month Japanese-funded trial public transit program.

The Phnom Penh Municipality in cooperation with the Japan International Cooperation Agency (JICA) has developed a plan for a two-route bus system operating on a north-south corridor linking Chbar Ampov with the Japanese Bridge as well as a shuttle service linking Sihanouk, Norodom, Kampuchea Krom and Nehru Boulevards.

"We have made a request for the Government of Japan to supply us 20 buses with seating for between 20 and 60 passengers each," Phnom Penh Municipal Governor Chea Sophara said. "I believe that we can get the buses on the road by May, and that the fares will be cheaper than what people will pay [driving] their own vehicles.."

JICA Assistant Resident Representative Koizumi Yukihiro says between 22 and 24 buses have already been sourced by JICA through the Ho Hwa Genting Bus Company, which runs numerous inter-city passenger bus service routes.

"Ho Hwa Genting already has a license to run a Phnom Penh bus service," Yukihiro said of the choice of the company as the service provider for the one month trial.

Yukihiro said that fares would be posted at between 500 and 800

riel, and that bus stops would be built every 300 and 500 meters along the two routes.

The bus service would operate daily between 5:30am and 7:30pm, with a frequency of 5-10 minutes between buses.

According to Yukihiro, the most challenging aspect of the plan will be the enforcement of a one-month ban on motorcycles and motorcycle taxis along the core section of the bus route on Monivong Boulevard between Sihanouk Boulevard and Kampuchea Krom.

"The ban on motorcycle taxis is to ensure that the buses can operate smoothly and safely during the trial," Yukihiro said.

To head off protests from motor cycle taxi drivers angered by being blocked from the use of one of the city's main thoroughfares to and from Psah Thmei, Yukihiro says JICA has funded repairs on the roads parallel to Street 63 and Street 105 to encourage their use as alternate North-South access routes.

Yukihiro said the trial bus plan would be evaluated for cost effectiveness after one month with a possibility for a permanent system in the near future.

"Ho Hwa Genting has already said that if the system operates well without motorcycle taxi obstacles and with fares of 800-1000 riels per passenger, they would like to operate it as a [permanent] public transit system."

But according to Ho Hwa Genting Operation Manager Teo Siew Chong, Yukihiro's rosy assessments of the potential viability of the public bus system is not shared by his company.

Siew Chong says that the company has serious concerns about how motodop drivers will react to a service that they will inevitably interpret as a threat to their livelihood.

"I'm sure that motodops will protest this service," he said.

Ho Hwa Genting is also doubtful about how receptive the general public will be to a bus service that will be perceived as far less convenient than cyclos and motorcycle taxis.

"People are used to being picked up and dropped off at their door by motodop...a bus service that only stops at set bus stops will not be very popular," Siew Chong said. "It will take another five or 10 years before Phnom Penh is ready for a real public bus service."

National Road 5

Cambodia-Japan Bridge

National Road 6

Russian Blvd.

Kampuchea Krom

Shihanouk Blvd.

Phnom Penh City Shuttle - PPCS
Green Line (Sihanouk - Nerhu - Kampuchea - Nordom)

Phnom Penh City Shuttle - PPCS
Blue Line (Along Monivong Blvd.)

Chbar Ampao Terminal

National Road 1
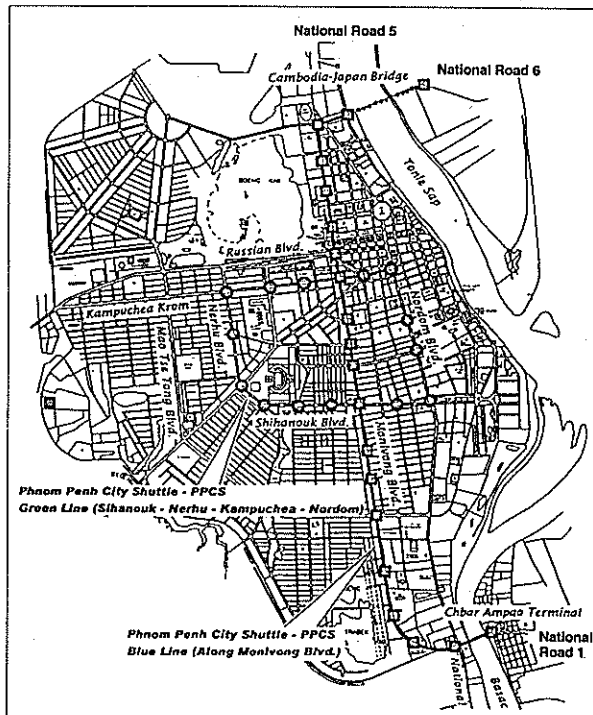
City bus service may not survive

By LON NARA
AND ERIN MORIARTY

Phnom Penh residents may have only a couple more weeks to take advantage of the city's new trial public bus service.

Both municipal government authorities and the company contracted to provide the service say it is unlikely that the air-conditioned buses will continue operating after the month-long trial phase ends on June 30 — at least for a while. Though the project has been deemed "successful", its funding remains in question.

The trial bus system involved two main routes and was developed by the Phnom Penh Municipality and Japan International Cooperation Agency, with buses provided by Ho Wah Genting Transport Company and APEX Cambodia Travel Service Co.

"Financially, it's very hard," said Masato Koto, a public transport planner for JICA. "Even in places like the United States and Japan, the public transportation systems cannot survive without government funding. If we think about a balance between cost and fares, then the fare would have to be more than 2,000 riels."

Bus fares were set at a flat 500 riels per trip during the first few days of operations, but then were raised to 800 riels. The buses initially carried more than 5,000 people a day, but daily ridership tapered off to about 2,500 to 3,000 passengers, Koto said, adding that the initial bulge in users was mainly students intrigued by the novelty of the service.

"If it's above 2,000 [passengers], then it's above our expectations," Koto said, noting that the buses are operating at about 45 per cent of capacity. "Overall, I think it has been successful — everybody is happy."

A total of 100,000 passengers will be served during the 30-day experiment, which will be followed by three months of research and planning.

"After we have completed the research and have designed the plan for Phnom Penh, then we will look for [funding] approval from the Japanese government," said Phnom Penh Municipal Governor Chea Sophara.

It is unclear how long that process could take and when the buses would resume running, Sophara said.

Bus drivers said they have been pleased with the steady stream of passengers using the new buses. However, they say navigating the cheerful anarchy of the city's crowded streets was a considerable challenge.

"I have difficulty in my driving because there are a lot of motorbikes and cars," said 35 year-old driver Kluot Vanna. "I always concentrate on driving. Sometimes I dare not to breathe."

Initial fears by organizers that mototaxi drivers might protest the buses due to a prohibition on small vehicles on Monivong Boulevard between Sihanouk and Kampuchea Krom Boulevards during the trial period have proven unfounded.

But Yin Sophat, a 50-year old father of six, complained that since the beginning of the city bus trial, his daily revenue has dropped from 15,000 riels to 7,000 riels.

"Our revenues are getting smaller and smaller. The people get the city bus instead of our motorbike taxi because the fare is cheaper than us," said Sophat, a native of Kampot province. "I would like to ask the government to stop the city bus business."

Restaurants along Monivong have also complained about the bus routes, saying that their patrons arrive by car and that the bus stops placed outside of their businesses detract from their ambiance, Koto said.

But most people — from daily passengers to the city's governor — seem to agree that the buses are a boon to the city's transportation network.

"The buses are very helpful to make the city beautiful, protect the environment, save lives from traffic accidents and help poor people not to spend too much money on transportation," Sophara said of the trial's benefits.

The clean, green lines of the city's trial buses will not been seen again unless funds are provided.

A20.4 BUS PASSENGER DEMAND ANALYSIS BY DISAGGREGATE MODEL

A20.4.1 THE METHOD OF THE MODEL CONSTRUCTION

A20.4.1-1 Specification of the Model

Choice models based on the multinomial logit models are built in order to predict the share of the bus use. In other words, the probability that alternative bus is chosen is given by equation below.

Pbus=exp(Vbus)/{exp(Vcar)+exp(Vmoto)+exp(Vdop)+exp(Vcyc)+exp(Vbus)}

The function V is specified as
Vi=   1Z1i   2Z2i   3Z3i   …   kZki

Thus, V is evaluated by multiplying each Variable by its coefficient and then summing the resulting products.

A20.4.1-2 Method of Inference

The method of inference is used the maximum likelihood method.

A20.4.2 DATA COLLECTION AND CHOICE SET DATA CONSTRUCTION

Data required for the disaggregate model construction is collected based on two kinds of following survey.

-Interview Survey for Bus Passengers of the Bus Operation Experiment
-Interview Survey for Drivers and Passengers of the other Transportation

A20.4.2-1 Interview Survey for Bus Passengers of the Bus Operation Experiment

The interview survey for bus passengers was carried out during the Bus Operation Experiment period. The outline of survey is as follows.

  Survey Item
    -Bus usage data (Bus trip description)
    -Evaluation of the experiment
    -Intended future bus use
    -personal attributes

  Enforcement period
    June 13, 14 (Bus fare is 800riel)
    June 28, 29 (Bus fare is 500riel)

  Enforcement place and number of samples
    10 bus stops /day
    20   40samples /bus stop

  Number of collected data
    June 13, 14   855 samples
    June 28, 29   882 samples

Survey Sheet

Present time (: AM/PM)
Interview Survey for Bus Passengers
1. Bus usage data
1.1 Purpose of the trip
   a. Commutation   b. School c. Business d. Shopping e. Amusement
   f. Others (   )

1.2 The contents of trip before and after bus use.
Origin   Method   Time required Departure bus stop Waiting time
( )   <   > < min > ( )   < min >-
Travel time Arrival bus stop Method Time required Destination
< min> ( )   < > < min > ( )
Address Origin
   Destination
1.3 When there is no bus service for the above-mentioned trip, what means of transportation do you use
and how much time is required?
   Means of transportation ( ) Time required (min)

2. About this experiment.
2.1 How did you know about this experiment?
   a. Television b. Radio c. Newspaper d. Poster e. Burner
   f. Word-of-mouth g. Notice bus operation   h. Notice traffic restriction
   i. Others (   )

 2.2 Please circle the appropriate comment for the bus use
                Comment
 (1) The time required (speed of the bus)   Good Fair Poor
 (2) Frequency of the operation   Good Fair Poor
 (3) Bus operation hours   Good Fair Poor
 (4) Comfort of the bus   Good Fair Poor
 (5) Bus air conditioning   Good Fair Poor
 (6) Capacity condition   Good Fair Poor
 (7) Appearance and cleanliness   Good Fair Poor

3. Intended future bus use
3.1 If the same bus as this experiment runs in the future, would you use it?
 (Using today's destination for example.)
   a. Yes, if it is the same service level as the experiment operation.
   b. Yes, even if the service level is lower than the experiment operation. 3.2
   c. Yes, if the service level is higher than the experiment operation. 3.3
   d. Yes, when individual conditions are suitable.   3.4
   e. No, I will not use in any condition.

3.2 If you answer b on question 3.1, under which condition would you use the bus?
   (1) Fare   a. Present condition level b. Maximum fare paid : riel
   (2) Frequency a. Present condition level b. Maximum waiting time: min
   (3) Time required a. Present condition level b. Maximum travel time : min
3.3 If you answer c on question 3.1, under which condition would you use the bus?
   (1) Fare   a. Present condition level b. Decreased to : riel
   (2) Frequency a. Present condition level b. Reduce waiting time to: min
   (3) Time required a. Present condition level b. Shorten time required to :
                         min

3.4 If you answer d on question 3.1, under which condition would you use the bus?
    a. When it is raining
    b. When going to social event
    c. When tired
    d. When drinking alcohol
    e. When you want to change daily routine
    f. When you want to air conditioned travel
    g. Others (in detail   )
4. About yourself
    (1) Gender   a. Male   b. Female   (2) Age (   ) age
    (3) Occupation   a. Freelance/Self Employee   b. Clerk   c. Taxi Driver
                       d. Motodop Driver   e. Cyclo Driver   f. Driver of Others   g. Housewife
                       h. Student   i. Company Executive
                       j. Company Employee   k. Public Servant
                       l. Others (   )
    (4) Home address :
    (5) Do you have a means of transportation you use
              a. Yes   If yes, which one a. Car b. Bicycle c. Motorbike
              b. No

A20.4.2-2 Interview Survey for Drivers and Passengers of the Other Transportation

The interview survey for drivers and passengers of the other transportation was carried out during the Bus Operation Experiment period. The outline of survey is as follows.

Survey Item
  -Evaluation of the experiment
  -Intended future bus use
  - Description of today's trip
  -personal attributes

Enforcement Period
    June 13 (Bus fare is 800riel)
    June 25 (Bus fare is 500riel)

Enforcement place and number of samples
    Central Market   200 samples /day
    Olympic Market   200 samples /day

Number of collected data
    June 13   219 samples for Central Market, 200 samples for Olympic Market
    June 25   230 samples for Central Market, 233 samples for Olympic Market

Survey Sheet

Interview Survey for Drivers and Passengers of the other Transportation (After)
1. About this experiment.
1.1 What do you know about this experiment?
        a. Both bus operation and two-wheeled vehicle road usage regulation.
        b. Only bus operation.
        c. Only two-wheeled vehicle road usage regulation.
        d. Neither bus operation nor two-wheeled vehicle road usage regulation.

1.2 How did you know about this experiment?
        a. Television b. Radio c. Newspaper d. Poster e. Burner
        f. Word-of-mouth g. Notice bus operation   h. Notice traffic restriction
        i. Others (   )

1.3 The bus operation experiment is been conducted on two routes of the city central area. Should the
    bus operation continue after the experiment runs from June 1st to 30th?
        a. Yes, the bus service should continue and be expanded.
        b. Yes, it should be limited to the city central area.
        c. The bus service should be expanded or limited whichever is sufficient.
        d. It doesn't matter.
        e. It is unnecessary.
        f. Don't understand.
1.4 The two-wheeled vehicle road usage regulation is been conducted on Monyvong Blvd. Should
the regulation continue after the experiment runs from June 1st to 30th?
        a. Yes, the regulation should continue and be expanded.
        b. Yes, it should be limited to the main street.
        c. The regulation should be expanded or limited whichever is sufficient.
        d. It doesn't matter.
        e. It is unnecessary.
        f. Don't understand.

2. Intended future bus use
2.1   ill you use the bus, if you go to the Central Market from here?
        a. Yes
        b. Yes, if the bus service improves.   2.2
        c. Yes, when individual conditions are suitable.   2.3
        d. No, use other means of transportation.   2.4
        e. Don't understand.
2.2 If you answer b on question 2.1, under which condition would you use the bus?
      (1) Fare   Will use decreased to :   riel
      (2) Frequency   Will use reduced waiting time to :   min
      (3) Time required Will use shortend time required to :   min

2.3 If you answer c on question 2.1, under which condition would you use the bus?
        a. When it is raining
        b. When going to social event
        c. When tired
        d. When drinking alcohol
        e. When you want to change daily routine
        f. When you want to air conditioned travel
        g. Others (in detail   )

2.4 If you answer d on question 2.1, What is the reason for not using a bus?
a. There are means of transportation, which can be used immediately, such as privately owned car and my motorbike.
       b. Other means of transportation are quicker.
       d. Fare is too high.
       e. The method of Use is not known well.
       f. Lack of direct travel.
       g. Others (in detail   )

2.5 If you answer b, c or d on question 2.1, which do you usually use to go to the Central Market from here?
       a. Car b. Taxi c. Motorbike d. Motodop e. Cyclo f. On Foot
       g. Bicycle h. others (   )

3. Today's trip
3.1 Where did your trip begin to the Central Market?
       a. from your house   b. From the office   c. from another place
  Please fill in the address of a place.
 (   )
3.2 Which did you use to come here?
       a. Car b. Taxi c. Motorbike d. Motodop e. Cyclo f. On Foot
       g. Bicycle h. others (   )

3.3 What is the reason for having not used a bus?
       a. The bus service is not known.
       b. The bus service is not running to the destination.
       c. It is necessary to use another means of transportation to go to the bus stop
d. There are means of transportation, which can be used immediately, such as privately owned car and my motorbike.
       e. Fare is too high.
       f. Other means of transportation are quicker.
       g. Arrival time is inaccurate.
       h. Lack of direct travel.
       i. The method of use is not known well.
       j. Others (in detail   )

4. About yourself.
       (1) Gender a. Male   b. Female   (2) Age (   ) age
       (3) Occupation   a. Freelance/Self Employee b. Clerk c. Taxi Driver
                      d. Motodop Driver e. Cyclo Driver f. Driver of Others g. Housewife
                      h. Student i. Company Executive
                      j. Company Employee k. Public Servant
                      l. Others (   )
       (4) Home address :
       (5) Do you have a means of transportation you use
             a. Yes   If yes, which one a. Car b. Bicycle c. Motorbike
             b. No

A20.4.2-3 LOS Data Construction

Following LOS data, such as distance, time, is created about each OD between 80 zones.
(LOS means level of service)
   -Road distance between 80 zones
   -Cost by mode between 80 zones
   - Bus stop, access igress time for each OD pair

LOS data was created in the following form.

Data Form Sample (Road distance, Unit: Km)

Zone	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.00	0.60	2.13	1.61	2.84	2.52	3.30	3.23	2.02	1.51	0.53	0.95	2.72
2	0.60	0.00	0.73	0.53	1.33	1.47	2.09	3.03	2.27	1.76	1.27	2.09	2.20
3	2.13	0.73	0.00	0.59	0.45	1.12	1.70	2.12	2.12	1.61	1.27	2.60	1.85
4	1.61	0.53	0.59	0.00	1.04	0.79	1.50	2.29	1.53	1.02	0.68	2.08	2.51
5	2.84	1.33	0.45	1.04	0.00	0.45	0.88	1.44	1.67	1.76	1.87	2.75	2.08
6	2.52	1.47	1.12	0.79	0.45	0.00	0.43	0.80	0.97	1.44	1.55	2.26	2.59
7	3.30	2.53	1.70	1.50	0.88	0.43	0.00	0.96	2.02	2.22	2.33	3.21	2.44
8	3.23	3.03	2.12	2.29	1.44	0.80	0.96	0.00	1.38	2.15	2.26	2.39	3.45
9	2.02	2.27	2.12	1.53	1.67	0.97	2.02	1.38	0.00	0.51	1.01	1.50	3.75
10	1.51	1.76	1.61	1.02	1.76	1.44	2.22	2.15	0.51	0.00	0.50	1.59	3.74
11	0.53	1.27	1.27	0.68	1.87	1.55	2.33	2.26	1.01	0.50	0.00	0.72	3.25
12	0.95	2.09	2.60	2.08	2.75	2.26	3.21	2.39	1.50	1.59	0.72	0.00	4.07
13	2.56	2.20	1.82	2.51	2.03	2.54	2.36	3.43	3.70	3.74	3.25	4.07	0.00
14	2.38	2.52	2.20	2.89	2.41	2.92	2.74	3.81	4.08	4.12	3.63	4.45	0.16
15	1.71	1.85	1.76	2.45	2.16	2.67	2.80	3.46	3.83	3.68	3.19	4.01	0.43
16	1.22	1.03	1.16	1.85	1.56	2.07	2.30	2.86	3.23	3.08	2.59	3.41	0.83
17	2.21	2.26	2.63	3.32	3.03	3.54	3.53	4.60	4.70	4.69	4.20	5.02	0.95
18	1.42	1.46	2.06	2.75	2.30	2.81	3.04	3.60	3.97	3.89	3.40	4.22	1.24
19	1.12	0.93	1.10	1.79	1.65	2.16	2.39	2.95	3.32	3.02	2.53	3.35	1.60
20	2.08	2.22	2.57	3.26	2.95	3.46	3.28	4.35	4.62	4.49	4.00	4.82	0.70
21	2.51	2.65	2.86	3.55	3.07	3.58	3.40	4.47	4.74	4.78	4.29	5.11	0.80
22	2.95	3.01	2.63	3.32	2.84	3.35	3.17	4.24	4.51	4.55	4.06	4.88	0.57
23	3.59	3.73	3.58	4.27	3.79	4.30	4.12	5.19	5.46	5.50	5.01	5.83	1.52
24	3.04	1.64	1.26	1.95	1.14	1.65	1.81	2.44	2.81	2.90	2.69	3.51	0.45
25	3.67	2.27	1.53	2.29	1.25	1.76	1.58	2.65	2.92	3.01	3.12	4.00	0.78
26	3.54	2.14	1.76	2.45	1.67	2.18	2.00	3.07	3.34	3.43	3.19	4.01	0.36
27	3.32	1.92	1.54	2.23	1.68	2.19	2.22	3.29	3.35	3.46	2.97	3.79	0.46
28	2.92	2.40	2.02	2.71	2.01	2.52	2.34	3.41	3.68	3.77	3.45	4.27	0.14
29	4.39	2.99	2.25	3.01	1.97	2.36	1.93	3.00	3.64	3.73	3.84	4.72	1.09
30	2.05	1.58	0.75	1.34	0.65	1.16	1.47	1.95	2.32	2.41	2.52	3.40	1.31
31	2.59	1.19	0.54	1.13	1.01	1.52	1.75	2.31	2.68	2.73	2.24	3.06	1.02
32	4.56	3.16	2.42	2.89	2.14	1.62	1.19	2.42	3.48	3.61	3.72	4.77	1.88
33	5.02	3.62	2.88	3.35	2.60	2.09	1.66	2.69	3.75	4.22	4.33	5.04	1.97
34	5.32	3.92	3.18	3.65	2.90	2.72	2.29	2.99	4.05	4.52	4.63	5.34	1.88
35	5.61	4.61	3.87	4.12	3.59	3.18	2.62	3.00	4.06	4.53	4.64	5.35	2.66
36	5.24	4.25	3.51	3.75	3.23	2.81	2.25	2.63	3.69	4.16	4.27	4.98	2.97
37	5.17	4.57	3.83	3.68	2.76	2.74	2.18	2.56	3.62	4.09	4.20	4.91	3.29
38	6.97	5.97	5.23	4.95	4.54	4.54	3.98	4.36	5.42	5.89	6.00	6.71	3.63
39	6.60	5.60	4.86	5.11	4.58	4.17	3.61	3.99	5.05	5.52	5.63	6.34	3.26
40	3.33	2.86	2.03	2.10	1.21	1.09	0.66	1.73	2.79	2.82	2.93	3.81	2.17
41	4.30	3.83	3.00	2.81	2.18	1.87	1.31	1.69	2.75	3.22	3.33	3.87	3.37
42	8.29	9.43	8.06	8.13	7.24	6.64	6.37	5.88	7.18	7.64	8.34	6.68	8.43
43	16.41	16.67	15.93	16.17	15.65	15.23	14.67	15.05	16.11	16.58	16.69	14.80	14.84
44	20.01	19.91	20.15	20.39	19.87	19.45	18.89	19.27	20.33	20.80	20.91	22.74	17.47
45	16.01	17.37	16.63	15.85	16.35	14.36	15.37	13.60	14.90	15.36	16.06	14.40	15.54
46	12.70	11.09	10.28	10.35	9.46	8.86	8.59	8.10	9.40	9.86	9.98	11.09	12.54
47	11.89	10.90	10.16	10.40	9.88	9.46	8.90	9.28	10.34	10.81	10.92	11.63	9.07
48	21.66	23.02	22.28	21.50	22.00	20.01	21.02	19.25	20.55	21.01	21.71	20.05	21.19
49	16.16	17.30	15.93	16.00	15.11	14.51	14.24	13.75	15.05	15.51	16.21	14.55	16.30
50	16.37	15.38	14.64	14.88	14.36	13.94	13.38	13.76	14.82	15.29	15.40	17.23	13.55
51	10.49	11.63	10.26	10.33	9.44	8.84	8.57	8.08	9.38	9.84	10.54	8.88	10.63
52	14.24	13.25	12.51	12.75	12.23	11.81	11.25	11.63	12.69	13.16	13.27	13.98	11.42
53	23.07	24.43	23.69	22.91	23.41	21.42	22.43	20.66	21.96	22.42	23.12	21.46	22.60
54	21.21	22.57	21.83	21.05	21.55	19.56	20.57	18.80	20.10	20.56	21.26	19.60	20.74
55	22.30	23.22	24.70	24.18	20.85	20.25	19.98	19.49	20.79	23.78	23.10	22.14	22.04
56	11.29	12.43	11.06	11.13	10.24	9.64	9.37	8.88	10.18	10.64	11.34	9.68	11.43
57	7.01	5.79	4.98	5.05	4.16	3.56	3.29	2.80	4.10	4.56	4.68	5.40	5.35
58	3.41	4.55	5.06	4.54	5.20	4.51	5.56	4.64	3.77	4.04	3.46	1.80	6.53
59	4.49	5.41	6.89	6.37	7.60	7.28	8.06	7.17	6.30	5.97	5.29	4.33	8.36
60	1.77	2.69	3.90	3.38	4.61	4.29	5.07	4.49	3.62	2.99	2.31	1.65	5.37
61	2.34	3.26	4.47	3.95	5.18	4.86	5.64	5.06	4.19	3.56	2.88	2.22	5.94
62	2.21	3.08	3.86	3.34	4.57	4.25	5.03	4.14	3.27	2.94	2.26	1.30	5.33
63	4.51	5.38	6.16	5.64	6.87	6.55	7.33	6.44	5.57	5.24	4.56	3.60	7.63
64	2.77	3.69	4.90	4.38	5.61	5.29	6.07	5.49	4.62	3.99	3.31	2.65	6.37
65	13.60	13.50	12.66	13.13	12.38	12.44	11.88	12.26	13.32	13.79	13.90	14.61	11.06
66	6.25	6.41	6.03	6.72	6.24	6.75	6.57	7.64	7.91	7.95	7.46	8.28	3.97
67	13.55	13.71	13.36	14.02	13.54	13.64	13.08	13.46	14.52	14.99	14.76	15.58	11.27
68	9.50	9.66	9.31	9.97	9.49	10.00	9.82	10.89	11.16	11.20	10.71	11.53	7.22
69	9.30	9.20	8.36	8.83	8.08	8.14	7.58	7.96	9.02	9.49	9.60	10.31	6.76
70	7.76	7.92	7.54	8.23	7.75	8.26	8.08	9.15	9.42	9.46	8.97	9.79	5.48
71	8.16	7.17	6.43	6.67	6.15	5.73	5.17	5.55	6.61	7.08	7.19	7.90	5.34
72	12.82	12.72	12.37	13.03	12.55	13.06	12.88	13.95	14.22	14.26	13.77	14.59	10.28
73	10.37	10.27	9.92	10.58	10.10	10.61	10.43	11.50	11.77	11.81	11.32	12.14	7.83
74	6.31	6.21	5.83	6.52	6.04	6.55	6.37	7.44	7.71	7.75	7.26	8.08	3.77
75	12.25	12.41	12.06	12.72	12.24	12.34	11.78	12.16	13.22	13.69	13.46	14.28	9.97
76	10.47	10.63	10.28	10.94	10.46	10.97	10.79	11.86	12.13	12.17	11.68	12.50	8.19
77	16.39	17.31	18.79	18.27	14.94	14.34	14.07	13.58	14.88	17.87	17.19	16.23	16.13
78	10.22	11.14	12.35	11.83	13.06	12.74	13.52	12.19	11.32	11.44	10.76	9.35	13.82
79	7.46	8.38	9.86	9.34	10.57	10.25	11.03	10.14	9.27	8.94	8.26	7.30	11.33
80	12.26	11.27	10.53	10.77	10.25	9.83	9.27	9.65	10.71	11.18	11.29	10.75	9.44

A20.4.2-4 Choice Set Data Construction

The intended bus use data with which bus users are assumed based on the following conditions is built.

Bus Fare > 500riel

Bus Frequency > 5min

Bus Operation Speed < 12.5km/h

Mode Choice

    Bus Use   847

    Motodop   287

Motorbike   861
Cyclo   12
Car   87

A20.4.3 DATA SET FOR THE MODEL

The data set for the models are shown in below.

Mode Choice: Bus, Motodop, Motorbike, Cyclo, Car
Travel cost: Fare for bus, Motodop and cyclo   Running cost for Car and Motorbike
Travel time: Total travel time from origin to destination
Out of vehicle time: Access time (e.g. time spent walking to the bus stop), Waiting time for transportation, Change time and Igress time (e.g. time from the bus stop to the destination)
Vehicle ownership: Car, Motorbike
Purpose of the trip: Commuting, Attending school, Business, Shopping and Amusement
Individual variables: Occupation, gender and age

Purpose	Choice set					Time					Cost				
of the trip	bus	dop	moto	cyclo	car	bus T	dop T	moto T	cyc T	car T	bus F	dop F	moto F	cyc F	car F
4	1	0	0	0	0	29.57	21.85	20.98	40.34	17.48	500	2010	1442	3015	4763
5	0	0	1	0	0	50.58	13.85	13.30	25.57	11.08	500	1274	914	1911	3019
5	0	0	1	0	0	50.58	13.85	13.30	25.57	11.08	500	1274	914	1911	3019
5	1	0	0	0	0	29.80	24.10	23.14	44.49	19.28	500	2217	1591	3326	5254
5	1	0	0	0	0	30.87	27.90	26.78	51.51	22.32	500	2567	1841	3850	6082
1	1	0	0	0	0	34.96	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
5	1	0	0	0	0	25.75	13.85	13.30	25.57	11.08	500	1274	914	1911	3019
5	1	0	0	0	0	40.42	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
6	0	0	1	0	0	52.65	23.80	22.85	43.94	19.04	500	2190	1571	3284	5188
5	1	0	0	0	0	26.57	26.90	25.82	49.66	21.52	500	2475	1775	3712	5864
5	0	0	1	0	0	54.66	53.35	51.22	98.49	42.68	500	4908	3521	7362	11630
5	0	0	1	0	0	46.66	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
5	0	0	1	0	0	42.07	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
2	1	0	0	0	0	30.29	16.95	16.27	31.29	13.56	500	1559	1119	2339	3695
4	1	0	0	0	0	31.80	21.30	20.45	39.32	17.04	500	1960	1406	2939	4643
2	0	0	1	0	0	46.07	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
4	0	0	1	0	0	40.07	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
4	0	0	1	0	0	41.07	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
1	1	0	0	0	0	39.07	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
1	1	0	0	0	0	31.76	26.90	25.82	49.66	21.52	500	2475	1775	3712	5864
2	1	0	0	0	0	43.96	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
1	0	0	1	0	0	40.07	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
2	1	0	0	0	0	22.70	2.25	2.16	4.15	1.80	500	207	149	311	491
6	0	1	0	0	0	41.92	33.20	31.87	61.29	26.56	600	3054	2191	4582	7238
5	0	0	1	0	0	34.81	30.85	29.62	56.95	24.68	500	2838	2036	4257	6725
2	1	0	0	0	0	27.60	11.55	11.09	21.32	9.24	500	1063	762	1594	2518
1	0	0	1	0	0	37.29	46.95	45.07	86.68	37.56	500	4319	3099	6479	10235
2	0	0	1	0	0	44.96	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
4	1	0	0	0	0	19.60	13.85	13.30	25.57	11.08	500	1274	914	1911	3019
1	1	0	0	0	0	31.80	21.85	20.98	40.34	17.48	500	2010	1442	3015	4763
5	0	0	1	0	0	60.16	27.90	26.78	51.51	22.32	500	2567	1841	3850	6082
1	1	0	0	0	0	37.97	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
5	1	0	0	0	0	34.96	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
1	1	0	0	0	0	28.75	13.85	13.30	25.57	11.08	500	1274	914	1911	3019
3	1	0	0	0	0	32.80	21.85	20.98	40.34	17.48	500	2010	1442	3015	4763
1	0	1	0	0	0	43.16	31.70	30.43	58.52	25.36	500	2916	2092	4375	6911
6	1	0	0	0	0	48.80	23.75	22.80	43.85	19.00	500	2185	1568	3278	5178
2	1	0	0	0	0	38.70	21.80	20.93	40.25	17.44	500	2006	1439	3008	4752
2	1	0	0	0	0	29.00	19.00	18.24	35.08	15.20	500	1748	1254	2622	4142
2	1	0	0	0	0	22.75	13.85	13.30	25.57	11.08	500	1274	914	1911	3019
2	1	0	0	0	0	36.96	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
2	1	0	0	0	0	24.75	13.85	13.30	25.57	11.08	500	1274	914	1911	3019
1	1	0	0	0	0	21.52	8.25	7.92	15.23	6.60	500	759	545	1139	1799
2	0	0	1	0	0	33.70	21.80	20.93	40.25	17.44	500	2006	1439	3008	4752
2	1	0	0	0	0	22.29	13.85	13.30	25.57	11.08	500	1274	914	1911	3019
2	1	0	0	0	0	23.75	23.10	22.18	42.65	18.48	500	2125	1525	3188	5036
2	1	0	0	0	0	38.97	29.90	28.70	55.20	23.92	500	2751	1973	4126	6518
2	0	0	1	0	0	39.69	2.05	1.97	3.78	1.64	500	189	135	283	447
2	1	0	0	0	0	26.29	16.95	16.27	31.29	13.56	500	1559	1119	2339	3695
2	1	0	0	0	0	24.60	16.95	16.27	31.29	13.56	500	1559	1119	2339	3695
2	1	0	0	0	0	35.42	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
1	1	0	0	0	0	25.57	21.30	20.45	39.32	17.04	500	1960	1406	2939	4643
2	1	0	0	0	0	29.80	24.10	23.14	44.49	19.28	500	2217	1591	3326	5254
2	1	0	0	0	0	29.85	21.30	20.45	39.32	17.04	500	1960	1406	2939	4643
2	0	0	1	0	0	40.97	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
1	1	0	0	0	0	32.80	26.90	25.82	49.66	21.52	500	2475	1775	3712	5864
2	1	0	0	0	0	29.80	21.30	20.45	39.32	17.04	500	1960	1406	2939	4643
2	0	1	0	0	0	31.97	29.90	28.70	55.20	23.92	500	2751	1973	4126	6518
2	1	0	0	0	0	33.75	16.95	16.27	31.29	13.56	500	1559	1119	2339	3695
2	1	0	0	0	0	27.80	21.30	20.45	39.32	17.04	500	1960	1406	2939	4643
2	0	0	1	0	0	38.97	29.90	28.70	55.20	23.92	500	2751	1973	4126	6518
1	0	0	0	0	0	36.97	26.90	25.82	49.66	21.52	500	2475	1775	3712	5864
0	1	0	0	0	0	42.92	45.05	43.25	83.17	36.04	500	4145	2973	6217	9821
5	1	0	0	0	0	44.77	19.80	19.01	36.55	15.84	500	1822	1307	2732	4316
4	0	1	0	0	0	34.97	33.15	31.82	61.20	26.52	500	3050	2188	4575	7227
5	1	0	0	0	0	69.92	45.05	43.25	83.17	36.04	500	4145	2973	6217	9821
6	1	0	0	0	0	49.92	46.95	45.07	86.68	37.56	500	4319	3099	6479	10235
2	0	0	1	0	0	34.59	46.70	44.83	86.22	37.36	500	4296	3082	6445	10181
3	1	0	0	0	0	37.19	19.10	18.34	35.26	15.28	500	1757	1261	2636	4164
4	1	0	0	0	0	21.55	7.60	7.30	14.03	6.08	500	699	502	1049	1657
6	0	0	1	0	0	31.19	19.10	18.34	35.26	15.28	500	1757	1261	2636	4164
2	0	0	1	0	0	49.05	21.40	20.54	39.51	17.12	600	1969	1412	2953	4665
4	1	0	0	0	0	25.45	13.90	13.34	25.66	11.12	500	1279	917	1918	3030

Access			Igress	Personal				
time	cost	w time	time	Gender	Age	Occupation	CarOwn	BikeOwn
5	750	3	2	2	30	1	0	1
8	0	0	2	2	15	5	1	1
8	0	0	2	2	15	5	0	1
5	0	0	0	1	17	5	1	1
4	0	0	0	1	22	5	1	1
1	0	0	3	1	23	2	1	1
5	0	0	0	1	36	1	0	1
4	0	0	4	2	50	1	0	0
5	0	0	10	2	37	1	0	1
4	0	0	0	2	50	1	0	1
8	0	0	10	2	17	5	0	1
10	0	0	0	2	14	5	1	1
8	0	0	0	2	38	1	0	1
3	0	0	10	1	17	5	1	1
4	0	0	4	2	45	1	0	0
2	0	0	10	1	19	5	0	1
4	0	0	2	2	31	1	0	1
4	0	0	3	2	32	1	0	1
3	0	0	2	1	30	1	0	1
2	0	0	2	1	30	2	0	1
3	0	0	10	1	16	5	0	1
3	0	0	3	1	32	2	0	1
5	0	0	10	1	17	5	0	1
2	0	0	5	1	51	1	0	0
3	0	0	0	1	50	2	1	1
2	0	0	10	2	16	5	0	1
3	0	0	3	2	30	2	0	0
4	0	0	10	2	17	5	0	1
2	0	0	2	2	41	1	0	0
4	0	0	4	1	41	2	0	1
10	0	0	20	1	44	2	0	1
4	0	0	5	1	40	2	0	1
4	0	0	0	2	17	5	0	1
5	0	0	5	2	30	2	0	1
4	0	0	5	2	31	1	0	1
10	0	0	3	1	25	2	0	0
10	1500	3	15	2	41	1	0	1
3	0	0	6	2	13	5	0	1
5	0	0	0	2	16	5	0	1
2	0	0	0	1	20	5	0	1
6	0	0	0	1	17	5	1	1
4	0	0	0	1	16	5	1	1
5	0	0	5	1	32	2	0	1
4	0	0	0	2	13	5	1	1
5	0	0	0	2	18	0	1	1
5	0	0	0	2	19	5	0	1
3	0	0	7	2	20	5	1	1
3	0	0	4	2	16	0	1	1
5	0	0	4	2	17	5	0	0
5	0	0	4	2	17	5	0	0
3	0	0	0	2	17	5	0	1
3	0	0	0	1	32	2	0	1
5	0	0	0	1	19	5	0	0
3	0	0	0	1	16	5	1	1
5	0	0	7	1	17	5	0	1
3	0	0	5	1	32	2	0	1
5	0	0	0	1	16	5	0	1
3	0	0	0	1	15	5	1	1
5	0	0	10	2	30	2	0	1
3	0	0	0	2	19	5	0	0
10	0	0	0	2	15	5	1	1
5	0	0	3	2	14	5	0	1
3	0	0	5	2	36	4	0	1
3	0	0	22	1	20	5	0	1
3	0	0	3	2	32	1	0	1
3	0	0	32	2	18	5	0	1
3	0	0	12	2	27	4	0	1
3	0	0	3	2	17	5	0	0
3	0	0	5	1	37	2	0	0
3	0	0	5	2	27	4	0	0
2	0	0	0	1	34	1	0	1
10	0	0	3	2	21	5	0	1
2	0	0	7	2	32	4	0	1

A20.4.4 ESTIMATION RESULTS

Tables show the estimated values of the coefficients of the models. The coefficients were estimated by the maximum likelihood method using the data described in the previous section.

Parameter	Commuting	School	Business/Shopping
Total travel time	-0.202261	-0.0392	-0.16539
Travel cost	-0.002046	-0.000846	-0.0012265
Access time(bus)	-0.54236	-0.11039	-0.12677
D_bus	0.0935	0.0722	0.0529
D_motodop	0.0012	0.8712	0.5712
D_motorbike	0.0003	0.9288	1.1624
D_car	2.3082	0.0322	1.0295
Likelihood ratio	0.3814	0.3989	0.3194
Number of samples	247	604	343
Hitting ratio	0.5492	0.5673	0.4736

A20.4.4-1 Evaluation of the Models

(1) Commuting Model

The result which predicted the bus share using the model built above is as follows.
The commuting model shows that the bus share is greatly increased from shortening of access time and total travel time.
Therefore, the increase in a bus user is expectable with an improvement of access.

ZoneOD   BusSotpOD
23   60   36   02   (Refer to Bus Stop Map)
6.63km

	Time	Cost	Access T	Modal Share
Bus	40.70	500	5	25.3%
Motodop	33.15	3,050		8.7%
Motorbike	31.82	2,188		66.0%
Cyclo	61.20	4,575		0.0%
Car	26.52	7,227		0.1%

Time : Total travel time Cost : Travel cost AccessT : Access time (bus)

ZoneOD   BusSotpOD
02   13   17   25   (Refer to Bus Stop Map)
2.2km

	Time	Cost	Access T	Modal Share
Bus	17.22	500	5	1.5%
Motodop	11.00	1,012		25.0%
Motorbike	10.56	726		49.1%
Cyclo	20.31	1,518		1.4%
Car	8.80	2,398		23.0%

ZoneOD   BusSotpOD
18   32   44   53   (Refer to Bus Stop Map)
2.67Km

	Time	Cost	Access T	Modal Share
Bus	28.93	500	5	0.4%
Motodop	13.35	1,228		25.9%
Motorbike	12.81	881		58.7%
Cyclo	24.65	1,842		0.7%
Car	10.68	2,910		14.3%

The modal share changing the access time of a bus from 5 minutes to 15 minutes is as follows.

	Time	Cost	Modal share by access time change			
			5min	7min	10min	15min
Bus	40.70	500	25.25%	10.25%	2.19%	0.15%
Motodop	33.15	3,050	8.66%	10.39%	11.33%	11.56%
Motorbike	31.82	2,188	66.02%	79.28%	86.39%	88.20%
Cyclo	61.20	4,575	0.00%	0.00%	0.00%	0.00%
Car	26.52	7,227	0.06%	0.08%	0.08%	0.09%

The modal share changing a bus fare is as follows.

	Modal share by bus fare change			
	400riel	500riel	800riel	1000riel
Bus	33.72%	25.25%	15.46%	10.83%
Motodop	7.68%	8.66%	9.79%	10.33%
Motorbike	58.55%	66.02%	74.67%	78.76%
Cyclo	0.00%	0.00%	0.00%	0.00%
Car	0.06%	0.06%	0.07%	0.08%

The modal share changing the increase rate of total travel time of the bus is as follows.

	Modal share by bus travel time change			
	90%	100%	110%	150%
Bus	43.49%	25.25%	12.92%	0.55%
Motodop	6.54%	8.66%	10.08%	11.52%
Motorbike	49.92%	66.02%	76.92%	87.85%
Cyclo	0.00%	0.00%	0.00%	0.00%
Car	0.05%	0.06%	0.08%	0.09%

Bus Stop Map
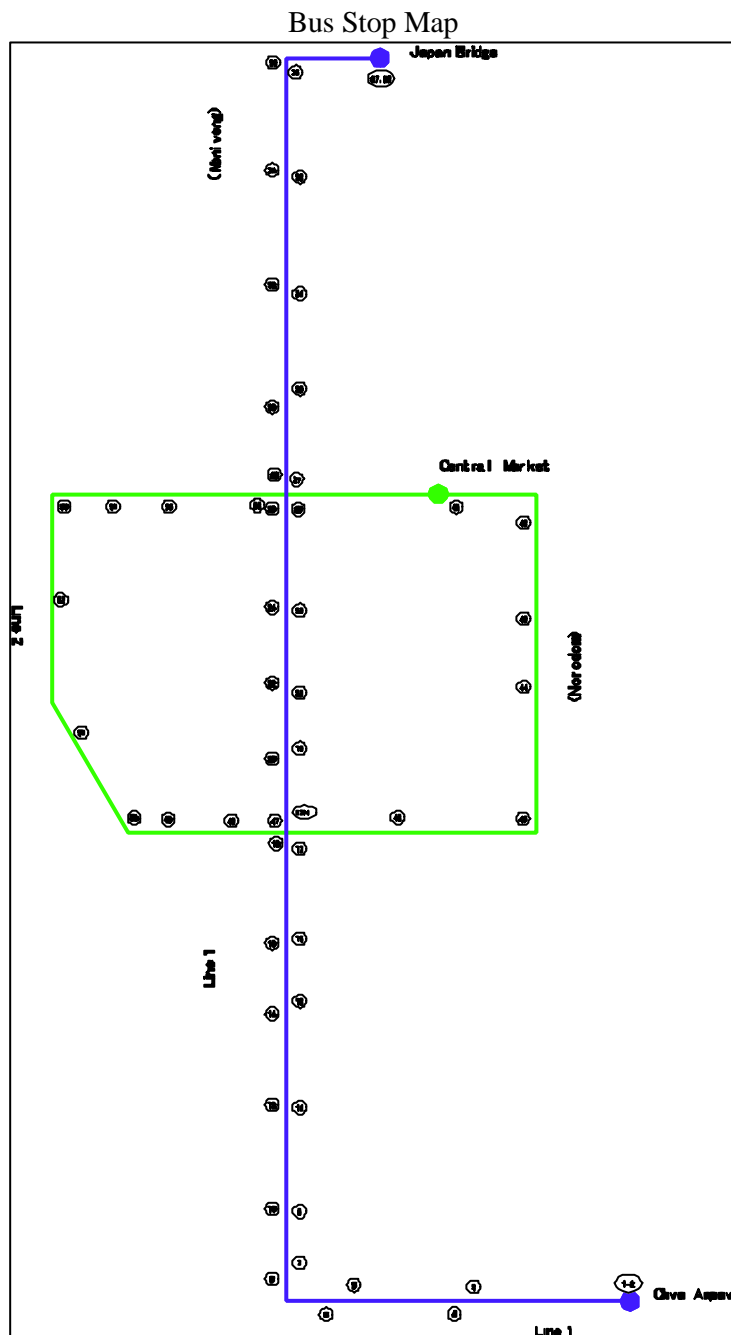
(2) School Model

The result which predicted the bus share using the model built above is as follows.
The school model shows that the bus share is increased from shortening of cost.
Therefore, the increase in a bus user is expectable with cost polic ies such as introduction of a school pass and a coupon ticket.

ZoneOD   BusSotpOD
23 60   36   02
6.63km

	Time	Cost	Access T	Modal Share
Bus	40.70	500	5	33%
Motodop	33.15	3,050		20%
Motorbike	31.82	2,188		46%
Cyclo	61.20	4,575		1%
Car	26.52	7,227		0%

ZoneOD   BusSotpOD
02   13   17   25
2.2km

	Time	Expense	Access T	Modal Share
Bus	17.22	500	5	10.4%
Motodop	11.00	1,012		33.1%
Motorbike	10.56	726		45.4%
Cyclo	20.31	1,518		6.3%
Car	8.80	2,398		4.8%

ZoneOD   BusSotpOD
18   32   44   53
2.67km

	Time	Expense	Access T	Modal Share
Bus	28.93	500	5	8.7%
Motodop	13.35	1,228		33.5%
Motorbike	12.81	881		48.6%
Cyclo	24.65	1,842		5.4%
Car	10.68	2,910		3.9%

	Time	Cost	Modal share by access time change			
			5min	7min	10min	15min
Bus	40.70	500	33.09%	28.40%	22.16%	14.09%
Motodop	33.15	3,050	19.86%	21.26%	23.11%	25.50%
Motorbike	31.82	2,188	45.96%	49.19%	53.47%	59.01%
Cyclo	61.20	4,575	0.76%	0.82%	0.89%	0.98%
Car	26.52	7,227	0.32%	0.35%	0.38%	0.42%

	Modal share by bus fare change			
	400	500	800	1000
Bus	36.71%	33.09%	27.73%	24.47%
Motodop	18.79%	19.86%	21.45%	22.42%
Motorbike	43.47%	45.96%	49.64%	51.88%
Cyclo	0.72%	0.76%	0.82%	0.86%
Car	0.31%	0.32%	0.35%	0.37%

	Modal share by time change			
	90%	100%	110%	150%
Bus	43.49%	33.09%	29.66%	18.21%
Motodop	6.54%	19.86%	20.88%	24.28%
Motorbike	49.92%	45.96%	48.32%	56.18%
Cyclo	0.00%	0.76%	0.80%	0.93%
Car	0.05%	0.32%	0.34%	0.40%

(3) Business/Shopping Model
The result which predicted the bus share using the model built above is as follows.

ZoneOD   BusSotpOD
23 60   36 02
6.63km

	Time	Expense	Access T	Modal Share
Bus	40.70	500	5	9.2%
Motodop	33.15	3,050		12.1%
Motorbike	31.82	2,188		78.4%
Cyclo	61.20	4,575		0.0%
Car	26.52	7,227		0.3%

ZoneOD   BusSotpOD
02 13   17 25
2.2   1.56

	Time	Expense	Access T	Modal Share
Bus	17.22	500	5	1.8%
Motodop	11.00	1,012		23.2%
Motorbike	10.56	726		63.9%
Cyclo	20.31	1,518		1.5%
Car	8.80	2,398		9.6%

ZoneOD   BusSotpOD

18 32   44   53

2.67km

	Time	Expense	Access T	Modal Share
Bus	28.93	500	5	0.5%
Motodop	13.35	1,228		22.7%
Motorbike	12.81	881		68.7%
Cyclo	24.65	1,842		0.9%
Car	10.68	2,910		7.1%

	Time	Cost	Modal share by access time change			
			5min	7min	10min	15min
Bus	40.70	500	9.20%	5.01%	1.94%	0.38%
Motodop	33.15	3,050	12.09%	12.65%	13.06%	13.27%
Motorbike	31.82	2,188	78.35%	81.97%	84.62%	85.96%
Cyclo	61.20	4,575	0.01%	0.01%	0.01%	0.01%
Car	26.52	7,227	0.34%	0.36%	0.37%	0.37%

	Modal share by bus fare change			
	400	500	800	1000
Bus	10.28%	9.20%	6.56%	5.20%
Motodop	11.95%	12.09%	12.45%	12.63%
Motorbike	77.42%	78.35%	80.64%	81.80%
Cyclo	0.01%	0.01%	0.01%	0.01%
Car	0.34%	0.34%	0.35%	0.36%

	Modal share by time change			
	90%	100%	110%	150%
Bus	16.58%	9.20%	4.92%	0.35%
Motodop	11.11%	12.09%	12.67%	13.27%
Motorbike	71.99%	78.35%	82.05%	85.99%
Cyclo	0.01%	0.01%	0.01%	0.01%
Car	0.31%	0.34%	0.36%	0.37%

A20.4.4-2 Prediction Result

The prediction result by the route of a bus experiment is as follows.

Prediction Result (Total Trip)

	Trip	%
Car	214,055	6.61%
Motorbike	2,068,020	63.82%
Motodop	847,215	26.14%
Cyclo	108,084	3.34%
Bus	3,219	0.10%
total	3,240,593	100.00%