

MINISTRY OF PUBLIC WORKS AND TRANSPORT
LAO PEOPLE'S DEMOCRATIC REPUBLIC

JAPAN INTERNATIONAL
COOPERATION AGENCY

THE STUDY
OF
MASTER PLAN
ON COMPREHENSIVE URBAN TRANSPORT
IN VIENTIANE
IN LAO PDR

FINAL REPORT
EXECUTIVE SUMMARY

SEPTEMBER 2008

KATAHIRA & ENGINEERS INTERNATIONAL

PREFACE

In response to a request from the Government of Lao People's Democratic Republic, the Government of Japan decided to conduct “The Study of Master Plan on Comprehensive Transport in Vientiane” and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Tatsuyuki Sakurai of Katahira and Engineers International between April, 2007 and August, 2008.

The team held discussions with the officials concerned of the Government of Lao People's Democratic Republic and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Lao People's Democratic Republic for their close cooperation extended to the study.

September, 2008

EIJI HASHIMOTO,
Deputy Vice President
Japan International Cooperation Agency

Mr. Eiji Hashimoto,
Deputy Vice President
Japan International Cooperation Agency

September 2008

Dear Sir,

Letter of Transmittal

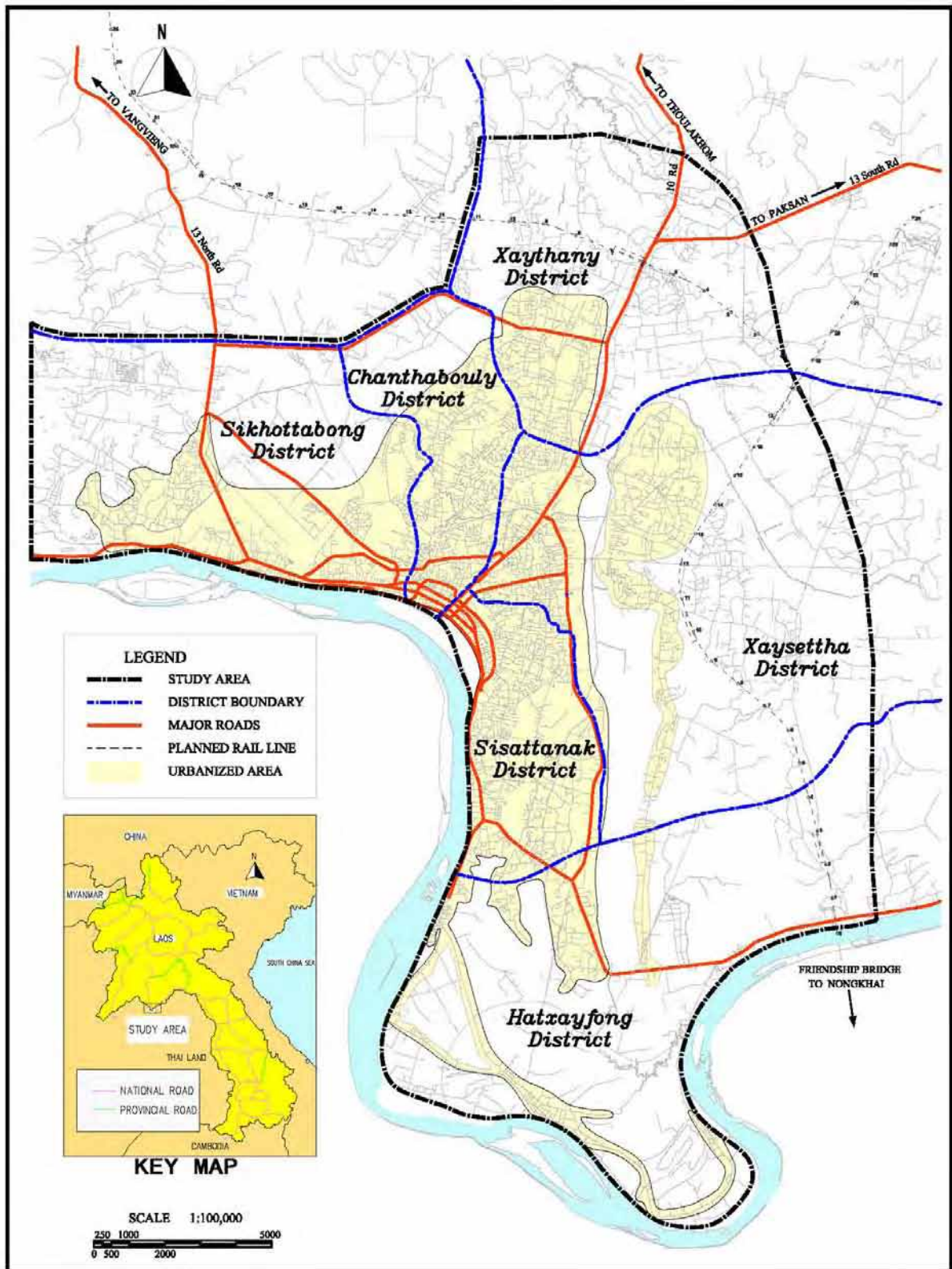
We are pleased to submit herewith the Final Report of the “The Study of Master Plan on Comprehensive Transport in Vientiane”. The report compiles the results of the Study and includes the advices and suggestions of the authorities concerned of the Government of Japan and your agency as well as the comments made by the Ministry of Public Works and Transport, Lao People’s Democratic Republic.

The report analyses the present and future conditions and demand of transport in Vientiane. It comprehensively covers the issues of transport including road, public transport, traffic management, traffic safety, institution, financing and environment. The report proposes ‘Completion of Road Network Scenario’ and ‘Bus Favored Scenario’ as the optimum scenario for comprehensive urban transport master plan with the target year in 2025. Also the report proposes 50 road projects, 5 bridge projects and 7 intersection improvement projects which are to be implemented in Short Term: 2009-2013, Medium Term: 2014-2018, and Long Term: 2019-2025.

We wish to take this opportunity to express our sincere gratitude to your agency and the Ministry of Foreign Affairs and the Ministry of Land, Infrastructure, Transport and Tourism. We also wish to express our deep gratitude to the Ministry of Public Works and Transport, as well as other Governmental Agencies concerned in Lao People’s Democratic Republic for the close cooperation and assistance extended to us during the Study. We hope this report will contribute to the development of the Lao People’s Democratic Republic.

Very truly yours,

Tatsuyuki Sakurai
Team Leader,
The Study of Master Plan on
Comprehensive Transport in Vientiane, Lao PDR



LOCATION MAP

ABSTRACT

ABSTRACT

Background

- The current traffic condition in Vientiane is not so severe compared with those in other Asian capital cities.
- However, the number of motorcycles and private cars are rapidly increasing, and traffic congestion is anticipated to occur in the future.
- Therefore, it is necessary to take actions now to prevent deterioration of traffic conditions in the future.
- Shifting from private vehicles to public transport is one of the effective measures for reducing emission of CO₂ which is indispensable for stopping the global warming.
- The Government of Laos is committed to introduce Environmentally Sustainable Transport (EST) and the master plan is expected to support the Government's policy on EST.
- In addition, the radical hike in prices of oil in the past one year or so is discouraging the use of private vehicles and amplifying the people's need to use public transport.

Objective

- To formulate a master plan on comprehensive urban transport in Vientiane,
- To prepare an implementation plan of the master plan,
- To conduct pre-feasibility for selected projects, and
- To pursue technology transfer to the counterpart personnel in the course of the Study.

Future Socio-Economic Framework

- The future socio-economic framework is forecasted as summarized below:

	2007	2025
Population	757,000	1,239,000
GDP/Capita	US\$ 957	US\$ 3,870
Vehicle (Incl. M/C)	215,000	494,000

Policy and Strategy

Vision of Vientiane

'Clean and safe city with functions of modern capital'

Policy and Strategy

- Road network development: Establishment of functionally balanced road network
- Public transport development: Mainly improvement of bus services
- Improvement of traffic management: Efficient use of existing road facilities

Alternatives of Urban Transport Master Plan

Scenarios of Road Network

- Three scenarios of the road network development plan were prepared and evaluated:
 - Scenario 1: Urgent Improvement Scenario
 - Scenario 2: Missing Link Construction Scenario
 - Scenario 3: Completion of Road Network Scenario
- Considering the traffic condition and economic parameters of each scenario, Scenario 3 is proposed as the Optimum Road Network.

Traffic Parameters

Case	Total PCU-Hrs	Total PCU-km	Ave. Travel Speed (km/hr)	Ave. V/C Ratio
Do-Nothing	364,006	7,467,732	20.5	1.38
Scenario 1	320,844	7,324,524	22.8	1.15
Scenario 2	235,057	7,199,951	30.6	1.02
Scenario 3	173,273	7,128,592	41.1	0.71

Economic Parameters

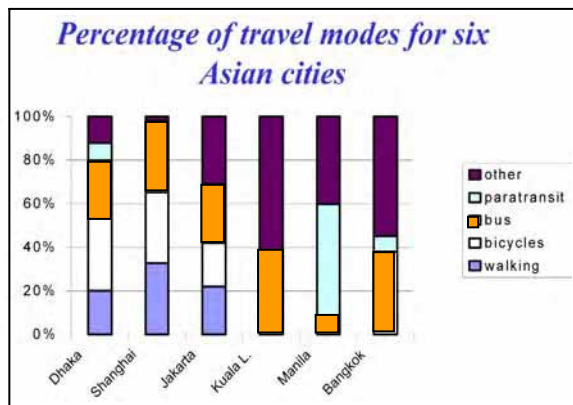
	Travel Cost (US\$1,000)	EIRR (%)	B/C	NPV (US\$1,000)
Do-Nothing	516,172	-	-	-
Scenario 1	490,877	13.5	1.11	8,429
Scenario 2	447,068	17.9	1.57	64,631
Scenario 3	414,736	18.1	1.54	87,237

Optimum Road Network (Scenario 3)



Alternatives of Urban Transport Master Plan

- Four (4) alternatives of Urban Transport Master Plan with different scenarios of the public transport development plan were prepared:
 - Alternative 1: Present Pattern
 - Alternative 2: Para-Transit-Oriented
 - Alternative 3: Bus-Favored
 - Alternative 4: Bus-Plus- LRT-Favored
- In all the alternatives, the Optimum Road Network, as explained above, was assumed.
- In evaluating the alternatives, the share of public transport was assumed to be 40% considering the cases of other Asian capital cities.



- Result of the economic and environmental evaluations are as shown below:

Economic Parameter

	Travel Cost (US\$1,000)	EIRR (%)	B/C	NPV (US\$1,000)
Do-Nothing	516,172	-	-	-
Alt. 1	414,736	18.1	1.54	87,237
Alt. 2	293,565	34.5	3.24	398,309
Alt. 3	269,815	39.6	4.17	551,257
Alt. 4	256,605	40.9	4.05	565,138

Comparison of Vehicle Emission (1)

Alternatives	HC		CO	
	Weight	Reduction	Weight	Reduction
Do-Nothing	2,562	-	7,784	-
Alt. 1	2,456	312 (4.0%)	7,472	312 (4.0%)
Alt. 2	1,365	1,197 (47%)	3,664	4,120 (53%)
Alt. 3	1,338	1,224 (48%)	3,583	4,201 (54%)
Alt. 4	1,331	1,231 (48%)	3,517	4,267 (55%)

Comparison of Vehicle Emission (2)

Alternatives	NOx		CO2	
	Weight	Reduction	Weight	Reduction
Do-Nothing	2,054	-	1,909	-
Alt. 1	1,946	108 (5%)	1,818	91 (5%)
Alt. 2	1,536	518 (25%)	1,379	439 (23%)
Alt. 3	1,495	560 (27%)	1,266	643 (34%)
Alt. 4	1,438	616 (30%)	1,214	694 (36%)

- In case of Alternatives 3 and 4, large reduction of emission is expected.
- Also, large economic return is expected for Alternatives 2, 3 and 4.
- Considering the economic, environmental and social aspects, Alternative 3 is selected as the Optimum

Alternative, and Alternative 4 is selected as the reserve plan for the future.

Road Network Development Plan

- A road network with functional hierarchy is proposed.
- Minimum ROW widths of 40m, 30m and 20m are proposed for Principal Arterial, Arterial and Collector streets, respectively.
- These ROW widths are also to accommodate Bus Rapid Transit and other public transport system.
- These ROW are to be acquired in advance and the actual widening is to be implemented in stages the traffic volume increases.
- 50 road projects, 5 bridge projects and 7 intersection improvement projects are to be implemented by the target year of 2025.
- These projects are prioritized based on benefit and other factors, and categorized into Short Term (2009 – 2013), Medium Term (2014 – 2018) and Long Term (2019 – 2025) Projects.
- The cost of each term is estimated as below:

Term	No. of Projects	Cost (US\$ mil.)
Short	Improvement of 14 road sections Replacement of 4 Bridges	84.4
Medium	Improvement of 14 road sections Replacement of 1 Bridge	80.6
Long	Improvement of 11 road sections Replacement of 1 Bridges	67.4

Case Study for Construction of Missing Link

- The missing link section of the Inner Ring Road, between Dong Palep Rd. and Nong Douag Rd., is selected as an example for planning of actual implementation, and case study was conducted.
- Project cost for this 4.7 km section is estimated at approximately US\$ 13 million.
- This project is expected to contribute to reduction of traffic congestion in the western part of the city center and to yield good economic return.

Index	Value
EIRR	18.5 %
B/C ratio	1.57
NPV (US\$ million)	6.8

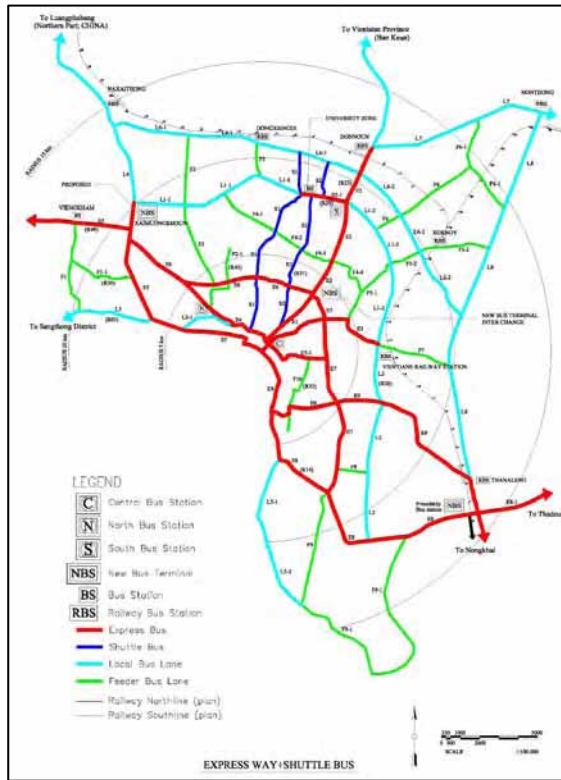
- Relocation of maximum 10 houses is anticipated to secure the ROW of the Project.
- Negative impacts to natural and living environment are estimated to be well within the allowable limit.

Public Transport Development Plan

- The target share of public transport is to be achieved stepwise from the current 4%; to 15% in 2013, to 25% in 2018 and finally to 40% in 2025.
- Bus is proposed as the main public transport mode.
- To transport the increased passengers, the following numbers of buses are to be procured.

ABSTRACT

- Short Term (2009 – 2013): 264 Units
- Medium Term (2014 – 2018): 310 Units
- Long Term (2019 – 2025): 352 Units
- Main bus routes are as shown in the figure below:



- Components of bus system to enable smooth bus operation are proposed: Bus-priority lane, exclusive bus lane, Bus Rapid Transit (BRT), bus stops and bus terminals, traffic control in favor of bus operation.
- The cost of the proposed Public Transport Development Plan by Term is as follows:

(US\$ Million)

Project	Term		
	Short	Medium	Long
I. Bus Capacity Improvement	8.4	17.3	25.7
II. Bus Priority Treatment	4.0	6.0	13.0
III. Bus Rapid Transit System	0	0	17.0
VI. Other System Improvement	2.0	10.0	20.0
Total	14.4	33.3	75.7

Traffic Management Plan

- Traffic management measures, are discussed from viewpoint of '3E' (Engineering, Enforcement and Education).
- Considering that the Government, the donors and NPOs are already implementing or planning to implement various measures, this Study focused on the following areas and proposed improvement:
 - Installation of raised median
 - Improvement of traffic signs, including pavement markings
 - Improvement of traffic black spot intersections with installation of traffic safety devices, traffic signs and pavement markings

Implementation Plan and Financing Plan

- Implementation of the proposed road projects and public transport projects are further distributed over years within each Term and the amount of fund required every year was estimated.
- The maximum annual amount for implanting the road projects is estimated to be approximately US\$ 20 million, while that for the procurement of bus fleet is estimated at about US\$ 3.5 million.
- The Government may need to borrow loan from the donors as the fund source for road projects but will be able to return the loan utilizing the surplus of government fund in the future.
- The Government needs to give some form of financial assistance to VSBC for procuring the proposed bus fleet.

Initial Environmental Examination (IEE)

- IEE for the proposed projects were conducted.
- Except a few road projects, no serious negative impact is anticipated.
- Some significant negative impacts are anticipated in cases of road projects passing residential areas and/or forest areas, and further EIA is required.
- Although road widening is to be implemented in stages, some social impact for land acquisition is anticipated.

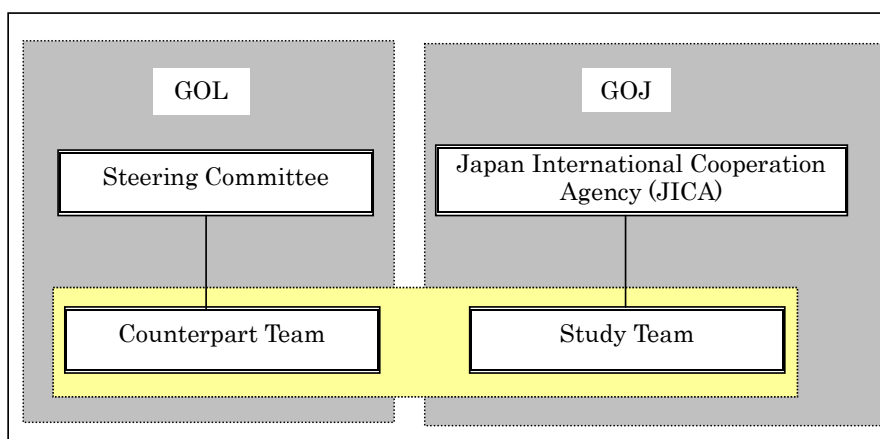
Pre-Feasibility Study on Shuttle Bus Service

- The shuttle bus service between the Central Bus Station and Dongdok Area (location of the National University of Laos) was selected as the model case for bus operation project and pre-feasibility study was conducted.
- 40 units of buses are needed to transport 40% of the students, or about 5,000 passengers, attending the morning, evening and night classes.
- US\$ 3.6 million is required to procure the necessary units of buses.
- This project is expected to yield good economic return and improvement in emission: The amount of reduction in CO2 corresponds to 63.7 ha of forest.

Recommendations

- It is recommended that the Government authorize this Master Plan.
- The target share of 40% for public transport should be adopted in the Government EST policy and/or environmental policy.
- To secure ROW for the road projects, the Government should promulgate legislations to designate future ROW and to regulate construction of new buildings within the designated ROW.
- The Government should prepare business plan of VSBC.
- A coordinating committee for urban transport should be established.

ORGANIZATION OF THE STUDY



JICA Headquarters

Mr. Tomiaki ITO	Transportation and ICT Group, Economic Infrastructure Dept.	Deputy Director General
Mr. Tomoyuki NAITO	Transportation and ICT Division II, Economic Infrastructure Dept.	Director
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Steering Committee

Mr. Bounchanh SINTHAVONG	Vice Mayer of Vientiane	Chairperson
Mr. Bouaphet SAYASANE	DDG of DOT, MPWT	Member
Mr. Pothong NGONPHACHANH	DDG of DOR, MPWT	Member
Mr. Thenkham THONGBONH	DDG of DHUP, MPWT	Member
Mr. Ketkeo SYHALATH	Vice President of VUDAA	Member
Mr. Keophilavanh APHAYATH	Director of URI	Member
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Mr. Keiichi MURAKAMI	Road Development Plan
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Mr. Toshinori TODA	Deputy Team Leader/Public Transport Plan
Mr. Ryuichi UENO	Traffic Survey/Transport Demand Forecast
Mr. Yasuo NABESHIMA	Traffic Management Plan
Mr. Hiroo TAKEDA	Economic and Financial Analysis
Mr. Yuji HATAKEYAMA	Environmental and Social Considerations

The Study of Master Plan on Comprehensive Urban Transport in Vientiane

EXECUTIVE SUMMARY

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Exchange Rate

US\$1.00 = Kip 9,628

Kip 10,000 = JPY 114

(As of Oct 2007)

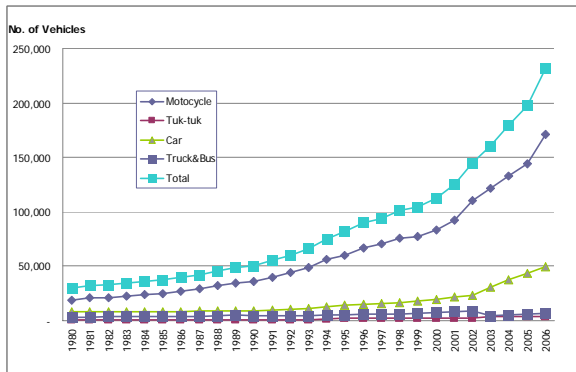
INTRODUCTION

INTRODUCTION

Background

- The current traffic condition in Vientiane is not so severe compared with the capitals of other Asian countries. However, the traffic volume in Vientiane is rapidly increasing as a result of rapid economic growth, and severe traffic congestion is anticipated to occur in the future.

Increase of Vehicles



- Both of the existing public transport and road network in Vientiane are not sufficient to cater the future traffic demand.
- Therefore, it is an urgent need to formulate a master plan of urban transport and start actions to cope with the increased future traffic demand.

Typical Para-Transit in Vientiane



Tuk-tuk (left) and Jumbo (right)

Global Concern on the Climate Change

- Concern over climate change or global warming has been rapidly growing worldwide in the recent few years.
- Reduction of the greenhouse gas or CO₂ is indispensable to stop global warming.
- Shifting from private vehicles to public transport is one of the effective measures for reducing emission of CO₂.
- Thus, the master plan increases its significance as the concern over global warming grows.

Environmentally Sustainable Transport

- In view of the above, the Government of Laos is committed to introduce Environmentally Sustainable Transport (EST) which is being promoted by UNCRD and other international organizations.
- Strategies and measures of urban transport master plan, including strengthening of public transport and reduction of use of private vehicles, are in line with the policies of EST.
- Therefore, the master plan is expected to support the Government's policy on EST.

EST Forum Held in Singapore, March 2008



Soaring Fuel Price

- Immediately after this Study had started, the prices of oil and fuel started to hike.
- The price of crude oil today is more than 5 times of that of one year ago.
- This radical hike in prices of oil and fuel is discouraging the use of private vehicles and amplifying the people's need to use public transport.

Objective

The objectives of the Study are four-fold:

- To formulate a master plan on comprehensive urban transport in Vientiane,
- To prepare an implementation plan of the master plan,
- To conduct pre-feasibility for selected projects, and
- To pursue technology transfer to the counterpart personnel in the course of the Study.

Study Area

The Study Area covers Districts of Sikhottabong, Chantabouly and Sisattanak, and parts of Xaythany District and Xaysettha District. (See the Location Map.)

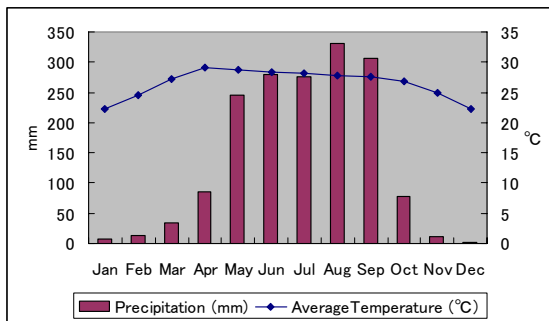
PART 1

PRESENT AND FUTURE ISSUES

1. PHYSICAL AND SOCIO-ECONOMIC PROFILE

Physical Profile

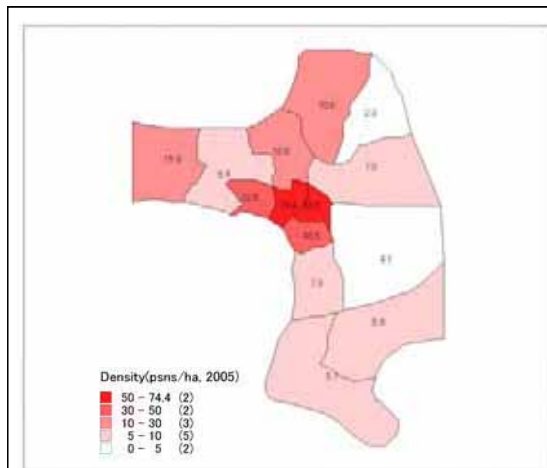
- Vientiane is located on the bank of the Mekong River and there are many ponds and marshy lands in the urbanized Districts.
- The area designated for urbanization is approximately 210 km².
- Altitudes of the ground surface ranges 160 m to 180 m above sea level.
- Rainy season falls from May to September and dry season occurs from November to March.



Demography

- According to the Census of 2005, the population of entire Vientiane and the Study Area are 691,000 and 422,000, respectively.
- Population density at present is higher in the city center.
- Next to the city center, the area along No.13 South Road and west end of the Study area show high population densities.
- Population growth rate is high in the northeast area of the Study area (along No. 13 South Road) and west end of the Study Area.
- Population in the city center is decreasing in the past 10 years (1995 – 2005)

Population Density



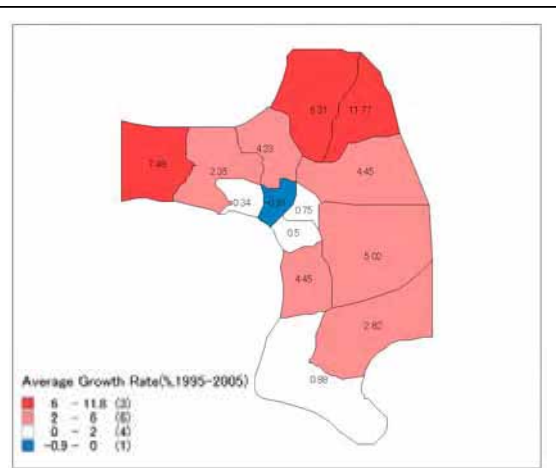
Land Use

The Vientiane Urban Development and Administration Authority (VUDAA) have prepared a land use regulation zoning map with the target year in 2010. In this map, land use is categorized into 14 use zones.

Land Use Map



Population Growth Rate



*Zone is defined in subsection 5.1.1

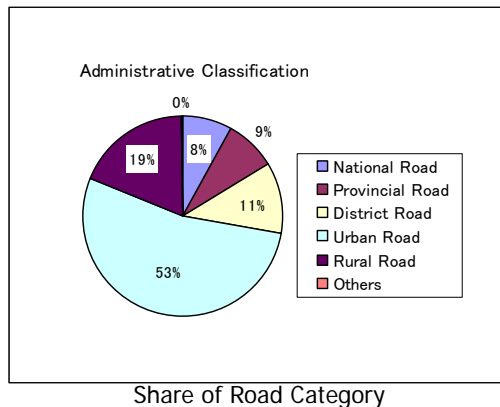
2. Road Network

Road Classification

- Roads in Lao PDR are classified into six (6) categories stipulated in the Road Law.
- MPWT is responsible for National Road (N.R.), and DPWT of each province for Provincial (P.R.), District (D.R.), Urban (U.R.) and Rural (R.R.) Roads.
- Most of Urban Road and Rural Road in Vientiane are managed by VUDAA, remaining roads by DPWT.
- The roads categorized in Special Road (S.R.) are basically managed by military, local community, private companies.

Administrative Classification & Surface Type in Vientiane (9 Districts) (km)

Category	Paved	Gravel	Earth	Total
N. R.	170.2	62.5	15.0	247.7
P. R.	47.6	95.2	3.6	146.4
D. R.	34.7	353.6	27.2	415.5
U. R.	182.5	213.8	109.4	505.7
R. R.	5.6	330.8	160.3	496.7
S. R.	3.9	40.6	9.5	54.0
Total	444.5	1,095.5	325.0	1,866.0



Functional Road Classification

- Functional classification of road network has not been officially established.
- VUDAA has a plan to classify the roads under its jurisdiction into Main Road and Feeder Road.

Cross Section

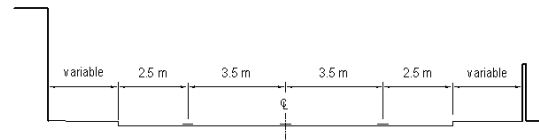
Roads Regarded as Arterial Road

- Arterial roads basically has multi-lane for both directions, some sections of which have narrow lanes on both sides for slow speed traffic and motorcycles.
- The road markings on the bituminous surface treatment are often worn out and practically non-exist or not visible.
- The sidewalk is basically provided in the urbanized area, while its width is not uniform

because of the availability of land and adjustment with road side conditions.

- In the suburban area, carriage way is set up with single lane for each direction.

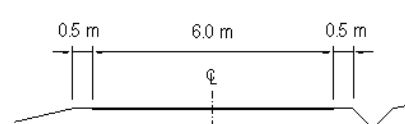
Typical Cross Section of Arterial Road



Roads Regarded as Collector Road

- All road sections of collector roads are composed of single lane for each direction.
- The mount-upped sidewalk is not provided and shoulder is utilized for pedestrian space.

Typical Cross Section of Collector Road



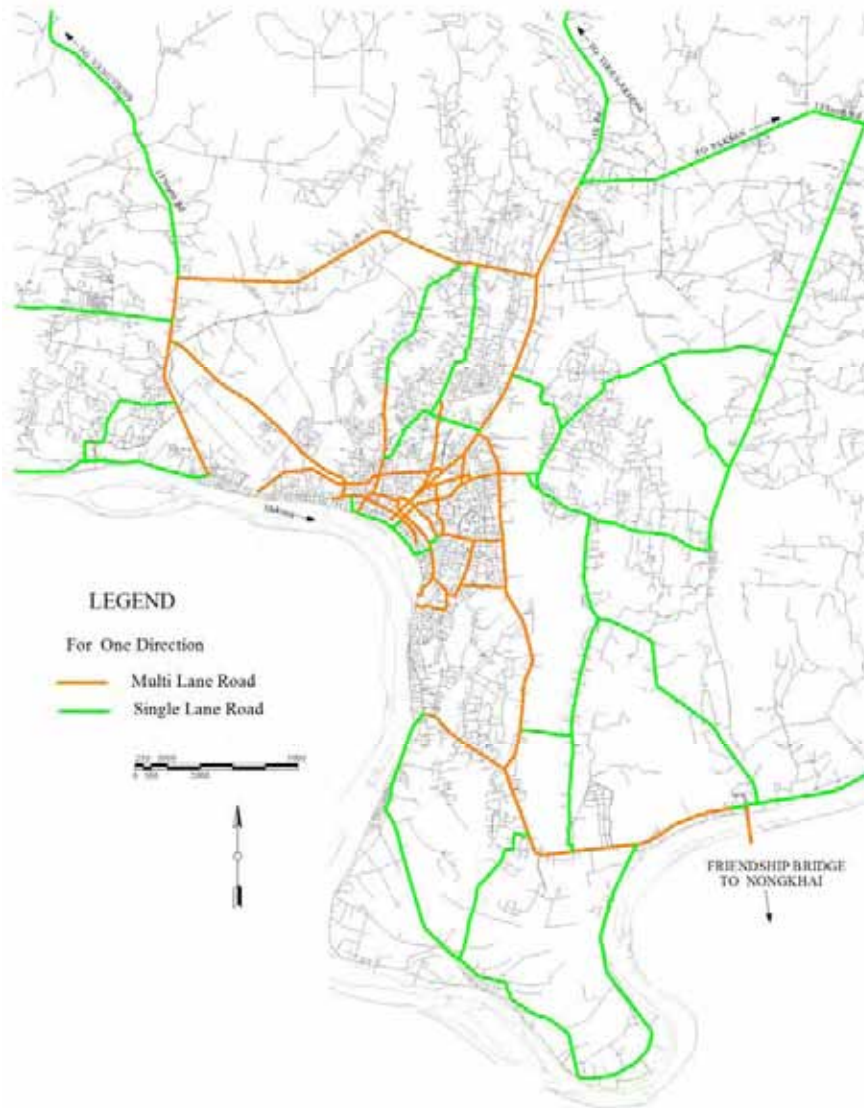
Bridge Condition

The following 4 bridges on main roads with two lanes are required to be replaced due to bottlenecks in traffic function and poor conditions in structural soundness.

- Bailey bridge with wooden deck, carriage of 4.0m wide and 30.3m in length (km6 Nong Niang – Jct. Dong).
- Steel girder bridge with wooden deck, carriage-way of 2.9m wide and 22.0m in length (Jct. Sa Nam Mar - Jct. B. Mai).
- Bailey bridge with steel deck, carriage of 4.0m wide and 18.3m in length (Jct. Sa Nam Mar - Jct. Mai).
- Bailey bridge with wooden deck, carriage of 4.0m wide and 24.3m in length (Rd.13Sk21 – B. Khok Sa At).

Typical Bailey Type Bridge

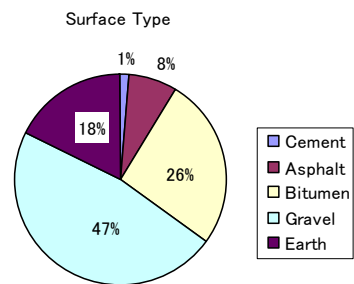




Basic Road Network and Number of Carriage way



Collapsed Shoulder & Raveled Edge



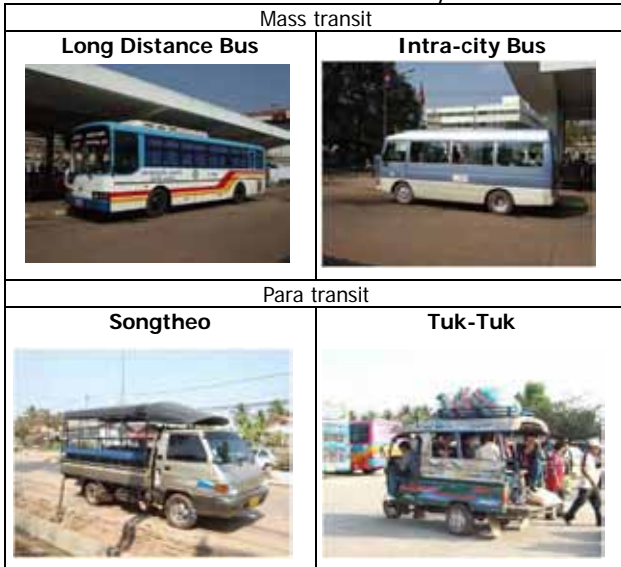
- Cement
- Asphalt
- Bitumen
- Gravel
- Earth

3. PUBLIC TRANSPORT

PRESENT PUBLIC TRANSPORT

- The public transport in Vientiane is mainly composed of bus and paratransit.
- Major types of para-transit are Tuk-tuk, Jumbo and Songtheo. Songtheo are mainly operating in the rural area.
- There are bus services for both intra-city travel and inter-city and international, long-distance travel

Public Transport in Vientiane



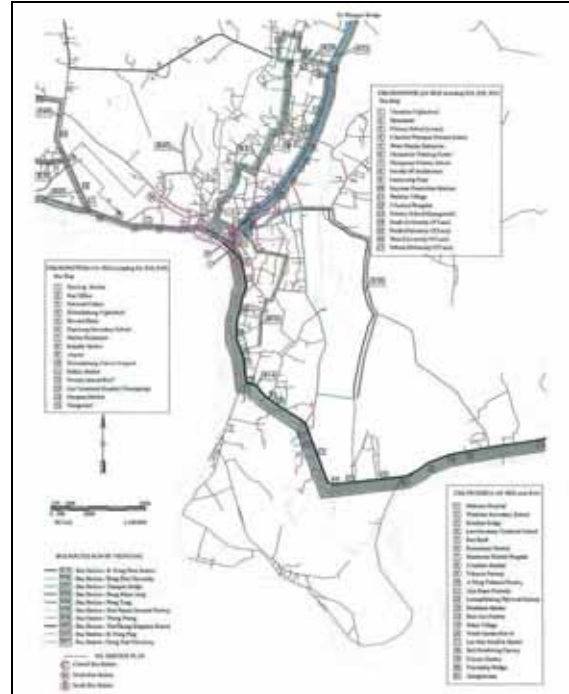
- There are bike taxis operating in the rural areas and they do not operate in the urban areas.
- A 3.5km-long section of new rail line from Thailand, through Friendship Bridge, is almost completed. The station of this rail line is located in Thanaleng. GOL intends to further extend the railway north to Vietnam and south to Southern Lao.
- There is an airport which serves to international and domestic flights.
- There is a ferry operating across the Mekong River about 5 km downstream from Friendship Bridge.

URBAN BUS SERVICE IN VIENTIANE

- There are two kinds of operators of bus services in Vientiane; Vientiane State Bus Company (VSBC) and Thong Li Pa Si Bus Company.
- VSBC is a 100% state-owned enterprise, and is providing bus services for urban transport in Vientiane and intercity bus services to some provinces.
- VSBC is independent enterprise but supervised by Department of Public Works and Transport (DPWC)
- VSBC is currently operating 51 units of buses for urban transport.

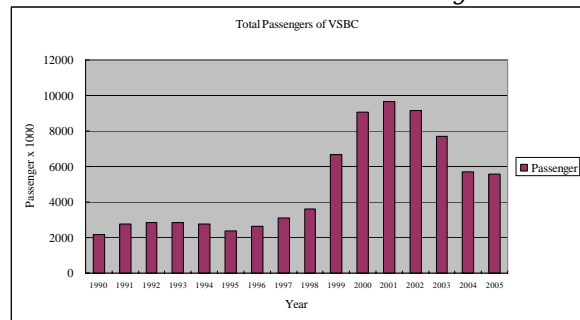
- Thong Li Pa Si started its operation in October 2007 and its service is limited compared to those of VSBC.

Urban Bus Route of VSBC



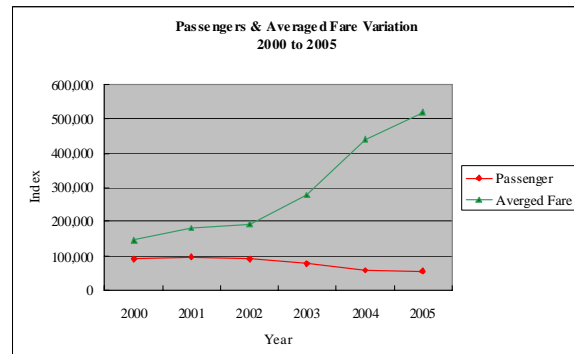
- The total number of passengers of VSBC increased from 1996 to 2001, but decreased since then.

Passengers of VSBC



- The revenue of VSBC is increasing since 1998 in spite of decrease in the number of passengers.
- This is due to the hike in fare implemented in the past few years.

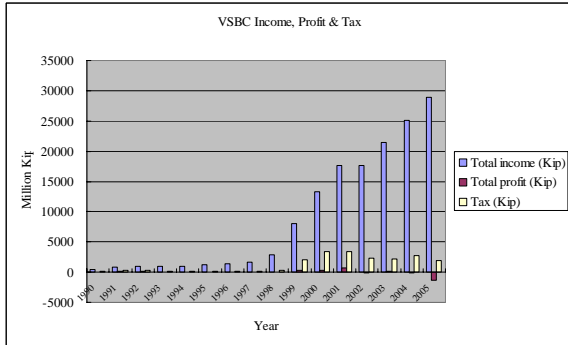
Hike of Bus Fare



Part 1: Present and Future Issues

- However, the profit has been decreasing and deficit was recorded in 2005.
- The deficit may be attributed to such factors as high fuel price, tax imposed on revenue regardless of profit and the number of employees which has not been reduced even though the revenue has been decreasing.

Revenue of VSBC



BUS TERMINAL AND BUS STOP

- There are three major bus terminals in Vientiane; Central Bus Station (CBS), Southern Bus Station (SBS) and Northern Bus Station (NBS).
- CBS is the sole urban bus service terminal in Vientiane, and is owned and operated by VSBC.
- It is located in the city center; adjacent to the Morning Market, the biggest and busiest market in Vientiane.
- Approximately 290 scheduled buses of urban routes depart CBS every day.
- CBS was constructed by ODA of Japanese Government

Central Bus Station



- SBS is owned and operated by private enterprise.
- It is located on National Road 13 South near junction between NR 13 South and Dongdok Road.
- It is used for travel to the southern provinces of Laos and for international travel to Vietnam.
- NBS is located along ASEAN Road, and is owned and

operated by the private company, Chitpasong Company.

- It is used for travel to northern provinces and for international travel to Kunming, China.
- Access to SBS and NBS is Tuk-tuk or Jumbo, or private vehicles.
- There are bus stops with shelter and bench along some of the major bus routes.
- However, number of such bus stops is rather limited.
- Buses often stop in an ad-hoc manner and load/unload the passengers.

Bus Stop with Shelter and Bench



PARA-TRANSIT

- There are 2,090 units of Tuk-tuk and Jumbo, 262 units of Songtheo and 132 units of taxi registered in Vientiane.
- Among 2,090 registered Tuk-tuk/Jumbo, only 1,887 are actually operating.
- There are associations for each of Tuk-tuk/Jumbo, Songtheo and taxi, and operators of these para-transit vehicles are supposed to register respective association.
- Tuk-tuk/Jumbo association is making effort to improve the service of Tuk-tuk/Jumbo, such as queuing arrangement and encouraging its members to undergo vehicle inspection.

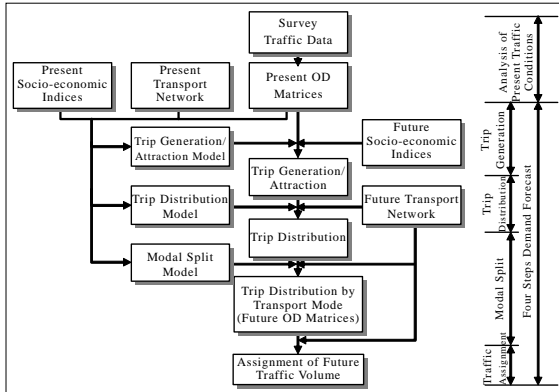
ADMINISTRATION

- Administration of public transport in Vientiane is the responsibility of Department of Public Works and Transport (DPWT) of Vientiane, who controls all public transport operators, state and private bus companies and all paratransit operators through each association.
- The tasks involved in the administration include approval of increasing number of vehicles, decision of travel fare, allocation of service routes, review of transport policy such as private sector involvement.

4. FUTURE TRAFFIC DEMAND

Work Flow

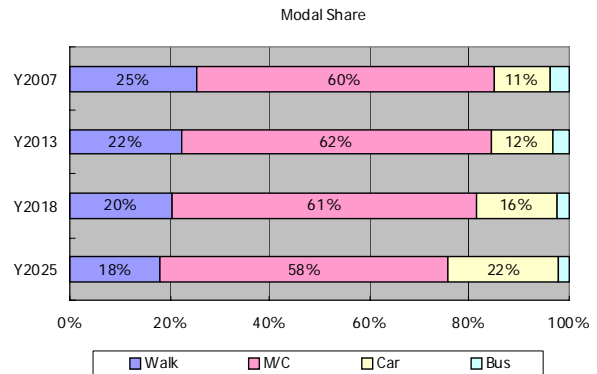
The figure below shows the workflow of future traffic demand forecast.



2007 to 2025.

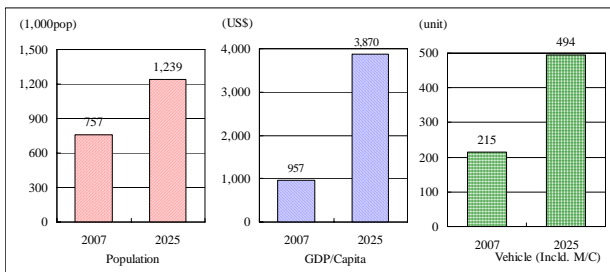
- This implies that the traffic volume of cars and motorcycles will increase in the future.

Modal Share



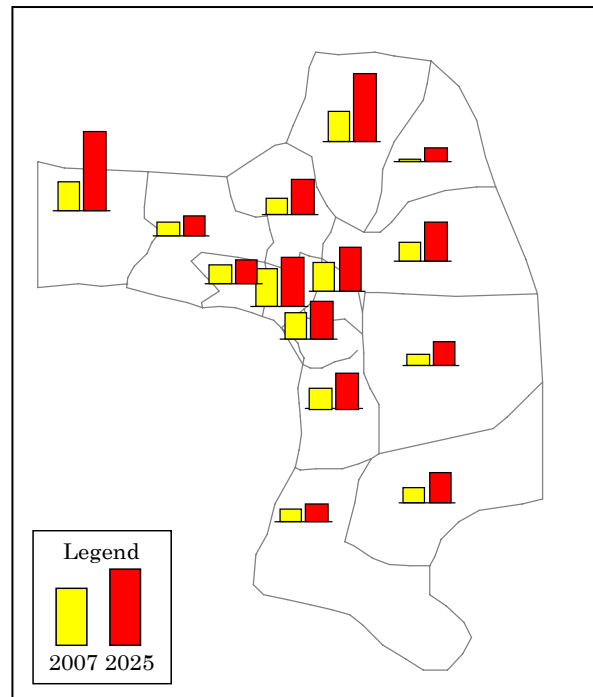
Future Socio-Economic Frame

- The population of Vientiane is estimated at about 750,000 in 2007 and is forecasted to grow to around 1,240,000 in 2005.
- GDP/Capita of Vientiane in 2025 is forecasted to become almost 4 times of that in 2007 (from US\$ 960 to US\$ 3,870).
- Vehicle registration in 2025 is forecasted to be about 490,000 compared with 215,000 in 2007.



Geographical Trip Distribution

- Due to increase of population in the current suburban areas, the future growth of the trip generation will occur mainly in the current suburban areas.



Future Urban Development

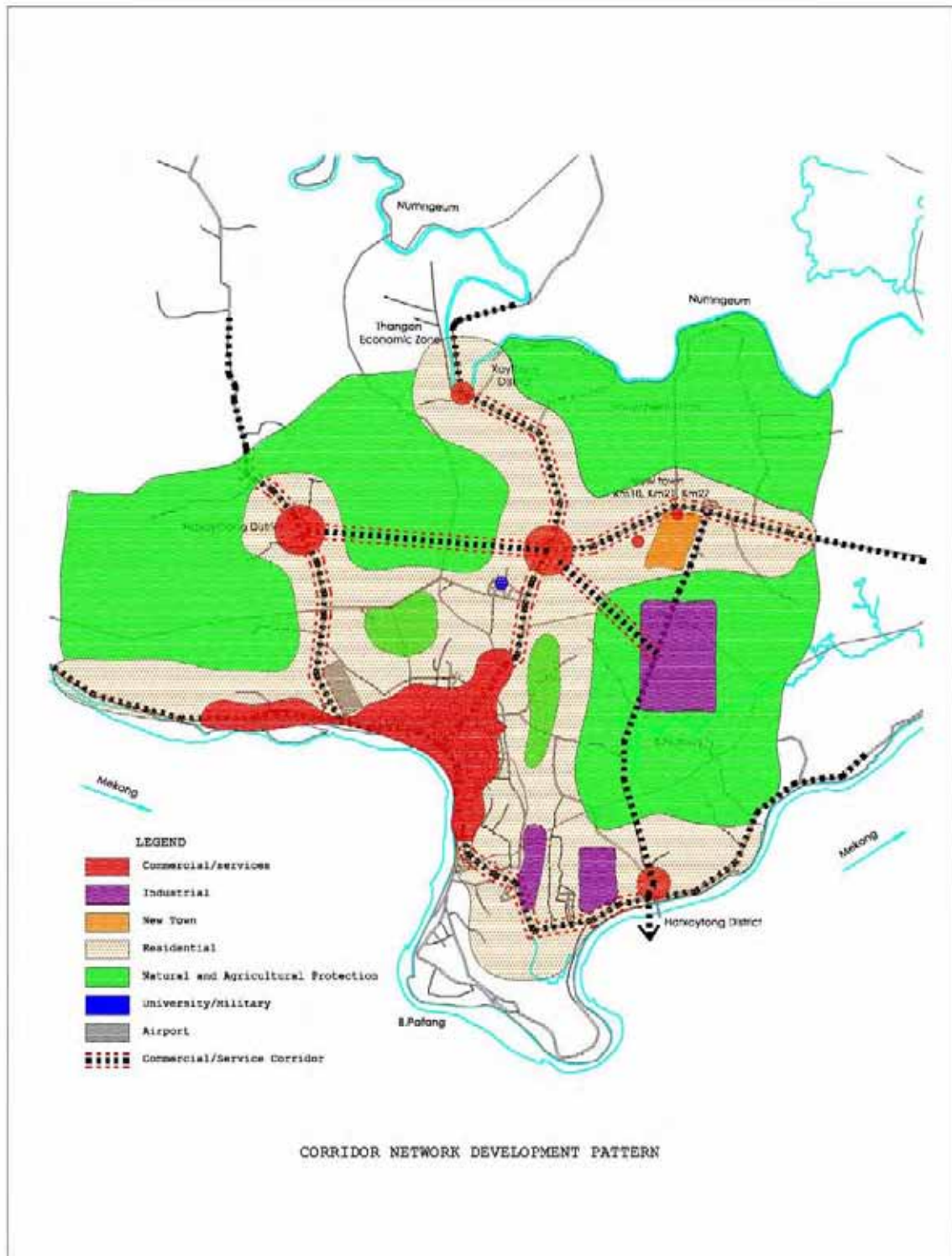
- It is assumed that the urban development occur along the transport corridors, as shown in the next page.

Future Trip Generation and Modal Share

- The number of total person trips in Vientiane doubles from 958,000/day in 2007 to 1,929,000 /day in 2025.

Year	Trip Purpose					TOTAL
	HOME	WORK	SCHOOL	OTHERS		
2007	471,471	170,264	170,754	145,144	957,633	
2013	608,709	250,509	184,808	194,955	1,238,981	
2018	740,984	322,793	203,941	241,307	1,509,025	
2025	946,575	437,588	231,258	313,444	1,928,865	

- While the share of "private car" will increase, the share of motorcycle will remain almost the same and those of "walk" and "bus" (public transport) will decrease from

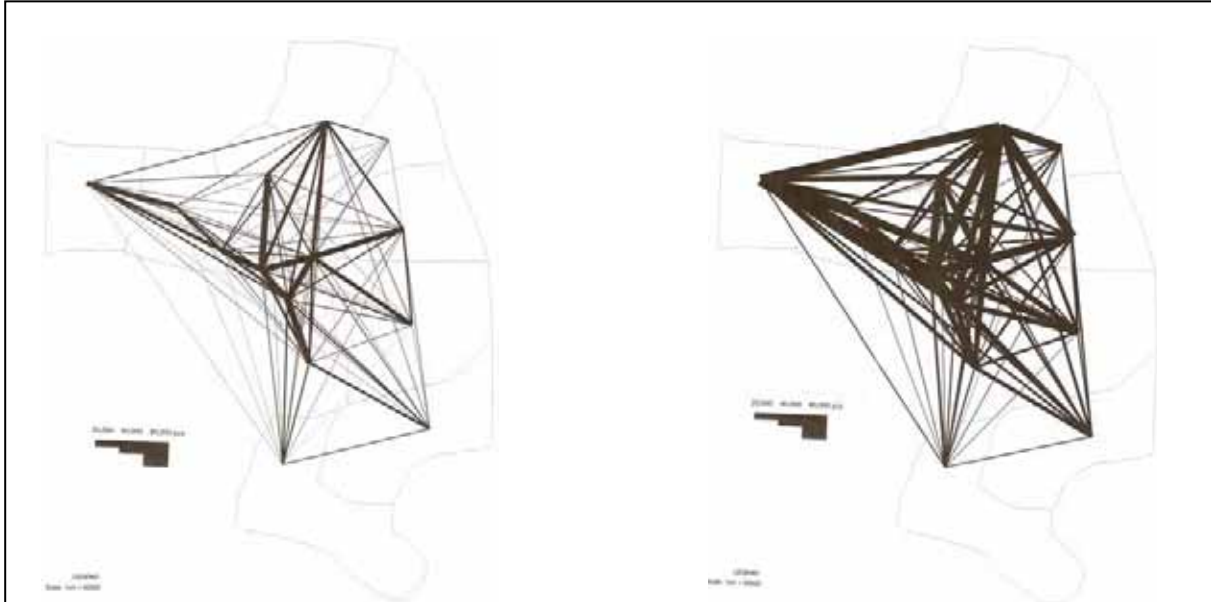


Desire Line

- The traffic demands in 2007 and 2025 are presented in the form of Desire Line in the figure below.
- It is seen that the demand between the suburban areas, or in the circular direction, will grow in the future.

Desire Line in 2007

Desire Line in 2025

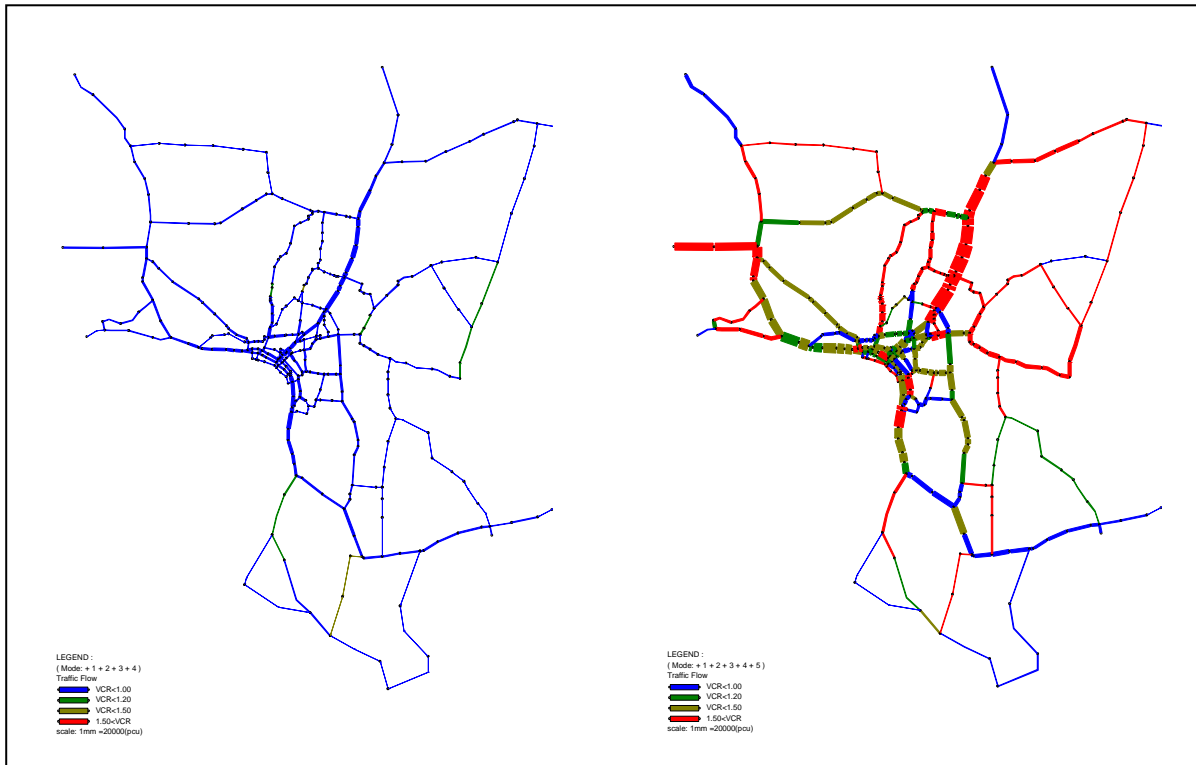


Traffic Demand Forecast

Forecast of future traffic demand using JICA STRADA programme shows that severe traffic congest will occur by year 2025 while the present traffic condition is fairly smooth.

Traffic Condition in 2007

Traffic Condition in 2025

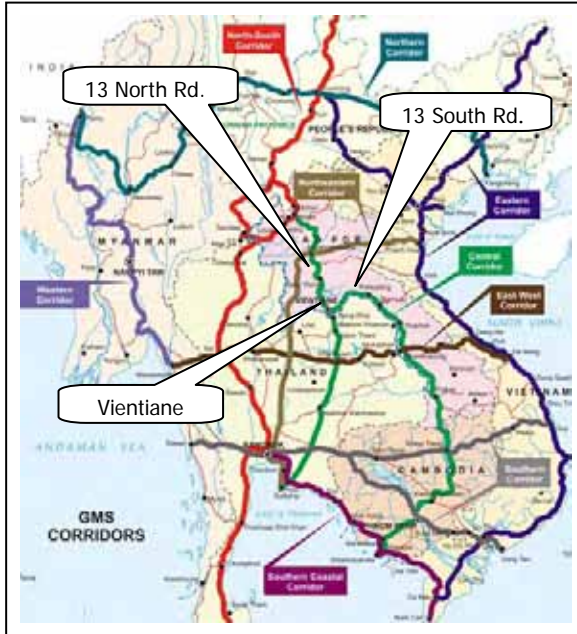


5. PRESENT AND FUTURE ISSUES

Present Situations of Vientiane

Function of Vientiane

- The center of the governmental and socio-economic activities as the capital.
- The center of social and economic development for the central region.
- International transport hub for GMS.



GMS Corridors

Features of Vientiane

Urban Structure

- Urban area has been expanding toward the northeast in a fan-shape centered at the Mekong River.
- Government facilities and central business district (CBD) are concentrated in the city center.
- In the suburban area, commercial and light industrial areas are located along the main roads with residential areas being dispersed in the whole city area.
- The whole city area is not intensively used: Most buildings are low- to medium-rising and there are many green areas.

Environment

- Urban landscape is attractive with abundant green areas, open spaces and traditional-style buildings.
- It is recommended to maintain the present attractive scenery in the city center for tourists.
- No serious environmental problems are found.

Road Network and Road Condition

Road Network

- Road network in the city center is formed in a grid pattern, while major roads in suburban area are in a radial pattern centering at the city center.
- Roads are categorized only from administrative viewpoint and functional hierarchy is not well developed.
- The Inner Ring Road plays an important role in the network but has not been completed yet.

Surface Conditions

- Main roads in the study area are basically paved with asphalt (40%), bituminous (44%), Cement (3%) and gravel (13%), among which the surface conditions of bituminous and gravel pavements are generally in poor condition.
- There are many intersections disorderly along main roads with minor roads.
- There are four (4) bridges on main roads being bottle necks in traffic function and poor conditions in structural soundness.

Traffic Conditions

Increase in Vehicle Registration

- The number of total registered vehicles in Vientiane in 2006 is more than 232,000 with a growth rate of about 11% per year.
- Annual growth rate of motorcycle is about 10.7%, while that of car is about 20%. These rapid growths have been continuing since 1998 and 2002, respectively.
- Motorization in Vientiane seems to have been in its 'exploding stage' since 1998.

Traffic Congestion

- Though traffic volume has rapidly been increasing, serious traffic congestion is not occurring yet.
- The future traffic demand forecast shows that the present road network will not be able to cater for the future traffic demand and severe traffic congestions will occur.

Traffic Characteristics

- Peak hour ratios in the morning and evening are as high as 15.0% and 10.8%, respectively. Reducing peak hour traffic volume to an appropriate level will become a major issue.
- Trips by motorcycle account for 65% of the total trips in the Study Area, while trips by public transport account for only about 6%.

- It is needed to encourage converting private vehicle to the public transport, especially for commuting, which leads to one of measures to prevent severe traffic congestions with mixed vehicle types, in particular during peak hours.

Traffic Management and Safety

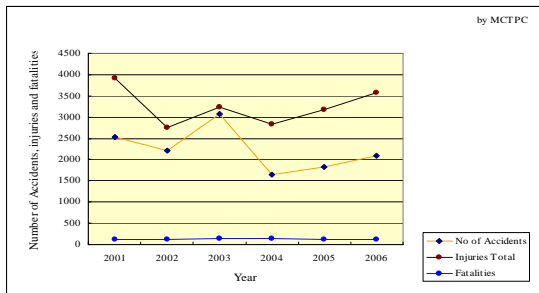
Traffic Management

- Separating high-speed vehicles and low-speed vehicles is needed at least on main roads.
- There are some excessively large intersections without markings. Intersections should be designed as compact as possible with adequate road markings; to guide traffic flow in order; to reduce the number of traffic conflict points; and to shorten exposure time of pedestrians and vehicles in the intersections.
- Such traffic devices as markings, traffic guide signs and traffic signals should be uniformed including not only in shapes but also location and color.
- There are many intersections without traffic signals along main roads in suburban area.
- The issues of the traffic management in the city center have been studied and incorporated in Vientiane Urban Transport Master Plan.

Traffic Safety

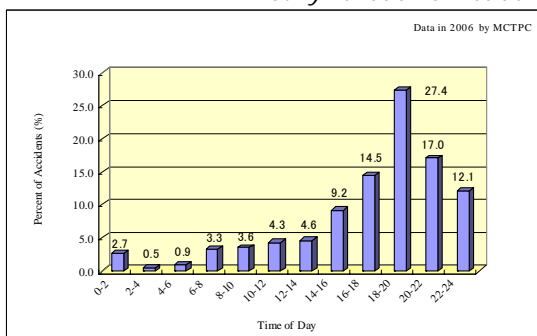
- The number of injury accidents has been increasing since 2002, while fatality accidents have been stable over six (6) years, ranging between 112 and 147.

Annual Variation of Traffic Accidents

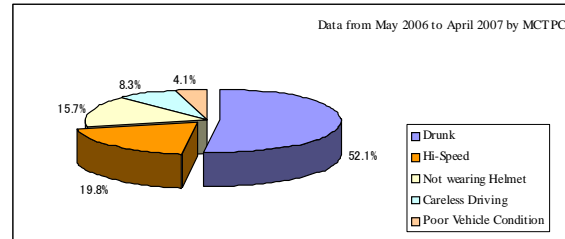


- The number of traffic accidents show steep increase after office hours up to 20:00. Causes of this phenomenon are presumably to be matter of visibility due to poor street lighting system and drunken driving, and haphazard or disorderly driving by the young.

Hourly Variation of Accidents



- Drunken driving, high speed and no helmet account for about 88% of the total fatality accidents.

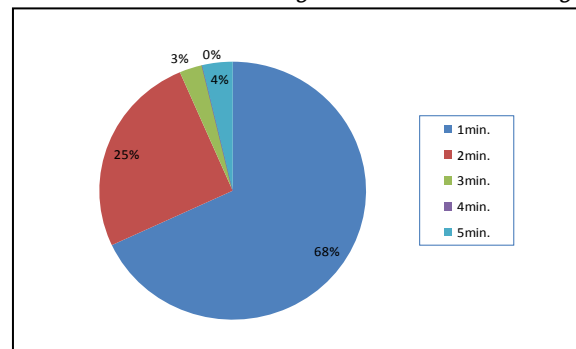


- Treatment of motorcycles is one of the major issues to address traffic safety as well as traffic congestion.
- MPWT has formulated the National Level Road Safety Plan, which was officially approved by the Prime Minister. This master plan is composed of 15 sectors covering almost all disciplines in the field of road traffic safety.

Parking

- Though there is still much room for car parking in the city center, parking spaces located in near attraction points are practically in full space, and car users feel that parking spaces are not enough.
- Drivers do not want to use parking lots more than 2 minutes-walk distance.

Allowable Walking Time from Car Parking



Public Transport

Interview Survey on Bus Service

- More than 55% of bus users feel the necessity of improvement; shortening of travel time is the highest (71%), followed by shortening of waiting time (67%) and extension of service hours (63%).
- Bus passengers have a quite strong complaint about air quality inside buses.

Bus Management and Operation System

- There are 3 bus stations in Vientiane. While the Central Bus Station (CBS) serves mainly for intra-city service, the South Bus Station (SBS) and North Bus Station (NBS) serve mainly for international and for inter-province services, respectively. SBS and NBS are owned and operated by private companies.
- Bus transit services in Vientiane areas and the

Part 1: Present and Future Issues

Central Bus Station (CBS) are owned and operated by Vientiane State Bus Company (VSBC).

- The government agencies responsible for controlling bus services are DPWT and Vientiane Governor for urban bus services and MPWT for international bus services.

Financial Situation of the Bus Company

- VSBC is governed by the Mayor of Vientiane, and does not have power to set bus fare based on its own business policies.
- Deficits of VSBC were recorded in 2004 and 2005. VSBC attributes the deficit mainly to repeated increase in fuel price and maintaining relatively low fare by political considerations.

Issues of Bus Transport System

- The roles and responsibilities of the concerned government agency are not clear.
- There is no established business plan for VSBC.
- Difficulty in providing smooth connection of bus services between CBS and the other stations due to conflicts on timetables among bus operation companies.

Para-Transit

While tuk-tuk and jumbo are well organized and controlled by Tuk-Tuk and Jumbo Association, the following problems are identified.

- There are some members who do not adhere to the regulations including parking at unauthorized spaces, overcharging and conflicts with passengers.
- The parking spaces for tuk-tuk and jumbo have been limited due to the increasing number of traffic volume.
- There are private vehicles that illegally provide services to the public.
- There are vehicles that are in poor conditions and without vehicle inspection certificate issued by the Association.

Railway

- The railway extension project between Dongphosi Station and the Friendship Bridge was constructed in April of 2008 with land acquisition for the first stretch of 3.45km funded by Thailand, the study of which was conducted in 2002 for a total length of 12.45km.
- As for the remaining section of 9.0km, the further study is being conducted by Agence Francaise de Development (AFD).

Future Issues

Function of Vientiane

- Perform as the centre of the governmental and socio-economic activities for both Lao PDR and the central region.

- Perform as the international transport hub for the Great Mekong Sub-Region (GMS).

Urban Structure

- Prevent sprawling of urbanized area.
- Maintain current attractive urban amenities with abundant green areas, open spaces and traditional-style buildings.
- Preserve present historical/cultural heritages and environment.

Road Network

- Establish the basic road network with functional hierarchy.
- Establish road network to support the development of public transport.
- Establish the basic road network to promote urban development plan.
- Replace substandard bridges, such as one lane and temporarily bridges, on main roads.
- Control access roads connecting arterial roads.

Traffic Demand

- Cope with rapid growth in traffic demand.
- Shift from private vehicle, especially for motorcycle, to public transport.
- Expand and upgrade public transport system incorporating para-transit.

Traffic Management and Safety

- Improve intersections including configuration, road surface markings, lighting and installing traffic signals.
- Separate carriage way for high speed vehicles from slow speed vehicles on arterial streets.
- Improve or uniform road surface markings including traffic guides.
- Enforce traffic regulations including parking.
- Treat appropriately motorcycles in terms of traffic safety and traffic congestion.
- Oblige owners who construct commercial buildings/houses or large scale facilities to provide off-street parking spaces by law.

Public Transport

- Need to upgrade both bus service system including facilities and quality of buses.
- Integrate or improve bus management/ operation system.
- Incorporate para-transit into the urban transport system.
- Take account of the moves of the railway extension project.

PART 2

TRANSPORT MASTER PLAN

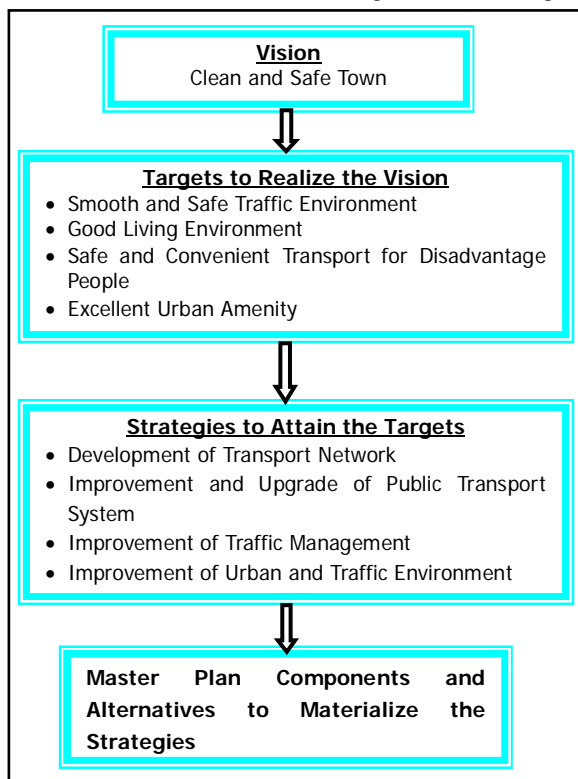
6. POLICY, TARGETS AND STRATEGY FOR TRANSPORT PLANNING

Vision of Future Vientiane and Targets

The vision of the future Vientiane, as the basis for formulating urban transport master plan, is assumed as 'Clean and safe city with functions of modern capital'. This leads to the following overall targets:

- Smooth and safe traffic environment,
- Good living environment,
- Safe and convenient transport for disadvantaged people, and
- Good urban amenity.

Vision, Targets and Strategies



Policy for Establishing Strategies

In establishing the strategies to attain the above targets, the policies as described below are adopted.

Urban Development and Road Network

The Corridor Network Development Pattern and the following urban development policies are assumed.

- To connect the missing links of the existing road network; especially complete the ring roads.
- To plan the preventive measures of urban transport to cope with the future traffic demand.
- To establish the urban transport corridor to guide desirable urban development.
- To develop high- to medium-story residential buildings and intensified commercial/service activities along the major transport corridor.

- To develop urban facilities, including water supply, sewerage system, waste-disposal and parks, to meet the requirements caused by the population growth.
- To maintain the existing desirable landscape; marsh, green areas and open spaces
- To preserve historical and cultural heritages.

Urban Transport System

The urban transport system, especially affordable means for public movement, should be provided to respond to the future traffic demand.

- Clear role sharing between mass-transit and para-transit.
- Harmonized and effective coordination between different transport modes.
- Shift from private vehicles to public transport and efficient usage of public transport.
- Especially, encouragement of commuting by public transport instead of private vehicles.
- Possible introduction of LRT system in the long future.
- Consideration of the role of Vientiane as part of the international/regional cross border logistics system.

Preservation of Urban Environment and Tourism Heritage in the City Center

The plan shall be intended to preserve the historical heritage and urban scenery, and to ensure good urban environment and amenities.

- Preservation of the historical area with the heritage value to attract visitors.
- Provision of serviceable and safe road facilities and well-designed access to attractive spots.

Modern City with Urban Structure and Development Potential in the Suburban Area

The plan shall be instrumental to build the modern Metropolitan Vientiane with harmonization of urban environment and structure. Construction of a city with modern urban function is essential to attract foreign investment and attain economic growth.

- Advanced traffic facilities and management with international standards in terms of system and quality.
- Functional connection between new development areas such as industry satellite city and logistics zones.
- Comfortable access to residential areas with prestige to prevent undesirable form of sprawl.

Basic Approach for the City Center

In the present city center, due consideration is given to the preservation of historical heritage and urban scenery with deliberate urban development control. The basic approach for the city center, therefore, shall be; strengthening of the public transport service; full utilization of existing facilities with minimum improvement intersections and construction of missing links; and promotion of effective management system involving education and enforcement.

- Effective traffic management system and securing traffic safety
- Strengthening and upgrading of public transport services.
- Improvement of intersections including road surface markings
- Renovation of bus terminals and facilities.
- Expanding paid off/on-street parking system.
- Provision of facilities for non-motorized vehicles.

Basic Approach for Suburban Area

As future population growth is expected to be induced into the suburban areas, the basic approach for this area is to formulate a systematic and functional transport network to be integrated into the proposed urban development scenario in order to provide serviceable access to new development areas.

- Establishment of functional road hierarchy considering the long distance and international traffic.
- Intensifying and expanding of the existing public transport services.
- Improving and widening of existing main roads and construction of missing links of main roads.
- Effectively and efficiently connecting with main roads between the central city and planned development areas.
- Securing ROW widths in a phase manner so as to minimize negative social impacts.

Strategy for Urban Transport

Strategy 1: Development of Road Network

- To provide the basic infrastructure for urban transport system.
- To serve the smooth operation of public transport services including buses.
- To contribute the improvement in traffic safety as well as in air pollution, noise and vibration with good road surface conditions and smooth traffic flow.

Strategy 2: Improvement and Upgrade of Public Transport System

- Appropriate system responsive to the future traffic demand

- Transport system which is appropriate and suitable for Vientiane as the capital city.
- Transport system which can coexist and mutually complement with the present para-transit system.
- Transport system which encourages motorcycle and private car users to convert their usage to public transport.

Strategy 3: Improvement of Traffic Management

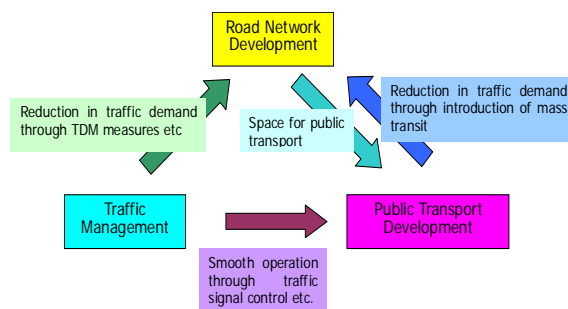
- Transport system which need not a large amount of investment and can flexibly respond to the future traffic demand increase.
- Reduction of traffic accidents.
- Preventing serious traffic congestion in near future.

Strategy 4: Development of Transport Network

- Improvement of pavement conditions of arterial and collector roads.
- Expansion of public transport which favorably affects the urban environment.
- Enhancement of non-motorized transit including provision of pedestrian zones.
- Introduction of eco-friendly buses.

Relation between the Components of Urban Transport Master Plan

The urban transport master plan consists of three major components; road network development, public transport development and traffic management. These three components are complementary, as well as in alternative relation, with each other.



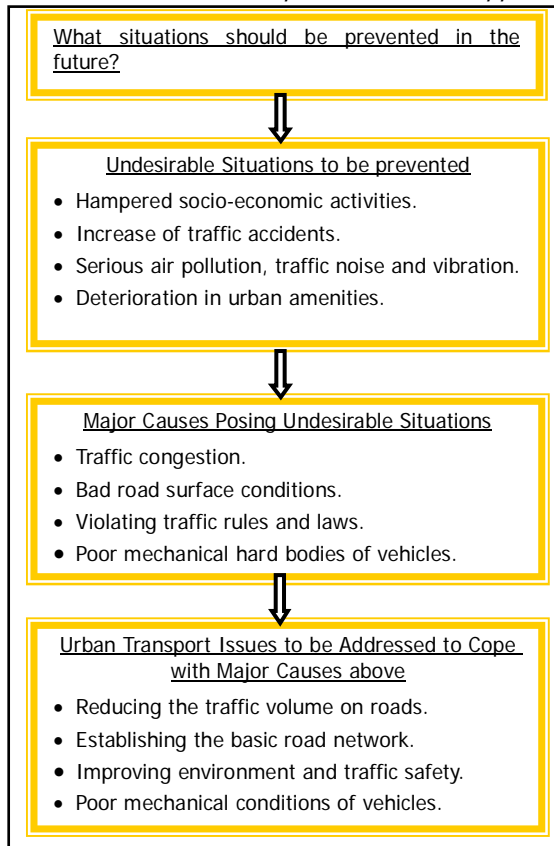
- Road network development is considered as a 'supply-side' measure since it is intended to increase supply capacity (traffic capacity).
- Traffic management and strengthening public transport is considered as 'demand-side' measures because they are intended to reduce traffic demand.
- Some of the traffic management measures, such as strengthening parking regulation, are considered to be a 'supply-side' measure since it regulates the illegal parking and recovers capacity of roads.

Part 2: Transport Master Plan

Preventive Approach for Future Urban Transport Problems

Since the problems of urban transport in Vientiane are not very severe at present, the measures to be proposed are to prevent the future problems, and thus, are based on 'Preventive Approach'.

Concept of Preventive Approach



Strategy to Encourage Shift from Private Vehicles to Public Transport

The one of the focal points of development of public transport is how to encourage shift from private vehicles to public transport. There are approaches from two sides:

Market-Based Approach (Voluntary Market Forces)

Market-based measures assign monetary value to different types of travel behavior and then rely on travelers to choose among them. Factors for deciding their choices include those listed below:

- Convenient and punctual public transport services with reasonable fares with diverse service routes provided.
- Providing monetary benefits to commuters including both workers and students.
 - Employers pay each worker travel allowance but charge parking fee for providing their parking spaces.
 - Employers give each worker a commuter pass in cooperation with public transport companies but

charge parking fee for providing their parking spaces to private vehicle users.

- Public transport companies provide special discounted commuter pass to students in order not only to encourage to shift motorcycle usage to public transport usage
- All the public parking spaces shall be charged.
- Such other measures as introduction of road pricing for private vehicle users.

Regulatory Approach (Compulsory Administrative Regulation)

Regulation mandates certain behaviors or prohibits others. It does not attach varying prices to different behaviors, nor does it leave the choice up to individual travelers. Instead it prohibits or limits by government fiat the behaviors it wants to discourage and permits or requires those it wants encourage.

- Prohibiting students' commuting by private vehicles mainly including motorcycles.
 - Providing such compensating measures as school bus and convenient and safe bus service for commuting is necessary.
- Introduction of color-coding system
 - Prohibiting automobiles with license plates ending in a particular digit number from driving on specific days, and those ending in other digits from driving on other specific days.
- Introduction of high-occupancy-vehicle (HOV) regulation
 - Cars loaded with less than three persons or so, including the driver, are not allowed to enter the city center.

7. TRANSPORT MASTER PLAN ALTERNATIVES

Components of Transport Master Plan

- The transport master plan consists of three major components; road network development plan, public transport development plan and traffic management plan.
- Since traffic management measures are more effective where measures of other two components (road improvement and public transport development) cannot be adopted and also since this is the master plan study to propose long-term and fundamental measures, they are given less weight than those of other components.
- Therefore, alternatives of transport master plan are discussed focusing on road network development plan and public transport development plan.

Scenarios of Road Network Plan

- Basic direction of road network development plan is to complete a functionally balance road network.
- The following three scenarios are discussed:

Scenario 1: Urgent Improvement Scenario

This scenario assumes that only urgent road improvement projects are implemented:

- Extension of the Inner Ring Road up to the north-eastern side of the airport,
- Widening of the existing sections of the Inner Ring Road into opposed 4 lanes, and
- Widening of the road connecting Dongdok – Saynamngeum – Chommani – Honseng into 4-lane road.

Scenario 2: Missing Link Construction Scenario

In addition to the Urgent Improvement Scenario, the following projects are implemented to complete the basic road network:

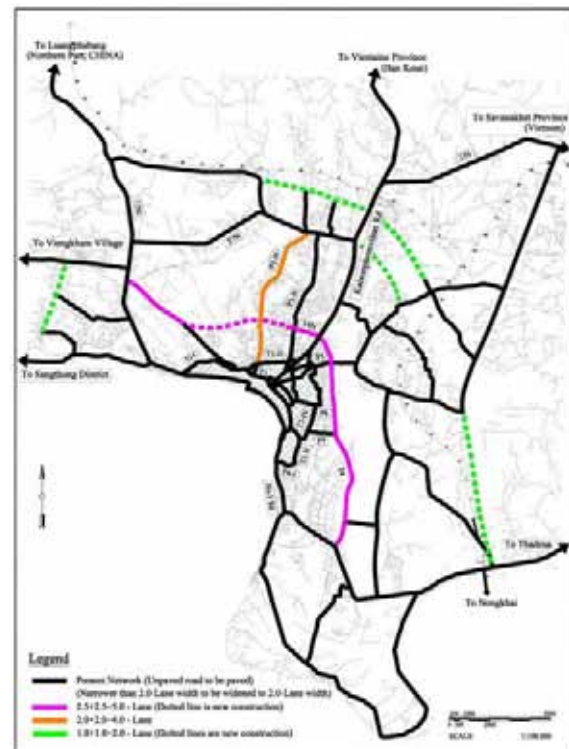
- Missing links are constructed as 2-lane roads.
- Unpaved existing roads with 2-lane width are paved.
- Road sections less than 2-lane width are widened into 2-lane width.

Scenario 3: Completion of Road Network Scenario

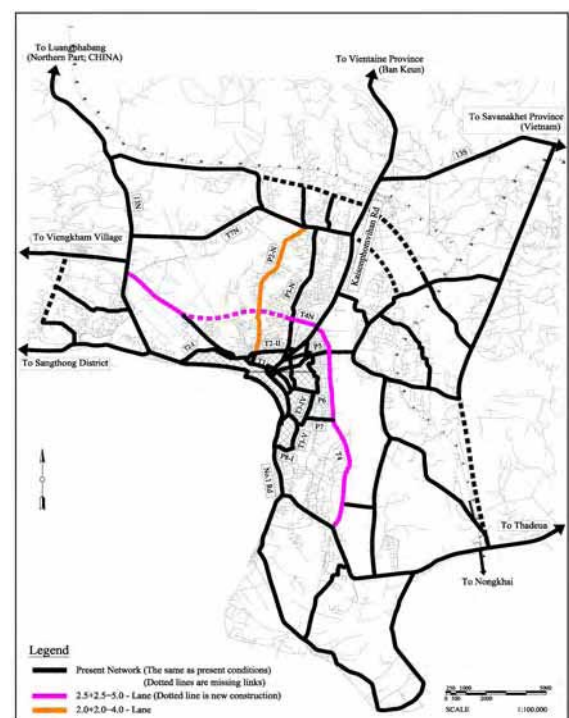
This scenario assumes that functional road network is provided so as to accommodate the traffic demand in the target year of 2025.

- The width of each road section is selected to be sufficient to accommodate the traffic volume of each section forecasted in 2025.
- Specifically, the cross-sections are selected as described in Chapter 17.

Scenario 1: Urgent Improvement

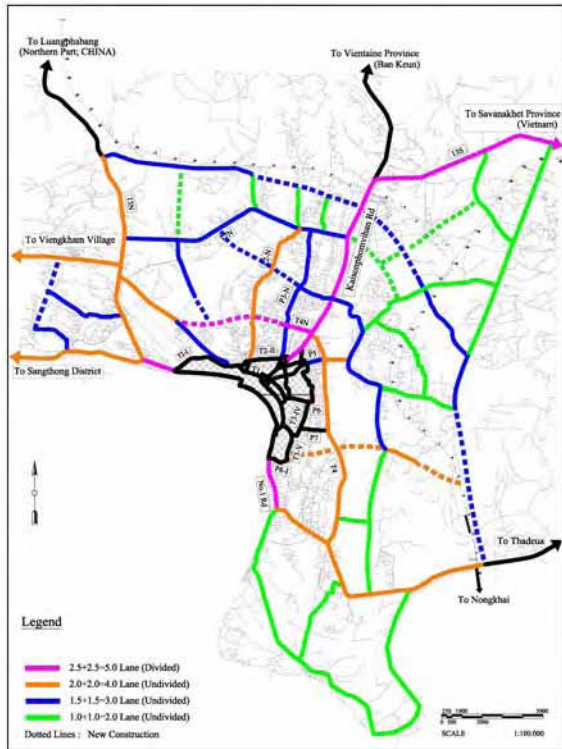


Scenario 2: Missing Link Construction



Part 2: Transport Master Plan

Scenario 3: Completion of Road Network



Comparative Evaluation of Scenarios

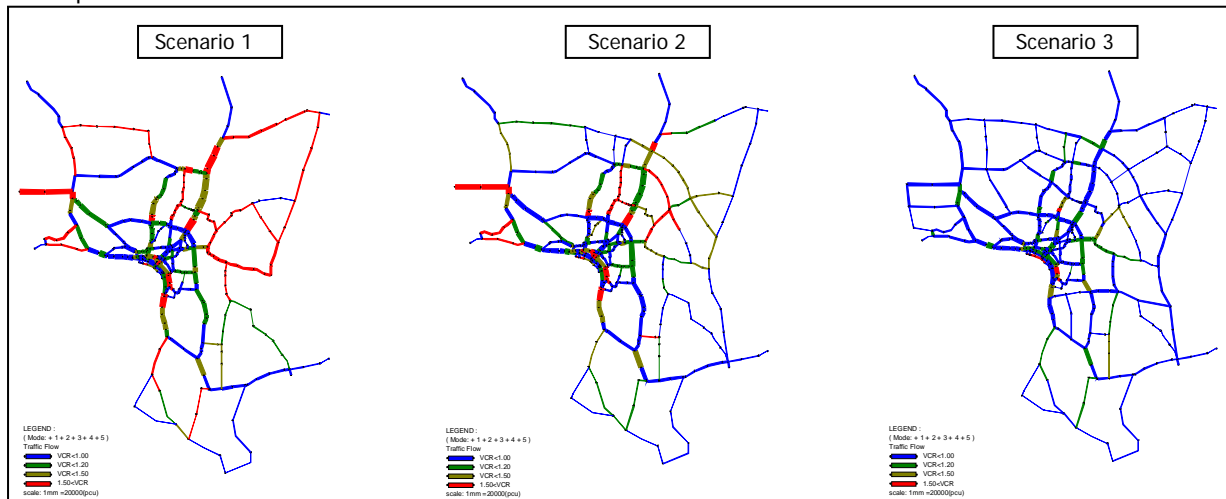
Traffic Condition

Total pcu-hours, V/C ratio and other parameters of traffic condition for each Scenario are compared in the table below:

Comparison of Traffic Parameters

Case	Total PCU-Hrs	Total PCU-km	Ave. Travel Speed (km/hr)	Ave. V/C Ratio
Do-Nothing	364,006	7,467,732	20.5	1.38
Scenario 1	320,844	7,324,524	22.8	1.15
Scenario 2	235,057	7,199,951	30.6	1.02
Scenario 3	173,273	7,128,592	41.1	0.71

- Traffic condition for each Scenario is shown at the bottom of the page. Traffic condition in Scenario 3 is acceptable while those in Scenarios 1 and 2 are not acceptable.



Environmental Evaluation

- Total vehicle emissions for various kinds of pollutants decrease as the total vehicle-km is decreased in each Scenario.
- Amounts of total emission for the Scenarios are calculated as shown in the table below:

Comparison of Vehicle Emission

	HC		CO		NOx	
	Weight (ton/yr)	Reduction	Weight (ton/yr)	Reduction	Weight (ton/yr)	Reduction
Do-Nothing	10,684	-	27,278	-	1,892	-
Scenario 1	10,448	236 (2.2%)	26,672	606 (2.2%)	1,860	32 (1.7%)
Scenario 2	10,281	403 (3.8%)	26,256	1,022 (3.7%)	1,809	83 (4.4%)
Scenario 3	10,277	407 (3.8%)	26,242	1,036 (3.8%)	1,790	102 (5.4%)

Economic Evaluation

- Economic benefits of road network improvement consist of saving in vehicle operating cost (VOC) accruing from reduction in the total vehicle-km and saving in travel time cost (TTC) accruing from reduction in the total vehicle-Hrs.
- Based on the value of benefit for each scenario, economic parameters for each scenario are calculated as below:

Economic Parameter

	Travel Cost (US\$1,000)	EIRR (%)	B/C	NPV (US\$1,000)
Do-Nothing	516,172	-	-	-
Scenario 1	490,877	13.5	1.11	8,429
Scenario 2	447,068	17.9	1.57	64,631
Scenario 3	414,736	18.1	1.54	87,237

Proposed Network

- Considering the above, Scenario 3 is proposed as the road network adopted in the Master Plan.

Traffic Condition of Scenarios

Alternatives of Public Transport Plan

With Scenario 3 for road network development selected, four alternatives of Master Plan, consisting different scenarios of public transport are formulated and examined:

Alternative 1: Present Pattern (Continuation of present traffic pattern)

- This alternative assumes that neither specific measures nor regulations are taken, except for ordinary management measures.
- The modal share is to change corresponding the growth of income level.

Alternative 2: Para-Transit-Oriented Scenario

- This alternative assumes encouragement of para-transit services using such small-scale vehicles as songtheo and tuk-tuk, while the bus services maintain the present share.
- The service of songtheo is expanded into urbanized areas where it is prohibited at present.
- This alternative becomes effective if bus service cannot be improved/strengthened due to lack of fund or other reason.
- Advantage of this alternative is that small-scale enterprises or even individuals can participate in this business because large investment is not required.
- Largest drawback of this alternative is its low efficiency and little contribution in reducing traffic congestion

Alternative 3: Bus-Favored Scenario

- This alternative assumes that the existing bus services are expanded on the arterial roads or high demand routes.
- Songtheo, tuku-tuk and jumbo are allowed to operate mainly on collector roads and local streets, as the feeder transport modes.
- The problems of present bus services, such as long waiting time, unreliable travel time, uncomfortable ride and poor bus stop facilities, are removed or improved to encourage use of bus services.
- Traffic environment favorable for bus operation, such as bus-priority lane, exclusive bus lane and signal control system adjusted for bus operation, is introduced.

Alternative 4: Bus-Plus-LRT Favored Scenario

- In this alternative, introduction of light rail transit (LRT) along major corridor is considered.
- Hence, this is more comprehensive public transport plan.
- Introduction of LRT becomes necessary if the number of passengers using public transport exceeds the

capacity of bus transport.

- Introduction of LRT is limited to the major corridors, due to constraint of demand density, and buses are to operate along many other routes where LRT is not operated.

Summary Table

The above alternatives are summarized in the table below:

Alternatives and Transport Modes

Alternative	Road Network		Public Transport			
	Exist-ing	Propo-sed	Car + M/C	Para-Transt.	Bus	LRT
Do-Nothing	○		⊙	○	○	
Alternative 1		○	⊙	○	○	
Alternative 2		○		⊙	○	
Alternative 3		○		○	⊙	
Alternative 4		○		○	⊙	○

Target Share of Public Transport

- Target share of public transport needs to be set for both preparing public transport plan and evaluation of master plan alternatives.
- Considering that the share of bus transport in other capital cities of Asia, including Jakarta, Bangkok and Kuala Lumpur, is 35 to 40 %, the target share of public transport in Vientiane is set at 40 %.

Share of Bus Transport in Asian Countries



After the target share of public transport is selected, the target share of each transport mode is set as shown in the table below.

Share of Each transport Mode

		Private Veh.		Public Transport			Walk & Bicycle
		Car	M/C	Para-Transit	Bus	LRT	
Year 2007		11.1	59.8	2.0	1.9	0	25.2
Year 2025	Alt. 1	22.2	57.7	0.1	1.9	0	18.1
	Alt. 2	17.9	24.0	30.0	10.0	0	18.1
	Alt. 3	17.9	24.0	10.0	30.0	0	18.1
	Alt. 4	17.9	24.0	10.0	25.0	5.0	18.1

Part 2: Transport Master Plan

Comparative Evaluation of Master Plan Alternatives

Traffic Condition

- The indicators of traffic condition for the alternatives are compared in the table below:

Comparison of Traffic Parameters

Alternatives	Traffic Parameter			
	PCU-km	PCU-Hr	Ave. Speed (km/hr)	Ave. V/C
Do-Nothing	7,467,732	364,006	20.5	1.38
Alt. 1	7,128,592	173,273	41.1	0.71
Alt. 2	5,113,107	107,486	47.6	0.51
Alt. 3	4,752,757	97,717	48.6	0.47
Alt. 4	4,708,633	96,531	48.8	0.47

- In all alternatives other than Alternative 1, traffic condition is forecasted to be greatly improved.

Economic Evaluation

- EIRR and other economic parameters are compared in the table below:

Comparison of Economic Parameters

	Travel Cost (US\$1,000)	EIRR (%)	B/C	NPV (US\$1,000)
Do-Nothing	516,172	-	-	-
Alt. 1	414,736	18.1	1.54	87,237
Alt. 2	293,565	34.5	3.24	398,309
Alt. 3	269,815	39.6	4.17	551,257
Alt. 4	256,605	40.9	4.05	565,138

- For Alternatives 2 to 4, large economic return is expected to be obtained due to large reduction in saving in travel cost accruing from reduction in traffic congestion.

Environmental Evaluation

In view of EST Strategy, reduction in vehicle emission is an important issue.

Total emission of various pollutants were calculated using the discharge rates listed in the table below:

Discharge Rate by Vehicle Type

	M/C	Pass. Car	Sonteo	Bus	Truck
HC	0.50	0.64	0.12	0.17	0.87
CO	2.00	0.64	0.63	2.22	2.22
NOx	0.15	0.72	0.49	2.00	3.38
CO2	80.0	230	340	600	700

Reductions in emission for the Alternatives are compared in the tables and figure below:

Reduction in Emission (1)

Alternatives	HC		CO	
	Weight	Reduction	Weight	Reduction
Do-Nothing	2,562	-	7,784	-
Alt. 1	2,456	312 (4.0%)	7,472	312 (4.0%)
Alt. 2	1,365	1,197 (47%)	3,664	4,120 (53%)
Alt. 3	1,338	1,224 (48%)	3,583	4,201 (54%)
Alt. 4	1,331	1,231 (48%)	3,517	4,267 (55%)

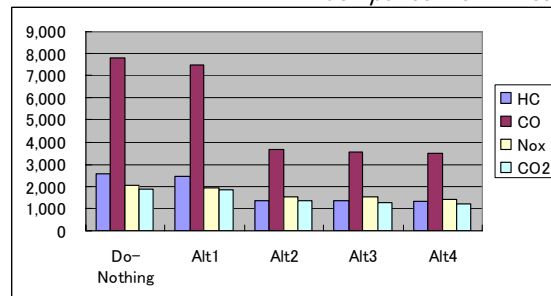
(Unit: kg/yr)

Reduction in Emission (2)

Alternatives	NOx		CO2	
	Weight	Reduction	Weight	Reduction
Do-Nothing	2,054	-	1,909	-
Alt. 1	1,946	108 (5%)	1,818	91 (5%)
Alt. 2	1,536	518 (25%)	1,379	439 (23%)
Alt. 3	1,495	560 (27%)	1,266	643 (34%)
Alt. 4	1,438	616 (30%)	1,214	694 (36%)

(Unit: Nox = kg/yr, CO2 = ton/yr)

Comparison of Emission



- As can be seen in the above, vehicle emission is greatly reduced in Alternatives 2 to 4.

Overall Narrative Evaluation

Overall narrative evaluation of the alternatives is shown in the table below:

Alternative 3 is selected as the most suitable scenario.

Overall Narrative Evaluation

Items	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Description	• No special measures against future traffic demand are taken except for road development.	• Paratransit vehicles are encouraged to increase and allowed to operate in the urbanized area.	• Bus services are improved/strengthened to attract more passengers and encourage shift from private vehicles to buses.	• LRT is introduced along major transport corridors where number of passengers exceeds the capacity of bus transport. • Bus services are provided together with LRT.
Advantages	• Only concentrating on road development is needed.	• Small-scale enterprises or individuals can participate.	• VBSC and other entities have sufficient experience of bus operation. Thus, it can be easily implemented if proper plan and preparation are made. • Socially acceptable.	• Large transport capacity can be provided. • Effective to reduce air pollution. • Suitable for modern city.
Disadvantages	• Urban amenities will be deteriorated due to heavily crowded traffic, air pollution and traffic noise. • Future traffic situations are not fit for the objectives and policy on the National Strategy and Action plan on EST.	• Less efficient in transport capacity and less effective in reducing traffic volume. • Large effort needed to control large number of paratransit vehicles.	• There is possibility that bus services are not financially viable. • Needs improvement of roads for bus routes. • Establishment of "exclusive bus lane" may be needed.	• Large amount of initial investment is needed. • High demand is needed to be financially viable.
Difficulty for Implementation	• Easy.	• Relatively easy.	• Easy if properly prepared (with necessary improvement of road network).	• Possible where sufficient road width is secured.
Evaluation	• Not recommended in terms of running counter to EST policy of the Government of LAO PDR.	• Not recommended in view of low efficiency, little contribution to improvement of air pollution.	• Most realistic scenario in that bus services exist.	• Needs further study depending on the demand for public transport.

8. SECTOR PLANS

8.1 ROAD NETWORK DEVELOPMENT PLAN

Problems of Present Road Network

- Ambiguity in functional hierarchy
- Incomplete circular road system
- Lack of some road links needed to support future urban development as proposed in Chapter 13 of the Main Text.
- Insufficient road width and poor surface condition on some road links to support smooth operation of the public transport

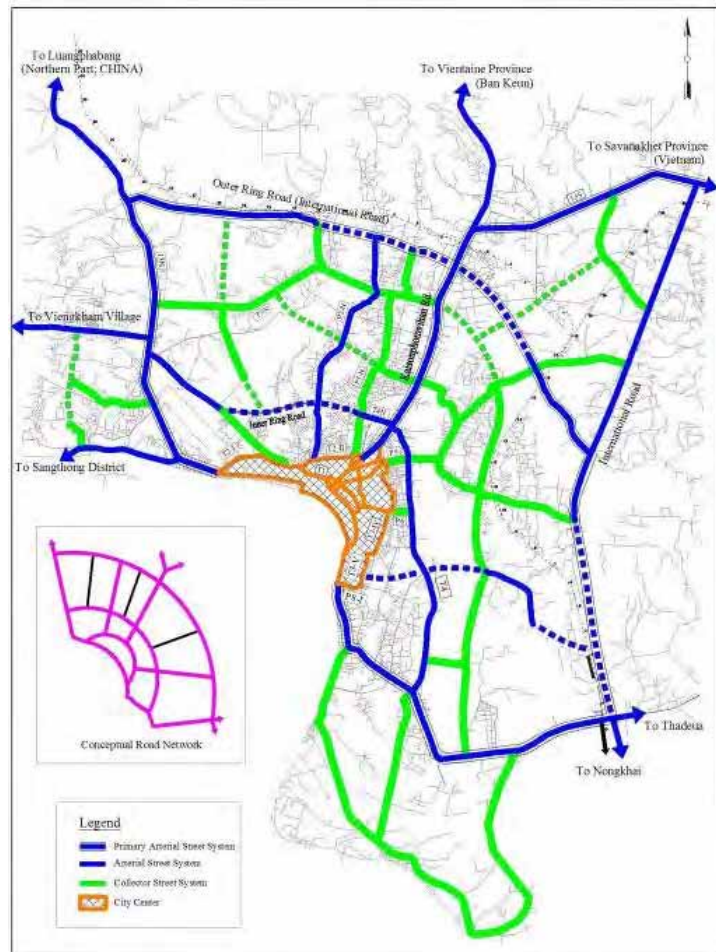
Concept of Proposed Road Network

- Introduction of functional road hierarchy consisting of primary arterial, arterial, collector and local streets,
- Establishment of arterial street system integrated with the proposed Corridor Network Development,
- Construction of missing links to complete the network; in particular, the proposed Inner Ring Road and Outer Ring Road,
- Full utilization of existing streets/roads to develop collector street system,
- Adoption of stage construction considering growth of traffic volume and difficulty/ easiness of land acquisition,
- Securing the right-of-way (ROW) for future widening,
- Preservation of existing city center area to maintain the desirable urban landscape.

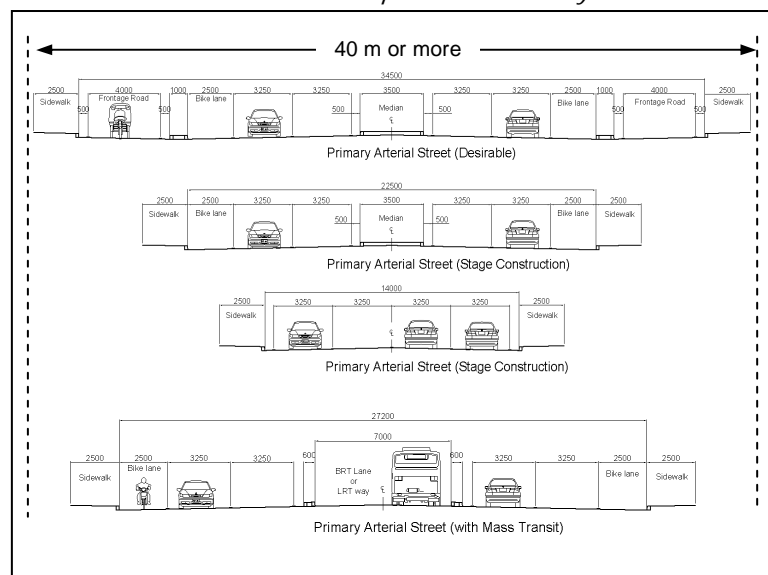
Cross-Sectional Composition

- Proposed cross-sectional compositions of Primary Arterial Street for the completed stage (desirable) and stage construction are as shown in the figure in the right.
- The width of ROW at the completed stage is 40 m or more.
- With this width of ROW, modern mass transit system, such as Bus Rapid Transit (BRT) can be accommodated.
- Proposed widths of ROW for Arterial Street and Collector Street are 30 m and 20 m, respectively.
- It is recommended that the widening be implemented in stages in accordance with the growth of the traffic volume.
- However, the Government should start actions for acquiring future ROW as soon as possible.

Proposed Road Network

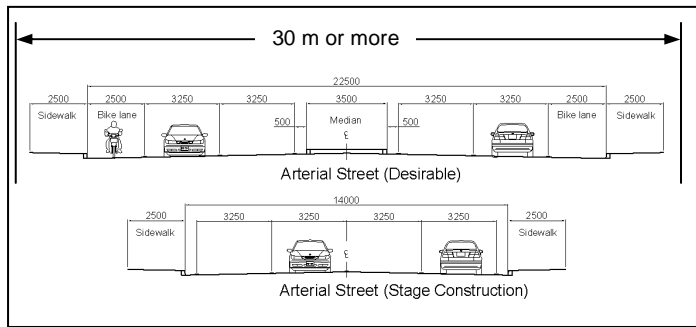


Cross-sectional Composition of Primary Arterial Street

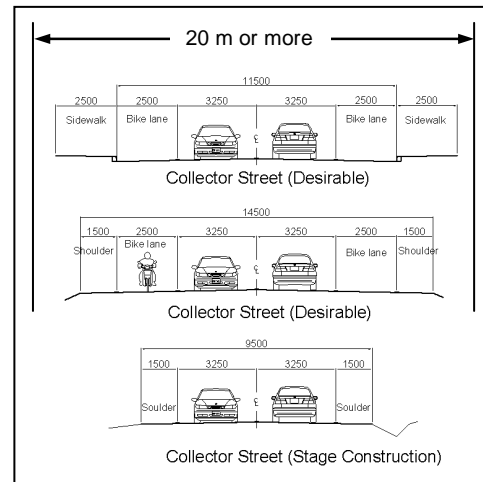


Part 2: Transport Master Plan

Cross-sectional Composition of Arterial Street



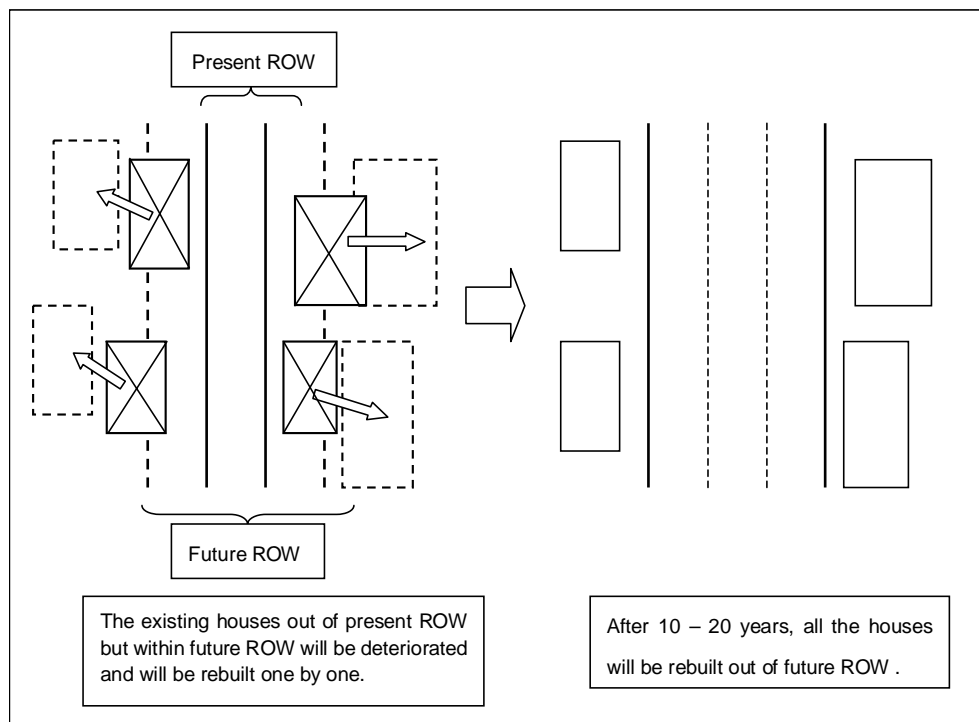
Cross-sectional Composition of Collector Streets



Securing Future ROW

- If the additional ROW needed for widening is to be acquired in a short period, it will cause harsh negative impact for those to be relocated.
- One of the practical methods for securing the future ROW with minimum negative social impact is to designate the future ROW and regulate the construction of new buildings within the designated ROW.
- In the process of socio-economic development, many houses and building become less useful and need to be rebuilt.
- Therefore, if this regulation is enforced, the number of houses to be relocated will be greatly reduced 10 – 15 years after promulgation of this regulation.

Concept of Securing Future ROW

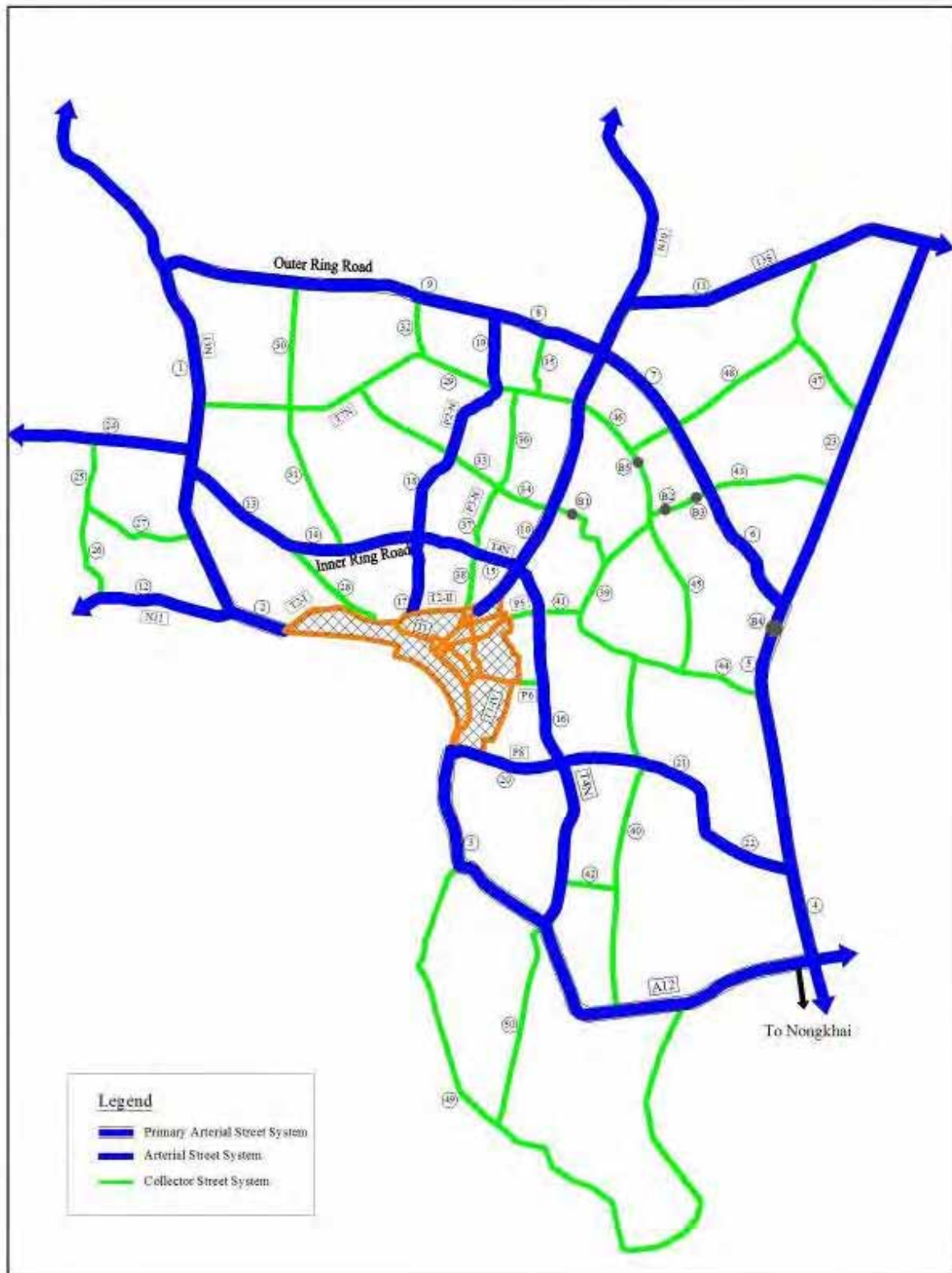


Road Projects

- To complete the proposed road network with road width to accommodate future traffic, road projects as listed below need to be implemented.
- Locations of these road projects are shown in the figure on in the next page.

List of Road Projects

No.	Road Section	Distance (km)	road width (m)	no. of lane (bike lane)	scope of work	Cost (million)
	Primary Arterial				sub total	\$71.46
1	Jct. Sikhay - 13N Km16	10.6	19.0	4+(0)	widening, overlay, sidewalk	\$11.92
2	Luang Phabang Rd.	1.6	27.5	4+(2)	overlay, land acquisition	\$1.02
3	Thadeua Rd.	3.5	27.5	4+(2)	widening, sidewalk	\$3.63
	Thadeua Rd.	12.9	19.0	4+(0)	overlay, land acquisition	\$5.92
4	Friendship Br. - B.Nakhouay	7.9	14.5	2+(2)	new construction	\$6.45
5	B.Nakhouay - B.Dong Kang	2.7	14.5	2+(2)	widening, pavement	\$3.31
6	B.Dong Kang - B.Xok Noy	4.1	14.5	2+(2)	widening, pavement	\$3.21
7	B.Xok Noy - 13S Km10	5.1	14.5	2+(2)	new construction	\$4.17
8	13S Km10 - B.Dongxiangdi	6.6	14.5	2+(2)	new construction	\$5.39
9	B.Dongxiangdi - 13N Km16	6.4	14.5	2+(2)	widening, pavement	\$5.00
10	Kaysonephomvihane Rd.	10.0	27.5	4+(2)	overlay, land acquisition	\$6.03
11	Jct. Don Noun - 13S Km21	9.0	27.5	4+(2)	widening, overlay, sidewalk	\$15.41
	Arterial				sub total	\$62.25
12	N11 Rd. (Jct. Sikhay - B.Nongda)	4.2	19.0	4+(0)	widening, overlay, sidewalk	\$5.10
	N11 Rd. (B.Nongda -)	0.8	19.0	4+(0)	widening, pavement, sidewalk	\$1.10
13	Nong Duag Rd. (13S - Inner ring)	3.8	19.0	4+(0)	widening, overlay, sidewalk	\$4.37
14	B.Pakthang - B.Phontong	4.2	27.5	4+(2)	new construction, sidewalk	\$7.95
15	Phonphanou Rd.	1.8	27.5	4+(2)	widening, overlay, sidewalk	\$3.10
16	Bldv. Kamphengmeuang	4.9	19.0	4+(0)	widening, sidewalk	\$3.51
	Bldv. Kamphengmeuang	6.0	19.0	4+(0)	widening, sidewalk	\$3.95
17	Savang Rd.	0.5	19.0	4+(0)	overlay, land acquisition	\$0.23
18	Dong Palep Rd.	2.3	19.0	4+(0)	widening, overlay, sidewalk	\$2.65
	Dong Palep Rd.	4.7	19.0	4+(0)	widening, overlay, sidewalk	\$5.80
19	Dong Palep Rd. - outer ring Rd.	2.1	9.5	2+(0)	widening, overlay	\$0.84
20	B.Sokpaluang - B.Xiangda	4.7	19.0	4+(0)	new construction, sidewalk	\$6.61
21	B.Xiangda - B.Khoumhin	1.8	19.0	4+(0)	widening, pavement, sidewalk	\$2.46
22	B.Khoumhin - outer ring Rd.	2.0	19.0	4+(0)	new construction, sidewalk	\$2.81
23	B.Dong Kand - 13S Km21	11.2	9.5	2+(0)	widening, pavement	\$5.52
24	13N Km11 - B.Viangkham	5.0	19.0	4+(0)	widening, overlay, sidewalk	\$6.25
	Collector				sub total	\$76.54
25	B.Nonkhilek - Provincial Rd. 106	3.6	14.5	2+(2)	new construction	\$2.94
26	B.Nonkhilek - N11 Rd.	2.0	14.5	2+(2)	widening, overlay	\$1.33
27	13N Km8 - B.Phosomboun	1.8	14.5	2+(2)	widening, overlay	\$1.19
	13N Km8 - B.Phosomboun	2.4	14.5	2+(2)	widening, pavement	\$1.88
28	Nong Duag Rd. (Inner ring - T2)	3.2	16.5	2+(2)	overlay, land acquisition	\$1.19
29	Dongdok Rd.(T7N)	11.7	16.5	2+(2)	overlay, sidewalk	\$11.27
30	B.Phonkeo - B.Dongkalao(T7N.)	3.6	9.5	2+(0)	new construction	\$1.90
31	B.Dongkalao(T7N) - Inner ring Rd.	4.6	14.5	2+(2)	new construction	\$3.76
32	B.Dongxiangdi - B.Nongphagna	1.6	9.5	2+(0)	widening, pavement	\$0.79
33	B.Nongphagna - B.Phonsavang	5.1	14.5	2+(2)	new construction	\$4.17
34	Sivilai Rd. (P3N - N13S)	1.5	16.5	2+(2)	widening, overlay, sidewalk	\$1.62
35	B.Dongdok - new outer ring Rd.	1.9	9.5	2+(0)	widening, pavement	\$0.94
36	Sivilai Rd. (B.Phonsavang - T4N)	3.0	16.5	2+(2)	widening, overlay, sidewalk	\$3.23
37	Pul Thong Rd.	2.2	16.5	2+(2)	widening, overlay, sidewalk	\$2.37
38	New Hong Kai Keo Rd.	1.7	16.5	2+(2)	overlay, land acquisition	\$0.63
39	13S Km6 - B.Xiangda	10.0	14.5	2+(2)	widening, overlay	\$6.63
40	B.Singda - Thadeua Rd.	3.6	9.5	2+(0)	widening, overlay	\$1.35
	B.Singda - Thadeua Rd.	3.4	9.5	2+(0)	pavement	\$1.67
41	That Luang Rd.	0.9	19.0	4+(0)	overlay, sidewalk	\$0.93
42	B.Dongkhamxang - Inner ring Rd.	1.5	9.5	2+(0)	widening, overlay	\$0.58
43	Jct.SaNamMar(cd109) - Jct.B.Mai	2.2	9.5	2+(0)	widening, overlay	\$0.82
	Jct.SaNamMar(cd109) - Jct.B.Mai	6.2	9.5	2+(0)	pavement	\$3.04
44	B.Nonkho(cd109) - B.Nakhouay	3.2	9.5	2+(0)	overlay	\$1.16
45	B.Vangxay(cd109) - B.Khamngoy	3.4	9.5	2+(0)	new construction	\$1.79
46	B.Khamngoy - 13S Km9	6.0	9.5	2+(0)	new construction	\$3.16
47	13S Km18 - B.Konk Gnai	5.2	9.5	2+(0)	widening, pavement	\$2.40
48	B.Khok Noy - Hong Beng	5.4	9.5	2+(0)	new construction	\$2.85
49	Jct.Ji Nie Mo(A12) - B.Thakhek	22.5	9.5	2+(0)	widening, overlay	\$8.42
50	B.SaLaKham(A12) - B.SaVang	4.8	9.5	2+(0)	new construction	\$2.53



Bridge Projects

- There are 4 existing bridges crossing the Hong Beng Stream on the proposed road network.
- All of those bridges are structurally unstable and have insufficient load capacity.
- The bridge widths are only for one-lane even though they are located on two-lane road.
- Thus, the replacement of those 4 bridges is urgent issue to secure the stable road traffic.
- In the course of the development of the proposed road network, the new collector link between Ban Kamngoy and No.13 South Rd. Km 9 will be constructed.

- One new bridge will be required for crossing the Hong Beng stream.
- In addition, one old Bailey bridge is located on National Road No.11 at approximately 7 kilometer from Sikhay Intersection.
- The table below summarizes the present condition of these bridges and proposed bridge project to replace them.

List of Bridge Projects

No.	Road Section	Present Condition			Proposed Project				Road Code
		Bridge Type	length (m)	width (m)	Bridge Type	lane (bike)	length (m)	width (m)	
B1	13S Km6 - B.Xiangda	Bailey	30.3	4.0	PC I-girder	2+(2)	45.0	14.5	Provincial 109
B2	Jct.SaNamMar - Jct.B.Mai	Steel girder	22.0	2.9	PC I-girder	2+(0)	30.0	10.5	District 155
B3	Jct.SaNamMar - Jct.B.Mai	Bailey	18.3	4.0	PC I-girder	2+(0)	20.0	10.5	District 155
B4	B.Nakhouay - B.Dong Kang	Bailey	24.3	4.0	PC I-girder	2+(2)	50.0	17.0	District 108
B5	B.Khamngoy - 13S Km9	N/A	N/A	N/A	PC I-girder	2+(0)	45.0	10.5	
	N11 Rd.	Bailey	30.3	4.0	-	-	-	-	National 11

Intersection Projects

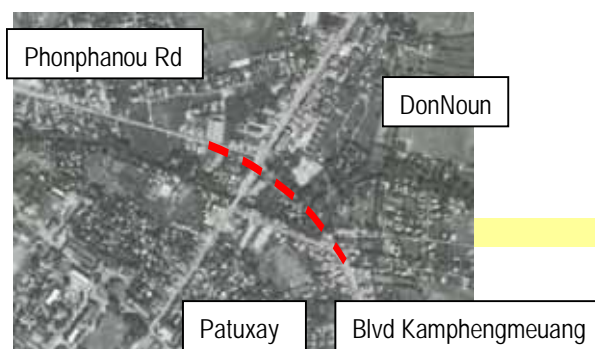
- Grade-separated intersections are often proposed in road network plan.
- However, the drawback of a fly-over is a negative impact to the urban view.
- All the intersections in the Study Area can cater for the forecasted traffic volume in year 2025 if left-/right-turning lanes are properly provided.

- Thus, at-grade intersections are recommended in this Study.
- The table below lists the proposed intersection projects.
- These intersection projects, except X5 Project, are described in 8.3 Traffic Management Plan.

No.	Intersection	Present Condition			Proposed Project	related road
		type	mark	leg	improvement	
X1	Odeon Intersection	signal	ex	5	median & access limt.	T2 & local
X2	Circus Intersection	median	ex	4	marking & signal	Dong Palep & Savang
X5	Phonphanao Intersection	uncontrol	none	4	relocation & signal	13S & T4
X6	That Luang Neua Intersection	uncontrol	none	4	marking & rumble strip	That Luag & local
X7	Phonetong Intersection	uncontrol	none	3	guiding & rumble strip	Phonphanou & Savang
X13	Thongkhankham Intersection	signal	ex	4	marking	17 & T2
X15	That Luang roundabout	roundabout	ex	4	realign & marking	That Luag & local

X5 Intersection Project

- This intersection is the crossing point of a primary arterial (No.13 South Rd.) and an arterial streets (Inner Ring Road).
- Currently, configuration of this intersection is staggered.
- This intersection needs to be improved to achieve smooth traffic flow.



Part 2: Transport Master Plan

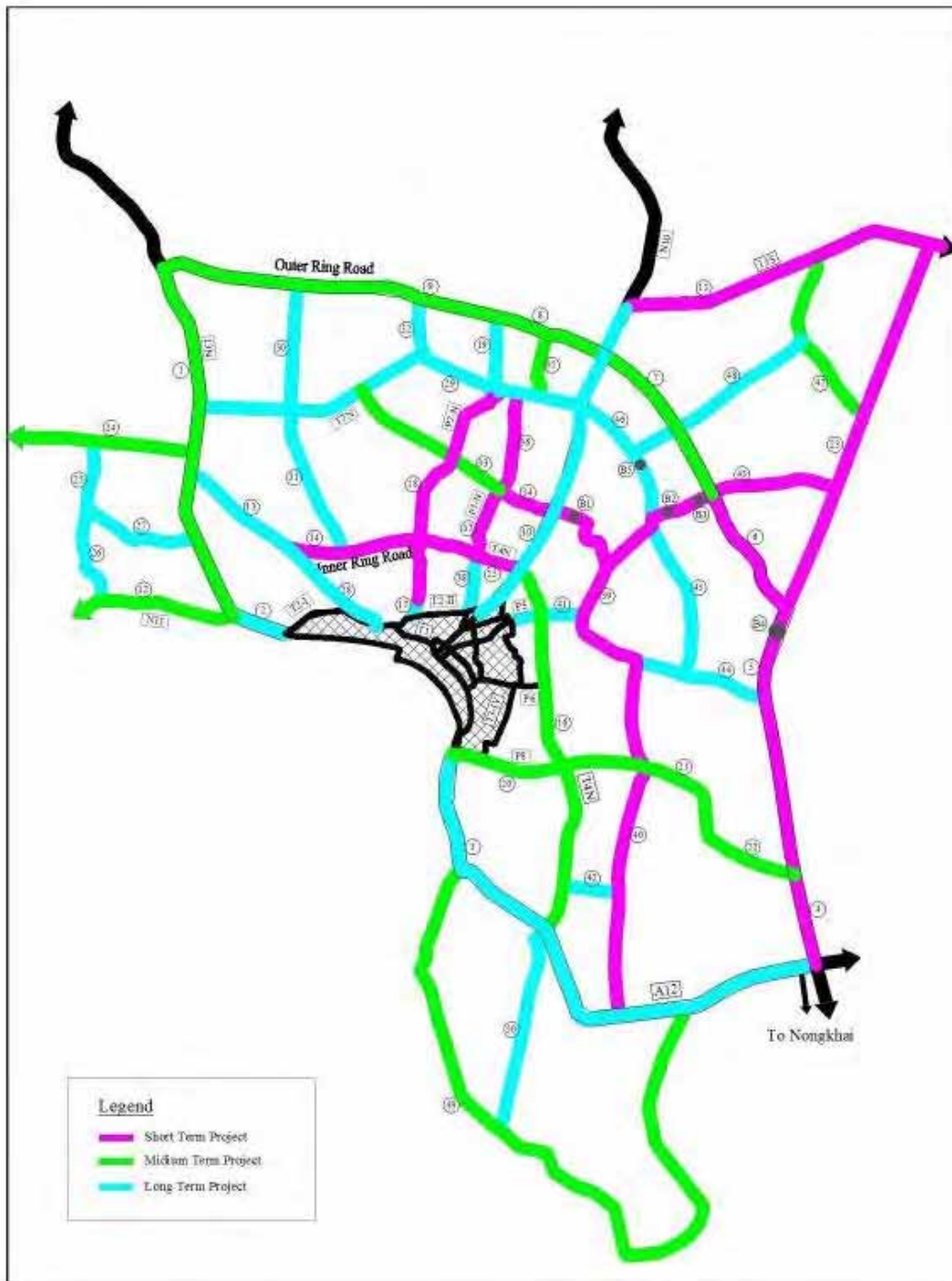
Staging Plan

- Fifty (50) proposed road projects are evaluated and prioritized based on the following criteria:
 - Planning Aspect: Compatibility with development plans, impact on socio-economic activity and/or basic human needs
 - Technical Aspects: Urgency, role in road network, technical difficulty

- Environmental Aspect: Social impact, natural impact, social acceptance
- Benefit Aspect: Traffic demand, project cost, benefit scale

The road projects are categorized into Short-, Medium- and Long-Term Projects as shown in the figure below.

Short-, Medium-, and Long-Term Projects



Case Study of Construction of Missing Link

Background

- The Master Plan does not show the detailed plan for the individual projects.
- A case study may be useful to illustrate the process of planning process of individual projects.
- The Inner Ring Road (IRR) is to be the main route for the traffic in circular direction in the urbanized area of Vientiane.
- The IRR is not complete as the western end of IRR, between Don Palep Rd. and Nong Douag Rd has not been constructed.
- The lack of the west-end section results in concentration of the traffic from the area in the west of the airport to the city center and increase of the congestion there.

- Thus construction of this section is urgent and expected to greatly contribute to improvement of traffic condition in the city center as well as western periphery of the city.
- For this urgency, construction of this missing link of IRR is selected as an example of road projects and case study is conducted.

Beginning Point, End Point and Section Length

- Beginning point is its intersection with Dong Palep Rd. and End Point is intersection with Nong Douag Rd.
- Section length of the section is 4.7 km.

Location Map



Part 2: Transport Master Plan

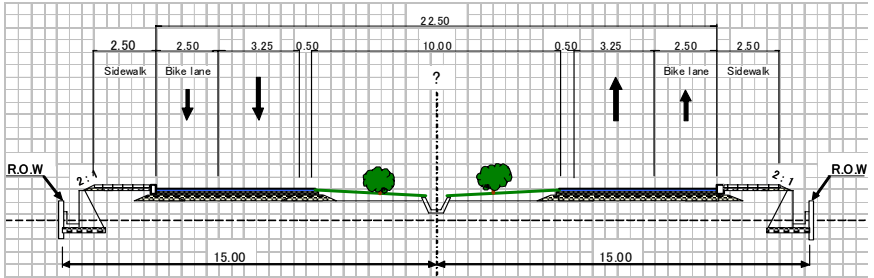
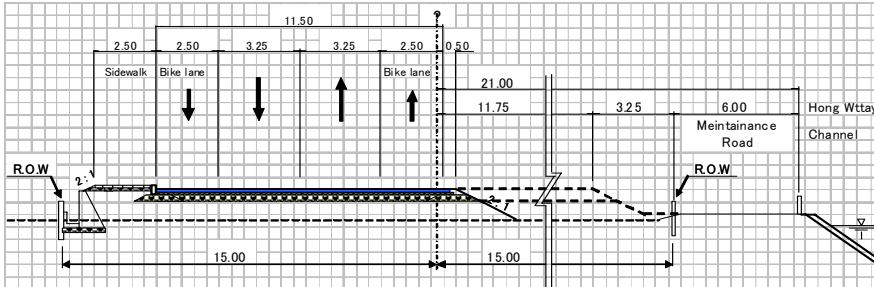
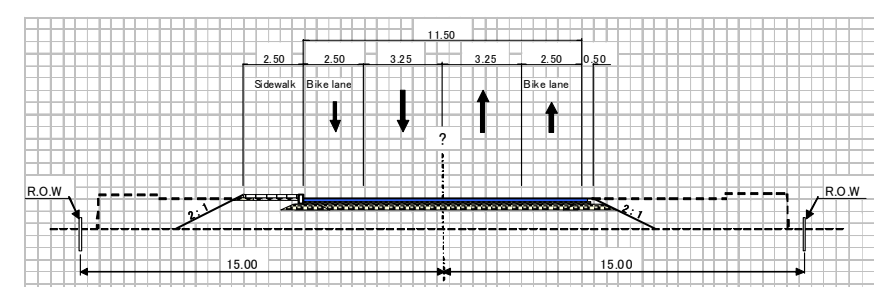
Alternative Routes

- From view point of connection to the west end of the existing section of IRR (Phonphanou Rd.), two alternative routes are possible, as shown in the location map.
- Considering the following aspects of each alternative route, the southern route (shown in red in the Location Map) is opted:
 - Desirableness of geometry
 - Required construction cost
 - Construction method involved

- Number of affected houses
- Easiness of acquisition of ROW

Cross-Sectional Composition

- The IRR is classified as an arterial street and the width of ROW at completed stage is to be 30 m.
- However, the cross section urgently needed is one full lane plus one bike lane for one direction.
- Three alternatives for cross section were examined.
- Considering the importance of minimizing the initial investment, Alternative-3 is adopted.

Cross Section	Features
<p style="text-align: center;">Alternative-1</p> 	<ul style="list-style-type: none"> • Suitable when the development quickly occurs along the road. • Easy construction and no re-construction work required. • Initial construction cost is the most expensive.
<p style="text-align: center;">Alternative-2</p> 	<ul style="list-style-type: none"> • Suitable when the development along the road occurs on one side only. • Construction of completed cross section is easier with less scrapping of constructed works. • Initial construction cost is less.
<p style="text-align: center;">Alternative-3</p> 	<ul style="list-style-type: none"> • Undesirable when the development along a road occurs quickly. • Construction of completed cross section is difficult involves many scrapping of constructed works and many re-construction works. • Initial construction cost is the lowest.

Bridge Design

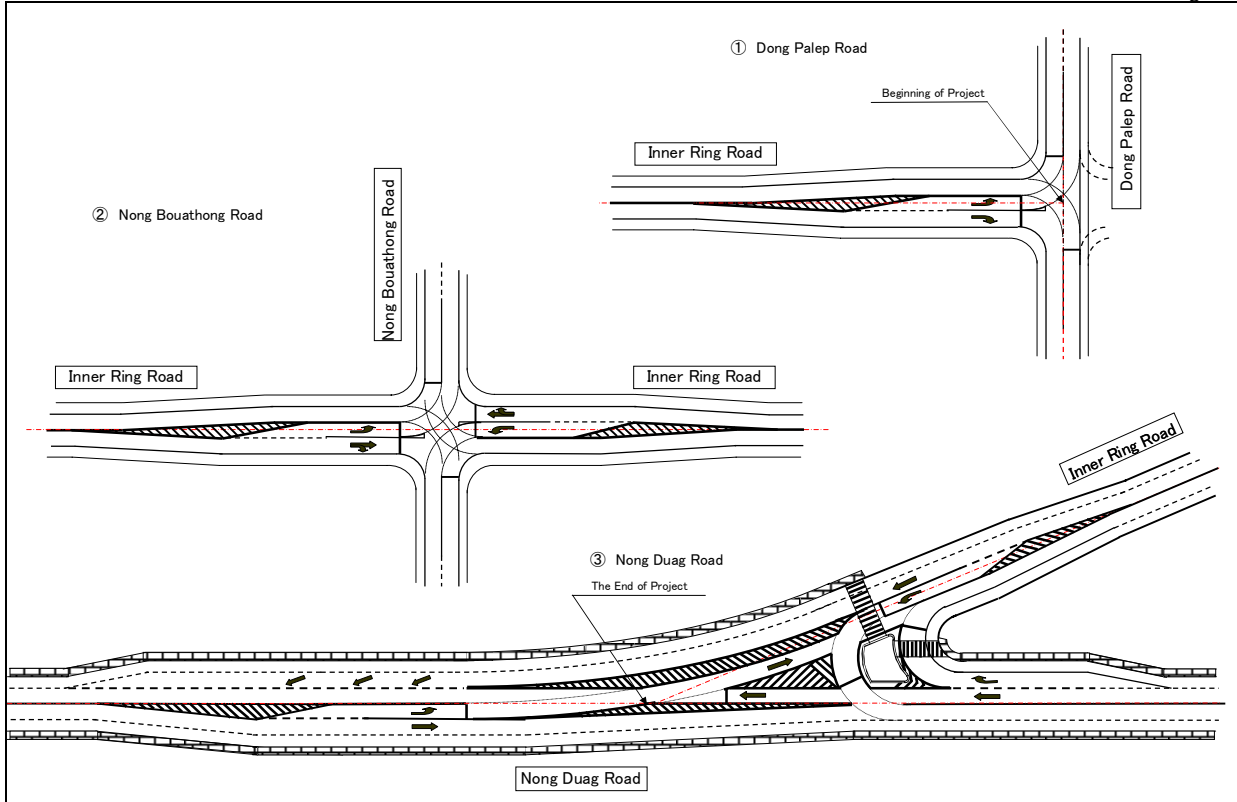
- One bridge needs to be constructed to cross Hong Wattay Channel.
- The outline of the bridge is as follows
 - Length: 16.0 m
 - Width: 14.0 m
 - Superstructure: RC – Multi Beam Type
 - Foundation Type: RC Pile

Pavement Structure

Pavement structure is as follows:
 Surface course: 5 cm
 Binder course: 5 cm
 Aggregate base course: 15 cm
 Granular subbase course: 20 cm

Intersection Design

Three intersection are to be constructed; at beginning point, end point and crossing point with Nong Bouathong Rd. Design of these intersections are shown in the next page.



Project Implementation Schedule

Major Work	Cost (M.US\$)	Year (Cal.)	2008	2009	2010	2011	2012	2013
Fund Preparation			██████████					
Consultant Selection					██████████			
Detailed Design					██████████			
Tendering						██████████		
Land Acquisition					██████████			
Construction						██████████		
Construction supervision						██████████		
Total								

Project Cost

The project cost is estimated at US\$ 12.962 million.

Item	Project Cost
1. Construction	4.627
2. Engineering & Management	0.463
3. Land Acquisition	6.694
4. Tax (10 % of Total of 1 – 3 Above)	1.178
5. Total	12.962

Part 2: Transport Master Plan

Economic Evaluation

- Economic evaluation shows that good economic return is obtained.

Economic Indicators

Index	Value
EIRR	18.5 %
B/C ratio	1.57
NPV (US\$ million)	6.8

- The sensitivity analysis indicates that even with 10 % higher cost and 10 % lower benefit, the project is economically viable.

Sensitivity Analysis

		Cost			
			-10%	0%	10%
Benefit	10%	EIRR	21.9%	20.1%	18.5%
		B/C	1.91	1.72	1.57
		NVP	9,902	8,698	7,494
	0%	EIRR	20.2%	18.5%	17.0%
		B/C	1.74	1.57	1.42
		NVP	8,017	6,813	5,609
	-10%	EIRR	18.5%	16.8%	15.4%
		B/C	1.57	1.41	1.28
		NVP	6,131	4,927	3,723

Environmental Evaluation

- Background concentration of pollutants and current noise level were surveyed three locations along the road (beginning point, end point and the middle point).

- Concentration of pollutants and noise level after opening of the Project Road to traffic is estimated to be well below allowable limits prescribed in Japanese and international standards.

Concentration of NOx (Unit: mg/m3)

Year	Background	Contribution	Annual Average	WHO Guideline	World Bank	Daily average	World Bank	Japanese standard
2013	0.015	0.004	0.019	0.04-0.05	0.1	0.019	0.5	0.11
2018	0.015	0.007	0.022			0.022		
2025	0.015	0.012	0.027			0.027		

Concentration of Particular Material (PM10) (Unit: mg/m3)

Year	Background	Contribution	Annual average	World Bank	Daily average	Japanese standard
2013	0.068	0.0003	0.068	0.1	0.089	0.1
2018	0.068	0.0004	0.068		0.090	
2025	0.068	0.0007	0.069		0.090	

Concentration of CO (Unit: mg/m3)

Year	Background	Contribution	Annual average	Daily average	US-EPA Standard	Japanese standard
2013	0.671	0.0118	0.683	1.366	42	11.6
2018	0.671	0.0169	0.688	1.376		
2025	0.671	0.0260	0.697	1.394		

Scoping of the Environment and Social Considerations

CONSTRUCTION OF MISSING LINK OF INNER RING ROAD		Alternative-1 (South)		Alternative-2 (North)		Without Project	
Aspect of environment	Rating*	Explanation	Rating*	Explanation	Rating	Explanation	
Social environment	B	9 households are to be relocated. Paddy field is acquired.	B	10 households are to be relocated. Paddy field is acquired.		No resettlement is involved.	
	+	Economic development will be induced along the new road.	+	Economic development will be induced along the new road.	B	Regional economy may suffer from congested roads in the surroundings.	
	B	Construction materials need to be acquired.	B	Construction materials need to be acquired.		Not applicable.	
	+	Accessibility to social infrastructure and local institute will be improved.	+	Accessibility to social infrastructure and local institute will be improved.	B	Traffic congestion should prevail in the surroundings.	
	++	New facilities will be generated along the road.	++	New facilities will be generated along the road.	B	Traffic congestion should prevail in the surroundings.	
	B	Construction of the road may affect the poor such as farmers who will lose their productive land to the project.	B	Construction of the road may affect the poor such as farmers who will lose their productive land to the project.		Not applicable.	
	C	The project may cause misdistribution of benefit and damage of farmers and the local residents. There are no cultural properties such as old temple and stupas along the proposed road.	C	The project may cause misdistribution of benefit and damage of farmers and the local residents. There are no cultural properties such as old temple and stupas along the proposed road.		Not applicable.	
	C	Conflict among the local people on future land use may occur.	C	Conflict among the local people on future land use may occur.		Not applicable.	
		The watercourse of existing channels is not changed.		The watercourse of existing channels is not changed.		Not applicable.	
		The new road facilitated with drainage system will improve health and sanitation conditions of local people.	+	The new road facilitated with drainage system will improve health and sanitation conditions of local people.		Not applicable.	
Natural environment	C	Infectious diseases such as HIV/AIDS due to inflow of construction workers.	C	Infectious diseases such as HIV/AIDS due to inflow of construction workers.		Not applicable.	
	B	Topography is not changed in any sections of the new road. No important geographical features are in the area.	B	Topography is not changed in any sections of the new road. No important geographical features are in the area.		Not applicable.	
	B	Soil erosion may occur due to construction methods.	B	Soil erosion may occur due to construction methods.		Not applicable.	
		No effect is foreseen.		No effect is foreseen.		Not applicable.	
	C	Some possible impacts on surface water may occur.	C	Some possible impacts on surface water may occur.		Not applicable.	
		No such areas are involved.		No such areas are involved.		Not applicable.	
		No important fauna & flora inhabit the paddy field and residential area through which the road passes.		No important fauna & flora inhabit the paddy field and residential area through which the road passes.		Not applicable.	
		No effect is expected		No effect is expected		Not applicable.	
	+	Paved lanes will improve the visual appearances of roads.	+	Paved lanes will improve the visual appearances of roads.		Not applicable.	
	+	CO2 emission is reduced by improvement of accessibility to a destination.	+	CO2 emission is reduced by improvement of accessibility to a destination.		Not applicable.	
Pollution	B	Air pollutants emitted from construction machines and vehicular traffic will affect ambient air quality.	B	Air pollutants emitted from construction machines and vehicular traffic will affect ambient air quality.		Not applicable.	
	B	River water may be contaminated by construction activities.	B	River water may be contaminated by construction activities.		Not applicable.	
	B	Spillage of lubricants or any petroleum products used for construction will cause soil contamination.	B	Spillage of lubricants or any petroleum products used for construction will cause soil contamination.		Not applicable.	
	B	Construction debris need to be properly disposed.	B	Construction debris need to be properly disposed.		Not applicable.	
	B	Noise and vibration may increase due to increased traffic of heavy vehicles.	B	Noise and vibration may increase due to increased traffic of heavy vehicles.		No applicable.	
		No effect is foreseen.		No effect is foreseen.		Not applicable.	
		No effect is foreseen.		No effect is foreseen.		Not applicable.	
		No effect is expected.		No effect is expected.		Not applicable.	
	B	Accident may occur due to generation of traffic.	B	Accident may occur due to generation of traffic.		Not applicable.	
		Accident may become clear as study progresses.		Accident may become clear as study progresses.		Not applicable.	

Part 2: Transport Master Plan

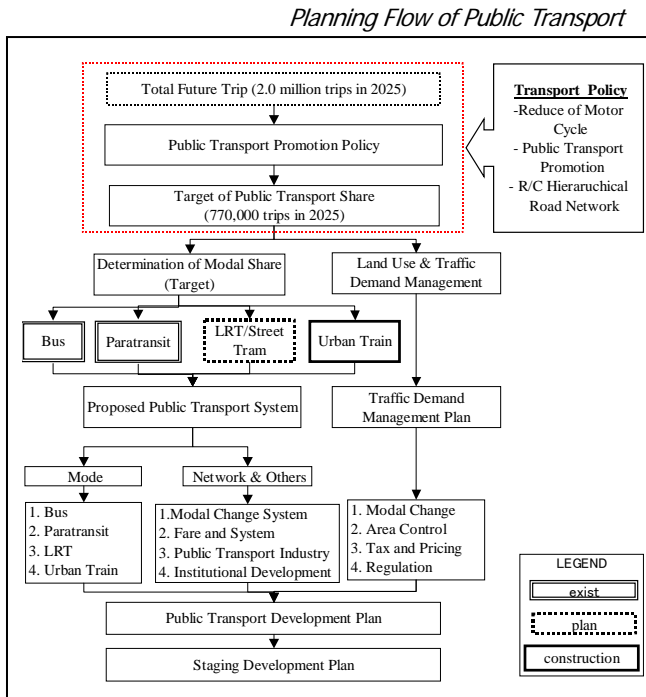
A: Serious impact is expected; B: Some impact is expected; C: Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses.); No Mark: No impact is expected. IEE/EIA is not necessary.

Where positive impact is expected, ++: Significantly positive impact is expected; +: Some positive impact is expected.

8.2 PUBLIC TRANSPORT PLAN

PLANNING FLOW

The flow of public transport planning is shown in the figure below:



IMPROVEMENT OF LEVEL OF SERVICES (LOS)

- The survey on the bus passengers' opinion showed that many bus passengers are not satisfied with the quality of present bus services.
- To attract more passengers, upgrading in the quality of bus service is indispensable.
- The Level of Service (LOS) of current bus services and target LOS are compared in the table below:

Level of Services

Availability			
Measures	Present LOS	Target LOS	Actions
Frequency :	C: <u>four bus routes</u> D~F: <u>others:</u>	A~B: <u>Express route</u> C: <u>Local routes</u> C: <u>Feeder routes</u>	• Increase in the number of bus • New bus network
Hour of Services	D:	B: <u>Express routes</u> C: <u>Others:</u>	• New bus modal change terminals
Service Coverage	13%	33%	
Comfort and Convenience			
Measures	Present LOS	Target LOS	
Reliability	D~F:	• B~C:	
Amenities	D~E: Mini buses	• C~D:	

Targets of Modal Share of Public Transport

- Currently, share of public transport is only 4 %.

Current Modal Share

Mode	Purposes				
	Home	Work	School	Others	Total
Walk	118 25%	27 16%	59 35%	38 26%	241 25%
Motor-cycle	283 60%	111 65%	102 61%	77 53%	573 60%
Public Transport	19 4%	6 4%	2 1%	10 7%	37 4%
Car	51 11%	26 15%	8 3%	20 14%	106 11%
Total	471 100%	170 100%	171 100%	145 100%	957 100%

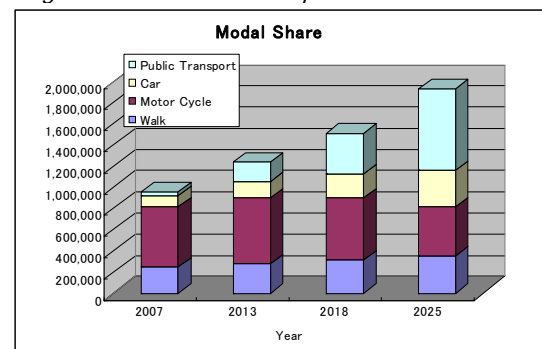
- Targeted modal share of public transport (PT) in 2025 is set at 40% of the total trips
- The target share of PT is increased in stepwise manner the current 4%; to 15% in 2013, to 25% in 2018 and finally to 40% in 2025.

Public Transport Share Target (unit: Trip)

Mode	2007	2013	2018	2025
Walk	241 25%	276 22%	309 20%	349 18%
Motor-cycle	572 60%	626 51%	589 39%	461 24%
Car	106 11%	149 12%	228 15%	352 18%
Public Transport	37 4%	188 15%	383 25%	767 40%
Total	958 100	1,239 100%	1,509 100%	1,929 100%

- These targets are to maintain use of motorcycles and private cars approximately at present level.

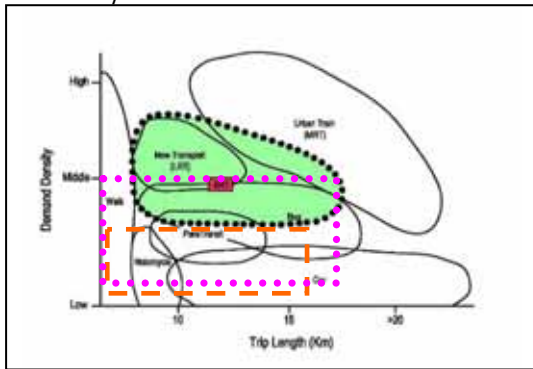
Target Share of Public Transport and Number of Trips



Modes of Public Transport

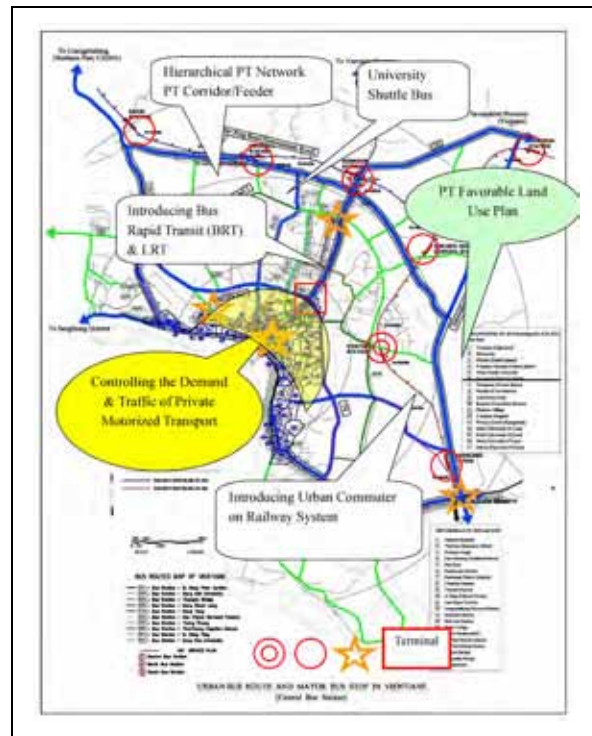
- The result of the traffic survey showed that the large portion of the trip length in Vientiane is 15 km or less.
- The current transport demand density in Vientiane is considered to be medium to low.
- Thus, bus and para-transit are suitable transport modes.
- In the future, LRT may become feasible as population density in Vientiane increase.

Relation Between Demand Density, Trip Length and Suitable Transport Mode



Current condition in Vientiane
 Future condition in Vientiane

Proposed Transport System



Components of Public Transport System

- In addition to transport modes, various components are involved in public transport system as summarized below.

Mode Development in Public Transport

Present Modes	New Modes
Mass Transit	New Mass Transit
<ul style="list-style-type: none"> • Bus 	<ul style="list-style-type: none"> • BRT • University Shuttle Bus • LRT
Para-transit	New Paratransit
<ul style="list-style-type: none"> • Tuk-Tuk • Sonteo • Taxi / Bike Taxi 	<ul style="list-style-type: none"> • Community Bus • Demand responsive Vehicle
Railway	Urban Railway
<ul style="list-style-type: none"> • Newly completed (Short length) 	<ul style="list-style-type: none"> • Commuter Train (Long future)
System Components	
Public Transport Network	
<ul style="list-style-type: none"> • Integration of bus, railway and para-transit • Combination of express/local/feeder bus service routes • New bus terminal and bus station at strategic points 	
Infrastructures and Environment	
<ul style="list-style-type: none"> • Well-developed road network as the platform • Traffic management for smooth operation of bus service 	
Operation and Management	
<ul style="list-style-type: none"> • Strengthening of bus business plan • Transformation of public transport industry for future 	
Oriented & Promotion Policy	
<ul style="list-style-type: none"> • Corridor Network Development to guide higher demand density along the main routes 	

Examples of Modern Public Transport

<p>Route Bus</p> <p>Seoul Bus System</p>	<p>Bus Network in Tokyo (part)</p> <p>Dense bus routes</p>
<p>New Bus(BRT): Priority lane</p> <p>BRT Curitiba (Source: ITDP)</p>	<p>Exclusive lane (Bus Way)</p> <p>Jakarta BRT (Source: ITDP)</p>
<p>LRT (3-Wagons): Mix/Fix Rail</p> <p>(Source: LRT NEWS)</p>	<p>LRT in Kumamoto, Japan</p>

Part 2: Transport Master Plan

BUS TRANSPORT DEVELOPMENT PLAN

Existing Problems

- Bus transport is proposed as the main public transport mode in Vientiane.
- The problems of the present bus service and their measures are summarized below:

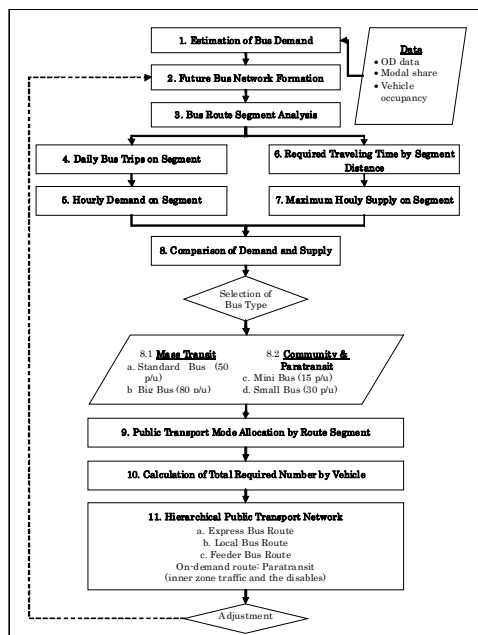
Problems and Measures of Bus Service

Existing Problems	Measures
<p>< Services Quality ></p> <p>Insufficient operation with less reliable arrival time</p> <p>Poor riding quality</p>	<p>Increase of bus units and bus services routes</p> <p>Securing reliability on bus time schedules</p> <p>Introduction of new bus fleet with air conditioning</p>
<p>< Busway and Facility ></p> <p>Insufficient road widths</p> <p>In sufficient capacity of Central Bus Station (CBS)</p> <p>Lack of bus stops with necessary facilities (lay-bay, shelters, benches, etc)</p> <p>No priority for bus operation (bus priority lane, bus- favored signal control etc)</p>	<p>Widening of roads used for bus routes</p> <p>Rehabilitation of CBS with bus stop location and route review</p> <p>Provision of bus stops with necessary facilities</p> <p>Provision of bus-priority lane, exclusive bus lane or busway</p> <p>Introduction of bus priority control of traffic signal system</p>
<p>< Bus Industries ></p> <p>Weak financial capacity of BSBC</p>	<p>Capacity development in bus business operation</p>
<p>< Administration ></p> <p>Lack of clear policy on bus on the side of Government</p> <p>No future vision nor business plan of VSBC</p>	<p>Preparation of policy and business plan of VSBC</p>

Planning Procedure

- The procedure of planning of bus transport is as shown below:

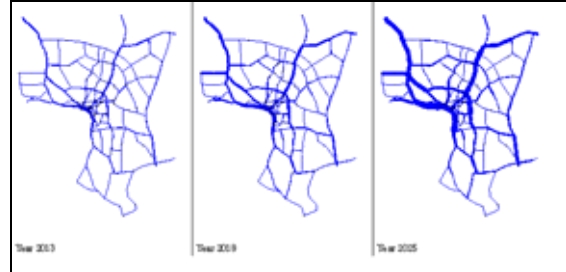
Flow of Bus Transport Planning



Estimation of Bus Demand Distribution

Bus demands from 2013 to 2025 estimated JICA STRADA program and the traffic data used for the traffic demand forecast explained before.

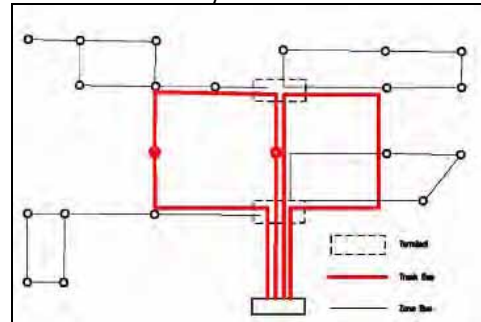
Bus Demands from 2013 to 2025



Bus Network Formation

Bus services become more efficient by combining trunk routes and feeder or zonal routes, as shown below.

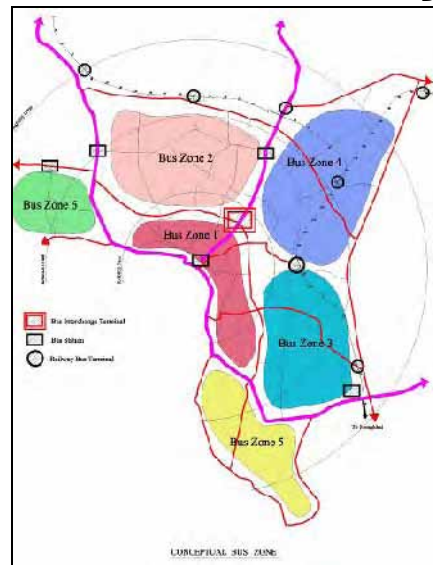
Concept of Trunk and Zonal Routes



Bus Planning Zones and Their Characteristics

- The Study Area is divided into 6 zones in order to plan suitable type of bus operation.

Bus Zone

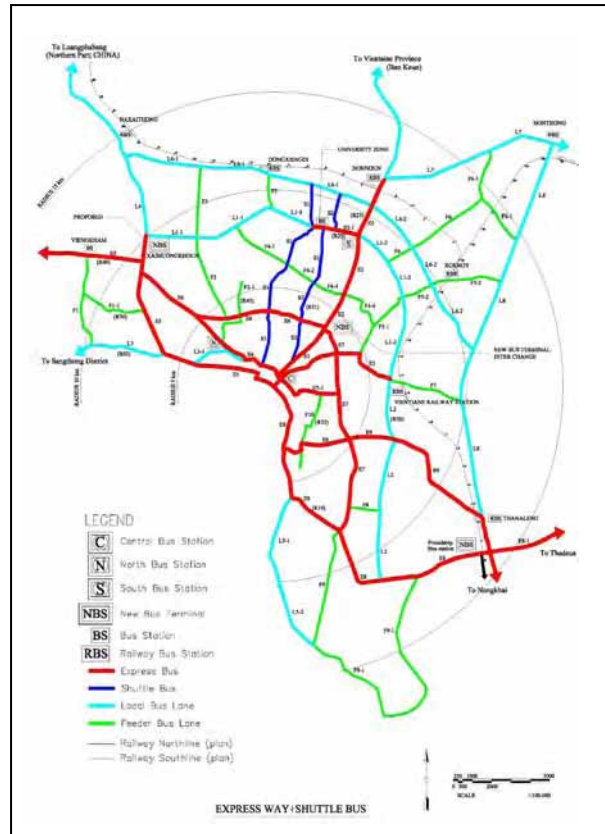


- Characteristics of 6 zones and bus route types are shown in the next page.
- Zone 1 is CBD and others are suburban areas.

Proposed Bus Zone Formation

Bus Zone	Zone Characteristic	Bus Routes
1	<u>Town and CBD</u> Bordering inner ring with high demand	Mostly express routes & Circulation bus routes
2	<u>Laos University Zone</u> Bordering Outer ring and NR 13 south and north with fairly high demand	University Shuttle bus routes & Local routes with feeder routes
3	<u>Vientiane Railway Station and Friendship Bridge</u> Bordering No13 South and access to Vientiane Railway Station and Friendship Bridge with fairly high demand	Express routes Local routes
4	<u>East areas</u> with low demand Para-transit favorable	Local and feeder routes
5	<u>South suburbs</u> with low demand Paratransit favorable	Local and feeder routes
6	<u>Viengkam Residential area</u> with high demand and <u>Western suburbs</u> with low demand where para-transit is favorable	Express route Local and feeder

Proposed Bus Routes & Segments



Bus Operation Plan

Service Type

- Type of bus services is selected based on the bus demand of the route.

Demand and Bus Routes Categories

Bus /Route Categories	Demand (2-direction)	Bus Services
1. Express Bus Route	> 1,000	Express Bus
2. Shuttle Bus Route	-	for University
3. Local Bus Route	500 to 1,000	Standard Bus
4. Feeder Bus Route	< 500	Small/Mini Bus

Required Number of Bus Units

ROUTE NO.	ORIGIN	DESTINATION	TARGET YEAR		
			2013	2018	2025
E1	CBS	DONNOUN RBS	14	14	14
E2-1	SBS	UNIVERSITY ZONE	3	3	3
E3	CBS	VIENTIANE RBS	8	9	9
E4	CBS	NORTHERN BS	4	4	4
E5	CBS	VIENGHAM BS	18	18	18
E6	NEW	NEW NORTH BS	14	14	14
E7	NEW	SOMSANOUK JCT.	13	13	13
E7-1	CBS	PHONETHAN JCT.	5	5	5
E8	CBS	FRIENDSHIP BS	23	23	23
E8-1	F. BS	THADUEA BS	6	6	6
E9	N13+	THANALENG RBS	16	16	16
S1	CBS	UNIVERSITY	12	12	12
S2	CBS	UNIVERSITY	9	10	10
Local	8Rts.	Local Bus Total	82	104	124
Feeder	10Rts	Feeder Bus Total	37	59	81
TOTAL (Bus Units)			264	310	352
Cost (million US\$)			8.4	17.3	25.7

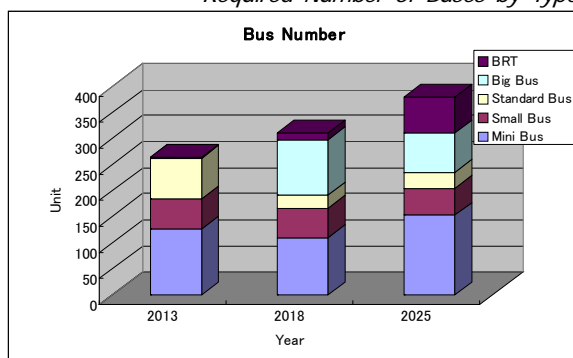
Bus Route Plan

- Based on the forecasted bus demand and applying the above bus categories, the routes of bus operation and types of services are proposed as shown in the figure on the upper right.

Required Number of Bus Units

The number of bus units required for each bus route is estimated from the forecasted bus demand is summarized below:

Required Number of Buses by Type



Note: shuttle bus does not consider peak hours

BUS TRANSPORT SYSTEM IMPROVEMENT

Increase Bus Fleet

- Increasing the number of buses is the first step to increase the capacity of bus transport. The main task is procurement of bus fleet.

Bus Priority Treatment

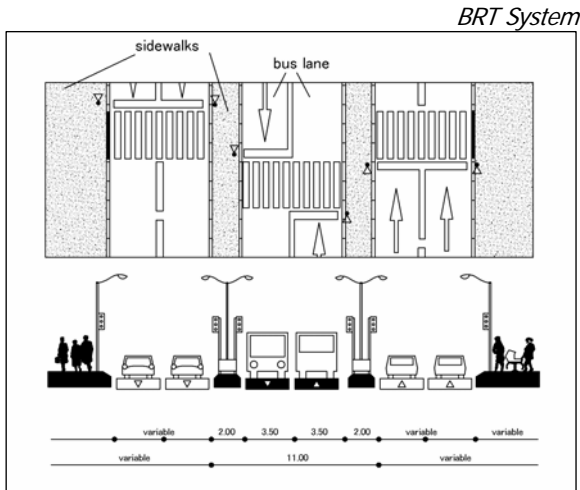
- Various bus priority treatment measures need to be introduced to secure smooth and stable operation of buses. These include bus-priority lane, exclusive bus lane, bus preferential treatments at intersections,

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signal priority, provision of safety islands for bus passengers, parking restrictions in the vicinity of bus stops, bus-stops relocation, and turn restriction exemption.

Bus Rapid Transit (BRT)

- BRT will be composed of six major elements to improve system performance and system benefits; private running way, interchangeable stations, suitable vehicles, effective fare collections, intelligence transport systems, and reliable service and operating plans.

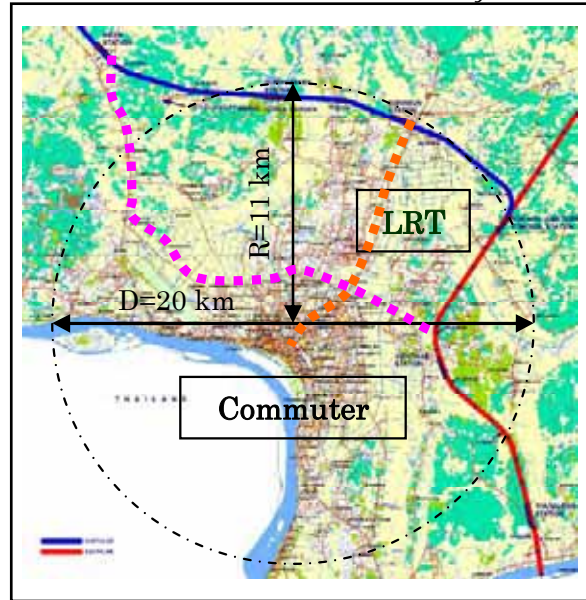


URBAN RAILWAY PROJECT

The existing railway ends at Thanaleng Station near the Friendship Bridge.

This railway is planned to be extended in the future. The future railway can be integrated in the urban transport system of Vientiane.

Possible Future Railway Network



Cost Estimate

- The costs of projects included in the Public Transport Development Plan are summarized in the table below:

Cost Estimate (US\$ Million)

Project	Term		
	Short	Medium	Long
I. Bus Capacity Improvement	8.4	17.3	25.7
II. Bus Priority Treatment	4.0	6.0	13.0
III. Bus Rapid Transit System	0	0	17.0
IV. LRT (see Note)	0	0	42.1*
V. Other System Improvement	2.0	10.0	20.0
Total	14.4	33.3	75.7

Note: *LRT is considered beyond long stage

PAPATRANSIT DEVELOPMENT PLAN

- Para-transit operators are proposed to co-exist with bus transport but gradually convert to use modern type of vehicles.

Proposed Improvement of Para-Transit

Para-transit	Present Situations	Improvement Issues
3 Associations 1. Sonteo, 2. Tuk-Tuk / 3. Jambo/Taxi under DOT of Vientiane	<ul style="list-style-type: none"> • Membership is requirement. • Sonteo operates on urban-rural routes • Tuk-Tuk operates in the town • Taxi operates at the station-base. 	<ul style="list-style-type: none"> • Coordination with mass transit modes • Upgrade by new vehicle • Usage for feeder transport

8.3 TRAFFIC MANAGEMENT PLAN

Planning Concept

- The basic planning concept of traffic management is to implement remedial but low-cost measures.
- These measures can be implemented within the short-term to prevent further deterioration of traffic conditions.
- Main objectives of such a traffic management plan should therefore be focused on effective ways to increase road capacity under the current conditions.

Objective of Traffic Management Plan

- The objective of a traffic management plan is to plan comprehensive measures based on the observation and analysis of the current traffic operation problems in Vientiane while predicting various traffic problems that are likely to occur in the near future, in order to achieve a safe, efficient and smooth traffic environment for all road users in the city.

Existing Problems

The following problems have been identified through various studies and observation by the Study Team:

- Disorderly traffic flow due to mixed traffic composition,
- Inadequate pavement markings such as median line and lane markings,
- Inadequate traffic signs,
- Inefficient traffic processing at intersections and along some road sections,
- Undeveloped traffic channelization facilities at intersections,
- Inadequate geometric structures,
- Lack of pedestrian islands and traffic safety facilities,
- Lack of pedestrian crossing facilities,
- Lack of signal control facilities,
- Inadequate traffic regulations, especially parking regulation,
- Lack of traffic accident database,
- Lack of traffic engineers.

Engineering Measures

- '3 E' (Engineering, Education and Enforcement) is basic principle of tackling traffic management/ traffic safety problems.
- The followings are the recommended engineering measures:

Road section improvement

- Provision and maintenance of pavement markings: Center line, lane marking, shoulder line
- Installation of raised median: Physically segregate two opposing traffic streams, restrict access to/ from the arterial road from/to the adjoining road and to provide refuge areas to pedestrians
- Provision of sidewalk and pedestrian crossing

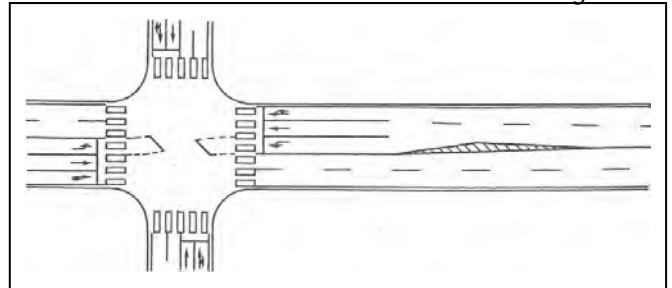
Raised Median



Improvement of Intersection

- Introduction of left-turn lane marking and/or exclusive left-turn lane

Exclusive Left-Turn Lane Marking



Improvement of Traffic Signal Control

- All-red signal phase: It is proposed that all-red signal phase after yellow signal phase be introduced to achieve total clearance of vehicles and pedestrians within the intersection.
- Review and improvement of signal heads and other control devices: Location of signal heads, pedestrian crossing, stop line markings and no-parking curb markings

Uniform Traffic Control Devices

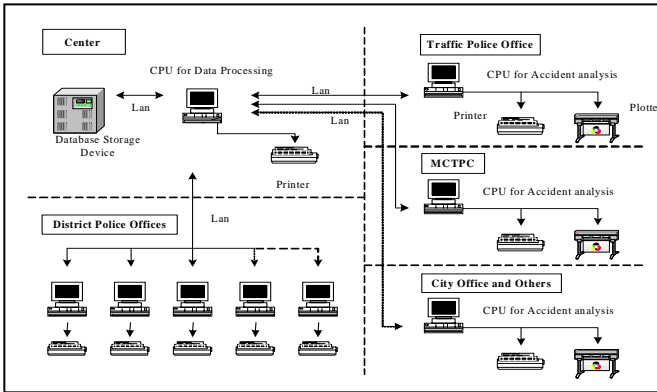
- Traffic control devices used in Vientiane are often not uniform.
- This leads to confusion on the side of drivers and makes driving hazardous.

Establishment of Traffic Accident Management System

- Establishing computerized traffic accident data base system is recommended.
- Using Global Positioning System (GPS) for identifying the location of accident is recommended.

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Computerized Traffic Accident Data Base



should focus on a few selected items so that the drivers can easily observe.

Traffic Demand Management

- Traffic management is a technique in alleviating over-concentration of traffic demand spatially and timely.
- Followings are typical measures of traffic demand management.
 - Improvement of public transport and/or encourage Park-and-ride: Reduce use of private vehicles
 - Staggering of working hour and/or school hour: To disperse commuting traffic
 - Improvement and enforcement of parking regulation: To discourage use of private vehicles

Traffic Safety Education

- Driver education: Driver education system directly related to drivers licensing system should be introduced, and drivers should be repeatedly re-educated at the time of renewal of driver's license.
- Qualified instructors for traffic safety education: Instructors of traffic safety education should be trained in three kinds of organization/institutions; school, traffic police department and private driving school.
- Introduction of traffic safety education in school curriculum: Young generation is absorptive to knowledge and effectively educated.
- Implementing regular traffic safety campaign
- Establishing traffic safety patrol and instruction unit; for education at school and kindergarten
- Construction of traffic safety park for traffic safety education

Traffic Enforcement

Parking Control

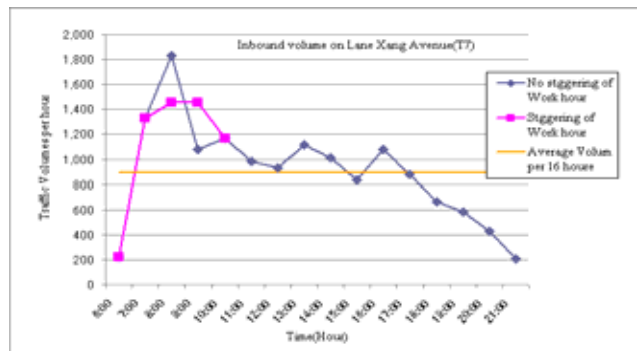
- Illegal parking is often the cause of traffic accident and traffic congestion.
- Strict enforcement against illegal parking in the city center will discourage using private cars and contribute to reduction of traffic demand.
- Survey on parking places and interview to drivers showed that the capacity of parking places is sufficient but drivers do not want to designated parking places if they are a little far from their objective place.

Illegally Parked Cars Narrowing Carriageway



- Strengthening enforcement and education against illegal drivers: It is recommended patiently instruct proper driving manner to the drivers. Instruction

Effect of Staggering Working Hour



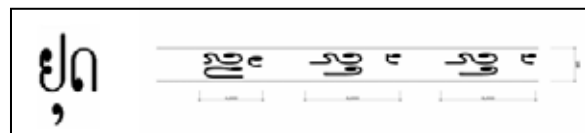
Proposed Traffic Management Projects

- Many of the exiting problems of traffic management/safety are being tackled by the Government, international donors and NPOs.
- Therefore, this Study focuses on the following areas:
 - Pavement markings
 - Improvement of black spot intersection by surface improvement, installation of pavement marking and traffic safety devices

Pavement Markings

- Use of symbol markings in combination with word markings: This makes markings more appealing and effective.

Word Markings for 'Stop' and 'Slow Down'



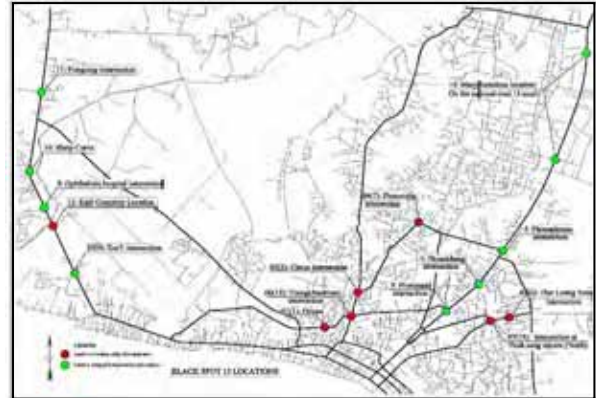
Symbol Markings for Bike Lane and Bicycle Lane



Installation/improvement of Lane Markings

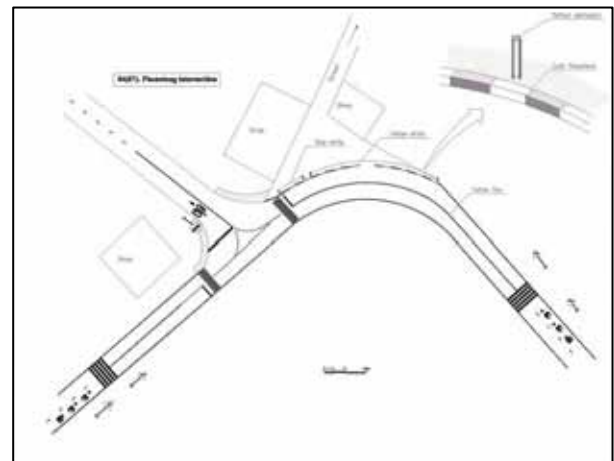
- It is proposed to install centerline markings and lane markings on the streets with a total length of 171 km, as shown below:

Road for Improvement of Pavement Markings (Urbanized Area)

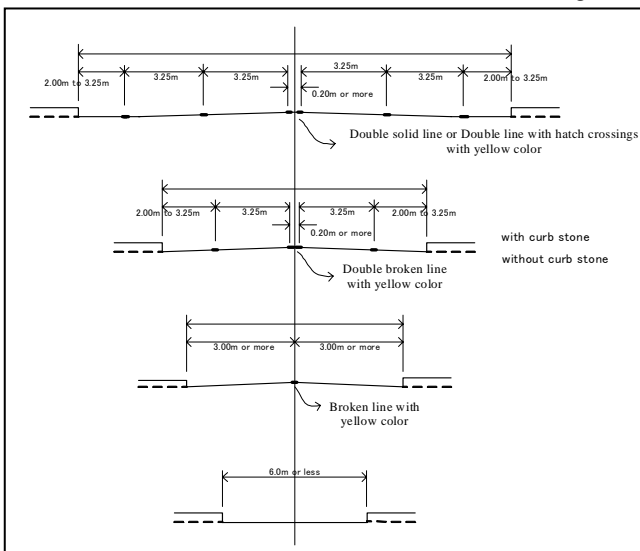


- An example of the preliminary design is shown in the figure below:

Example of Preliminary Design



Design Standard of Longitudinal Pavement Markings



Cost Estimates

- The cost for installing pavement markings on the streets with a total length of 171 km is estimated at US\$ 1 million.
- The total cost for improvement of 7 intersections are estimated at US\$ 0.9 million.

Improvement of Black Spot Intersections

- Fifteen intersections have been identified as traffic accident black spots.
- Among them, those intersections shown in green circle in the figure below are being studied in studies/projects other than this Study.
- Accordingly, 7 intersections, as shown by red circle in the figure below, are selected for preliminary design of pavement markings and traffic safety devices.

9. OVERALL IMPLEMENTATION PLAN

Implementation Schedule

• The projects of Road Network Development, Public Transport Development and Traffic Management are proposed to be implemented in three terms:

- (i) Short Term: 2008 – 2013 (5 Years+)
- (ii) Medium Term: 2014 – 2018 (5 Years)
- (iii) Long Term: 2019 – 2025 (7 Years)

• The road projects to be implemented in each Term have been selected based on the prioritization criteria described in Chapter 17. These projects are further distributed within each Term considering such factors as easiness of implementation, urgency and magnitude of required fund.

• Table in the next page shows the Implementation Schedule of the projects included in the Road Network Development Plan and Public Transport Development Plan.

Annual Amount of Fund Requirement Road Projects

- The cost of road projects for Short-, Medium- and Long-Term are as shown in the table on the right.
- These cost are further broken down to annual amount based on the implementation schedule as shown in the table in the next page.
- The maximum annual disbursement is estimated at approximately US\$ 20 million.

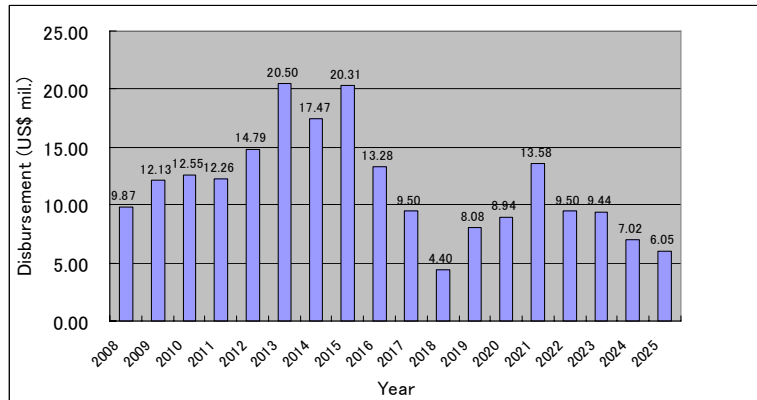
Public Transport Project

- The cost of public transport projects by term is summarized in the table on the right:
- Annual disbursement for procurement of bus fleet is estimated as shown in the figure on the right.
- The annual disbursement for procurement of buses are at the level of around US\$ 3.5 million.

Fund Requirement of Road Project by Term

Term	No. of Projects	Cost (US\$ mil.)
Short	Improvement of 14 road sections Replacement of 4 Bridges	84.4
Medium	Improvement of 14 road sections Replacement of 1 Bridge	80.6
Long	Improvement of 11 road sections Replacement of 1 Bridges	67.4

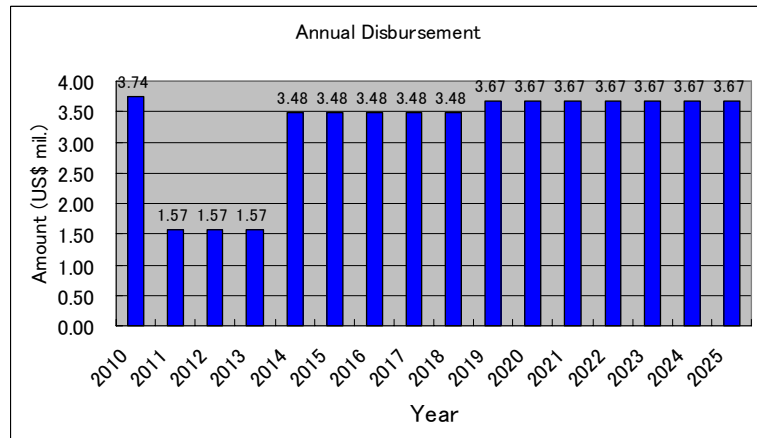
Annual Disbursement for Road Projects



Fund Requirement of Public Transport

Term	Project	Total Cost (US\$ mil.)
Short	<ul style="list-style-type: none"> • Procurement of 264 units of buses • Improvement of 3 bus terminals • Provision of bus priority lane for 10 km • Intersection Improvement 	14.4
Medium	<ul style="list-style-type: none"> • Procurement of 310 units of buses • Improvement of 1 bus terminal • Construction of 1 new modal change station • Provision of bus priority lane for 20 km 	33.4
Long	<ul style="list-style-type: none"> • Procurement of 352 units of buses • Improvement of 1 bus terminal • Construction of 1 new modal change terminal 	75.7

Annual Disbursement for Procurement of Bus Fleet



Part 2: Transport Master Plan

Cost for Construction/Improvement of Facilities for Public Transport

- Annual disbursement for construction/ improvement of the public transport facilities, such as bus lane and bus terminal are as shown in the right:

Cost of Facilities (Short Term)

Year	2010	2011	2012	2013
Amount (US\$)	0.25	1.25	3.25	1.25

Cost of Facilities (Medium Term)

Year	2014	2015	2016	2017	2018
Amount (US\$)	2.40	2.40	2.40	2.40	2.40

Cost of Facilities (Long Term)

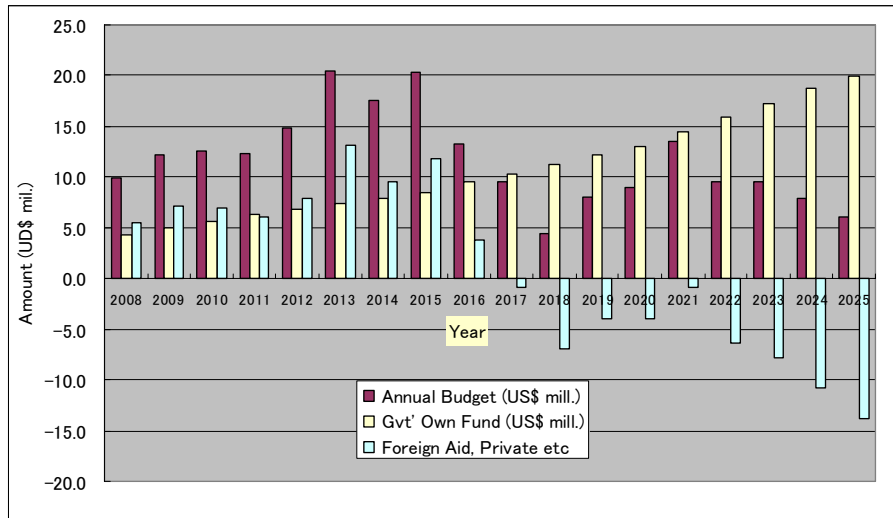
Year	2019	2020	2021	2022	2023	2024	2025
Amount (US\$)	2.86	2.86	3.86	2.86	2.86	11.36	11.36

Financing Plan

Road Projects

- The total budget of MCTC for road in FY 2004/05 was approximately US\$ 78 million, including own resource of the Government and foreign financial assistance.
- Thus, US\$ 20 million corresponds to approximately 25 % of the total road budget of the Ministry.
- Currently, the total expenditure of DPWT of Vientiane and VUDAA on road, including those financed by the foreign aid, is considered to exceed US\$ 20 million.
- However, large portion of this US\$ 20 million comes from foreign aids.
- Thus, the Government cannot supply sufficient fund to fully implement the Master Plan Projects with its own fund.
- On the other hand, the revenue of the Government, and thus the fund available for road, is expected to increase in the future as the national economy grows in the future.
- Therefore, it is reasonable to plan foreign aid to fill the financial gap between the amount needed for development of road network and the amount supplied by Government's own fund with foreign aid, including loan from WB, ADB and JBIC, and return the loan in the later years.

Change of Financial Gap

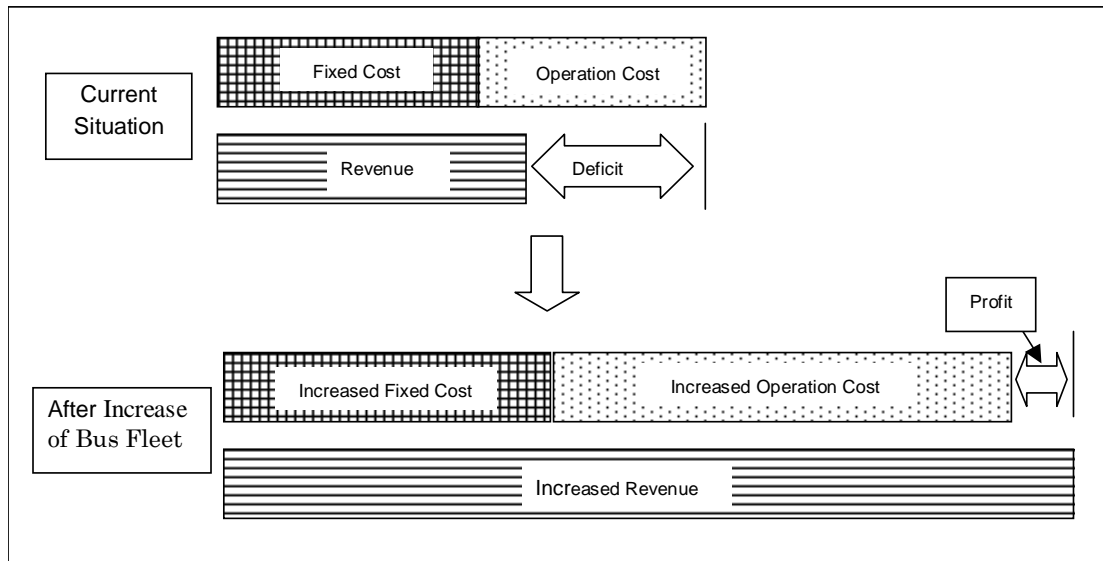


Procurement of Bus Fleet

- As for the Public Transport Development, approximately US\$ 1.5 – 3.7 million is required every year for the Short Term.
- Considering that the annual revenue of VSBC in FY 2005/06 was in the order of US\$ 3 million and the profit was minus, the amount required for procurement of new bus fleet may be excessively large to be borne by VSBC alone.
- Accordingly, some kind of financial assistance, either by the Government or foreign aid, needs to be considered.

- There are several possible fund sources for the Government/VSBC:
 - (i) Commercial loan
 - (ii) Loan from the aid agencies such as the World Bank, ADB and JBIC
 - (iii) Loan from the fund operated by the Government such as National Pension Fund
 - (iv) Grant/subsidy from the Government
 - (v) Participation of private investor(s)
- Government may consider giving financial support for operation of bus services, but it may be difficult to give large amount of subsidy/grant for procurement of new bus fleet.

- Thus, the main fund source for procurement of the new bus fleet is assumed here to be loan from the aide agencies, including WB, ADB and JBIC, for the purpose of discussion of financing plan.
- Although the current financial condition of VSBC is in deficit, there is a possibility that it will be improved if the number of buses will be increased and the total revenue will be increased.



Institutional Problems Associated with Implementation of Master Plan

Securing ROW

- One of the salient features of this Master Plan is 'Preventive Measures'.
- From this viewpoint, securing ROW before widening of road becomes necessary is strongly recommended.
- To effectively secure future ROW, it is recommended to designate the future ROW and regulate construction of new building within the designated ROW.
- This will allow the owners/residents of the houses to be relocated plan the timing of relocation at their own decision and greatly mitigate the negative impact associated with the relocation.

Business Plan of VSBC

Preparation of business plan of VSBC is the first step establishing good bus services.

The Ministry should establish a policy on public transport and discuss the business plan of VSBC based on the policy.

Coordination Committee on Urban Transport

- Solution of problems of urban transport often needs close coordination/cooperation of relevant institutions.
- Therefore, it is recommended that a coordination committee on urban transport be established.
- The committee shall consist of the members including the following:
 - Vice Minister in charge of transport, MPWT (Chair person)
 - Director of Transport, MPWT
 - Director of Roads, MPWT
 - Vice Governor of Vientiane in charge of transport
 - Mayors of Districts
 - Representative of VUDAA
 - Representative of Traffic Police
 - Representative of Bus Operators
 - Representative of Para-Transit Associations
 - Representatives of Users of Public Transport/Roads, such as University, Chamber of Commerce

10. ECONOMIC AND FINANCIAL EVALUATION

Economic Evaluation of Road Network Plan

- Economic evaluation generally aims to find the economic feasibility by examining whether the project will bring about sufficient contribution to the national or regional economy based on the comparison of the costs and benefits.
- Travel Time Cost (TTC) and Vehicle Operating Cost (VOC) are the main items of the benefits to be quantified. Other items such as accidents reduction benefit is not take into account here.

Travel Time Cost (TTC)

- To quantify the travel time cost, time is evaluated in monetary term. The following data are used to evaluate the time.

Basic Data for Calculating TTC

ITEMS	VALUE
GDP (million Kip)	30,599,882
Number of Labor	2,738,893
Annual Working Hour	2,000
Hourly Product (US\$/hour)	0.522
Exchange Rate (Oct. 2007)	1\$=9,628 Kip

- Occupancy ratio is taken into consideration in calculating TTC.

Calculated TTC (Unit: US\$/Hr)

\$/hr	M/C	Car	Sonteo	Bus	Truck
TTC	0.280	0.495	0.861	3.044	3.044

Vehicle Operating Cost (VOC)

VOC is further divided into distance dependent and time dependent components. VOC thus obtained is shown below:

Calculated VOC

	M/C	Car	Sonteo	Bus	Truck
VOC(US\$/km)	0.064	0.116	0.207	0.365	0.358
VOC(US\$/hr)	0.063	1.110	1.027	1.094	1.035

Project Cost

Project Costs of the 3 scenarios for road network development as explained in the section of Transport Master Plan Alternatives are as follows:

Project Cost

	Financial cost (US\$ Mil.)	Economic cost (US\$ Mil.)
Scenario 1	87.0	78.0
Scenario 2	125.0	112.5
Scenario 3	217.0	195.3

Economic Indicators

The results of the economic analysis in terms of EIRR, B/C ration and NPV are as shown below:

Economic Indicators of Road Network Development

	Speed (km/h)	V/C ratio	EIRR	B/C ratio	NPV (US\$ Mil.)
Do Nothing	20.7	1.38			
Scenario 1	23.1	1.15	13.5%	1.11	8.429
Scenario 2	30.5	1.02	17.9%	1.57	64.631
Scenario 3	40.8	0.71	18.1%	1.54	87.237

Sensitivity Analysis

- The result of sensitivity analysis shows that EIRR of 15% is obtained even with 10% reduction in the benefit and 10% increase in the cost.

Sensitivity Analysis

		Cost			
		-10%	0%	+10%	
Benefit	+10%	EIRR	21.4%	19.6%	18.1%
		B/C	1.88	1.69	1.54
		NPV(US\$ Mil.)	128.322	112.142	95.961
	0%	EIRR	19.8%	18.1%	16.7%
		B/C	1.71	1.54	1.40
		NPV(US\$ Mil.)	103.418	87.237	71.057
-10%	EIRR	18.1%	16.5%	15.1%	
	B/C	1.54	1.39	1.26	
	NPV(US\$ Mil.)	78.514	62.333	46.152	

Economic Evaluation of Public Transport Plan

Public Transport Alternatives

- Public transport alternatives are generated as follows:
 - Alternative 1: continuation of the present pattern
 - Alternative 2: para-transit oriented
 - Alternative 3: bus transit oriented
 - Alternative 4: LRT is introduced

Project Cost

- The project costs are estimated as below.

Project Cost

	Financial cost (US\$ Mil.)	Economic cost (US\$ Mil.)
Alternative 1	2.060	1.854
Alternative 2	48.859	43.973
Alternative 3	47.244	42.520
Alternative 4	79.398	71.458

Economic Indicators

- Economic indicators are shown below together with traffic indicators:

Traffic and Economic Indicators

	Speed (km/h)	V/C ratio	EIRR	B/C ratio	NPV (US\$ Mil.)
Alternative 1	40.8	0.71	18.1%	1.54	87.237
Alternative 2	47.2	0.51	34.5%	3.24	398.309
Alternative 3	48.3	0.47	39.6%	4.17	551.257
Alternative 4	48.4	0.47	40.9%	4.05	565.138

Sensitivity Analysis

- The sensitivity analysis is carried out for the Alternative 3. The resultants are presented below.
- Even in the worst case, very high EIRR is expected.

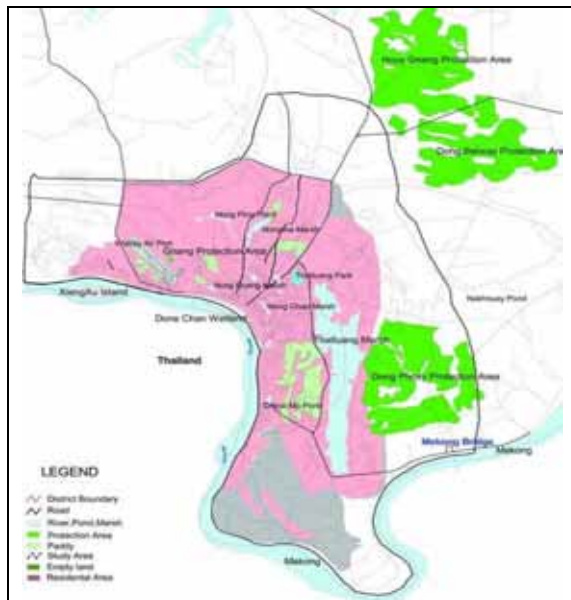
Sensitivity Analysis

		Cost			
		-10%	0%	+10%	
Benefit	+10%	EIRR	46.0%	42.5%	39.6%
		B/C	5.09	4.58	4.17
		NPV(US\$ Mil.)	641.214	623.798	606.382
	0%	EIRR	42.8%	39.6%	36.9%
		B/C	4.63	4.17	3.79
		NPV(US\$ Mil.)	568.672	551.257	533.841
-10%	EIRR	39.6%	36.6%	34.1%	
	B/C	4.17	3.75	3.41	
	NPV(US\$ Mil.)	496.131	478.715	461.300	

11. ENVIRONMENTAL ASSESSMENT

Environmental Characteristics in Vientiane

- Protected Areas;
 - Two National Biodiversity Conservation Areas (NBCAs) as national level and four Forest Protected Areas as prefectural level.



- Air quality and noise
The levels are safe and acceptable based on international standards (Environmental Monitoring and Management Center, September 2002 to February 2003).

Environmental Laws in Lao PDR

- Laws;
 - Environmental Protection Law (EPL), 1999.
 - Regulation on Environment Assessment, 2002.
 - Land Law, 1997.

EIA Procedures

- Approval of ECC;
No construction shall be undertaken until STEA has issued ECC for the project.
- Four counterparts need to be involved;
Project owner, STEA, DPRA, its concerned ministries and general public
- EIA Procedures;
 - (1) A project explanation to DPRA to screen the project
 - (2) Further environmental assessment to carry out or not. If not, STEA issues ECC. If yes, to carry out IEE including EMP.
 - (3) If the project is required to undertake EIA, the IEE report shall contain TOR for the scoping of EIA.
 - (4) After review of EIA, STEA determines whether to issue ECC or not.

Initial Environmental Examination (IEE)

- Total 6 ranks (A, B, C, No Mark, + and ++) for evaluation of 30 impact items were used.
- Evaluation of "With Project" and "Without Project" as alternatives
- Scoping of IEE for the Following Projects;
 - (1) Improvement of Intersections
 - (2) Widening of Roads
 - (3) Construction of Roads
 - (4) Replacement of Bridges
 - (5) Construction of Bus Terminals
- Impacts and Mitigation Measures;
 - (1) No significant adverse impact will occur except that, in the intersection of South 13 Road and T4 Road where large land acquisition and resettlement are involved.
 - (2) Although road widening will take place only within the ROW, some impacts on natural and social environments are still anticipated.
 - (3) Some significant impacts on natural and social environments, especially where some sections of the new roads pass through forest and residential areas in which large number of land acquisition and resettlement activities are involved and further EIA study is required.
 - (4) Temporary shops and houses nearby Nong Niang bridge are relocated. Waste materials and debris from replacement activities should be disposed properly.
 - (5) Where acquisition of local residential land is required, resettlement action plan with adequate compensation measures will be prepared.
- Scoping of IEE for Transport System Alternatives;
 - Zero-Alternative (Do Nothing)
Present Pattern (Road and Traffic).
 - Alternative 1
Completion of Road Network.
Bus-Oriented Public Transport.
 - Alternative 2
Completion of Road Network.
Bus + LRT
- Impacts and Mitigation Measures;
 - Largely acceptable of improved bus service and LRT
 - Traffic congestion and accident will be reduced/
Large amount of investment for LRT is required.
- Five Steering Committee meetings and two Stakeholder meetings were held. Main comments are as follows:
 - Master plan contributes to improvement of road network and public transportation.
 - Accident and congestion as well as dust should be considered.
 - The major concern of the district's officers is land acquisition and resettlement activities.
 - LRT system would require large financial scale for investment, though it is a good system for long term period.

12. PRE-FEASIBILITY STUDY ON SHUTTLE BUS SERVICE BETWEEN CENTRAL BUS STATION AND DONGDOK

OBJECTIVES

- Various projects for achieving smooth, safe and comfortable urban transport are proposed in this Master Plan.
- These projects are categorized into Short-, Medium- and Long-Term Projects based on such factors as urgency, easiness/difficultness of implementation and magnitude of negative impact.
- These proposed projects needs further study before they are actually implemented.
- it is desirable that some examples of outline of project be presented illustrating the process of planning of implementing the proposed projects.
- The quality of the current bus service between the Central Bus Station (CBS) and Dondock is very low and causing various problems including the traffic accidents of students commuting by motorcycles.
- Thus the project of shuttle bus services between CBS and Dongdock is very urgent.
- Therefore this project is selected for the Pre-Feasibility Study as an example.

Problems of Present Bus Operation

Number of Students

The following numbers of students are attending the classes of three time zones:

Class Hours and Number of Students

Class Shift	Class Time	Register
1. Morning Class	8 : 00 ~ 12 : 00	6,810
2. Evening Class	13 : 00 ~ 16 : 00	7,324
3. Night Class	17 : 30 ~ 20 : 30	7,091

Frequency of Present Bus Operation

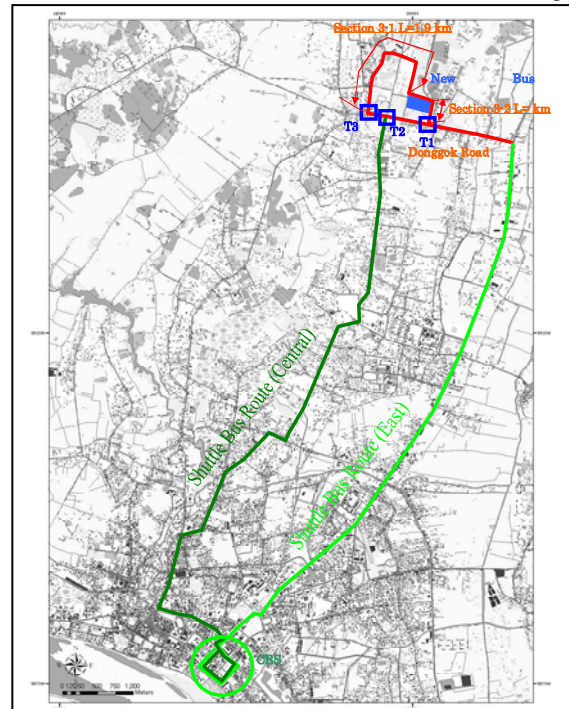
Outline of the present operation is summarized below:

Present Operation

Time Zone	Frequency (Time/Hr)	Interval (min.)	Transport Capacity (Person/Hr)
6:30- 7:30	2.7	33	135
10:30-12:30	2.2	36	110
15:30-17:00	1.6	38	80
All day	1.5	37	-

- Evidently, the present operation cannot transport substantial portion of the students.
- Also, the operation ends at 17:00 in the evening and students/staff who go home after night class cannot use bus.

Shuttle Bus between CBS and Dongdok



Present Bus Operation and Passenger Survey

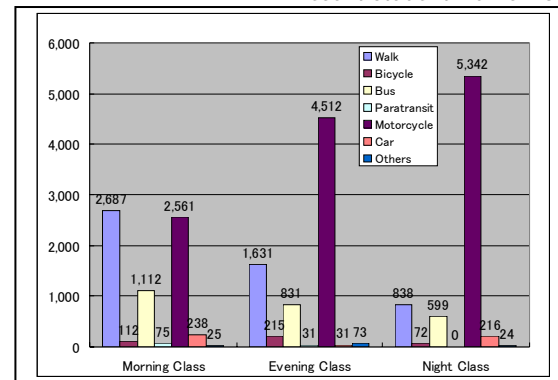
Mode of Traffic Commuting to the University

The modes of traffic commuting to the University are shown below.

It is noted that very large portion of the students of night class use motorcycles and there is no one using bus.

In the morning class, percentage of the students using bus is fairly high ((16%)

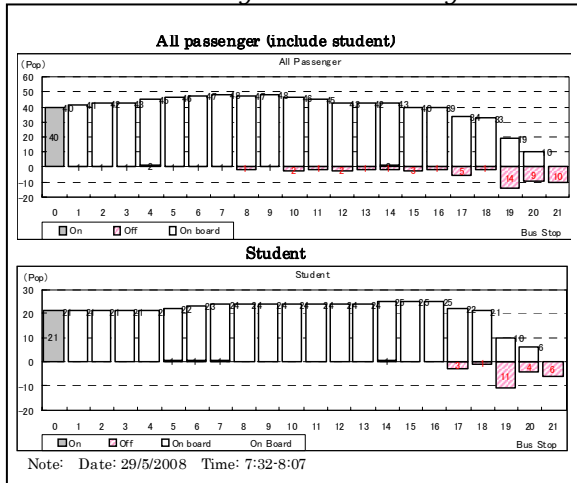
Present Student Traffic Modes



Degree of Congestion

- The busses are carrying more than the capacity in the peak hours.

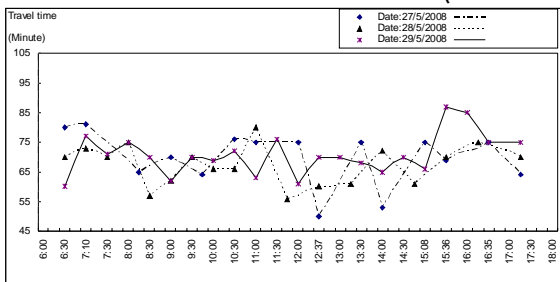
No. of Passengers in the Morning Peak Hour



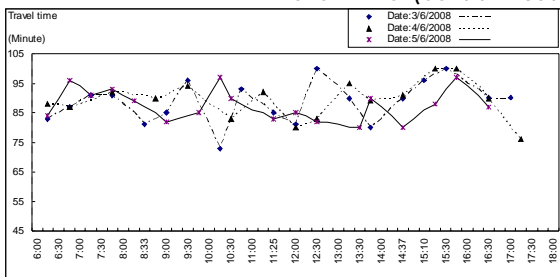
Travel Time

- Travel time between the CBS and Dongdock is considerably different depending on the route.
- This is considered to reflect road/traffic conditions of the routes.

Travel Time (East Route)



Travel Time (Central Route)

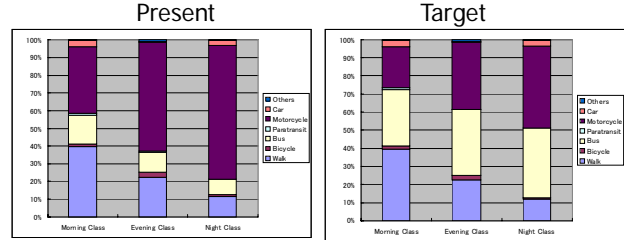


Bus Operation Plan

Target Number of Student Passengers

- The target is set at that 40% of the students of the University currently using motorcycles shift to the bus.

Present & Targeted Modal Share



- By shifting 40% of motorcycle to bus, the number of bus passengers is estimated as follows:

Planned Numbers of Passenger for the Shuttle Bus Service

	Morning Class	Evening Class	Night Class	Total
Bus Passenger	1,024	1,805	2,137	4,966

Required Number of Bus Operation

- To transport the planned passengers with buses with capacity of 50 sheets, the following number of buses are required.

Planned passenger and required bus trips

	Morning Class	Evening Class	Night Class	Total
Passenger	1,024	1,805	2,137	4,966
Bus Trips	20	36	43	33

Bus Operation Plan

- The outline of the operation plan is shown below:

Bus Operation Plan

Item	Morning Class	Evening Class	Night Class
Class Hour	8:00~12:00	13:00~16:00	17:30~20:30
Peak Hour at CBS	6:30~7:30	10:30~12:30	15:30~17:00
Peak Period	1 hr = 60mts	2hrs=120mits	1.5hr = 90mts
Bus Passenger	1,024	1,805	2,137
Bus Trips	20	36	43
Planned Frequency	0.78 (trip/hr)	1.00 (trip/hr)	0.80 (trip/hr)
Operation Numbers	26 (unit)	36 (unit)	40 (unit)
Riding Quality	0.65	0.90	1.45
Head Time (minute)	2.3	3.3	3.0

Part 2: Transport Master Plan

- To transport the target number of students, the number/ frequency of bus operation is greatly increased.
- Hour of operation is extended to 21:00 to transport the students/ university staff after closing of night class.
- With this operation, the level of service (LOS) is improved:

Present and Improved LOS

LOS Measures	Present LOS	Improves LOS	Remark
Frequency	E:	A:	3minitus
Hours of Services	D:	B:	Special night bus
Passenger Load	E: or F:	B: or D:	Night lass: 1.45
Reliability	F:	B:	Operation Target

Route and Facility

Route Selection

The present bus routes are shown below. As the central route is expected to be improved soon, bus operation will be much improved.

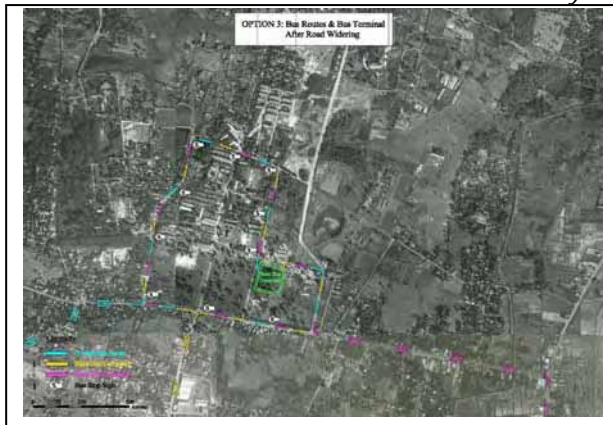
Outline of Roads Used as Bus Routes

Route	Bus	Route	(km)	Condition
1 East	VSBC	CBS - Lan Xang Av. - Dongdok Rd - Campus	12.1	4-lane AC
2 Central	VSBC	CBS - Savang Rd - Campus (2-lane DBS)	11.2	2-lane AC (by 2009)

Bus Circulation Plan in the University Zone

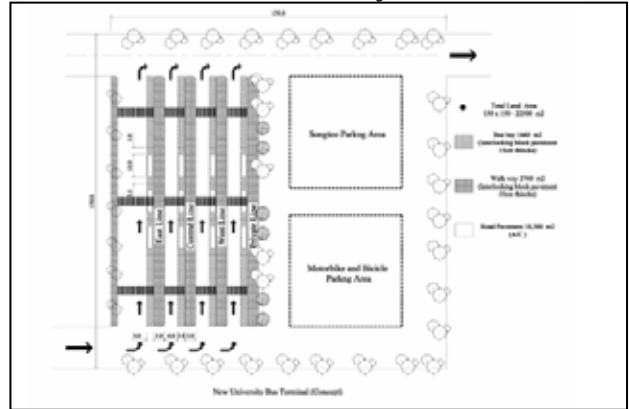
- In the University Area, bus is to run one-way on the exclusive bus way up to a new university bus terminal.

Bus Circulation Plan in the University



It is proposed that a bus station be newly constructed in the University area.

New University Bus Terminal Plan



Improvement of Bus Route Roads Near the University

- The roads near the University are narrow. These roads are needs to be widened.

Present Narrow Road along the University



Improvement of Intersections

- Three intersections near the university needs improvement.

Dongdok Road From New Bus Terminal



Dongdok Road From Central Route



Dongdok Road to University Road



Bus Circulation Plan in CBD and Road Side Stop

CBD Bus Circulation Plan



Project Component

Summary of Project Components

- Project components are summarized below:

Summary of Project Components

Component	Specification	Quantity	Agency
1. Bus Procurement	50 sheets with air conditioning Low bed deck	40 units	Bus Operator
2. Route Improvement			
2.1 Dongdok Road Upgrading	4-lane carriageway Bus private/priority lane Slow moving lane Walkway	0.9 km	MPWT
2.2 Intersection Improvement	Left turn lane Traffic Signal Walk Crossing	3 T-Section	MPWT
2.3 University Road improvement	2-lane carriageway exclusive bus lane + walkway	2.3km 1.1km	MPWT
3. University Bus Terminal construction	Bus lane/Bus bay Paratransit Parking Motorcycle/ bicycle parking		MPWT/ University

Cost Estimate

Costs of the components and the entire project are estimated as below:

Cost Estimates

Component	Unit	Q'ty	Unit Price	Amount
1. Bus Procurement	Unit	40	90.605	3,624
2. Route Improvement				
2.1 Dongdok Road Upgrade	km	0.9	1,502	1,352
2.3.1 University Road	km	2.3	1,100	2,530
2.3.2 University Road	km	1.1	1,206	1,327
3. Univ. Bus Terminal	100m ²	22.5	5	113
Total				8,964

Fares and Fare Policy

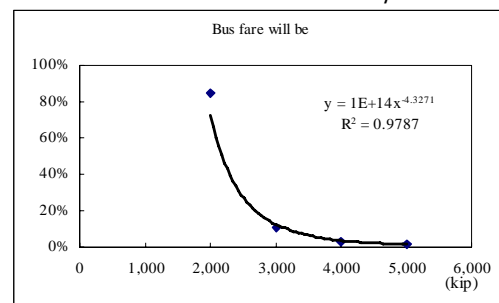
Fare System

- Fare level should be set considering the operating cost and willingness-to-pay of the passengers.

Vehicle Operating Cost

VOC	US\$/km	Kip/km
VSBC CEC	0.475	4,133
VOC	0.451	3,924

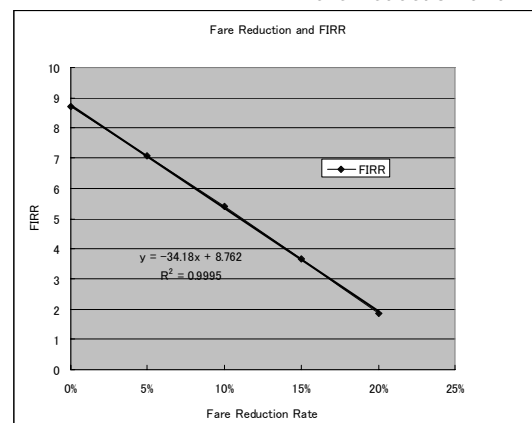
Acceptable Bus Fare



Fare Level for the Shuttle Bus Service

- Fare allowance is shown below. Twenty percent of fare reduction may be allowable by positive FIRR.
- In order to maintain the fare below allowable limit, the government may extend bus operators tax exemption.

Fare Reduction and FIRR



Part 2: Transport Master Plan

Financial and Economic Analysis

Financial Analysis

- Result of the financial analysis is shown below:

Financial Indicators

Index	Value
FIRR	8.7
B/C ratio	0.9
NPV(US\$)	-527,000

(Discount Rate: 12%)

- Result of the sensitivity analysis is shown below. Cost reduction is more sensitive than revenue. Effective management efforts is required.

Sensitivity Analysis

Item	Criteria	Cost			
		-10%	0%	10%	
Benefit	10%	FIRR	15.4%	11.8%	8.7%
		B/C	1.10	0.99	0.90
		NPV	516	-32	-579
	0%	FIRR	12.1%	8.7%	5.7%
		B/C	1.00	0.90	0.82
		NPV	21	-527	-1,074
	-10%	FIRR	8.7%	5.4%	2.5%
		B/C	0.90	0.81	0.74
		NPV	-474	-1,021	-1,569

Economic Analysis

- Result of the economic analysis is shown below:

Economic Indicators

Index	Value
FIRR	26.1
B/C ratio	1.37
NPV(US\$)	1,678,000

Sensitivity Analysis

- Result of the sensitivity analysis is shown below: Cost and benefit sensitivity is deemed same.

Sensitivity Analysis

Item	Criteria	Cost			
		-10%	0%	10%	
Benefit	10%	EIRR	36.7%	30.9%	26.1%
		B/C	1.67	1.51	1.37
		NPV	2,756	2,301	1,846
	0%	EIRR	31.5%	26.1%	21.6%
		B/C	1.52	1.37	1.24
		NPV	2,133	1,678	1,223
	-10%	EIRR	26.1%	21.1%	16.8%
		B/C	1.37	1.23	1.12
		NPV	1,510	1,055	600

Pre-EIA for Shuttle Bus Service

- Positive impact
Reduction of CO2 emission of 13.3% is expected by shifting transport modes of approximately 5,000 students from motorcycle to bus. It is equivalent to the quantity absorbed by an area of 63.7ha forest per year.
- Negative impacts
Minor land acquisition for intersection improvement is necessary, felling of trees is expected for a new bus terminal, and air pollution and traffic congestion should occur during construction.
- As an option for land acquisition of the private house, the surrounding road widening by approximately 5m will encroach into the university property. In this case fencing and green buffer will be required to protect university atmospheres and landscaping.

Recommendation

- IEE is required for the project, according to "Regulation on Environmental Impact Assessment of Road Projects in Lao PDR (2004)".
The IEE report to be submitted to STEA includes; Institutional Requirement, Environmental Monitoring and Management Plan, and Monitoring Cost.
- For smooth conduct of IEE study and early approval of ECC, Lao government is recommended to make an early start on above matters including land acquisition plan.
- Land use for ROW of Bus Private lane, green belt and side walk in the University campus is required. This will improve university landscaping and quality of environment of fringe of the university campus.

**CONCLUSIONS
AND
RECOMMENDATIONS**

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Urban Transport Master Plan

- A comprehensive transport master plan is proposed integrating the development plans and considering future socio-economic growth of Vientiane.
- The proposed transport master plan is expected to bring about smooth and safe traffic condition which results in better living environment including better air quality.
- The Master Plan also supports the Environmentally Sustainable Transport (EST) policy of the Lao Government.
- Combination of 'Completion of Road Network Scenario' and 'Bus Favored Scenario' (with co-existence of para-transit and a long-term vision of LRT) is selected as the optimum scenario.
- It is proposed to set a target of converting 40 % of trips from motorcycles and private cars to public transport in year 2025.
- It is expected that implementation of the Master Plan reduce HC and CO by about 50 % and NO_x and CO₂ by about 30 % compared with the case where nothing is done.

Road Network Development Plan

- A road network with a basic pattern consisting of radial arterial roads and circular arterial roads is proposed. Arterial roads in radial direction are No. 13 North Rd. (Luan Phabang Rd.), Lane Xang Ave./Kayson Phomvihane Rd./No. 13 South Road and Thadeua Rd. while circular arterial roads are Inner Ring Road and Outer Ring Road.
- The traffic condition in the Study Area is not severely congested at present but congestion is anticipated in the future due to rapid growth of vehicle ownership.
- Thus, it is proposed to start preparation for widening of existing streets/road, construction of missing links and improvement of problematic intersections.
- Such widening, construction and improvement are proposed to be implemented in stages to cope with the growth of traffic volume.
- It is proposed that the Government start actions for securing ROW for future widening by designating the future ROW in the urban plan and regulating construction of new buildings in the designated ROW.
- In total, 50 road projects, 5 bridge projects and 7 intersection improvement projects are proposed.

- These projects are to be implemented in 3 terms as follows:

Short Term: Year 2009 – 2013

Medium Term: Year 2014 – 2018

Long Term: Year 2019 – 2025

- A case study on New Construction of Missing Link of Inner Ring Road was conducted.
- The project cost is estimated at approximately US\$ 12.96 million.
- This Project yields good economic return as shown below:
 - EIRR = 18.5%
 - B/C Ratio = 1.57
 - NPV = US\$ 6.8 million
- As for social impact, relocation of about 10 houses is anticipated in either case of the alternative routes.

Public Transport Development

- Strengthening of public transport is necessary for providing safe, smooth and comfortable mobility to various people including commuters, students and disadvantaged people.
- Strengthening public transport is also necessary to reduce the use of private vehicles, including motorcycles, and thus, reduce vehicle emission.
- It is proposed to strengthen the bus services and to allow para-transits to co-exist with bus as feeder transport.
- It is anticipated that LRT may become necessary and/or feasible in the long future.
- It is estimated that the following number of buses are required to transport the people who will shift from motorcycles and private cars to buses:
 - 264 units by year 2013 (End of Short Term)
 - 310 units by year 2018 (End of Medium Term)
 - 352 units by year 2025 (Target year or end of Long Term)
- To secure smooth and reliable operation of bus services, such facilities as fixed bus stops with shelter and pool for para-transit, bus-priority lane and/or exclusive bus lane and traffic light system adjusted to bus operation should be provided.
- In the Long Term, Bus Rapid Transit (BRT) system with segregated bus lane and bus stops should be introduced.

Traffic Management/Safety

- GOL is studying and implementing various measures of traffic management and traffic safety with support of the donors.
- Installation of raised median and properly designed pavement markings is expected to improve traffic flow and reduce traffic accident.
- Provision of left-turn lane in the approaches of some intersections is expected to effectively improve the traffic flow.
- Enforcement against illegal parking should be strengthened.
- There needs to be standard guideline for traffic control devices (traffic signs, pavement markings etc) to minimize the confusion on the side of drivers.
- Establishment of computerized data collection and analysis system of traffic accidents is proposed to identify the accident black spots and prepare proper safety measures.
- Education of drivers and pedestrians should be enhanced.
- A total of 7 black spot intersections are selected and measures of improvement are proposed.

Financing Plan

- The amounts of fund needed for implementing the Master Plan projects, including road network development, public transport development and traffic management/safety, for Short-, Medium- and Long-Term are US\$ 99 million, US\$ 114 million and US\$ 143 million, respectively.
- For the road network development, the maximum required annual budget is estimated to be approximately US\$ 20 million which is considered to be within possible range in view of the current budget amount of roads in Vientiane.
- It is anticipated that the Government needs to borrow fund from foreign aid agencies to fill the financial gap between the amount required for road projects and its own fund up to year 2016, but will have surplus of fund and will be able to amortize the loan as the economy grows.
- For procurement of buses, US \$ 8.5, 17.4 and 25.7 million are needed for Short-, Medium- and Long-Term, respectively.
- In view of the present tight financial condition of VSBC, the Government needs to consider either introducing foreign financial assistance or Government's own fund for procurement of the required bus fleet.

- There is a possibility that the financial condition of VSBC be improved as the number of bus unit increases and the revenue increases because the relative share of fixed cost generally decreases as the revenue increases.

Economic Evaluation

- The proposed Road Network Development is expected to yield good economic return as shown below:

$$\begin{aligned} \text{EIRR} &= 18.1\% \\ \text{B/C} &= 1.54 \\ \text{NPV} &= \text{US\$ } 87.3 \text{ million} \end{aligned}$$

- The proposed Public Transport Plan yields good economic return as shown below:

$$\begin{aligned} \text{EIRR} &= 39.6\% \\ \text{B/C} &= 4.17 \\ \text{NPV} &= \text{US\$ } 551.3 \text{ million} \end{aligned}$$

Environmental Evaluation

- Some negative social impact is anticipated widening and new construction of roads. Such impact can be mitigated by designating the future ROW and regulate building new house within the designated ROW.
- The Master Plan, as a whole is expected to reduce traffic congestion and air pollution.
- With implementation of proposed Public Transport Plan, emission of CO₂ is expected to be reduced by about 30%.

Pre-Feasibility Study of Shuttle Bus Service Between Central Bus Station and Dongdok

- Shuttle Bus Services Between Central Bus Station and Dongdok (National University of Laos) is selected for Pre-Feasibility Study for its urgency.
- The outline of the planned Shuttle Bus Service is as follows:
 - Service Hours: 6:30 AM (Departure from CBS) – 9:00 PM (Departure from NUL)
 - Frequency: Around 1 per 3 min. during peak hours
 - Target Number of Passengers: 5,000 passengers/day (one way)
- Forty (40) units of buses are required to provide the above service.
- Total cost of the entire Projects, including procurement of new bus fleet, improvement of roads and intersections, and construction/improvement of bus terminals and bus stops, is estimated at US\$ 8.96 million.

- Economic return of bus operation, excluding improvement of associated facilities, yield good economic return as summarized below:

EIRR = 26.1 %

B/C Ratio = 1.37

NPV = US\$ 1.68 million

(With discount rate of 12 %)

- If the loan with an interest rate of 7%/yr or less is obtained, the shuttle bus service is feasible as a business.
- Positive impact of the project is reduction in vehicle emission: Reduction of CO₂ equivalent to 63.7 ha of forest absorption is expected.

Recommendation

Authorization of Master Plan

- This Urban Transport Master Plan has been prepared incorporating future development plans and forecasted socio-economic growth of Vientiane and is expected to support sound urban development of Vientiane and healthy and comfortable lives of the citizens.
- The Master Plan proposes various projects for achieving the objective of Master Plan. These projects are technically and economically feasible.
- Also, these projects can be financed by the Government's own fund and/or foreign assistance which can be amortized in the near future.
- In view of the rapidly growing worldwide concern on global warming and soaring of fuel prices, the Master Plan increases its significance.
- However, because of large-scale investment and necessity for change of social paradigm, the Master Plan needs political commitment if it is to be implemented.
- Therefore, it is strongly recommended that the Master Plan be authorized by being incorporated into the national environment policy and/or development plan of Vientiane.
- Above others, the target of "shifting 40 % of trips using motorcycle and private cars to public transport" should be adopted in the national policy on environment and transport.

Urgent Action

- The current traffic congestion in Vientiane is not severe compared with those in the capital cities of other ASEAN countries.
- However, due to rapid increase of motorcycles and private cars, severe traffic congestion is anticipated in the future.

- Therefore, it is recommended that the Government take urgent actions to secure right of way for future widening of the roads/streets.
- For securing future right of way in a manner with minimum negative social impact, it is recommended that the government designate the future right of way and regulate building of new houses within the designated right of way.
- The current VSBC is considered to possess sufficient capacity/experience for operation of bus services. However, there is no well-recognized future business plan.
- It is recommended that the Government prepare, in close consultation with VSBC, the future business plan of VSBC which covers plan of increasing bus fleet and financing plan for it.
- It is recommended that a coordination committee for urban transport be established.
- It is recommended that the Government implement the projects for which case study and pre-feasibility study were conducted. If necessary, the Government should seek financial and/or technical assistance of multi-lateral and/or bilateral donors.