CHAPTER 6 TRAFFIC SITUATION

6.1 CURRENT CONDITIONS

6.1.1 Outline of Traffic Surveys

In this project the traffic surveys showcased in Table 6.1-1 were conducted in order to grasp current traffic conditions, identify issues, and plan for the future.

Table 6.1-1 Outline of Traffic Surveys

Survey	Objectives	Description
Person Trip Survey (Including public transport survey)	・Identify household (HH) and individual level attributes. ・Sample daily movement patterns within the Target Area (TA).	Sampled 4,700 households within TA
Activity Diary Survey	・Sample daily activity patterns of TA residents	・Sampled 100 households within TA ・Collected daily activities of household members of 6 years and older
Cordon Line Survey	・Obtain volume of person-trips to/from external area of the TA ・Obtain volume of person-trips corresponding to through traffic	Conducted at 13 locations: ・9 roadside survey locations ・3 bus terminals ・Wattay Airport
Screen Line Survey	・Calibrate present OD matrix through traffic counts	Conducted at 14 roadside locations.
Peak Hour Traffic Count Survey	・Obtain traffic volume in peak periods for comparison with 2007 levels	Conducted at 27 roadside locations during peak periods: ・Morning peak: 6:00-9:00 ・Afternoon peak: 15:00-18:00
COVID-19 Traffic Survey	・Obtain traffic volume at major cordon/ screen line, and peak traffic count survey locations to compare with pre-pandemic levels.	Conducted in the following manner: ・Cordon line: ・Screen line: ・Peak-period traffic counts:
Parking Interview Survey	・Collect basic information needed for additional modal shift model	Sampled 200 motorcycle users and 200 car users.

Source: JICA Expert Team

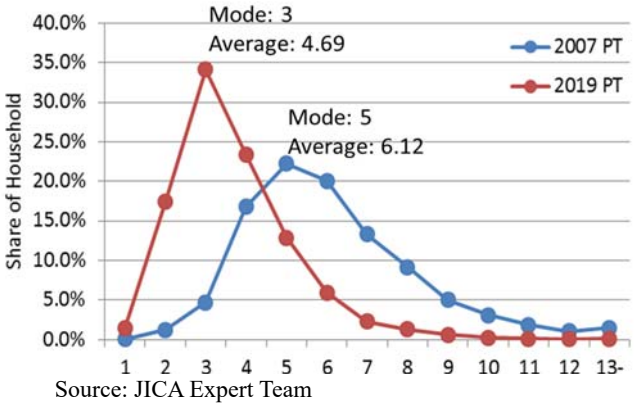
6.1.2 Traffic Survey Results

A summary of major traffic survey results relevant to the description of the overall current traffic conditions is given in this section. Details on the survey methodologies as well as the obtained results have been outlined in the Technical Report of the Preliminary Analysis on the Traffic Survey.

(1) Person-Trip Survey

1) Household Characteristics

From the Person-Trip (PT) survey, household size was found to decrease from an average of 6.12 members in 2007 to an average of 4.69 members in 2019, as presented by Figure 6.1-1. This average household size was obtained from the use of an expansion factor based on the number of households in 2019 and applying it to the survey results. It is important to note that the 2019



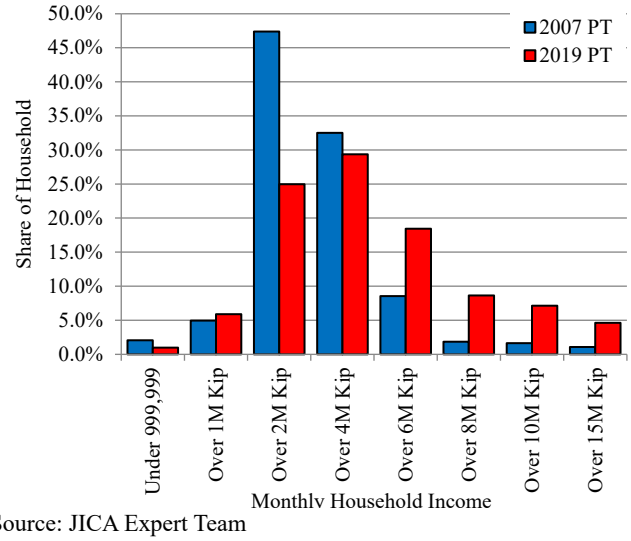
Source: JICA Expert Team

Figure 6.1-1 Average Household Size

TA was expanded to account for village boundaries as well as development areas and thus it is larger than the one for the 2008 Master Plan.

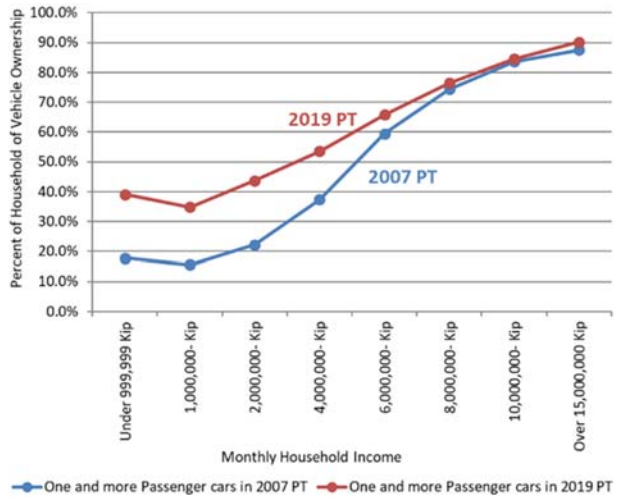
In relation to the average monthly household income, the 2019 survey results reported an increase of 3.4% in comparison to 2007 levels. As shown in Figure 6.1-2, the mode for 2007 PT survey consisted in the 2,000,000 to 3,999,999Kip/month income bracket, amounting to an average of 4,300,000 Kip/month, while in 2019, the mode shifted to the 4,000,000 to 5,999,999Kip/month income bracket and raising the average to 6,400,000 Kip/month. Therefore, the proportion of middle-income class residents has increased.

When comparing monthly household income with passenger car ownership, 2019 ownership levels in lower income class households were found to be higher than those of 2007. As presented by Figure 6.1-3, the general trend was for an increase in around 20% for households with monthly household incomes of 2,000,000 Kip/month and lower. Moreover, increments in ownership at income levels above 2,000,000 Kip/month generally decreased in magnitude with the increase in monthly household income.



Source: JICA Expert Team

Figure 6.1-2 Average Monthly Household Income



Source: JICA Expert Team

Figure 6.1-3 Car Ownership by Monthly Household Income

2) Trip Characteristics

For the study of trip characteristics, the PT survey targeted population of 6 years old and over. As showcased in Table 6.1-2, for the base year of 2019, the population of 6 years old and over amounted to approximately 665,000 persons, representing a 75% increase compared to the one reported in the 2007 PT survey of around 380,000 persons.

In addition to an increase in population, the total number of trips increased by 11.1%, from 957,630 trips/day in 2007 to 1,077,460 trips in 2019. When dividing the total number of trips by the population of 6 years old and over, a trip rate, or in other words an approximate average number of trips per person per day is obtained. It is important to note that in the estimation of the trip rate, population can be further subclassified into trip maker and non-trip maker, where trip maker consists in persons who left their home for more than 30 minutes for any purpose and non-trip maker including the remaining population.

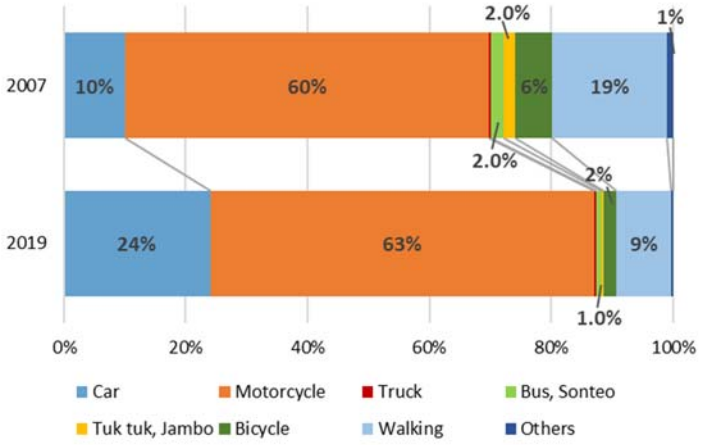
In the case of the 2019 PT survey, the gross trip rate, including trip makers and non-trip makers, amounted to 1.62 trips/persons/day; while the net trip rate, including only trip-makers, was 2.36 trips/persons/day. In comparison, the trip rate for 2007 was 2.52 trips/persons/day and since it is considered that this figure represents the net trip rate (hence only accounting for trip maker population), it represents a decrease of around 6.3%. Moreover, trip rate was found to vary according to age and gender, with gross trip rates, in general, decreasing with age and women of 30 years old and over having lower trip rates.

Table 6.1-2 Trip Rate Comparison Table (2019 and 2007 PT Survey)

Item	2007 PT Survey	2019 PT Survey
(a) Population 6 years old and over ('000)	380.0	665.0
(b) Trip maker Population ('000)		456.9
Non-Trip Maker Population ('000)		208.2
Ratio of Trip Maker Population		68.7%
(c) Total Number of Trips ('000 trips/day)	957.63	1,077.46
(c)/(a) Gross Trip Rate (trips/person/day)		1.62
(c)/(b) Net Trip Rate (trips/person/day)	2.52	2.36

Note: 2007 PT Survey's trip rate of 2.52 trips/person/day is considered to only account for trip maker population and thus represents the net trip rate.
Source: JICA Expert Team

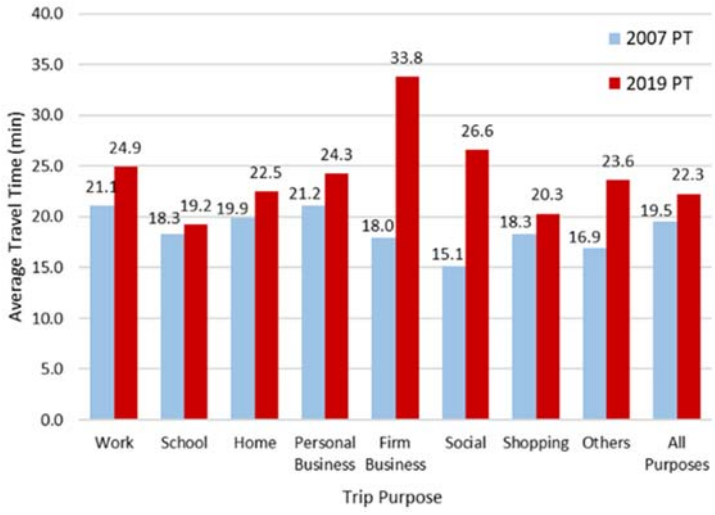
In relation to the modal share, as presented by Figure 6.1-4, the trend was for an increase in the share of private vehicles (14% for passenger cars and 3% for motorcycles), while decreasing for other transport modes.



Source: JICA Expert Team

Figure 6.1-4 Comparison of Between 2007 and 2019 Modal Share

As for the average travel times according to trip purpose, all trip purposes reported an increase on average travel times when compared to the 2007 PT survey results. Findings are showcased in Figure 6.1-5.



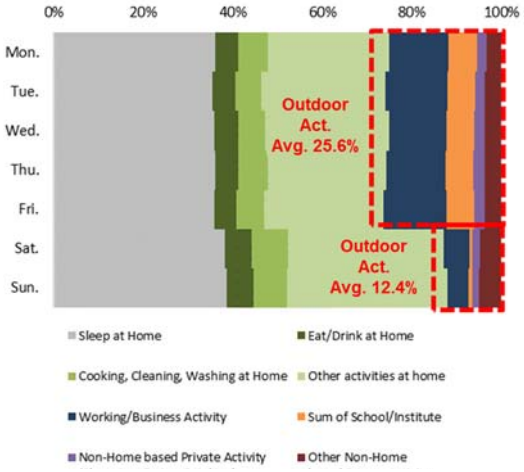
Source: JICA Expert Team

Figure 6.1-5 Average Travel Times by Trip Purpose

(2) Activity Diary Survey

Detailed activity patterns of 385 household members from a sample of 100 households were obtained from conducting the activity diary survey. In general, TA residents target of ADS, were found to mainly perform indoor activities; with 25.6% of weekday activities and 12.4% of weekend activities being performed outdoors, as showcased by Figure 6.1-6.

From the results, as presented by Appendix for Traffic Situation Figure 1.4-1, few differences were found among weekdays, where work and school activities are high and non-home-based private activities peaking at lunchtime. Regarding weekend patterns, as shown in Appendix for Traffic Situation Figure 1.4-2, non-home-based private activities are higher than weekdays, however, the difference is marginal.



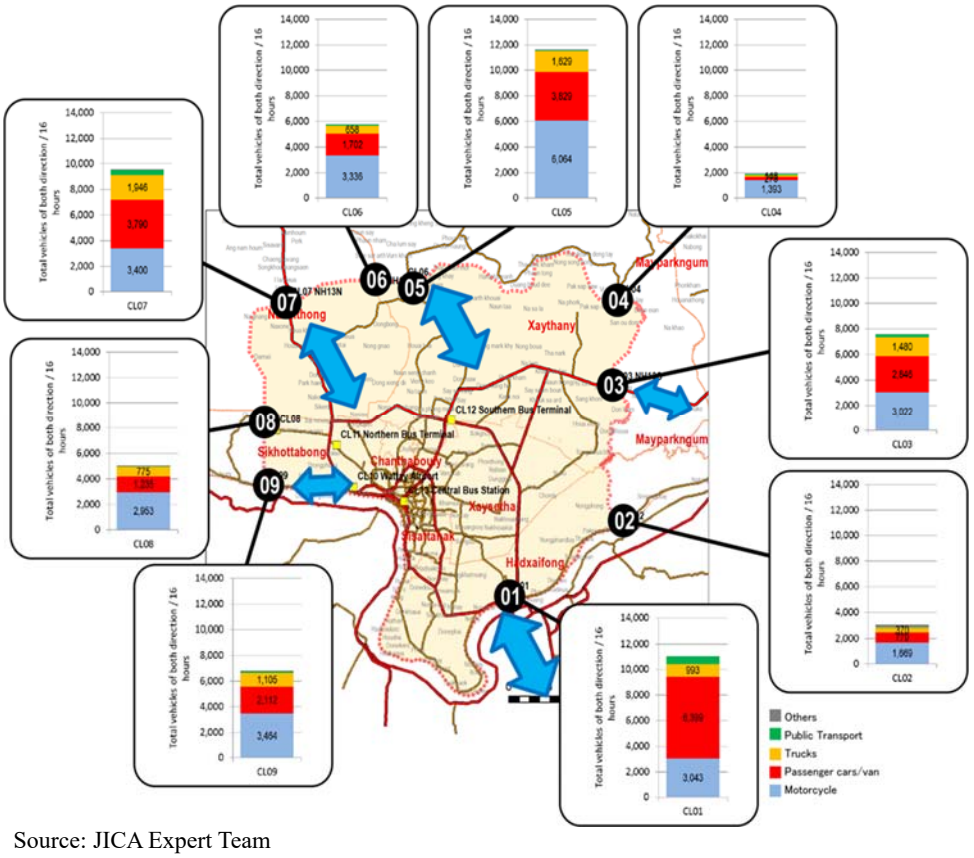
Source: JICA Expert Team

Figure 6.1-6 Distribution of Activities

(3) Cordon/Screen Line and Peak-Hour Traffic Count Survey

1) Cordon Line Survey

A cordon line survey was conducted at a total of 13 locations; nine locations consisted of roadside survey locations, three were placed at bus terminals, and one was located at Wattay Airport. Implementation schedules at roadside survey locations mainly consisted of 16-hour survey periods from which 24-hour traffic volume was then obtained by expanding the 16-hour traffic count results. Results of traffic counts conducted at cordon line survey locations are shown in Figure 6.1-7.



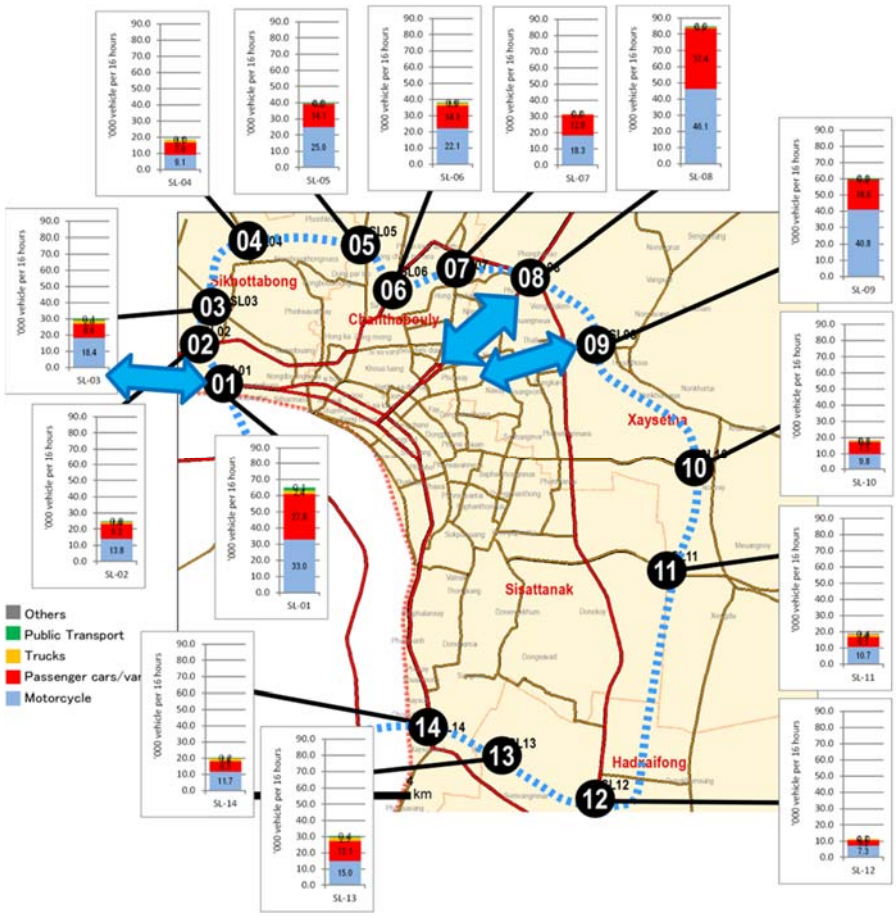
Source: JICA Expert Team

Figure 6.1-7 Traffic Count Results at Cordon Line Survey Locations

Results of expanding the 16-hour traffic count results to obtain 24-hour traffic volumes are shown in Appendix for Traffic Situation Table 1.1-1. All roadside cordon line survey locations were expanded with the exception of CL-03, CL-05, and CL-07 since these locations had 24-hour survey implementation schedules. Bus terminal passenger counts corresponding to CL-11, CL-12 and CL-13 are presented in Appendix for Traffic Situation Table 1.1-2. In the case of airport passenger counts (CL-10), results are shown in Appendix for Traffic Situation Table 1.1-3.

2) Screen Line Survey

Screen line survey was conducted at a total of 14 locations. In a similar way as with the cordon line survey, implementation schedules at roadside survey locations mainly consisted of 16-hour survey periods from which 24-hour traffic volume was then obtained by expanding the 16-hour traffic count results. Results of 16-hour traffic counts conducted at screen line survey locations are shown in Figure 6.1-8, while expanded results are shown in Appendix for Traffic Situation Table 1.1-4.

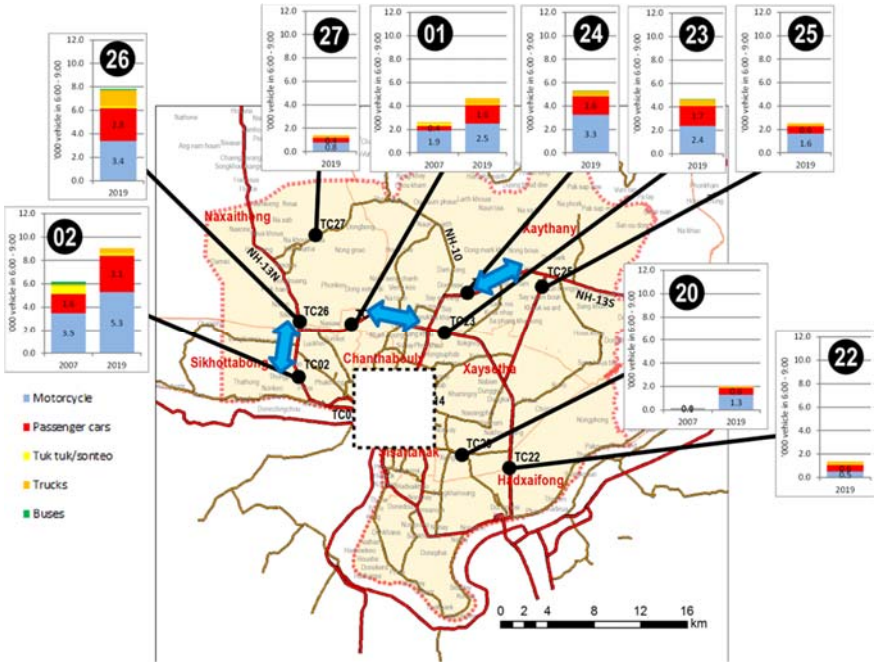


Source: JICA Expert Team

Figure 6.1-8 Traffic Count Results at Screen Line Survey Locations (16-hours)

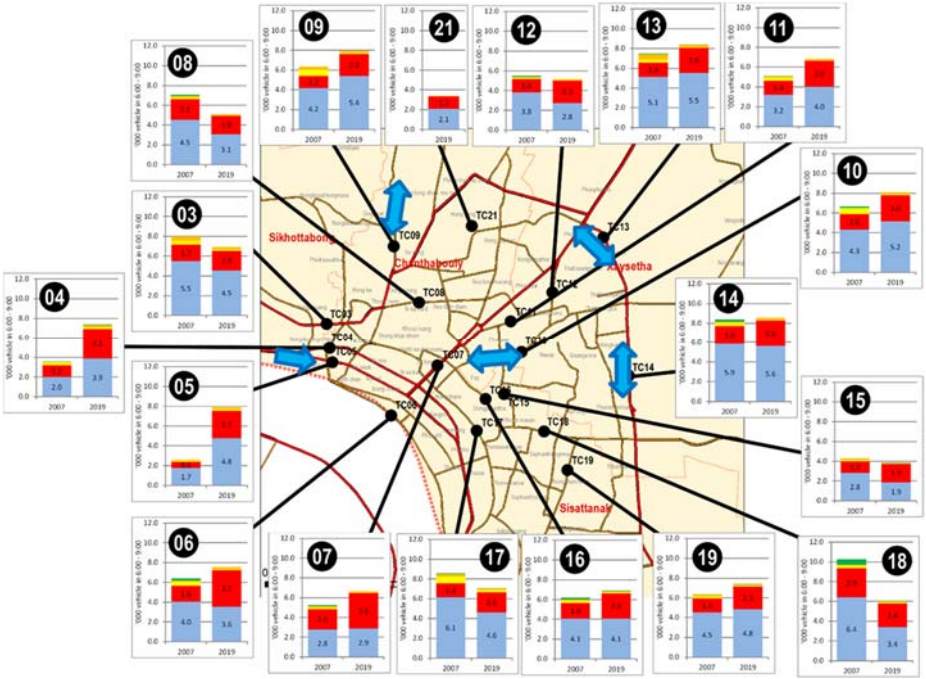
3) Peak-Hour Traffic Count Survey

Peak-hour traffic counts were conducted at a total of 27 locations. Results under the current project and a comparison to 2007 traffic count results for the morning peak (6:00-9:00) are shown in Figure 6.1-9 and Figure 6.1-10.



Source: JICA Expert Team

Figure 6.1-9 Morning Peak Traffic Count Results (Outer Survey Locations)



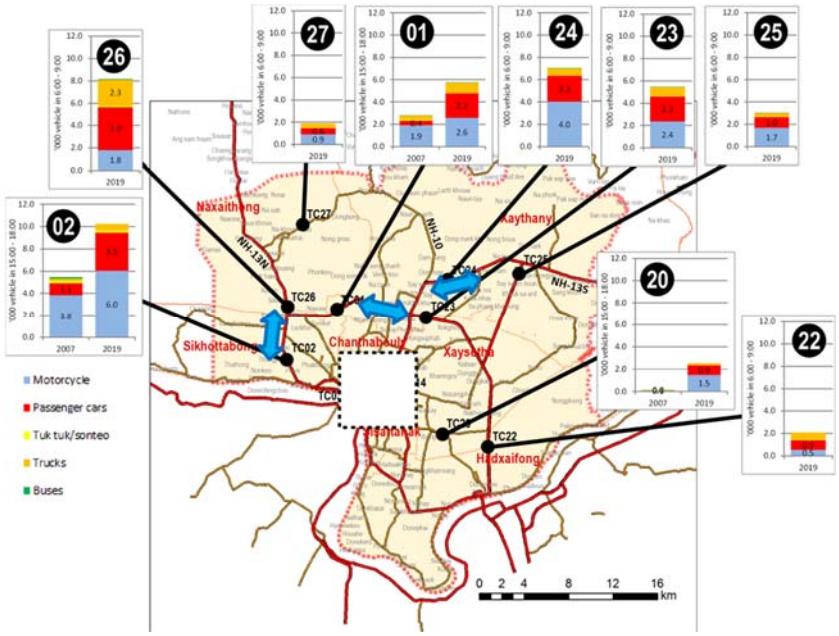
Source: JICA Expert Team

Figure 6.1-10 Morning Peak Traffic Count Results (Inner Survey Locations)

From the outer survey locations, location No. 2 reported the highest traffic volume, with around 9,000 vehicles counted at the morning peak. Moreover, major traffic flows corresponded to traffic circulating along outer ring roads. In the case of inner survey locations, several locations registered traffic volumes close to or above 8,000 vehicles. However, when comparing the survey results with those of the 2007 PT survey, some locations (No. 8, 3, 17, and 18) registered a decrease in traffic volume when compared with 2007 levels. In such locations, motorcycle traffic volume tended to

decrease while passenger car volumes increased or slightly decreased.

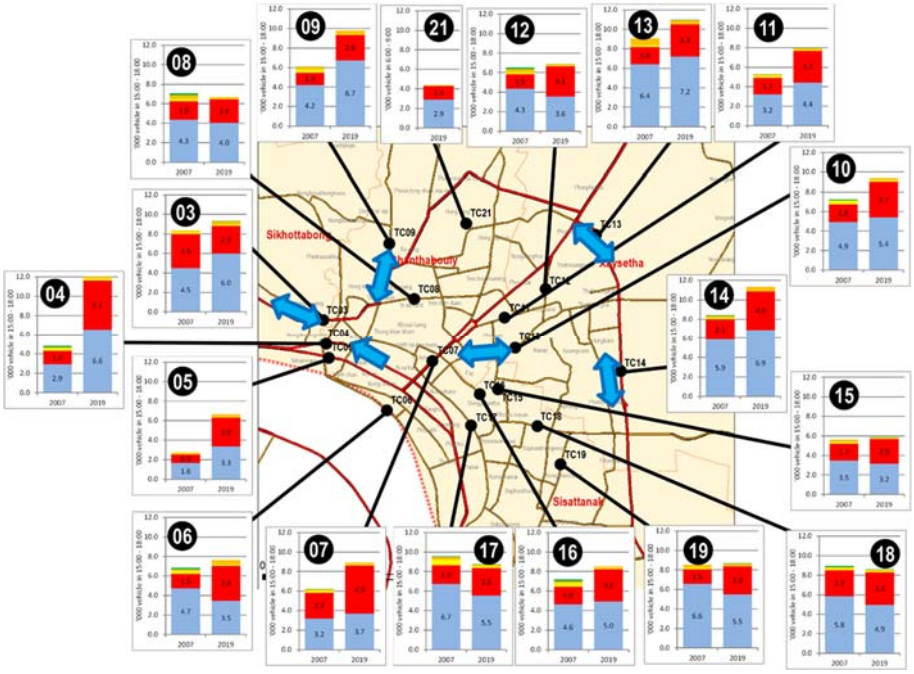
As for the afternoon peak results (15:00-18:00), outer survey locations are presented by Figure 6.1-11. From the results, locations along NR13N were among the locations that recorded the highest traffic volumes, following similar trends to the ones registered in the morning peak.



Source: JICA Expert Team

Figure 6.1-11 Afternoon Peak Traffic Count Results (Outer Survey Locations)

Inner survey locations, as showcased by Figure 6.1-12, followed similar trends to the ones registered by the morning peak traffic count results, with major traffic flows along roads that are currently serving the function of ring/axial roads. Moreover, a summary of the comparison between 2007 and 2019 traffic volumes by transport mode is given in Appendix for Traffic Situation Table 1.1-5.



Source: JICA Expert Team

Figure 6.1-12 Afternoon Peak Traffic Count Results (Inner Survey Locations)

(4) COVID-19 Traffic Survey

As with other countries, the COVID-19 pandemic affected the mobility of people in Laos as a result of safety-related restrictions. In the particular case of Vientiane, the first lockdown restrictions were implemented in April 2020, temporarily having a significant impact on traffic flows. In order to assess whether the temporal restrictions had permanently affected traffic flows, an additional traffic survey was conducted in October-November 2020, once major restrictions on urban road transport had been lifted and in consideration of the project delivery schedule for traffic demand forecast outputs.

Surveyed locations included major points of the cordon/screen line and peak hour traffic count surveys, as shown in Appendix for Traffic Situation Table 1.2-1, Table 1.2-2, and Table 1.2-3. As for survey results, a comparison of between 2019 and 2020 traffic volumes obtained at traffic survey locations is presented in Table 6.1-3. From the results, average traffic volumes varied within around 10% of 2019 levels, with notable exceptions being morning peak traffic counts (18.1% average decrease) and traffic volumes at Friendship Bridge (73% decrease). These notable differences are considered to be related to temporal changes in commuting patterns, rise in work-from-home schemes, and border restrictions at the time in which the survey was implemented. A comparison of traffic volumes by survey location is presented in Appendix for Traffic Situation Figure 1.2-1, Figure 1.2-3, and Figure 1.2-5.

Table 6.1-3 Comparison of Traffic Volumes at Traffic Survey Locations (2019-2020)

Item	Cordon Line Locations	Screen Line Locations	Traffic Count Locations	
			Morning Peak	Evening Peak
Average Decrease (%)	7.8*	5.4	18.1	11.7
Average Increase (%)	8.4	1.9	8.8	7.2

Note: Cordon line locations exclude Friendship Bridge, where a decrease of approximately 73% in traffic volume was reported due to border restrictions that were in place during the implementation of the survey.
Source: JICA Expert Team

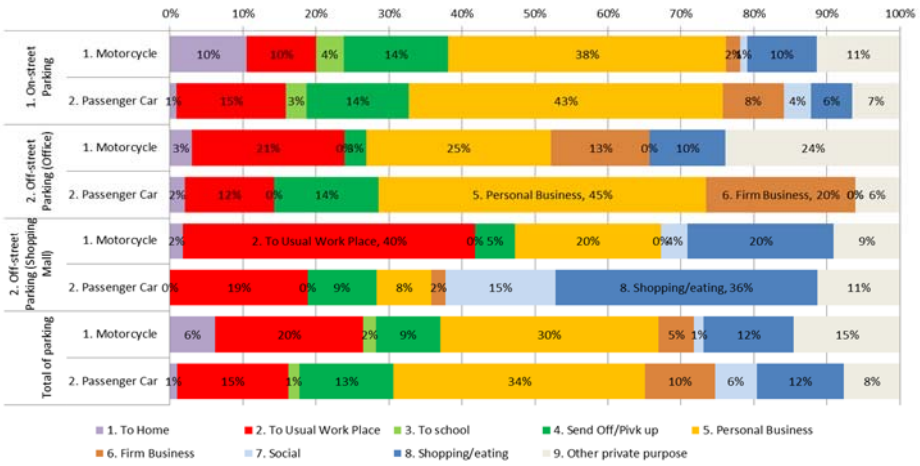
In relation to the observed passenger occupancy, major decreases in average occupancy rates were mainly observed for public transport and paratransit modes, while no major differences were found on occupancy of private vehicles. Detailed average occupancy rates per transport mode can be found in Appendix for Traffic Situation Figure 1.2-2, Figure 1.2-4, and Figure 1.2-9.

From the results obtained, the observed impacts were deemed to be the effects of pandemic-related temporal changes and safety restrictions. Therefore, the observed impacts were not considered to permanently impact the underlying traffic patterns significantly and as a result the future traffic demand forecast was based on 2019 traffic survey data.

(5) Parking Interview Survey

Since the Vientiane Sustainable Urban Transport Project had studied in December 2018 the parking demand in Vientiane's city center, the implementation of a parking survey under the current project focused on obtaining characteristics of parking users, as well as other relevant information needed for the preparation of forecast models. The survey contents consisted of an on-street and off-street parking user interview survey targeting motorcycle and passenger car user, which were aimed at obtaining user information and stated preference in relation to parking regulations and public transport alternatives.

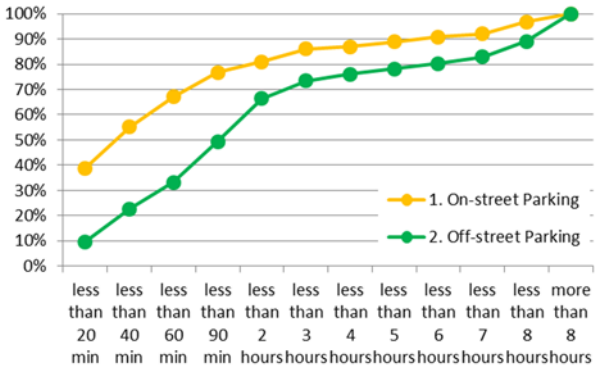
In relation to the survey results, parking purposes for on-street parking, for both motorcycle and passenger cars users, was found to mainly consist in "send-off/pick-off" and "personal business" purposes. Additionally, 10% of on-street motorcycle parking was found to be regarded as home parking. A detailed summary of the parking purpose by parking type and transport mode can be found in Figure 6.1-13.



Source: JICA Expert Team

Figure 6.1-13 Parking Purpose by Parking Type and Transport Mode

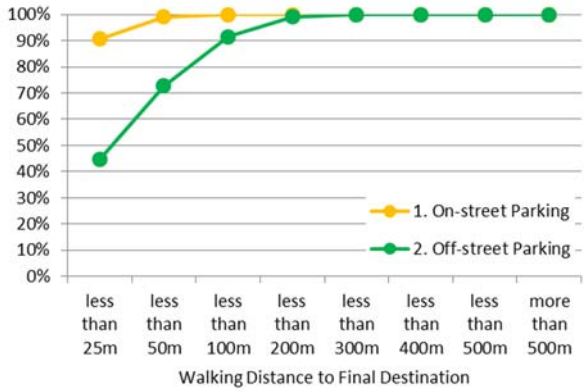
In relation to parking duration, on-street parking duration was found to be shorter than off-street parking, with around 70% of the interviewees reporting parking for less than 1 hour, as presented by Figure 6.1-14. Moreover, no major differences were found between parking duration reported by motorcycle and passenger car users, as shown by Appendix for Traffic Situation Figure 1.3-1.



Source: JICA Expert Team

Figure 6.1-14 Parking Duration by Parking Type

Regarding the walking distance to final destination, around 90% of on-street parking and 45% of off-street parking users walk less than 25m, as presented by Figure 6.1-15. Additionally, in a similar way as parking duration, no major differences were found between motorcycle and passenger car users, as showcased by Appendix for Traffic Situation Figure 1.3-2.



Source: JICA Expert Team

Figure 6.1-15 Walking Distance to Final Destination by Parking Type

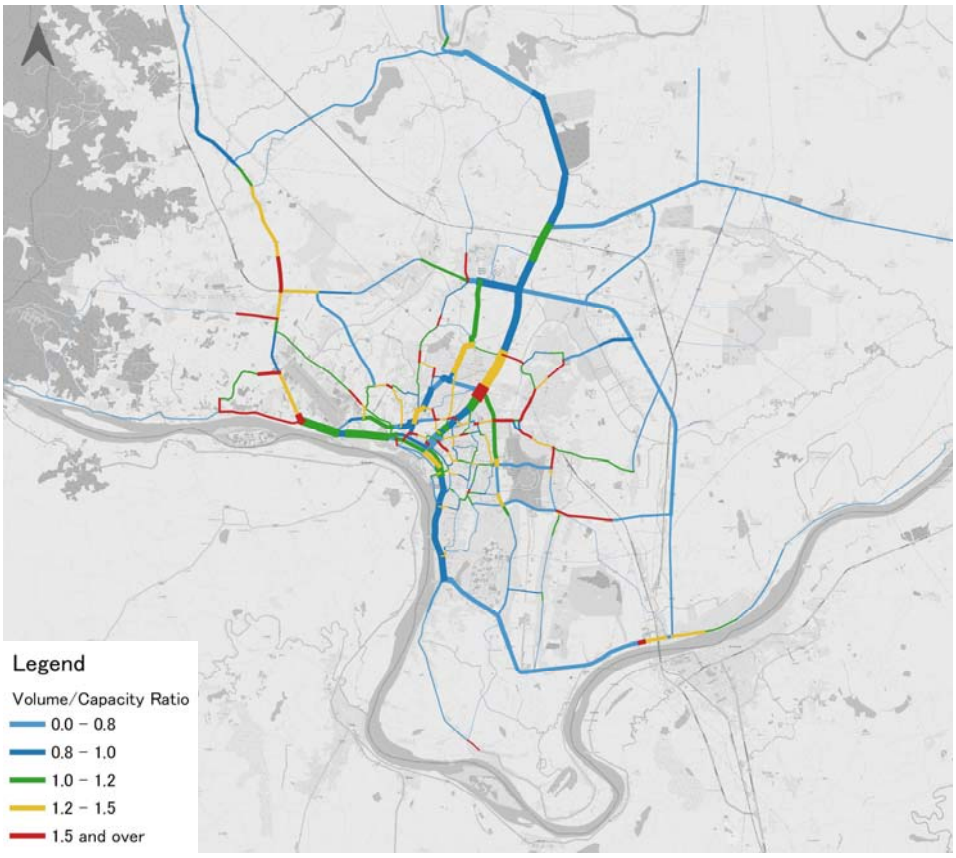
As for the stated preference survey, private purpose trips of motorcycle users were found to be slightly more interchangeable to public transport than business purpose trips. On the other hand, for passenger car users, business trips were found to be more interchangeable than trips with private purposes. However, it is important to note that in both cases the identified differences were small. A summary of the modal choice for motorcycle users by parking purpose can be found in Appendix for Traffic Situation Figure 1.3-3, and for passenger cars user in Appendix for Traffic Situation Figure 1.3-4.

6.1.3 Current Traffic Congestion

In order to assess the current level of congestion in the road network of the TA at the base year of the traffic demand forecast, 2019, a simulation based on the results of the traffic surveys was conducted. Modelling and simulation of traffic conditions as of 2019 was performed using STRADA traffic demand analysis software version 4.0.7.

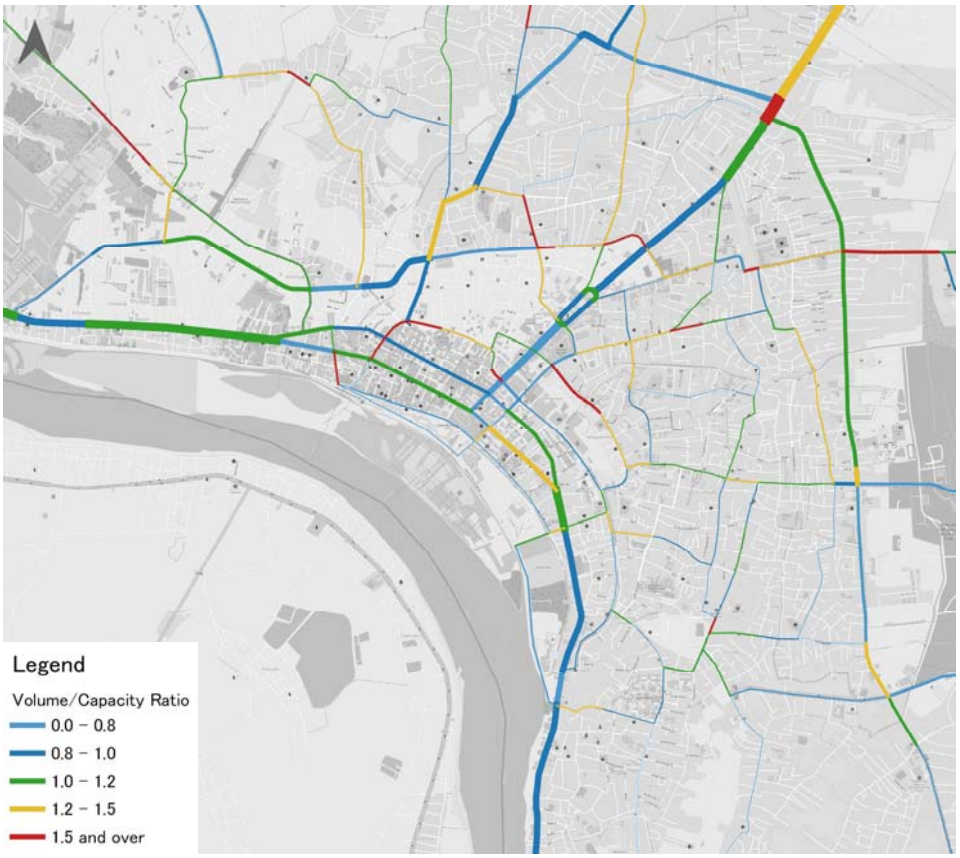
Results are showcased in Figure 6.1-16 and Figure 6.1-17, with traffic congestion being assessed through the volume/capacity ratio. Road sections which are handling traffic volumes below their maximum capacity are shown in blue, while oversaturated roads are displayed in green, yellow, and red in accordance with the level of oversaturation as measured by the volume/capacity ratio. Furthermore, the width of roads in the network is used to represent traffic volumes.

From the modelling and simulation of current traffic conditions, it is visible that some sections of arterial roads are facing traffic volumes that may be surpassing their maximum capacities. Moreover, although the current road network attempts to distribute traffic through some ring and axial roads, the lack of connectivity among them significantly hinders them from achieving their purpose. Thus, traffic is effectively diverted from lower capacity collector roads, a situation that is particularly noticeable in the central area of Vientiane.



Source: JICA Expert Team

Figure 6.1-16 Traffic Situation: Base Year (2019)



Source: JICA Expert Team

Figure 6.1-17 Traffic Situation in Central Vientiane: Base Year (2019)

6.2 WORSENING OF TRAFFIC CONGESTION IN THE FUTURE

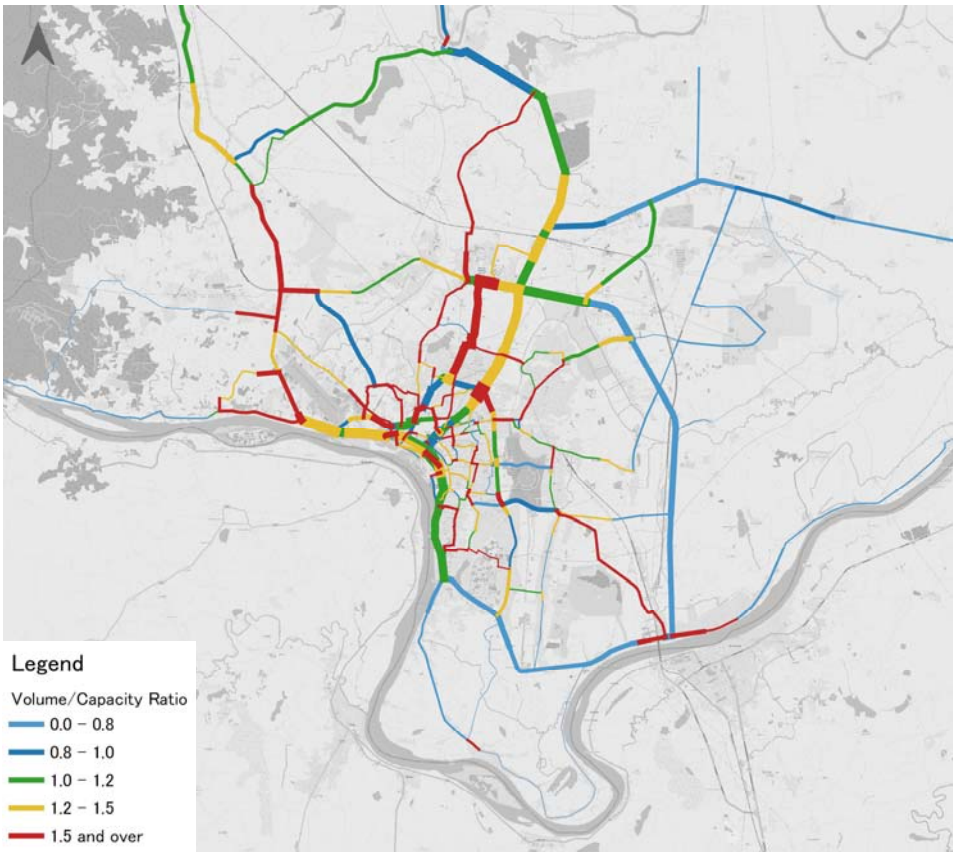
Based on the current conditions relevant to the traffic situation in TA, future traffic conditions were explored in order to assess the case where no action planned in this Urban Transport Master Plan is taken, referred to as the Do-Nothing case. Under this Do-Nothing case, it is assumed that the number of trips within TA will continue to increase following changes in conditions described in the previous chapters, however, no improvements of any kind are conducted and thus the current road network prevails in the future without any changes.

Technical details delineating the overall process for forecasting future trips are described in the Technical Report for Traffic Demand Forecast. In the same way as for the presentation of current levels of traffic congestion, simulations were conducted using STRADA traffic demand analysis software version 4.0.7 and traffic congestion is assessed through the volume/capacity ratio.

6.2.1 Traffic Situation for Do-Nothing Case

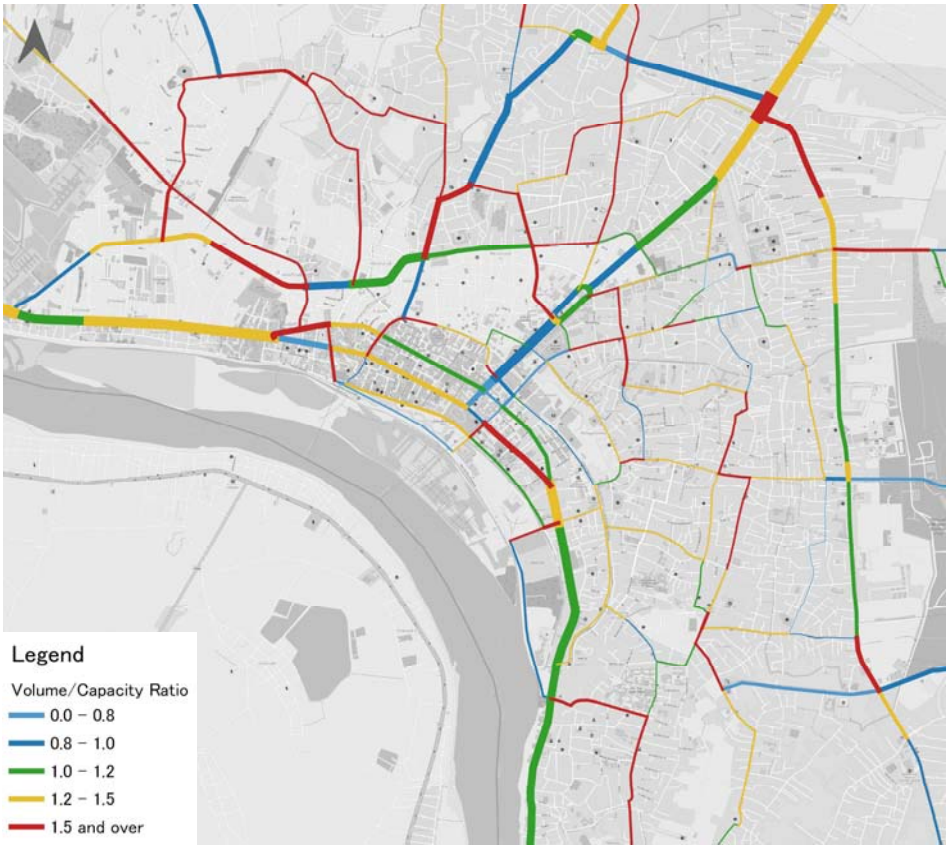
The traffic situation for the Do-Nothing case is presented at three different time periods that corresponds to the short (2027), middle (2032), and long (2040) terms foreseen in the Urban Transport Master Plan.

As showcased in Figure 6.2-1 to Figure 6.2-6, under the case in which the current Urban Transport Master Plan is not followed, traffic congestion is expected to significantly worsen from the levels of congestion presented in the base year of 2019. Furthermore, in a similar way to the current traffic situation, the lack of connectivity among ring and axial roads results in them not being able to effectively divert traffic from lower capacity collector roads and thus causing levels of congestion to rise.



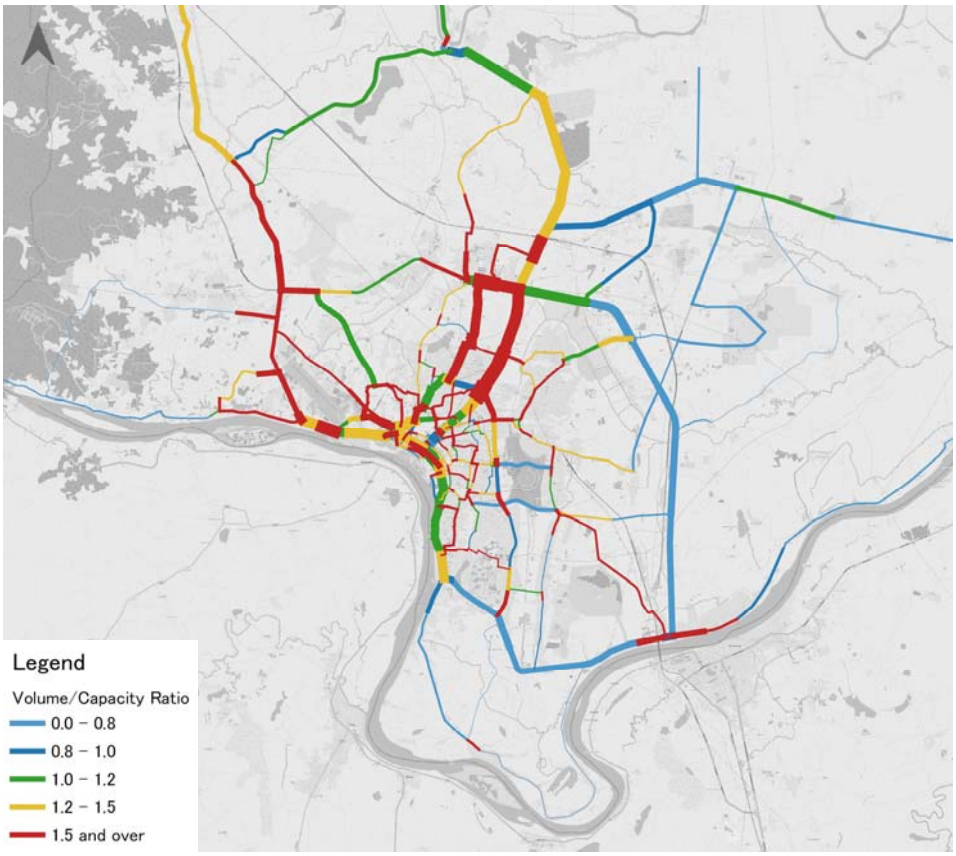
Source: JICA Expert Team

Figure 6.2-1 Traffic Situation: Do-Nothing Case (2027)



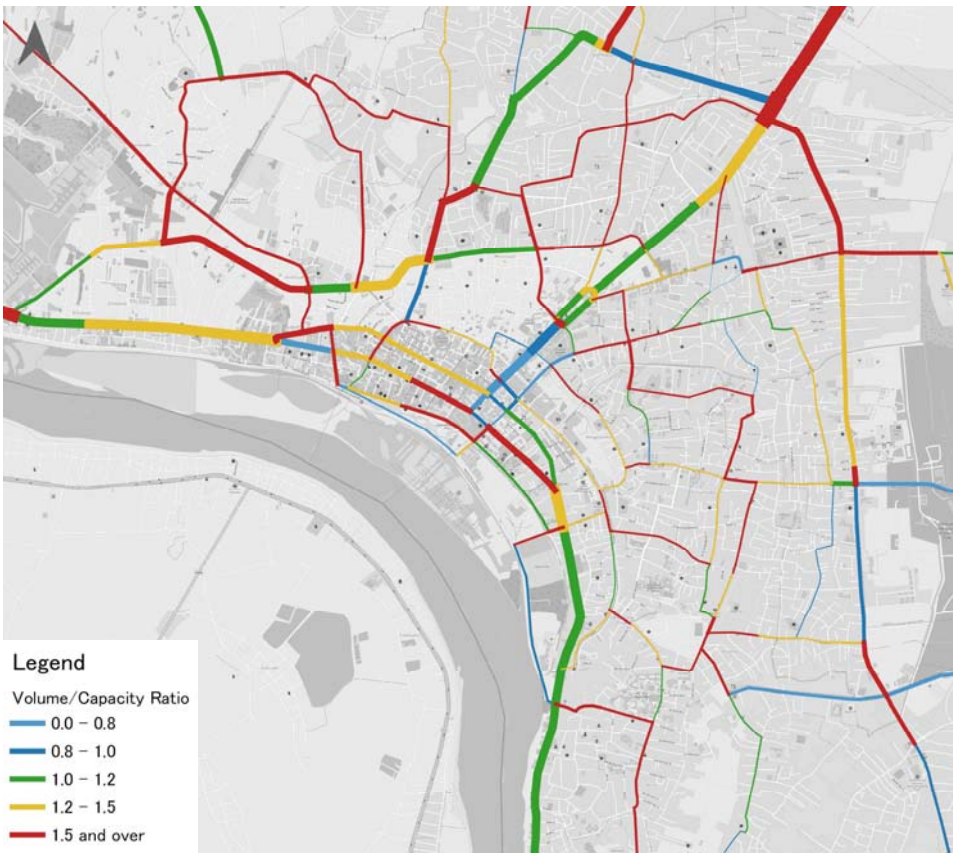
Source: JICA Expert Team

Figure 6.2-2 Traffic Situation in Central Vientiane: Do-Nothing Case (2027)



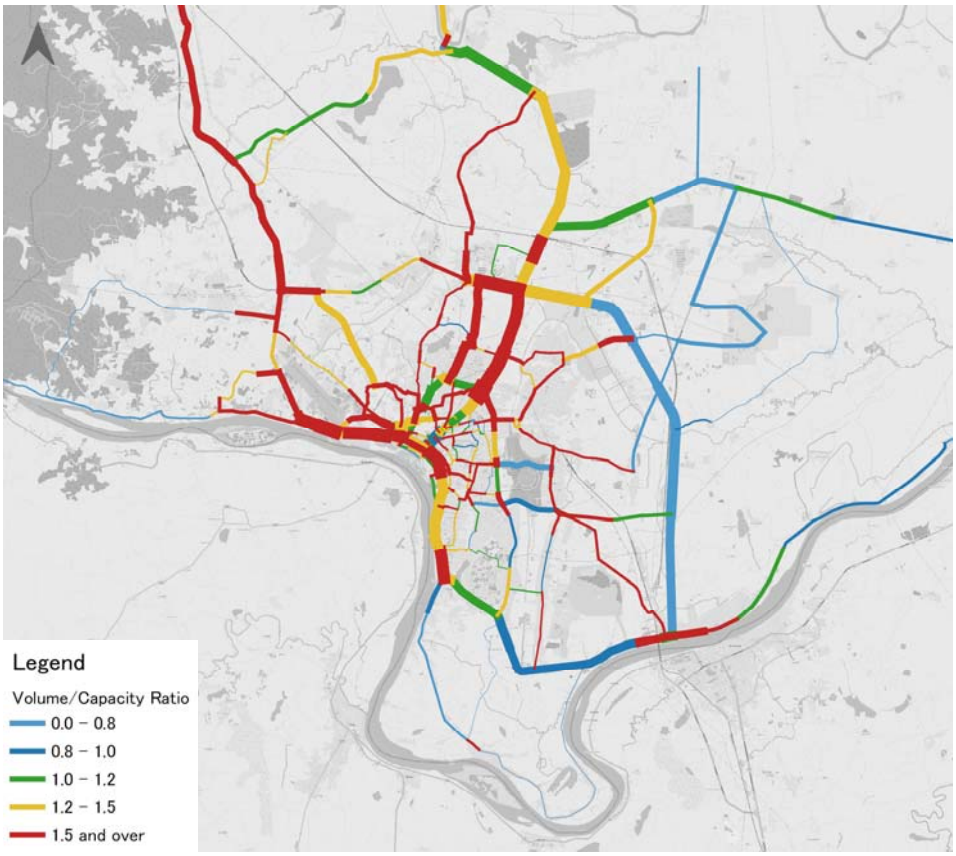
Source: JICA Expert Team

Figure 6.2-3 Traffic Situation: Do-Nothing Case (2032)



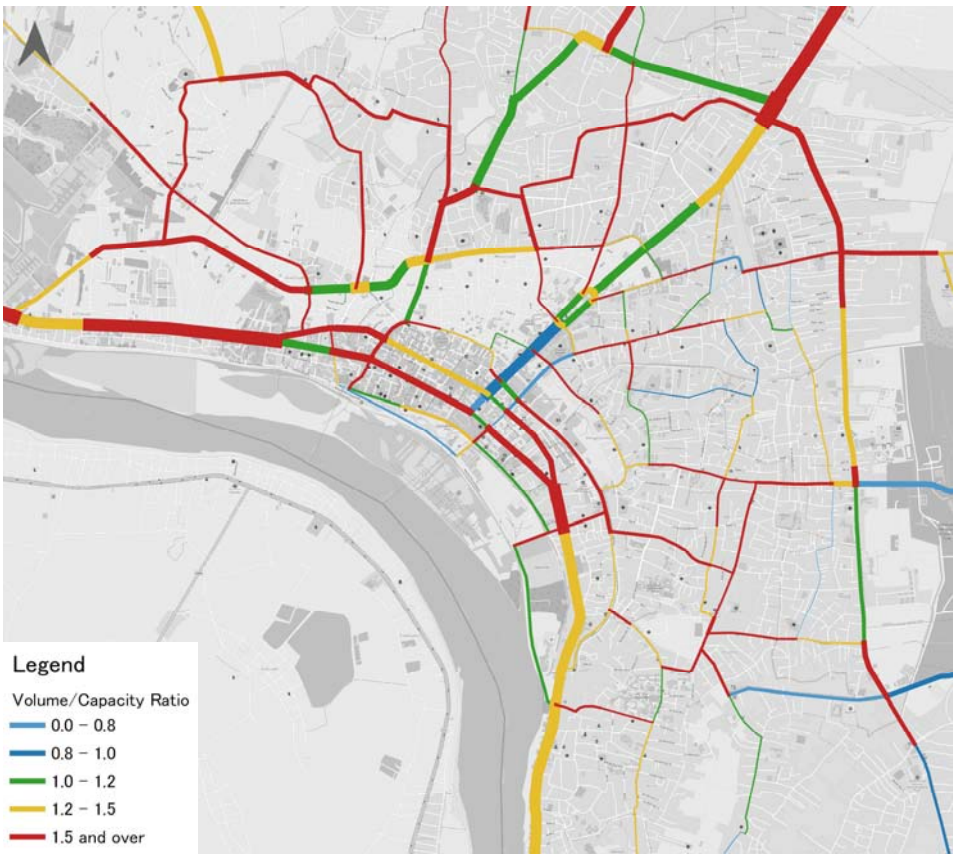
Source: JICA Expert Team

Figure 6.2-4 Traffic Situation in Central Vientiane: Do-Nothing Case (2032)



Source: JICA Expert Team

Figure 6.2-5 Traffic Situation: Do-Nothing Case (2040)



Source: JICA Expert Team

Figure 6.2-6 Traffic Situation in Central Vientiane: Do-Nothing Case (2040)

CHAPTER 7 TRAFFIC MANAGEMENT AND TRAFFIC SAFETY

7.1 TRAFFIC MANAGEMENT

7.1.1 Objectives of Traffic Management

The main objectives of traffic management are to ensure the safe and efficient flow of traffic on existing roads and to reduce the environmental impact. Objectives of traffic management and typical methods for achieving them are listed in Table 7.1-1.

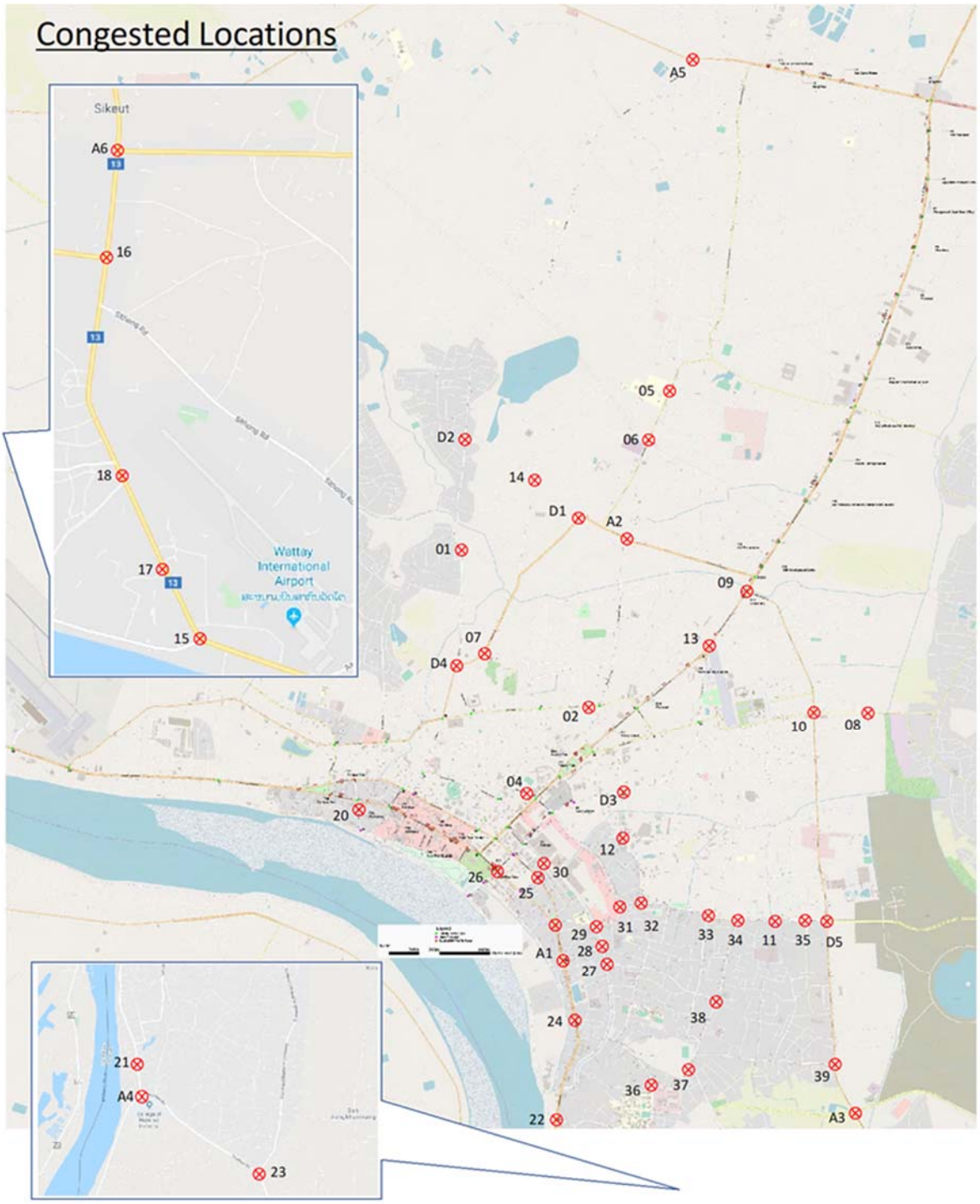
Table 7.1-1 Objectives of Traffic Management and Typical Measures

Objectives		Representative method
Safety	Reduction of accident probability	• Spatial /temporal separation of traffic flow (Sidewalk, Bike path, One way, Traffic signal) • Simplification of traffic flow (designated direction out of the road, induction zone) • Elimination of risk factors (prohibition of parking, removal of falling objects) • Ease of recognition to other transportation (roadway light, curb mirror, stop sign) • Sharing of information regarding to hazard spots and road shape (hazard sign, delineator)
	Rapid rescue of accident victims	• Rapid recognition of accident (emergency call system due to in-vehicle device)
Effectiveness	Effective use of capacity	• Appropriate allocation of capacity (upgrading of signal control, reversible lane) • Elimination of factors that decrease capacity (no left-turn, adjustment of road construction, ETC) • Simplification of traffic flow (passing segmentation each by each direction)
	Distribution of demand (leveling out)	• Avoiding spatial concentration of traffic demand (provision of information, route navigation, road pricing) • Avoiding temporal concentration of traffic demand (provision of information before departure)
	Controlling of demand	• Change towards public transportation (bus lanes, measurement of public transport interchange) • Promotion of usage of bike or walking (bike paths, bike parking lots) • Reduction of traffic demand (HOV, parking regulation)
Environment	Reduction of CO2 emission	• Measurement of traffic smoothness • Controlling of diesel vehicles passing (restriction on a large size car)

Source: JICA Expert Team

7.1.2 Current Congested Points

Based on the suggestions from the counterpart and the survey team, about 50 congestion points in Vientiane were identified as shown in Figure 7.1-1. Initially, the Department of Public Works and Transport (DPWT) had already compiled a list of congested areas in Vientiane. In further discussions were held between the counterpart, those who know Vientiane's traffic conditions, and the JICA expert team. As a result, several additional congestion points were identified and added to the list.

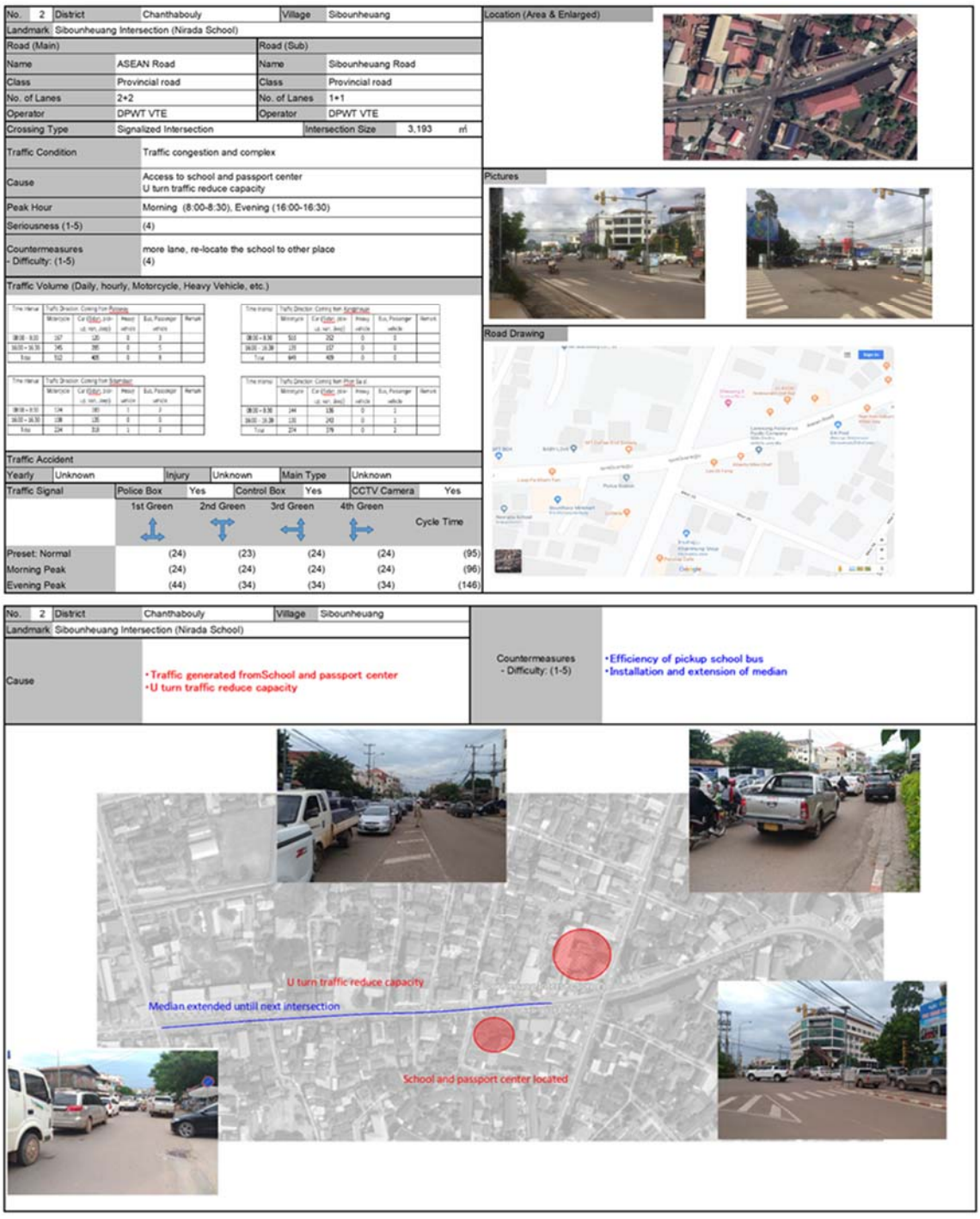


Source: JICA Expert Team

Figure 7.1-1 Current Congested Points

7.1.3 Traffic Analysis Certificates

The congested areas identified in 7.1.2 were individually surveyed and results identifying relevant traffic issues were summarized in certificates, as shown in Figure 7.1-2. These information and diagnosis are separately compiled as Immediate Action Plan.



Source: JICA Expert Team

Figure 7.1-2 Traffic Analysis Certificates

7.2 TRAFFIC SAFETY

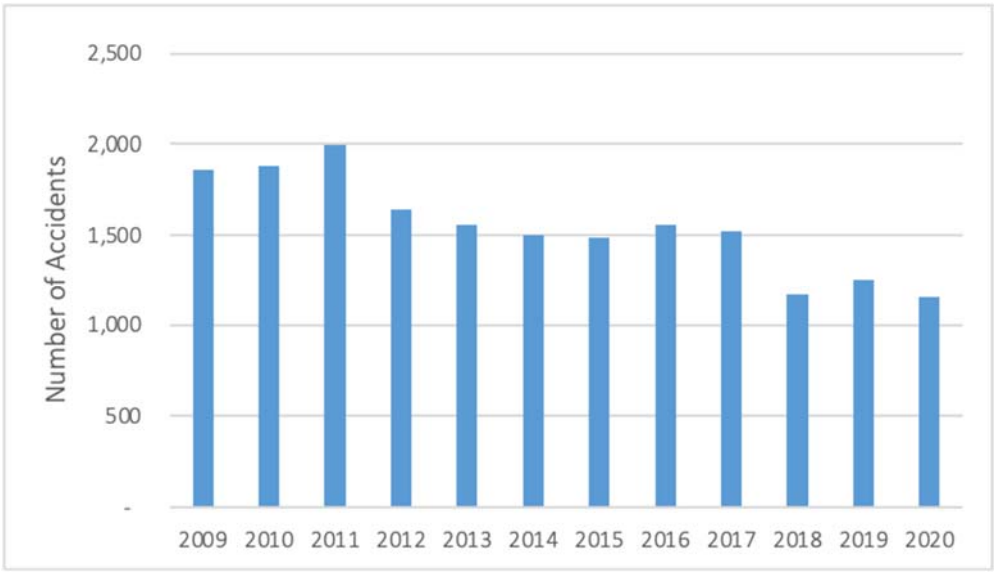
This chapter discusses the various problems and issues relevant to technology in traffic safety, traffic safety education, and traffic enforcement based on the available traffic accident data at present. This discussion is aimed at reducing traffic accidents in Vientiane in an effective manner.

7.2.1 Traffic Accident and Enforcement

Department of Traffic Police (DTP) is currently in the process of implementing the "Lao PDR Road Safety Action Plan". This in addition to carrying out the monitoring of outcomes through the collection of traffic accident/enforcement data. This effort attempts to gather and analyze the traffic accident/enforcement data in Vientiane in a more detailed and precise manner. These traffic accident/enforcement data are summarized every month and reported to DPWT and MPWT. This section uses the 2009 to 2020 traffic accident data and the 2019 enforcement data from MPWT.

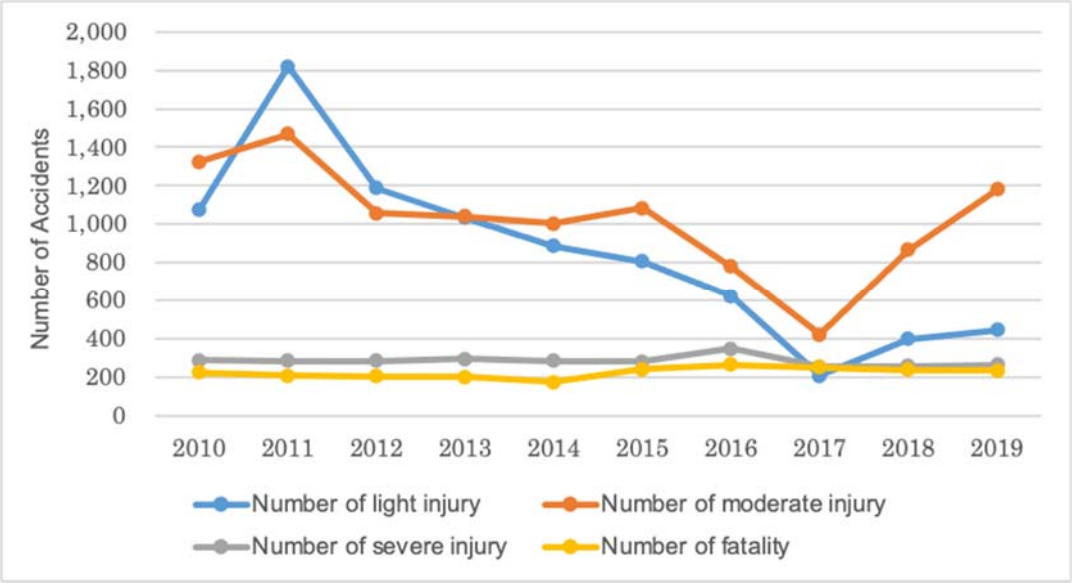
(1) Trend of Traffic Accidents

The trend of traffic accidents is shown in Figure 7.2-1. The number of total accidents is gradually declining. Moreover, the trend of injury/fatality by traffic accident, shown in Figure 7.2-2, showcases that the number of light/moderate injuries are clearly in decline. However, the number of severe injuries and fatalities, while it is not considered to be a high value, has kept constant at around 200-300 cases.



Source: Department of Transportation.

Figure 7.2-1 Trend of Traffic Accidents



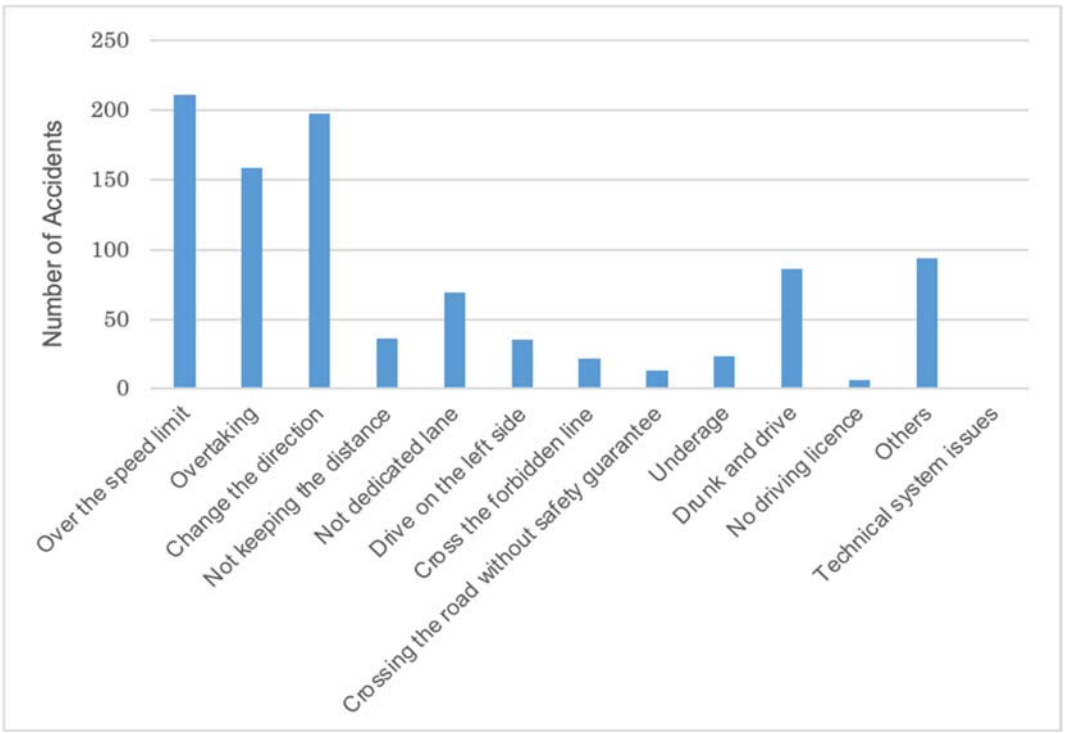
Source: Department of Transportation.

Figure 7.2-2 Trend of Injury/Fatality by Traffic Accident

(2) Major Causes of Traffic Accidents

Figure 7.2-3 illustrates the number of traffic accidents by cause. From Figure 7.2-3, accidents are mainly caused by the following reasons:

- Driving over the speed limit
- Overtaking
- Changing direction
- Drinking and driving



Source: Department of Transportation.

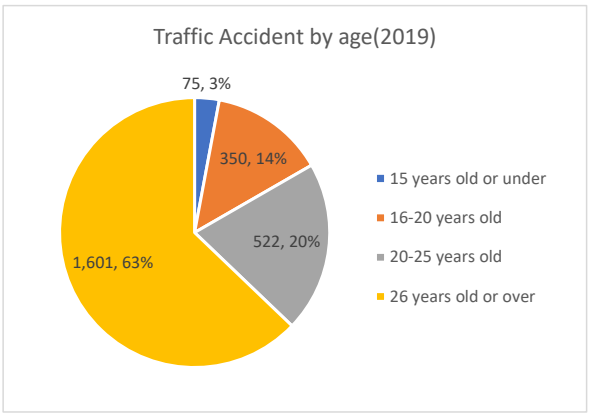
Figure 7.2-3 Number of Injuries/Fatalities by Cause

Source: Department of Transportation

Figure 7.2-4 illustrates the ratio of traffic accidents by age, in 37% of all traffic accidents persons under 25 years old are involved. Furthermore, Source: Department of Transportation

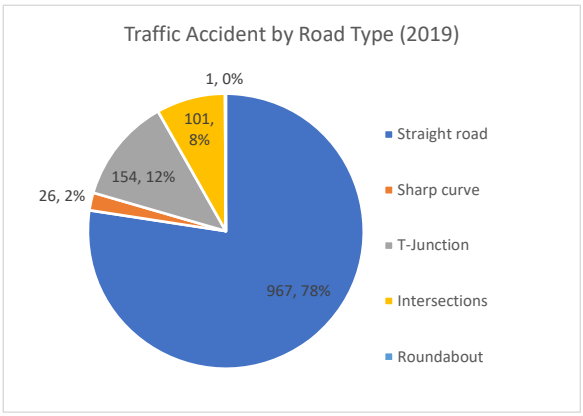
Figure 7.2-5 illustrate the ratio of traffic accidents by type of road section. According to Source: Department of Transportation

Figure 7.2-5, 78% of all traffic accidents occur on straight roads.



Source: Department of Transportation

Figure 7.2-4 Ratio of Traffic Accident by Age

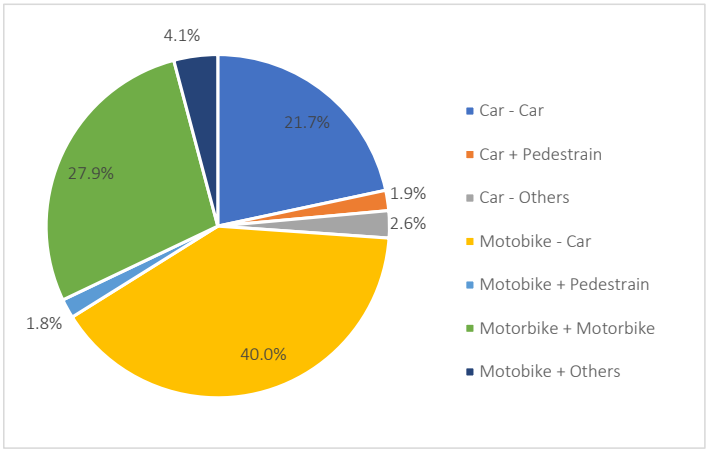


Source: Department of Transportation

Figure 7.2-5 Ratio of Traffic Accident by Road Type

Source: Department of Transportation

Figure 7.2-6 illustrates the types of vehicles involved in traffic accidents in 2019. Accidents between a vehicle and a motorcycle were the most common, representing 40.0% of all accidents. The ratio of accidents related to vehicles not including motorcycles is 26.2%, while the ratio of accidents related to motorcycles not including vehicles is 33.8%.



Source: Department of Transportation

Figure 7.2-6 Ratio of Traffic Accident by Type of Vehicles and Obstacles

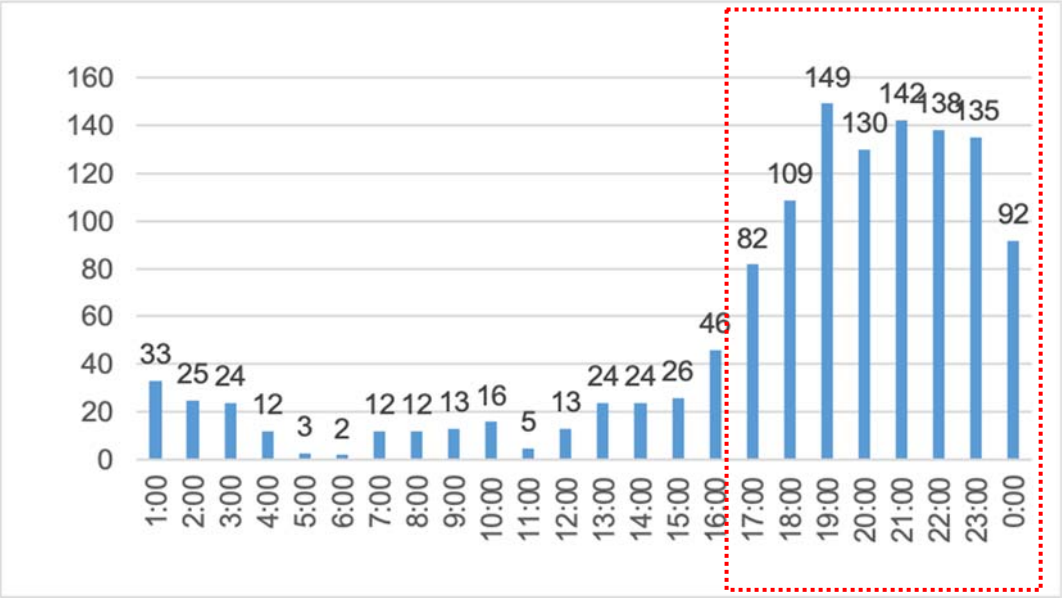
(3) Hourly Variations of Traffic Accidents

Figure 7.2-7 illustrate the hourly variations of traffic accidents in 2019. From the showcased data, the following observations can be made.

Traffic accidents tend to happen more frequently between the 7-hour-period going from 17:00 to 24:00. Within this period a total of 977 accidents were recorded, representing 77% to the total

number of traffic accidents in 2019. In particular, the period from 19:00-20:00 has the highest percentage share of traffic accidents, at 12%, or 149 accidents.

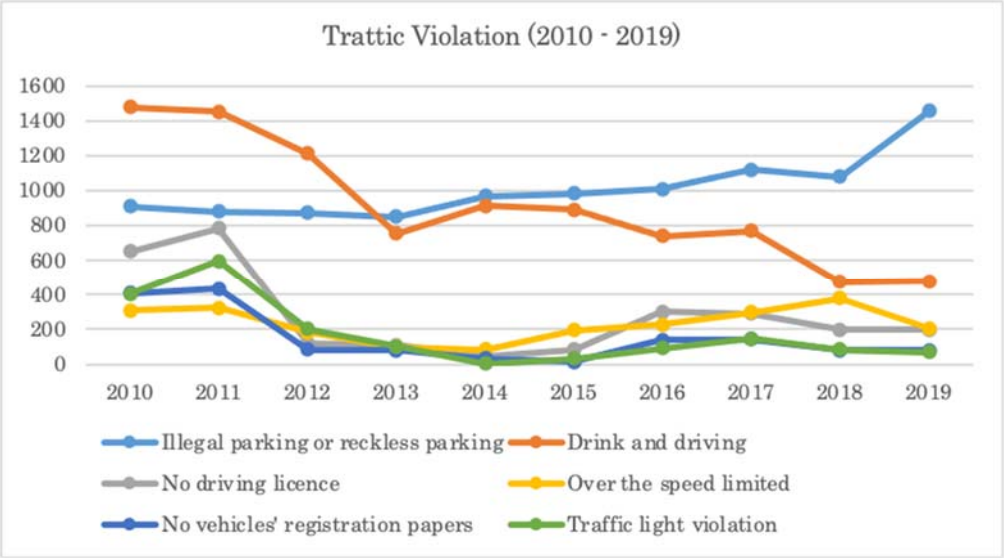
Possible reasons for this pattern of accident occurrence could be poor visibility during these time periods as dusk occurs, or when alcohol consumption is customarily higher in Lao PDR.



Source: Department of Transportation.

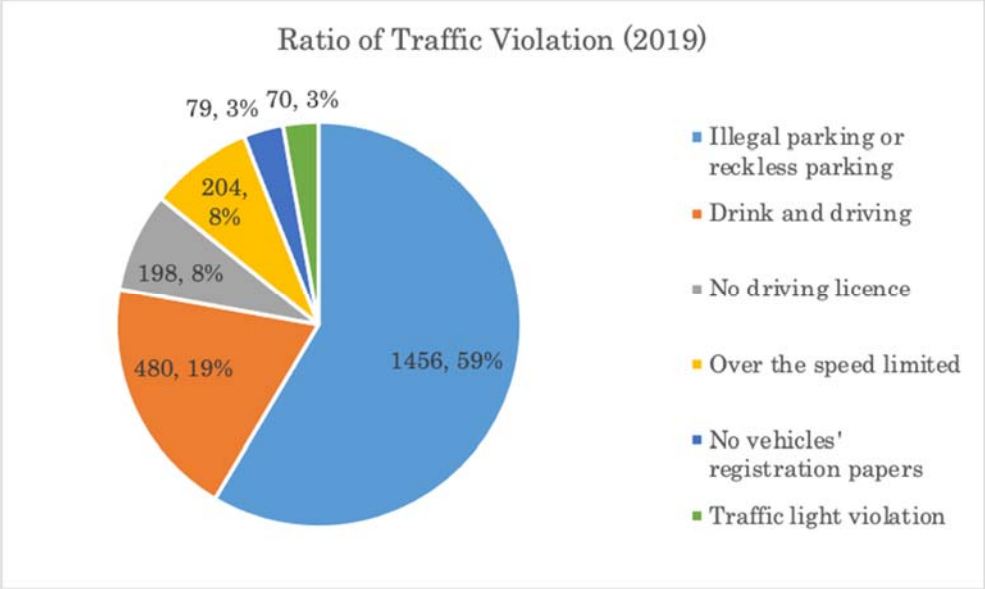
Figure 7.2-7 Traffic Accident by Time

- The trend of traffic violations is shown in Figure 7.2-8 and Figure 7.2-9. The number of drinking and driving cases is gradually declining. On the other hand, the trend of illegal parking or reckless parking increased until 2019. The number of other violations is relatively small compared to the above violations, but the number of driving without a driver's license and driving over the speed limit totaled around 200 cases.
- Regarding the ratio of each traffic violation, the highest ratio is illegal parking or reckless parking, accounting for about 60% of all traffic violations. The next one is drinking and driving, accounting for about 20%. These two violations account for about 80% of all violations.



Source: Department of Transportation.

Figure 7.2-8 Trend of Traffic Violations



Source: Department of Transportation

Figure 7.2-9 Ratio of Traffic Violations

CHAPTER 8 SOCIAL AND ENVIRONMENTAL CONSIDERATION

8.1 ENVIRONMENTAL LEGISLATION

8.1.1 Environmental Laws in Lao PDR

The Urban Transport Master Plan and its related projects are required to follow relevant environmental legislation. Thus, in this section, key legal codes recently enacted after 2010 are summarized. Key relevant legal framework/regulations/guideline of those studies are summarized in the table below.

Table 8.1-1 List of Recent Enacted Environmental Codes in Lao PDR

SEA	ˇ Guidelines on Strategic Environmental Assessment, Lao PDR (No: 6616/MONRE, Vientiane Capital City, Date: 31 December 2018) ˇ Decision on SEA approved by Minister of MONRE, No 0483/MONRE, Date 06 February 2017 ˇ Environmental Protection Law (amendment: No:29/NA Date 18 December 2012, Article 19)
IEE/EIA	ˇ Degree on Environmental Impact Assessment (the Degree on EIA) (No.21 MONRE 2019) ˇ Agreement on National Environmental Standards (Promulgation of the Decree on Accreditation and Promulgation of National Environmental Standards No. 81/Rev, dated February 21, 2017) ˇ Environmental Impact Assessment Guidelines（2012） ˇ Decree on Environmental Impact Assessment (112/PM, 2010) ˇ Regulation on Environmental Assessment in the Lao PDR（2002）

Source: This Study, 2023

8.1.2 Compensation and Resettlement in Development Projects in the Lao PDR

summarizes major legal codes of land-take and resettlement in Lao PDR. Within Lao PDR's Constitution, it is declared that land is a national heritage. The Land Law (2003) clarifies that groups or individuals can acquire land legally in three ways: allocation by the state, transfer (defined as 'sale, transfer or exchange'), and inheritance (Articles 52, 57, and 58). In Lao PDR, the compensation principles and policy framework for land acquisition and resettlement are governed by the following laws, decrees, and regulations.

Table 8.1-2 Major Legal Codes of Land-Take and Resettlement

	Legal Codes/Regulations	Descriptions
1	Constitution (2003)	Article 16 of the Constitution declares that the State protects and promotes all forms of property rights: State, collective, and private domestic and foreign investment in the Lao PDR. Article 17 states that the State protects the property rights (such as the rights of possession, use, usufruct, and disposition) and the inheritance rights of organizations and individuals. It also declares that land is a national heritage, and the State ensures the rights to use, transfer, and inherit it in accordance with the laws.
2	Land Law (2003)	Adopted by the National Assembly in 2003 (supersedes the Land Law 01/97 dated 12 April 1997), the Land Law is the principal legislation by which the State exercises its constitutional responsibility for tenure, access, use, management, and preservation of land. Compensation is treated in Articles 68 to 72 of the Land Law. Article 70 states that persons or entities requiring a right-of-way and who thereby cause damage to crops or buildings must make appropriate compensation. Article 71 was added to the amended law. It states that when the use of land belonging to other persons or organizations becomes necessary for the public interest, the State will compensate any damage suffered by the rightful user of the requisitioned land, as appropriate. Furthermore, the Law requires that each village, province, municipality, or special zone keep 5% of its total land area in reserve to ensure the compensation of requisitioned land.
3	Road Law (1999)	In this law, MPWT is the responsible ministry for the management and supervising lands allocated for transportation activities. Road width shall have the area consisting of carriageway, shoulders, pathways, drainages, slope of road, and Right of Way (RoW) (Article 17). All construction and other activities are banned within RoW except in extraordinary cases, for which the permission to initiate activities is to be requested from the road management authority (Article 21).
4	Forestry Law (2007)	This law sanctions the conversion of forests and forest land to other uses (i.e., for transmission line right of way) when necessary and in the public interest (subject to approval from responsible authorities). It however places responsibility on individuals or organizations given permission to convert forest to another use to pay a conversion fee, perform land reclamation, and plant trees. The law allows the continuation of long practiced activities such as collecting wood for fences and fuel, non-timber forest products (NTFP), hunting and fishing for non-protected species for household consumption, and other customary uses.
5	Decree of the Prime Minister on Compensation and	The Decree and Regulations adopted in 2005 & 2010 under Water Resource and Environment Administration (WREA (currently MONRE)) define principles, policies, & procedures for land acquisition, compensation and resettlement for all development projects including those funded by

	Legal Codes/Regulations	Descriptions
	Resettlement of People Affected by Development Projects (Decree 192/2005)	the Government of Lao PDR, private investors and/or donors. Technical guidelines include regulations which cover all stages of project development from project identification and pre-feasibility studies through construction & operation of the project.
6	New improved decree 699/ PMO-WREA (currently MoNRE) dated 12 March 2010 on Compensation and Resettlement of the Development Projects.	The technical guidelines included in this regulation cover all stages of project development, from project identification and pre-feasibility studies through construction and operation of the project.
7	PM Implementation Decree 101/PM, 20 April (2005)	Article 25 presents various goals for expropriation or requisition of private land, which are defined as follows: 1. Land for public facilities, 2. National defense, 3. National security, 4. Specific development by the State, 5. Accessing irrigation systems, canals, electricity wire installation, water pipes, etc. Article 24 mentions the 'withdrawal' of land use rights and refers to Article 62 of the Land Law, elaborating on the 4 types of 'loss of land use rights', while land expropriation is set in the Article 63 entitled 'termination of land use rights'. Article 24 states 'The Government and the Land Management Authority are charged with making the decision on the withdrawal of land use rights and land utilization rights within the scope of their right and power'…and the person subjected to the withdrawal must be informed in writing at least 6 months in advance.
8	PM Decree on the Implementation of the Land Law No 88, 03 June (2008)	Provides the most detailed definitions of relevant terminologies, such as state land, collective land, land use, land use rights, land utilization rights, land concession, etc. Article 28 on compensation for the losses of land states that the damage to the concerned person will be compensated on a case-by case basis as follows: 1. In case of necessity to use land for public facility, national defense, national security or using the land for specific development purposes by the state 2. Use land for the purpose of building passage way, irrigation canal, electric wire track. The compensation of the losses may be paid in cash or in kind, or by providing land in exchange, based on the mutual consent reached by the two parties in an appropriate manner
9	Mining Law (1997)	Article 47 states the following: Mining operators shall perform the following compulsory expenses such as ① Resettlement of the population from the mining and ensure their livelihood, ② Compensation of damage to land, constructions and crops, ③ Rental of land, ④ Environmental protection, and ⑤ Improvement and rehabilitation of the mining area. Such funds shall be included in the capital of the mining projects.
10	Law on Investment Promotion (2009)	The law stipulates principles, regulations and measures regarding the promotion and management of domestic and foreign investment in Lao PDR. It aims at a centralized and uniformed management of investments, to increase the overall investment climate of the country and to be in line with national policy and existing rules and regulations. The law thereby sets the overarching framework for investment in land leases or land concessions.
11	PM Decree 135 on State Land Lease and Concession (2009)	This decree divides land concessions into administrative and commercial types, and outlines the requirements to be met for granting land concessions of state land. Before determining the area to be leased or conceded it is necessary to do a land survey, prepare a land map and prepare a land use map. If the area to be leased or conceded extends into the land of the people or individual land, the land use rights of the corresponding parties should be maintained by advising the lessee or concessionaire to conclude contracts with the land owners, or to give such land into a share.

Source: JICA, 2014

8.2 ENVIRONMENTAL MANAGEMENT SYSTEM

8.2.1 Organization

Following table summarizes relevant environmental agencies and institutions of both SEA and EIA/IEE process.

Table 8.2-1 Key Environmental Agencies and Institutions Within VTMP

SEA	MoNRE (Ministry of Natural Resources and Environment)
IEE/EIA	DoNRE (Department of Natural Resources and Environment) at Vientiane

Source: JICA Expert Team, 2023

8.2.2 Environmental Standards

The Environmental Protection Law (EPL) (1999), of which a new version was issued in 2012, is the main piece of environmental legislation in Lao PDR at the national level. The EPL mandates that MONRE and the Prime Minister's office be the main government agency responsible for environmental protection. In 2017, a new legal code, entitled "Decree on National Environmental Standard (2017)" was issued encompassing the air quality, water quality, soil quality and others.

8.3 ENVIRONMENTAL CHARACTERISTICS IN VIENTIANE

8.3.1 Protected Areas

Forest Law categorizes the forest in Lao PDR into three categories for the purpose of preservation and development: Protected Forest, Conservation Forest, and Production Forest. Definitions for each type of category are summarized in Table 8.3-1. Forest in the National Biodiversity Conservation Areas (NBCAs) is categorized into Conservation Forest. In the Law, it is not allowed to cut trees, mine mineral resources, and convert lands to other uses in Protected Forests and Conservation Forests. However, with the official procedure along with the government, lands in the protected areas may be transferred to other purposes.

Table 8.3-1 Description of Forests in Lao PDR

Category	Expected Functions
Protection forests	- Protection of water resources, riverbanks and roadsides - Prevention of soil erosion, protection of soil quality, and strategic areas for national defense - Protection from natural disasters, environmental protection and so on
Conservation forests	- Conservation of nature - Preservation of plant and animal species, forest ecosystems, and other valuable sites of natural, historical, cultural, tourism, environmental, educational, and scientific research experiments.
Production forests	- Production uses, as well as wood and forest product businesses which satisfy the requirements of national socioeconomic development and people's living.

Source: Forest Law (2007)

Table 8.3-2 summarizes the list of protected areas at the national and provincial levels in Vientiane Capital and Figure 8.3-1 shows the locations of those protected areas in the central area. The current condition and management policies of nearest forest reserves and national park are to be briefly described later.

Table 8.3-2 List of Protected Areas in Vientiane Capital

No	Items	Total Area (ha)	Area Covered by Vientiane Capital (ha)	Village/District Location	Function
1	Phou Khao Khoay	200,000	33,400	Xaythany and Mayparkngum districts	National Protected Area
2	Phou Phanang	70,000	46,000	Sikhottabong, Naxaithong and Sangthong districts	National Protected Area
3	Dongphosy	1,793.25	1,793.25	Xaysetha district: Xiengda village, Nakhuay village Hadxaifong district: Nong Hieo village, Dongphosy village, Dong Khamsang village.	Provincial/Capital Protected Area
4	Dong Houay Gnang	808	808	Xaythany district	Provincial/Capital Protected Area
5	Dong Banxay	788.75	788.75	Xaythany district: Dong Sanghin village, Phokham village, Xaysomsouk village, Khok Sa At village, Phonthon village, and Nakhok village	Provincial/Capital Protected Area
6	Done Xang Fay	48,548	48,548	Mayparkngum district	Provincial/Capital Protected Area

Source: JICA (2013)

8.3.2 Natural Environmental Conditions

Lao PDR is located in the middle of Indo-China Peninsula and shares borders with five countries: Thailand, Cambodia, Vietnam, China, and Myanmar. The country is a land-locked country with rich forest and has valuable and ecologically abundant natural resources. Vientiane Capital is the capital city of the country and is located in the alluvial plain of the Mekong River.

As per the country as a whole, the project area enjoys a tropical climate with two seasons: the rainy season from April to October and the dry season from November to March. Annual rainfall in Vientiane area ranges from 1,140 to 2,290 mm per annum, based on data from 1976 to 2005, and

has an average rainfall of about 1,600 mm. Cyclones and depressions, which generate in the South China Sea affect the hydro-meteorological temperature, ranging from 22.3 to 34.3 degrees Celsius degrees and with an average humidity that ranges from 50 to 91 percent.

Average elevation of the Vientiane Capital is 159 m. The area along the Mekong River, especially the urban area in Vientiane Capital, is alluvial plain consisting of a sandy gravel layer covered with clayey soil. The former is composed of sand, gravel, shingle, clay and peat, while the latter consists of gravel, shingle, sandy, kaolinite and laterite.

The Mekong River is an international river, flowing in Lao PDR, Cambodia, China and Thailand, and is utilized for various purposes, such as water transport, water supply, and hydro-power supply for people living in the surrounding countries. The water level of Mekong River varies by about ten meters between the dry and rainy seasons.

8.3.3 Social Environmental Conditions

Vientiane is the capital and the largest city of Lao PDR. The capital is divided administratively into 9 districts, has a total area of about 3,920 km^2, and is located on the banks of the Mekong River, close to the Thai border. Vientiane was the administrative capital during French rule and, due to economic growth in recent times, is now the economic center of Laos. The city had a population of 1,001,477 as of the 2023 Census.

Vientiane is noted as the home to one of the most significant national monuments in Laos, Pha That Luang, which is a known symbol of Laos and an icon of Buddhism in Laos. Vientiane Capital has several historical heritage sites and cultural assets, as shown in Figures 8.3-1 and 8.3-2, with most of them concentrating in the city center. However, in the project area, there are no archaeological resources.

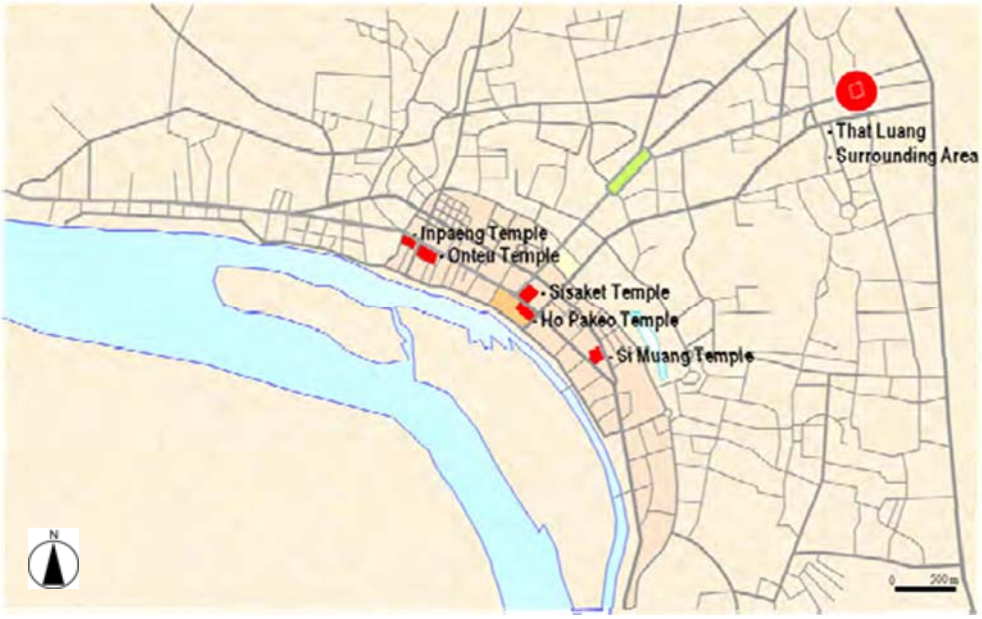
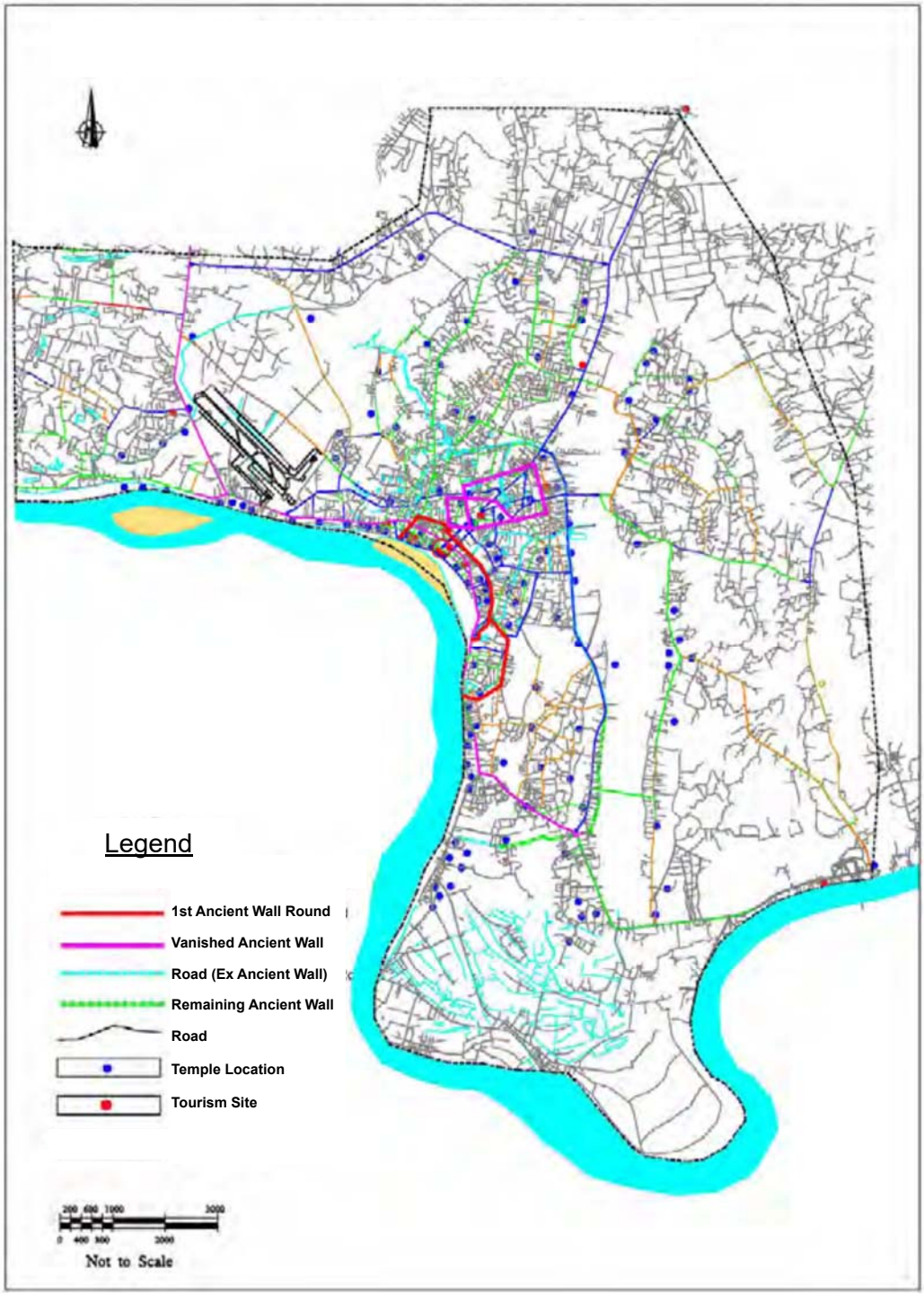


Figure 8.3-1 Heritage Site in the Vientiane City



Source: The Comprehensive Study on Logistics System in Lao PDR (2011)

Figure 8.3-2 Heritage Sites in Central Vientiane Capital

8.3.4 Constraints on Urban Development

Development of the urban space in Vientiane has been driven by different players. During the colonial period, urban space was rebuilt many times. From 1893-1953, French colonial authorities restored, planned and redeveloped the city. In post-colonial time, the city was repaired, designed and developed further through the construction of roads, offices and residences from inner to outer urban zones. The urban development vision has adjusted to global development trends, especially principles of the sustainable development. The vision has been implemented by several means, such as through the principles of marketization, privatization, and neo-liberalization, using the urban master plan and urban development strategies. In the early 2000s, neo-liberal policy has been

used in the urban development planning, linking the city into structures of the global capital.

Converting the land into capital is an economic policy that utilizes natural resources for the development through the granting of concessions. The policy was initially designed to reduce the spending of the state on the infrastructure development. As a result, many state agencies have been relocated to the suburban and outskirt areas. Similarly, some urban communities have been relocated from urban sites. The process was approved by the central government with the participation from local authorities, bureaucrats, local people, and investors. All methods have transformed the urban landscape, local livelihoods and the state land under the planning for the urban redevelopment. The shift has resulted both in direct and indirect beneficiaries.

For future urban development in Vientiane, there are many issues remaining to be addressed. These include urban governance, public space management, urban gentrification, everyday life, and the rights to the city. Without further studies into these areas, it will not be possible to understand many urban-related questions. At the same time, it is recommended that public policy-makers and related state authorities shall promote the participation of different stakeholders in decision-making process.

There are two possible successful approaches for the master plan implementation: the top-down approach and the bottom-up one. The top-down approach deals with strategic development direction, defined by the master plans. It is suggested that in the framework of implementing a master plan, economic, environmental, financial, and social norm instruments should be applied in combination with regulative devices, as the later solely could be ineffective. On the other hand, the bottom-up approach emphasizes on the community empowerment and the inclusion of people at the grass-root level into development processes. In order to move forward the collective actions within the implementation of the Urban Transport Master Plan, it is crucial to encourage a common understanding by sharing directions and collaborating with various sectors.

Within the VTMP study, a participatory strategic environmental assessment (SEA) study was initiated in January 2022. First of all, a common prototype discussion platform was established in order to disseminate VTMP-related information across various stakeholder while sharing common understanding of VTMP. Series of workshops and stakeholder meetings were conducted in order to collect possible feedback from stakeholder, that would be incorporated within VTMP revising process. In total, various stakeholder groups such as 37 relevant governmental organizations as well as Lao Women's Union, Lao Youth Union, and Small and Medium Enterprises Association participated. So that, this participatory SEA can be categorized as one of the bottom-up approach, mentioned above.

Counterpart agencies such as MPWT, DPWT and DoT recognized the usefulness of this SEA study approach to implement the urban planning of Vientiane. It is essential to encourage those counterpart agencies to deepen their understanding of this participatory SEA and to continue to use this discussion platform for medium and long-term planning process in order to achieve smooth consensus of future urban development activities.

8.4 GEO-DESIGN

Using environmental information, summarized within previous sections, then, next step is to how to incorporate that information into the urban transport planning and/or the master plan development processes. Most of that information, mentioned above, would be crucial points to be addressed carefully through a series of consultations and/or discussion with various stakeholders.

The geo-design is one of useful concepts and methods in order to get all stakeholders and various professions involved in collaboratively designing and realizing the optimal solution for spatial challenges, utilizing all available techniques and data in an integrated process. This design technique includes the project conceptualization, analysis, design specification, stakeholder participation and collaboration, design creation, simulation, and evaluation (among other stages). Figure 8.4-1 shows one of typical landscape design process, using geographic information system (e.g., Stenitz et. al., 1996).

This geo-design process brings the geographic analysis into the design process, where the initial

design sketches are instantly vetted for the suitability against myriad database layers describing a variety of physical and social factors for the spatial extent of the project. This suitability analysis provides a framework for the design, giving land-use planners, engineers, transportation planners, and others involved with design, tools to leverage the geographic information within their design workflows.

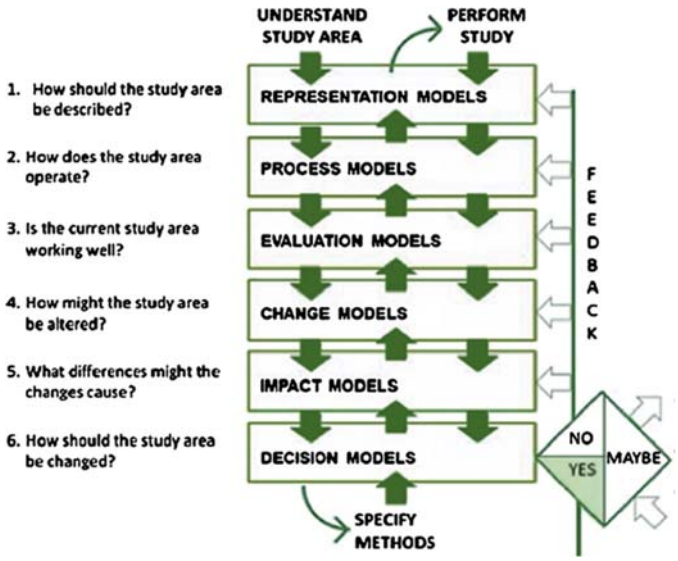


Figure 8.4-1 Landscape Design Process (Steinitz et. al., 1996[1])

It is noted that this geo-design approach is not implemented within VTMP study. However, as one of future tasks and/or recommendations, this approach shall be integrated within future VTMP-related study in order to make entire urban planning process more smooth, systematic and comprehensive one.

[1] Steinitz et. al., 1996, Biodiversity and landscape planning with Geographical Information Systems : alternative futures for the region of CAMP Pendleton, California, U.S.A, https://www.semanticscholar.org/paper/Biodiversity-and-Landscape-Planning%3A-Alternative-of-Steinitz-Binford/43bbef73f5bf05b45d732e56f1f63174e2b165c7

CHAPTER 9 FINANCIAL CONDITION

9.1 BUDGETARY SYSTEM

9.1.1 Budget Law

State Budget Law was approved by the National assembly in May 2016. In recent years, the budget deficit has been widening, making reform of both revenues and expenditures a pressing issue.

In addition to the need for fiscal stabilization, there have been frequent reports of problems with fiscal norms, such as the discovery of off-budget projects at the budget execution stage and fraudulent activities by tax collection officials.

As for laws and regulations related to public investment, the revised Law on Investment Incentives, which went into effect in April 2017, defines PPP projects as a form of investment and also positions PPP as one of the areas for concession projects.

9.1.2 Budget Preparation

The internal process prior to budget approval is described below.

- Incorporation of proposed projects into the Five-Year Plan of MPWT. Although the Five-Year Plan 2021-2025 has already been completed, a Mid-Term Review will be taking place in 2023, which will require a review of the proposed projects and the consideration of new projects relevant to annual policy and current conditions.
- The proposed projects should be consistent with the work plans of MPWT, currently 18 overall goals result in 11 work plans.
- The evaluation of the internal rate of return (IRR) are considered as detailed planning, thus, projects that require a feasibility study (FS)/IRR evaluation should be proposed to the relevant sector for consultation.
- After incorporation into the Five-Year Plan, the next step is to prepare P-CAP applications for projects and to submit them to the Ministry of Planning and Investment (MPI) for budget approval. Once the proposed project/application met the criteria, certification of meeting the criteria will be issued, however, this does not guarantee that budget will be allocated.
- Several criteria were set by MPI in order to limit the number of new projects and avoid having to incur in new public debt, of which only 10% is allocated for new projects. Thus, the agency proposing projects needs to discuss and prioritize projects following the national agenda and by identifying urgent issues to be addressed accordingly.

9.1.3 The Role of Central Government in Local Government Finance

Touching up with budget allocation structure, National Assembly conducts the internal allocation through the following prioritization.

- 1st priority: specific target/obligation (e.g., construction of Lao-China railway)
- 2nd priority: budget managed by MPI (consisting of a relatively low amount), targeting provincial and ministerial plans

  Budget managed by MPI is structured as:

(a) 40-50% for debt projects

(b) 40-50% for continuity projects

(c) 10% for new projects

- 3rd priority: budget managed by the Ministry of Finance (MOF), targeting other projects not classified as 2nd priority

Since within the budget allocation process MPWT has not direct route to approach MOF, MPWT's Department of Planning and Finance follows the below budget approval process.

- Internal Process:
  MPWT's Departments => Department of Planning and Finance => MPI
- External process:
  MPI => National Assembly => MOF => MPWT

MPI will evaluate and prioritize projects in accordance with the national agenda/programs and Five-Year Plan of each Ministry.

Lastly, a reverse internal process will be done for circulating the budget.

In addition, budget planning approval is application-based, namely, through the P-CAP application (a process supported by JICA under MPI) which details expected activities, outcomes, and project realization. Moreover, the P-CAP application consists of several categories and a detailed study may be required based on the type of project/program and its economic returns.

The budget review process for DPWT and MPWT follows a similar process. Namely, DPWT submits a project request to MPWT's Planning Division, which then submits the project to the Cabinet for approval.

9.1.4 Finance Arrangement for Urban Development

The above-mentioned is the overall process on how to derive the implementation budget under MPWT. However, an independent process can be done by Vientiane Capital. Thus, the implementation budget for the Urban Transport Master Plan's Proposed projects will not be limited to the national level, it may derive from the provincial level as well.

In addition, the government attracts investment by promoting PPP schemes under various forms (e.g., Build-Operate-Transfer), mobilizing development funds, and through the emission of National Bonds. Thus, proper project planning and design, in addition to close collaboration with relevant organizations will play a significant role to realize the implementation of the current Urban Transport Master Plan. During the course of budget request and budget negotiations, it is desirable to negotiate budgets with related agencies to ensure that budget allocations for urban transportation MPs are properly taken into account.

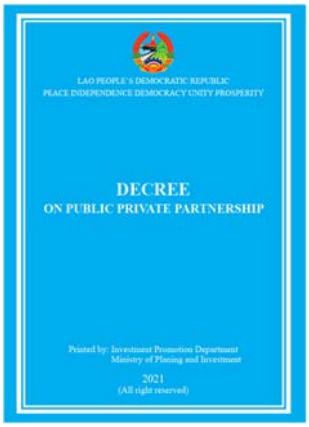
9.2 FINANCING AND RESOURCES FOR DEVELOPMENT

9.2.1 Macro-Economic Target

In the particular case of road maintenance, the budget is managed by the Government of Lao PDR (GOL). At the present, the annual budget of the road and bridge sector in Laos is almost entirely allocated to maintenance costs, and every year 90% of the road development budget depends on foreign aid.

9.2.2 Public Private Partnership

GOL has been relying on the national budget and foreign aid for the development of various types of infrastructure that form the foundation of the country. There are growing expectations for PPPs to achieve a strong economic foundation and reduce the country's economic vulnerability. However, as of the time of the report, no investors have expressed willingness to utilize the PPP system. In the future, it will be necessary to change the PPP system to make it more user-friendly for investors, as well as to create and promote projects that will attract investors.



Source: MPI.

Figure 9.2-1 Decree on Public-Private Partnership in Laos

On this matter, the decree on Public-Private Partnership in Laos has entered into force on January 1, 2022. According to this decree, the flow of a PPP project from its initial proposal submission to bidding is as follows.

Procedure	Authorities in charge
Preparation and submission of initial proposals	Office of Public-Private Partnership
Review of initial proposals (within 20 days)	Committee for Investment Promotion and Management (MPI)
Preparation and submission of a proposal (for new projects outside of the government development program [e.g., introduction of advanced technology])	Private sector
Review of the proposal (within 15 days)	Committee for Investment Promotion and Management (MPI)
Preparation and submission of FS and Environmental Impact Assessment Report	Office of Public-Private Partnership / Private sector
Review and approval of FS and Environmental Impact Assessment Report (within 90 days)	Committee for Investment Promotion and Management (MPI)
Revision of FS and Environmental Impact Assessment Report (within 60 days)	Implementing agency / Private sector
Preparation of bidding requirements and other documents (within 3 days after approval of the above FS, etc.)	Implementing agency / Private sector
Selection of Bid Control Committee	MOF, Implementing agency and Committee for Investment Promotion and Management (MPI)

CHAPTER 10 URBAN TRANSPORT ISSUES

10.1 PUBLIC TRANSPORT

Public transport issues and challenges in Vientiane to be solved through the future realization of the Urban Transport Master Plan are summarized in Table 10.1-1. Based on the data collection and transport surveys implemented as an initial part of the public transport planning, the issues and challenges were categorized into six viewpoints. Each of them is described as follows.

Table 10.1-1 Public Transport Issues and Challenges

No	Issues	Description
1	Motorization, COVID-19 and decreasing public transport usage	• Decline in public transport ridership due to motorization • Change in transport behavior and avoidance of public transportation due to the COVID-19 pandemic • Further decrease in the share of public transport from 5.4% (2007) to 1.4% (2019)
2	Inconvenient and unpredictable public transport services	• Aging bus fleets and inadequate maintenance • Decrease in punctuality and slow speed due to traffic congestion • Low frequency of service, short service hours, and early termination of buses • Need for further improvement of bus stop environment and information provision
3	Uneven delivery of public transport services leading to social disparities	• Worsening of public transport service provision due to withdrawal of bus routes and private operators (songteo, tuk-tuk, etc.) • Population coverage within 500 m catchments of public transport is limited to about 45.9%. • Need to ensure fundamental mobility for low-income groups, elderly, students, and people with disabilities
4	Vulnerabilities of transport network and dependence on informal transport	• Inadequate coordination of public transport network and operation • Need for coordination of fares and schedules for seamless transfers • Inadequate bus routes typically in ring and semi-trunk roads
5	Fragile governance system to operate public transport and coordinate operators	• Unsustainable self-financed system of the Vientiane Capital State Bus Enterprise (VCSBE) • Insufficient cooperation between bus and songteo in terms of operation schedules, routes, fares, stops, among other aspects
6	Urban sprawl and lack of integrated strategies with urban development	• Urban sprawl, with residential areas expanding into suburban and peripheral areas • Lack of a legal system that allows for integrated urban development with public transport investment

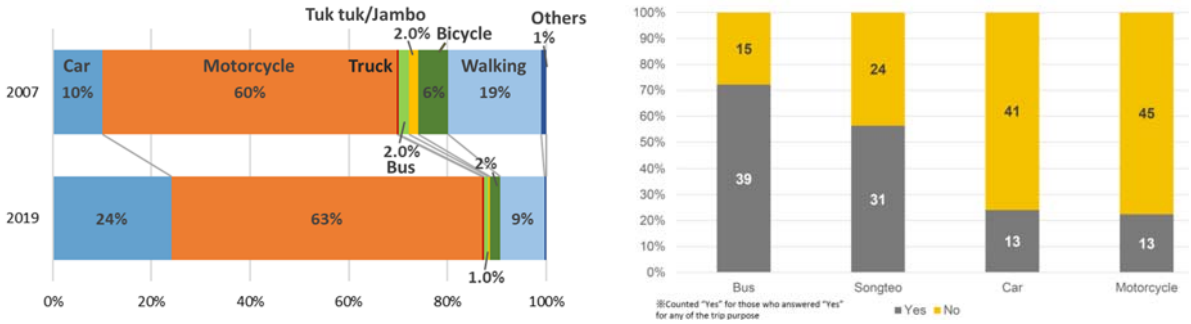
Source: JICA Expert Team

10.1.1 Motorization, COVID-19, and Decreasing Public Transport Usage

In the past decades, Vientiane witnessed an increasingly rapid motorization, with the population heavily depending on motorcycles as a basic mode to travel around the city and resulting in a severe decrease of public transport usage. A trend that follows what some Asian megacities have experienced[1].

As shown in Figure 10.1-1,shown on the left, although there has not been a significant change in the modal share of motorcycles, it has remained consistently high in both 2007 and 2019, accounting for 60% and 63% respectively. On the other hand, modal share of cars more than doubled in 2019 (24%), compared to that in 2007 (10%). This change strongly indicates that private cars have been becoming accessible for a larger population in Vientiane, resulting in the substantial modal shift from motorcycles to private cars in this decade.

Modal share of public transport in Vientiane consisted of 4% in 2007 (with this figure including public buses, tuk-tuk, and jambo) and fell to less than 2% for public transport and 1% for public buses in 2019. Moreover, the share of non-motorized transport consisting of walking and bicycle also decreased from 25% in 2009 to 11% in 2019. Therefore, indicating the accelerating formation of auto-dependent urbanization and highlighting the drastic changes in transport-related attitudes of individuals in Vientiane. As a result of this irreversible motorization, ridership of public transport has severely decreased, which adversely affects the sustainability of Vientiane's public transport system.

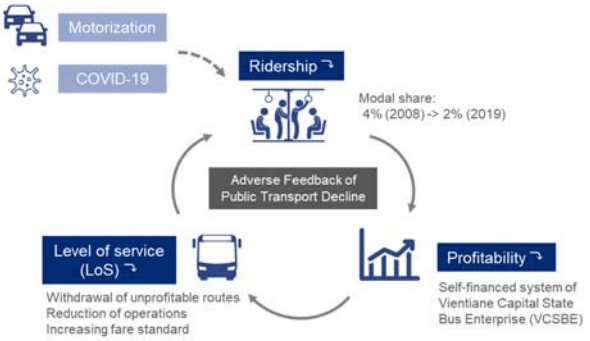


Change in Modal Share between 2007 and 2019 **Changes in Modal Choice after COVID-19**

Source: JICA Expert Team

Figure 10.1-1 Changes in Modal Share Due to Motorization and COVID-19

In addition to motorization, COVID-19 became a major force of changes and has accelerated the degradation of Vientiane' public transport situation. In order to avoid COVID-19 infection, the use of public transportation, which is dense and close to people, was avoided, and the means of transportation was changed to private cars and motorcycles. As shown in Figure 10.1-1, results of an interview survey aimed at public transport users showed that more than half of them and almost 70% of bus users changed their travel mode after the COVID-19 pandemic. These findings indicate drastic changes in individual transport-related attitudes, moving towards avoiding public



Source: JICA Expert Team

Figure 10.1-2 Adverse Feedback of Public Transport Decline

[1] Hickman, R., Fremer, P., Breithaupt, M. & Saxena, S. 2011. Changing Course in Sustainable Urban Transport. An Illustrated Guide, Manila, Asian Development Bank.

transport modes and preferring private modes.

Due to the combined impact of motorization and COVID-19, as shown in Figure 10.1-2, the public transport system in Vientiane faces a negative feedback loop. This has resulted in declining profits for the operator, VCSBE, and deterioration on the level of service (LoS). Consequences of this include the discontinuation of unprofitable routes, reduction of operations, increase of fares, and ultimately contributing to further decreasing public transport ridership.

10.1.2 Inconvenient and Unpredictable Public Transport Services

The negative feedback loop leading to the decline of public transport has increasingly led to common circumstances associated with a poor LoS. The self-financed system of the operator, VCSBE, forces them to adjust service provision to public transport users in response to temporal demands and to degrade its service quality based on profitability. The following are some of the common factors contributing to the poor LoS of public transport services in Vientiane.

- Aging bus fleets with inadequate maintenance,
- Decrease in the punctuality of the public transport services due to increasing traffic congestion,
- Low frequency of services and short service hours,
- Deteriorating quality of bus stops, and
- Inadequate information provision.

Inconvenient and unpredictable service provision of public transport negatively amplifies service unreliability to its existing and potential users, leading to further acceleration of motorization in Vientiane.

Aging and Lack of Maintenance of Public Transport Vehicles

Decreased Punctuality and Speed of Service Due to Traffic Congestion

Source: JICA Expert Team

Figure 10.1-3 Inconvenient and Unpredictable Public Transport Services

10.1.3 Uneven Delivery of Public Transport Services and Social Disparities

Public transport plays an essential role in delivering access to social and economic opportunities for all citizens, and simultaneously the spatially uneven delivery of its services would be associated with social disparities in developing cities[2]. It is estimated that the current public transport network, consisting on the joint network of urban and intercity buses and songteo services operated in Vientiane, only covers approximately 45.9% of citizens within 500 m catchments. Socially vulnerable population, such as low-income groups typically living in the peripheral areas of the city, might face limited accessibility to the city center where employment opportunities concentrate due to the lack of public transport services. Students, children, women, and elders who do not have access to private vehicles would also face daily difficulties to travel by public transport to educational facilities and other social services, such as hospitals, as well as other places needed to cover their needs. Worsening service provision of the public transport in Vientiane due to the

[2] Oviedo Hernandez, D. and Dávila, J.D. 2016. Transport, urban development and the peripheral poor in Colombia—Placing splintering urbanism in the context of transport networks, Journal of Transport Geography, Vol. 51, pp. 180-192

discontinuation of bus and paratransit operations would compel low-income population and children to lose their basic access to travel to the destinations they require and would force them to find alternative transport means. Accessibility to opportunities for low-income groups, elders, students, and people with disabilities need to be ensured through adequate provision of public transport services.

10.1.4 Vulnerabilities of Transport Network and Dependence on Individual Paratransit Operators

The network extension of the public transport system in Vientiane is spatially confined to radial lines from the city center to the suburb areas along arterial roads. This network structure basically reflects a monocentric urban structure concentrating in the central business district (CDB) of Vientiane. Unintuitively, public transport operations in ring and semi-trunk roads are limited, contributing to the insufficient population coverage of public transport services in suburban areas that are relatively close to the city center. The network also lacks sufficient local services and fails to catch up with urban sprawl in peripheral areas of the city, leading to inaccessibility in those areas. The future realization of a polycentric urban structure would require a dense public transport network to guide balanced urban development and spatially cover the urban stretches to avoid traffic saturation in the city center.

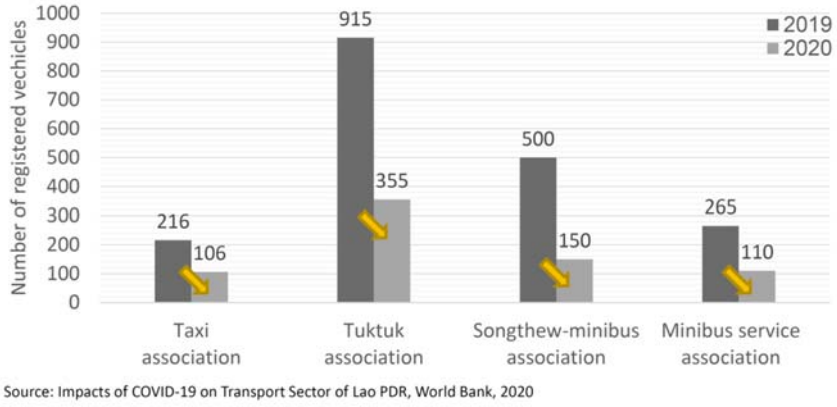


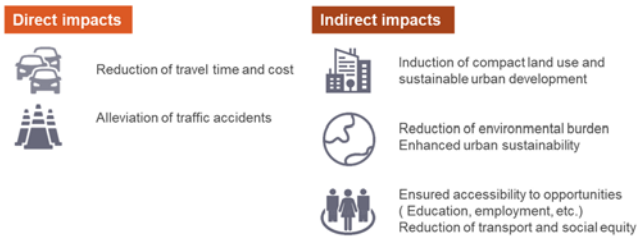
Figure 10.1-4 Decreasing Number of Registered Vehicles after the COVID-19

The current network of public transport in Vientiane is relatively vulnerable, depending on individual paratransit operators such as songteo. As shown in Figure 10.1-4, the number of vehicles registered in taxi, tuk-tuk, songteo, and mini-bus associations largely dropped due to the impact of COVID-19, with tuk-tuk and songteo specifically facing severe decreases. In addition, most of the public bus routes operated by VCSBE are spatially overlapped with the licensed routes of songteo. It is therefore clear that songteo and other equivalent paratransit services have ever played an important role to meet a gap between actual transport supply and potential demand yet became vulnerable especially due to the COVID-19 pandemic. Since these paratransit services are basically demand-responsive and flexible depending on the actual situation, it would be essential to re-position as a part of the public transport system in Vientiane to sustain the basic mobility of citizens even in the suburban and peripheral areas. Active coordination between the public side and these private operators would be required to transform the public transport system into a more resilient one.

10.1.5 Fragile Governance System to Operate Public Transport and Coordinate Operators

The existing governance system for public transport in Vientiane lacks the necessary control over individual paratransit operators and ride-hailing services, making it increasingly challenging to provide reliable and accessible mobility options for the city's residents. As discussed above, the negative feedback loop of public transport decline is unavoidable under the self-financed system of VCSBE. Additionally, the cooperation between VCSBE buses and songteo in terms of operation schedule, routes, fares, stops, and other relevant aspects is also insufficient.

The current governance system and finance scheme need to be reviewed to ensure access to socioeconomic opportunities in Vientiane. Actually, public transport investment programs are often evaluated based on their direct impacts, such as the through the reduction of travel times and costs, as well as the alleviation of traffic accidents. However, as listed in Figure 10.1-5, public transport demonstrates a great potential to disseminate a variety of indirect impacts on the city. The typical example of the impacts is to induce dense and compact urban forms along high-quality public transport lines, leading to transit-oriented development (TOD). The densified urban development along public transport would enhance economic viability and sustainable operation of public transport through the continuous increases in ridership and fare collection.



Source: JICA Expert Team

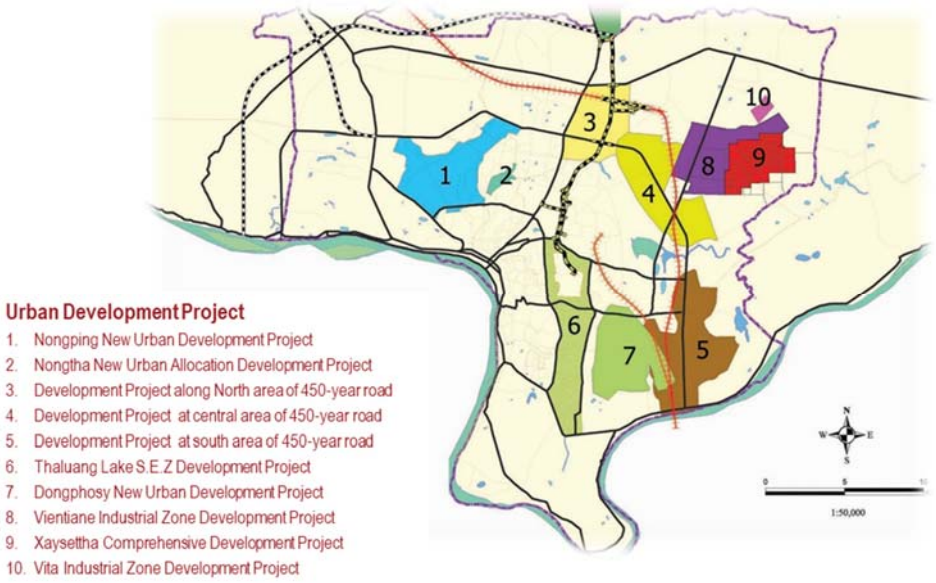
Figure 10.1-5 Direct and Indirect Impacts of Public Transport

Another example of the indirect impacts is to reduce the environmental burden caused by transport, such as through the reduction of emissions of greenhouse gasses (such as CO_2) and other air pollutants (such as NOx, and SOx). This supported by a modal shift from private vehicles (cars and motorcycles) to public transport and enabled by improved access to the public transport network. A reduction in greenhouse emissions would contribute to the mitigation of climate change, not only in Laos, but also across the world.

The last example of the indirect impacts is to distribute and ensure accessibility for all of the citizens even without private vehicles. If public transport services are spatially biased in the city coverage, the gap in access to the city center between household members with their private vehicles and those without them would become larger. Therefore, public transport is essential to ensure socioeconomic activities of all individuals in a sustainable way, contributing to the achievement of SDGs (Sustainable Development Goals) in the long term. Both direct and indirect impacts of public transport should be considered to discuss how we could change public transport governance to a sustainable one as a part of the urban system.

10.1.6 Urban Sprawl and Lack of Integrated Strategies with Urban Development

Motorcycle-led motorization has spatially stretched the urban edges of Vientiane, forming low-density urban sprawl in the suburbs and peripheral areas. As illustrated in Figure 10.1-6, urban development projects are now planned to realize urban clusters in the surrounding areas of the city center and form poly-centric urban forms. However, those projects are planned basically without strategic connection with trunk public transport lines due to the lack of political integration with urban development and public transport. The establishment of an urban planning mechanism to harmonize with public transport planning is essential in the long term.



Source: General Urban Plan of Vientiane Capital 2030.

Figure 10.1-6 Future Urban Development Projects

10.2 ROAD NETWORK AND ROAD CONDITION

10.2.1 Issues of Road Network

It is observed that certain improvements on the road network, such as installing right- and left-turn lanes at several intersections and improvement of road markings, have been implemented. However the existing road network has the following problems:

- The concept for main ring and radial roads was defined in the 2008MP, but the linkage with public transport and the concept based on the latest traffic situation has not been determined yet.
- The existence of missing links in the road network causes constant traffic congestion during the peak hours
- The Inner Ring Road (Kamphengmeuang Road) particularly plays an essential role in the network. However, some parts in its Western section have not been completed yet.
- Many intersections where main roads cross in the city center experience traffic congestion.
- The staggered intersection where the Inner Ring Road meets Lang Xang Avenue has serious congestion during the peak hours due to the road alignment of the Inner Ring Road.

10.2.2 Issues of Road Conditions

Conditions of road surface often give important/serious influence on not only riding quality but also traffic safety and traffic congestion. Seen from this viewpoint, the existing roads in Vientiane have the following problems.

- Unmaintained or unrepaired roads are frequently seen. Characteristic defects, such as potholes, ruts, and cracks can be found in many sections.
- Dirt remains along many drainage-path sections at each side of the road.
- Road markings cannot be seen because they are covered with dirt.
- Road markings are frequently worn and completely fade in some cases, which could impact road safety and decrease road capacity.
- On-street parking and parking on sidewalks is frequent in the city center and along roads with shops.
- On-street in front of bus stops is seen occasionally, obstructing public bus operation.

10.3 TRAFFIC MANAGEMENT AND PARKING

10.3.1 Issues of Traffic Management

Traffic management plays an important role for securing smooth and safe traffic. The prolems as listed below aere obsereved in the Target Area.

- Inefficient signal operation. Signal system control is not implemented.
- Friction between traffic circulating within roundabouts and through traffic is commonly observed.
- Road markings (center line and lane markings) are not clear.
- Insufficient pedestrian facilities. More sidewalks and pedestrian bridges should be installed.
- Traffic congestion at intersections and streets surrounding schools, due to school drop-offs and pick-ups.
- Illegal on-street parking reduces traffic capacity on roads.
- Illegal street parking blocks the sidewalks.
- On-street parking and parking on sidewalks is frequent in the city center and along roads with shops.
- On-street in front of bus stops is seen occasionally, obstructing public bus operation.

10.4 TRAFFIC SAFETY

In line with the escalating traffic volume, it is crucial to give careful attention to safety concerns. Based on the site survey conducted by VTMP, the JICA Expert Team (JET) identifies the following issues of notable importance:

- The enforcement of traffic laws and regulations on drivers who disregard them is inadequate. Improved compliance with traffic regulations by all drivers would enhance road safety and subsequently increase road capacity.
- A significant number of drivers disregard lane markings designed to ensure smooth traffic flow, resulting in blocked lanes when vehicles come to a stop and reducing road capacity. In addition, the vehicles behind the stopped vehicle are forced to transit through narrow spaces, posing traffic safety problems. Furthermore, since many drivers force their way into the intersection even after the signal changes, it is not possible to secure an appropriate time for each signal phase, resulting in inefficient intersection management. Moreover, since the traffic flow does not follow the traffic signals, it is a dangerous situation in terms of traffic safety.

According to the data on traffic accident factors, it can be confirmed that drunk driving and driving without a license are very common, apart from unproper driving behavior (speeding, overtaking, change the direction). Since these factors consist of basic requirements for drivers to before driving, awareness campaigns and strict crackdowns are necessary.

10.5 ENVIRONMENTAL ISSUES

10.5.1 Environmental Accountability

Within this study, it is found that no unit nor section of DPWT is in charge of the environmental governance and/or environmental clearance of any of DPWT's infrastructure development projects. The legal framework for the environmental management of the public infrastructure projects has already been developed, however, meaningful implementation would still need some improvement. Especially, it is quite important for all donor-financed projects that require appropriate environmental accountability during all project cycles (i.e., planning, construction and operation phases).

10.5.2 Urban Environmental Conservation

Due to the rapid urban development activities of Vientiane, some of important ecosystem areas, such as the wet land and/or forest reserves have disappeared during the last several years. To have a balanced and sustainable development for Vientiane, it is essential to have joint inter-ministry coordination that covers land use plans (e.g., the Ministry of Planning), urban development policy (DPWT/MPWT), and urban ecosystem conservation policy (MoNRE/DoNRE) periodically. The Strategic Environmental Assessment (SEA), initiated within VTMP in January 2022, would be one of the vital tools to provide a common platform for inter-ministry and/or inter-sectoral discussion and information sharing, while aiming to achieve strong consensus for future urban development policy of Vientiane.

10.6 INSTITUTION AND LEGISLATIVE ISSUE

10.6.1 Knowledge Management:

Accumulation of knowledge, both in indibidual staff and in institutions, is essential for upgrading the capacity of any institution. From this viewpoint, the following problems are seen in the relevant institutions.

- Personnel in charge of traffic control lack the necessary expertise and skills.
- Job duties of staff members do not align with their areas of study.
- Continuity of individual research is disrupted and adapting to new fields takes time.

- There is a lack of policies to encourage creative and academic activities among personnel.
- Upgrades are required for adequate traffic flow management, traffic signal control, mobility management, and traffic violation detection.
- Developing human resources within the organization is challenging.

10.6.2 Equipment:

Sufficient supply of the equipment and materials used for enforcement and/or management of traffic is indispensable for proper implementation of traffic enforcement and/or traffic managemen measures. The problems of equipment are as listed below:

- Inadequate supply of basic materials and equipment required for operations.
- Traffic-related data is only kept in paper format, resulting in inefficient administration.
- Shortage of equipment necessary to enforce inflow control for large vehicles and manage traffic.
- Insufficient maintenance of streetlights, traffic signal systems, and roundabouts.
- Shortage of equipment necessary for traffic management and to create traffic databases and accident statistics.
- Advanced technology is lacking for basic analysis of traffic demand, and traffic demand forecasting tools such as STRADA and Arch GIS are missing.

10.6.3 Cooperative Structure of the Organization:

Good cooperations among the relevant organizations are essential for effective management of the urban traffic. Following are the problems seen in the relevantion of the organizations involved in the management of the traffic in Vientiane.

- There is no permanent cooperative structure for conducting technical exchanges and trainings between industry, government, and academia.
- Formal interaction between leaders of the organizations is absent, leading to delayed collaboration.
- Few formal meetings occur between organizations, resulting in policy duplication and inconsistency.
- There are no long-term projects to collaborate with international organizations.

10.7 FINANCIAL CONDTION

As mentioned in Chapter 9, the Government of Lao PDR (GOL) can only allocate 10% of its total budget for new projects. In implementing the Urban Transport Master Plan, the project should be given high priority among other public transportation and road projects.

Nevertheless, the GOL's budget is far from plentiful, so it is necessary to consider including the potential use of alternative financing schemes, such as public private partnerships (PPPs).

10.8 BEHAVIOR CHANGE

Even with the physical improvements described so far, public transportation sustainability cannot be sustained by the number of people who naturally change their behavior. It is necessary for more people to choose actions that can solve transportation problems.

- Because family members have never used the bus or have grown up without it themselves, the idea of using it in the first place never occurred to them.
- Low awareness of how to ride the bus or do not know where the buses run.
- Need to commute to work by private car or motorcycle to take children to school.

CHAPTER 11 URBAN TRANSPORT MASTER PLAN STRUCTURE

11.1 VISION AND MISSION

The Vision and Mission for the Urban Transport Master Plan (VTMP2040) are shown below.

11.1.1 Process of Formulating Vision and Mission

The process of forming the vision and mission began with the people of Laos discussing in workshops the current commendable aspects of Vientiane as well as areas that require improvement. Throughout these discussions, key terms, as indicated in the figure below, were identified. These terms embody what the people of Laos want to preserve and the challenges they wish to overcome. Consequently, they became the foundation for the discussions leading to the determination of VTMP2040's vision and mission.

Keywords on Good Aspects of Vientiane		Keywords on Problems/Issues in Vientiane	
Green	Mixed/Diverse	Dusty/Dirty	Disorganized Land Use
Good Old Townscape	Relaxed	Poor Drainage/Sewage	Uncomfotable, Inconvenient and Limited Public Transport
Center of Education	Close to Nature	Chaotic Traffic Behavior	Rule Breaking

Figure 11.1-1 Keywords from Workshop Discussions

With these fundamental understandings, the current relevant development plans were reviewed to ensure there were no inconsistencies with the vision and mission of VTMP2040. This process was facilitated through discussions with Lao project counterparts and the JICA Expert Team. For more information on the reviewed development plans, refer to Chapter 2. In these discussions, keywords from higher-level development plans were extracted to shape the vision for this Master Plan.

Figure 11.1-2 Keywords for the Vision and Mission

Considering these keywords and accounting for the role of the urban transport sector, three keywords were selected as a policy core: sustainable, modern, and joyful walking space. The vision and mission were composed by integrating these words based on working group (WG) discussions throughout the course of the VTMP project.

- Sustainable (inclusive, eco-friendly, and economical)
- Modern (public transport system)
- Joyful Walking Space (walkable, enjoyable)

Results were discussed and approved by the joint coordination committee chaired by the Governor of Vientiane.

Vision	Towards an accessible, livable and sustainable city for everybody in 2040
Mission	Create an inclusive, sustainable and modern urban transport system along with a joyful walkable environment

11.1.2 Urban Transport Systems and Measures Related to the Core Keywords

This section illustrates urban transport measures that are related to the core keywords of VTMP2040's mission.

(1) Sustainable (Inclusive, Eco-Friendly, Economical)

The transportation mode to be developed in the future needs to be environmentally and financially sustainable in Vientiane's urban transportation.

Low-emission electric bus fleet (Singapore)

Focus on sustainable PT and NMT modes (Copenhagen)

Inclusive urban cable car transport for poor areas (Medellin)

Free public transport (Luxembourg)

Barrier-free public buses (Japan)

(2) Modern (Public Transport System)

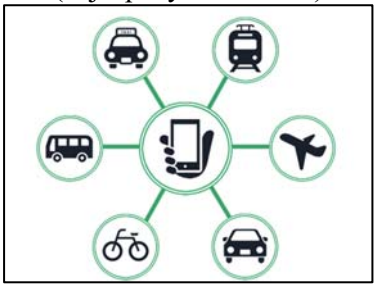
More convenient, comfortable, and accessible transport is desirable through modern systems utilizing ICT.

Scheduled bus service (Airport Shuttle in Vientiane)

Use of clean and small vehicles (E-jeepneys in Manila)

High-capacity BRT (TransMilenio in Bogota)

Medium-sized bus for narrow roads (Mu Bus in Tokyo)



Maas (Mobility as a Service)

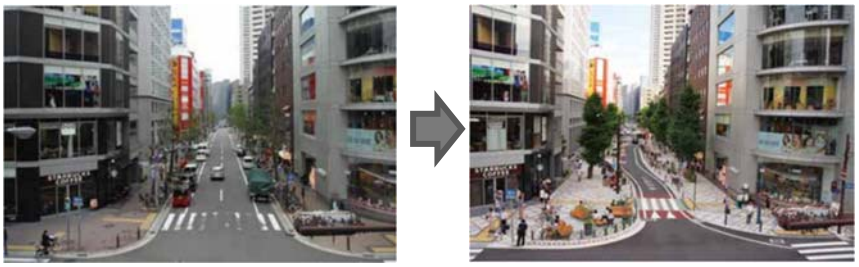
(3) Joyful Walking Space (Walkable)

A physically walkable apace is needed to realize a joyful walking space.

Promenade and car-free road along the riverside (Vientiane)

Improvement of sidewalk and parking space (Vientiane)

Covered pedestrian walkway connecting buildings (Manila)



Rearrangement of road components (Kobe)

(4) Joyful Walking Space (Enjoyable)

It is essential to design spaces that are not only comfortable but also enjoyable, in order to motivate people to actually want to walk.

Pedestrian Paradise scheme on weekends (Ginza)

Night market along the street (Luang Prabang)

New bus terminal at Lao-ITECC Mall (Vientiane)

Restored and preserved historical station (Tokyo)

Boulevard and park by the river (Phnom Penh)

11.2 FUTURE DEVELOPMENT SCENARIO

11.2.1 Alternative Scenarios

To achieve VTMP2040's vision and mission, three development scenarios were set up. Following this, several rounds of discussion took place to determine the most suitable scenario.

Figure 11.2-1 Established Scenarios

(1) Scenario 1: Do-Minimum

- Only highly feasible public transport development projects and road improvement projects that have already been initiated, have been approved by the government, or for which donors have expressed support will be implemented.
- For example, this scenario includes the implementation of BRT projects in the public transportation sector and urban expressway projects in the road sector.
- It is expected to improve mobility service level in the areas along the BRT line and reduce traffic congestion along newly constructed/improved road.
- On the other hand, people outside the BRT coverage area will become more dependent on cars and motorcycles, which will further worsen traffic congestion and have other negative effects.

(2) Scenario 2: Public Transport Intensive

- Mobility services insufficient in the do-minimum scenario will be covered by measures mainly focused on public transportation development.
- The public transportation coverage area is the widest compared to other scenarios.
- It is expected to provide equal opportunities for participation in social activities to all, including those who do not own cars or motorcycles and those who have difficulty driving.
- It should be noted that the goal of this scenario is to provide equity for all people as described above, and not to handle all traffic demand with public transport.
- It does not mean that road construction will not be implemented at all. Roads needed to build public transportation networks, road axes in suburban areas where road network density is insufficient, and bypasses to handle heavy vehicles passing through urban areas will be

constructed.

- Since the required investment is lower than for road construction, it is more financially sustainable than Scenario 3, discussed below.

(3) Scenario 3: Road Intensive

- Mobility services insufficient in the do-minimum scenario will be covered by measures mainly focused on road network development.
- Since BRT construction is included, the public transport coverage area is the same as in the Scenario 2.
- Further road construction is expected to further increase people's dependence on cars or motorcycles.
- As long as the demand for cars and motorcycles continues to grow, road traffic capacity must continue to expand. Therefore, there is concern that the budget required for road construction will continue to grow.
- On-street parking will increase in the city center, further exacerbating traffic congestion. In addition, an increase in large-scale roadside stores in the suburban areas is expected to reduce the vitality of the city center.

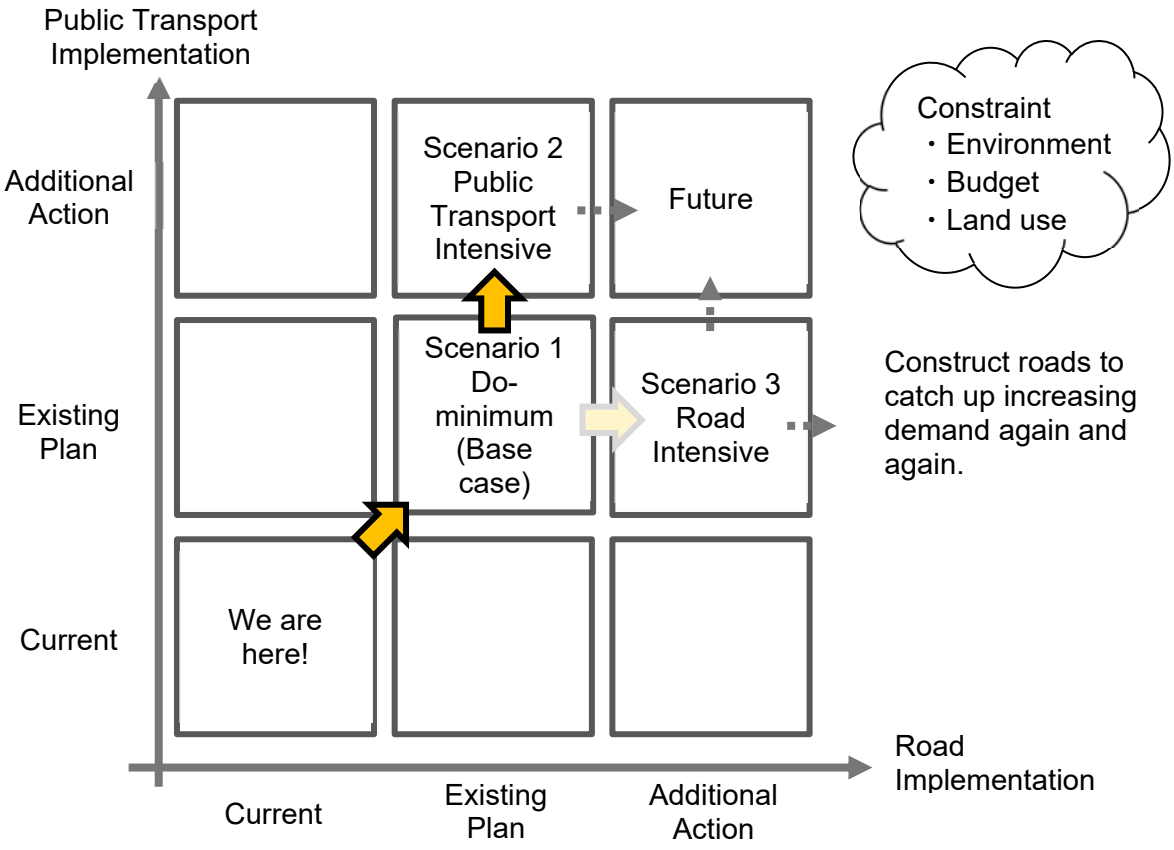


Figure 11.2-2 Relationship of the Scenarios

11.2.2 Scenario Selection

In discussions between Lao project counterparts and the JICA Expert Team regarding the present situation and future vision, it was identified that the existing landscape and rich greenery are a part of Vientiane's charm. Consequently, it was required that these elements be preserved even during the development of the transportation network. Sidewalk improvements to create a walkable environment should be undertaken, but large-scale land acquisition is undesirable because it would change the townscape. Therefore, under these conditions, to accommodate future transport demand it is necessary to promote public transportation improvements that can handle additional transport demand with relatively lower road capacities mainly through the reallocation of space in existing roads. Accordingly, for future developments, **Scenario 2 was selected**, which focuses on the development of a public transport network that efficiently utilizes existing roads, while keeping landscape changes due to road network expansion to a minimum.

Moreover, it has been clearly demonstrated in various international cases that if road construction is the primary focus, the need for further road construction to meet transport demand can lead to an accelerating cycle of motorization, necessitating endless road construction. Such demand-driven development has its limitations and requires substantial investment to solve the resulting issues. Given these considerations, an approach that intensively focuses on public transport is suitable for achieving sustainable development in Vientiane.

Figure 11.2-3 Congestion in Other Cities

11.2.3 Key Factors for Scenario 2 (Public Transport Intensive Scenario)

In this section, the previously selected Public Transport Intensive scenario is elaborated upon. According to this scenario's core policy, development is primarily pursued with a focus on public transport. An attempt is made to reshape Vientiane's current urban transport system into a new one based on Bus Rapid Transit (BRT). This project is already ongoing and demonstrates high feasibility for implementation in Vientiane, thus serving as the foundation of urban transport network. Moreover, adequate consideration is necessary for the sustainability of the new urban transport system after its establishment. It is vital to strike a balance between new construction and adoption of current elements of the system. To this end, it's important that both the administration and citizens take a serious stance on consciously proceeding with the investments needed for the shift from the existing transport system to the new system.

For continuation of the new urban transport system, financial profitability is a necessity, which requires strategies to increase revenue and control expenses.

(1) Transition to Increase Revenue

A transition towards long-term financial sustainability through an increase in revenue includes:

- Implementation, continuation, and enhancement of service levels,
- An urban transport system supported by citizens (it's important for government staff to take the lead in using the system to encourage citizens),
- Inducing changes in behavior.

(2) Transition to Decrease Expenses

A transition towards long-term financial sustainability through the control of expenses includes:

- Effective utilization of existing resources,
- Expansion of traffic capacity by regulating on-street parking, removing obstacles on sidewalks for improved pedestrian environment, and introducing a traffic signal system that allows for further optimization of road capacity,
- Ensuring new road construction and expansion projects fundamentally supports the public transport network, while new constructions are minimized.

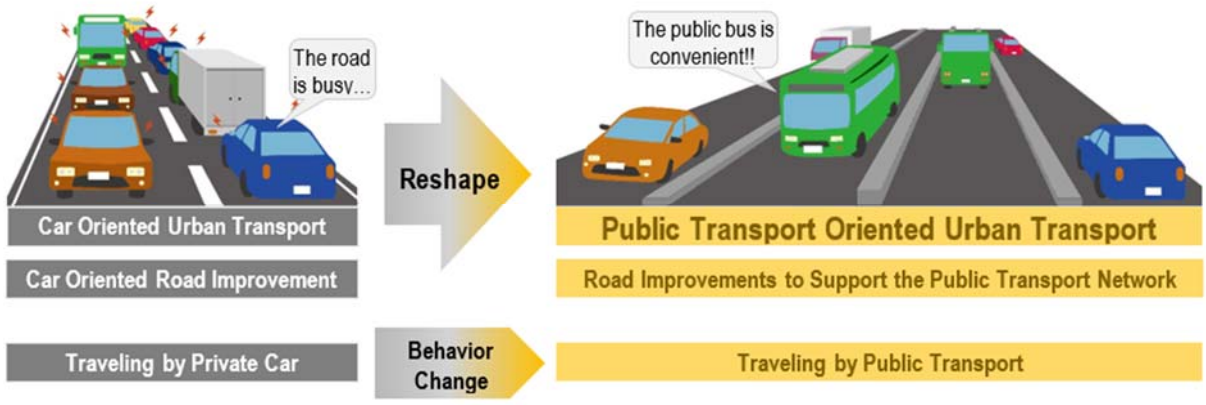


Figure 11.2-4 Required Factors for Reshaping

The goals and strategies set according to this scenario are demonstrated in the following section.

11.3 GOALS AND STRATEGIES

11.3.1 Overview of Goals and Strategies

The goals and strategies defined by Lao project counterparts and the JICA Expert Team are presented in Figure 11.3-1. These goals and strategies are the result of working group discussions conducted throughout the project and are aimed at fully supporting and being consistent with VTMP2040's vision and mission statements.

As for the general process for defining these goals and strategies, working group discussions first addressed the hierarchy between the master plan's vision, mission, goals, and strategies, to later review the identified issues by the project and then formulate appropriate goals and strategies. Thus, the resulting goals represent desired outcomes for Vientiane that effectively overcome currently identified issues, while strategies are approaches aimed at achieving these goals.

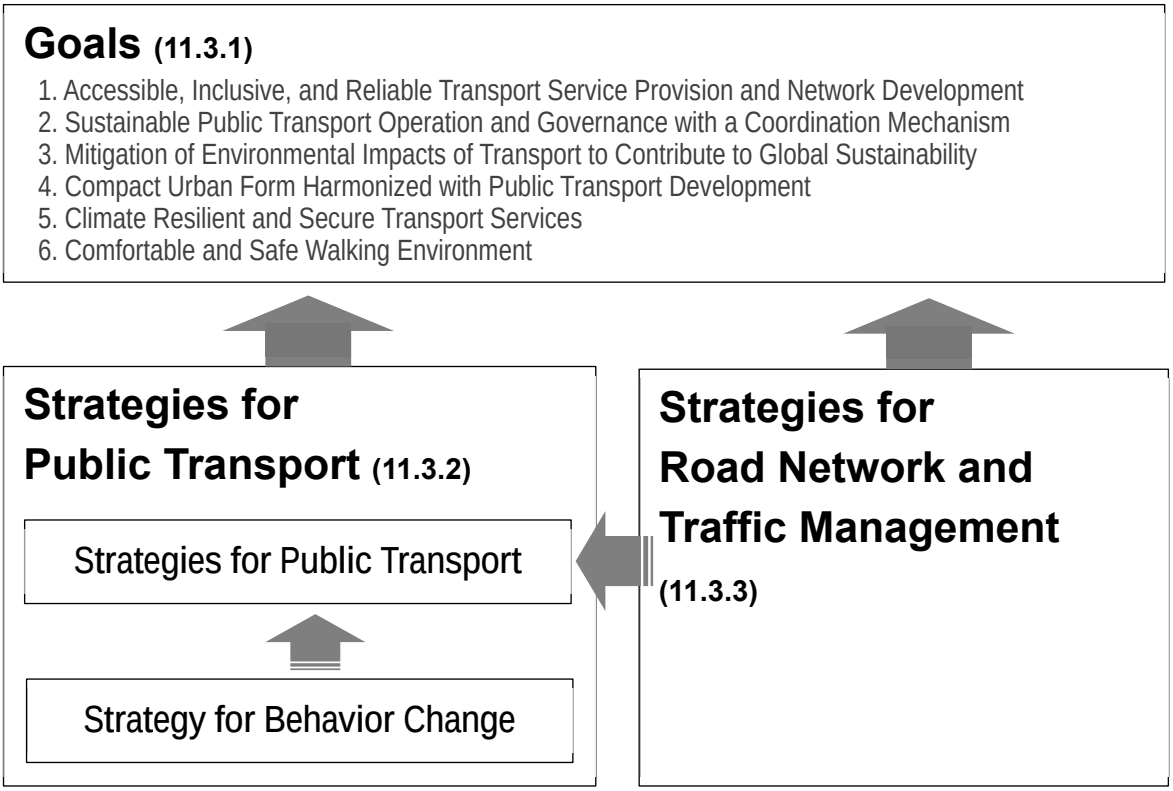


Figure 11.3-1 Goals and Strategies of VTMP2040

In the process of defining strategies, the developed goals were explored from the perspectives of public transport and road network/traffic management to identify the goals that each side would contribute. As a result, four goals each are achievable from the perspectives of public transport and road network/traffic management, while all of VTMP2040's six goals are fully addressed. Further explanation of the contribution of each side is given in the following sections.

11.3.2 Public Transport

(1) Goals

Goal 1: Accessible, Inclusive, and Reliable Transport Service Provision and Network Development

High-quality public transport services which will be accessible, inclusive, and reliable for all of the citizens in Vientiane will play an essential role in the realization of social inclusiveness with their extended network development. The social roles of the current public transport system in Vientiane

have been incrementally degraded due to the external force of changes including the motorcycle-driven motorization and COVID-19. The deteriorated level of service (LoS) due to such changes has contributed to the further decrease ridership and fare collection, forming a negative feedback loop of the public transport decline. As a result, public transport decline could reach the "point of no return"[1] in which its negative feedback and changes amplify each other beyond control, unexpectedly leading to the cruel division of society by transport. Whilst public transport is a catalytic agent in transport, the spatial maldistribution of its services would become a "mechanism" to expand social and economic disparities through the uneven distribution of accessibility in Vientiane. Therefore, incremental improvement and strategic investment in the public transport system will be essential to provide the "right to the city"[2] to all individuals including socially disadvantaged groups of people such as low-income groups, disabled, children, females, ethnic minorities, and others. Accessible, inclusive, and reliable transport services need to be equally provided for the achievement of the inclusiveness in Vientiane's society.

Goal 2: Sustainable Public Transport Operation and Governance with a Coordination Mechanism

Public transport operation and its governance system will be enhanced to become sustainable with appropriate coordination mechanisms among public and private operators. The current public transport system in Vientiane basically depends on the self-financed bus operator, Vientiane Capital State Bus Enterprise (VCSBE), and individual paratransit operators, such as songteo. Whilst their continuous operations are essential to ensure individual access to daily opportunities, the current governance system of public transport in Vientiane naturally nudges the operators into demand-responsive operations. This operation and governance mechanism is quite vulnerable in the long term to external economies of changes, such as motorization and temporal changes in demand (i.e., the COVID-19 pandemic), as discussed above. The functional demarcation of formal public and private services is also ambiguous in terms of their overlapped routes. It would be effective to integrate the paratransit services with the whole public transport system in Vientiane rather than for them to be competitors of the public bus, given their demand-responsiveness and flexibility. In order to realize the effective collaboration among the public and private operators, the public transport operation and governance system needs to be reformed to realize its sustainability and continuous operation.

Goal 3: Mitigation of Environmental Impacts of Transport to Contribute to Global Sustainability

Environmental impacts of transport on the planet will be reduced through the introduction of a sustainable transport system in Vientiane, contributing to global sustainability and support efforts to mitigate climate change. The motorcycle-led motorization in Vientiane has been shifted to a car-oriented one in this decade, which would lead to the continuous increase in the environmental burden of transport, such as through the emission of greenhouse gases (including CO_2, and NO_x and SO_x). As for the emissions of NO_x and SO_x, they negatively affect the health of dwellers in the middle term, thus increasing the emission of greenhouse gases would contribute to frequent and intensified natural disasters, such as a floods in the case of Vientiane, due to the global warming in the long term. Therefore, the Urban Transport Master Plan aims for a modal shift from private motorcycles and cars to environmentally-friendly public transport with the promotion of non-motorized transport including walking and cycling. Moreover, incentivizing the introduction of electric vehicles would also be an effective form to mitigate the direct impacts of transport.

Goal 4: Compact Urban Form Harmonized with Public Transport Development

Strategic urban planning and effective land use control will be harmonized with public transport development to realize compact urban forms along with high-quality public transport lines in Vientiane. Motorcycle-led motorization has spatially stretched low-density residential areas in the suburban and peripheral areas in Vientiane without insufficient urban planning control. Lack of

[1] Kitamura, R., Golob, F, T., Yamamoto, T., Wu, G. (2000) 'Accessibility and auto use in a motorized metropolis'. Paper presented at the 79th Transportation Research Board Annual Meeting, Washington.

[2] Lefebvre, H. (1996). Writings on Cities, translated and edited by Eleonore Kofman and Elizabeth Lebas, Blackwell Publishers.

strategic harmonization between transport and urban development would enhance further unorganized and scattered suburbanization in the peripheries, which is unfavorable for public transport. High-quality public transport would own an influential power to realize compact and linear urban form along public transport corridors in the long term. This urban form would improve public transport ridership and therefore fare collection. Urban development projects, such as new sub-centers, are planned to mitigate urban and transport concentration in the city center and transform the urban structure to a poly-centric one. The establishment of urban planning mechanisms to harmonize with public transport investment program is essential to realize transit-oriented development (TOD) in those development areas.

(2) Strategies

In order to achieve the vision, mission, and four goals set forth in the Urban Transport Master Plan, six strategies and two target indicators were identified in the field of public transport planning. The relationship between the set goals and strategizes is shown in the Figure 11.3-2 below. The details of target indicators and each strategy are described later in this section.

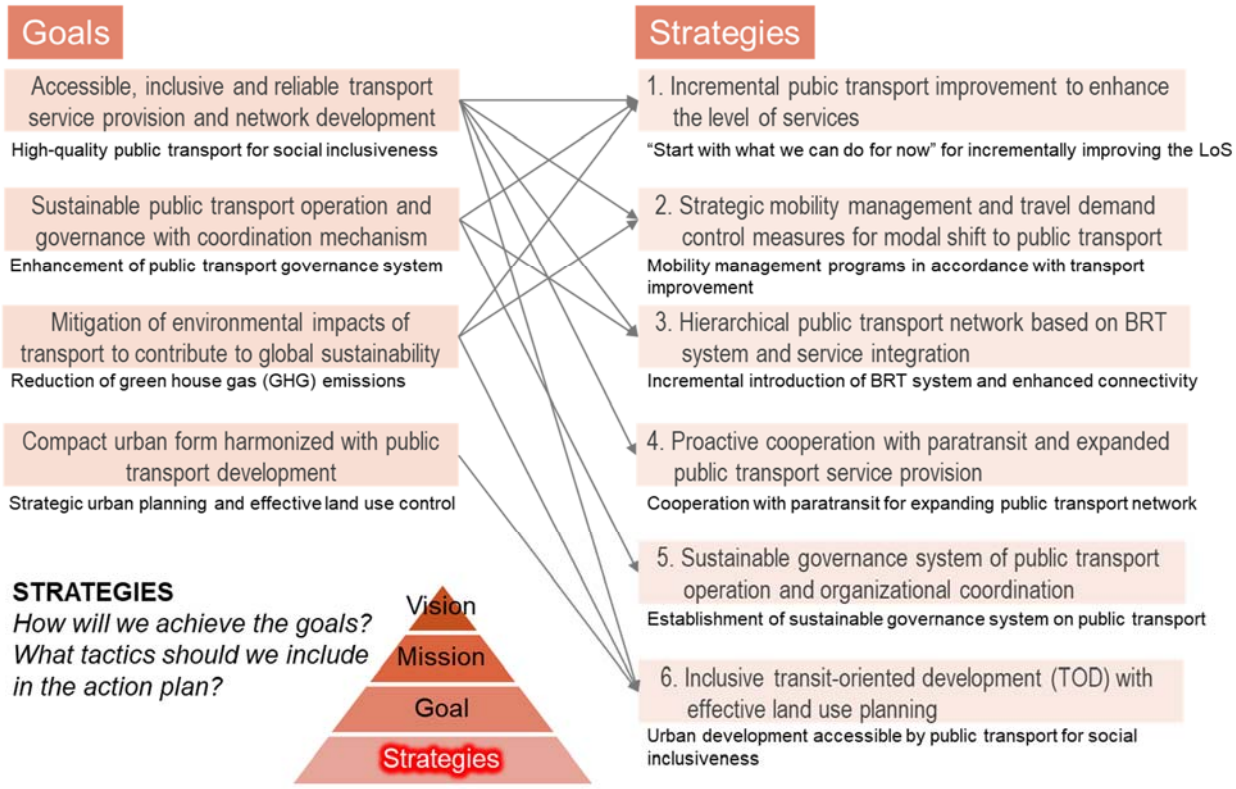


Figure 11.3-2 Relationship between Goals and Strategies

Target Indicators

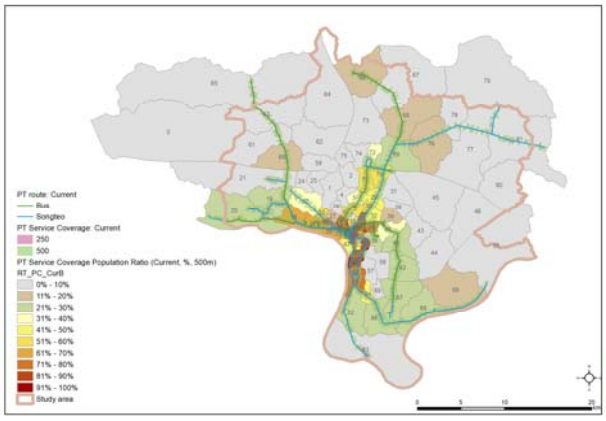
As mentioned earlier, based on the mission, vision, and strategies to be aimed in this master plan (MP), the two target indicators are set to measure the progress of this MP in the field of public transport planning: 1) public transport share, and 2) population coverage of public transport services. The current status and future targets are summarized in Table 11.3-1, Figure 11.3-3, and Figure 11.3-4.

The target of public transport share for 2040 is set at 30.0%, to be achieved gradually by increasing the share from the current level of 1.4%. Furthermore, the target of population coverage is set at 60.0% in 2040 for the population living within 500 m of a public transportation terminal or stop. This taking into account the distance that current public transportation users actually walk from cases in other cities, the psychological distance users are willing to walk, and the walkable distance in the Target Area (TA).

Table 11.3-1 Target Indicators

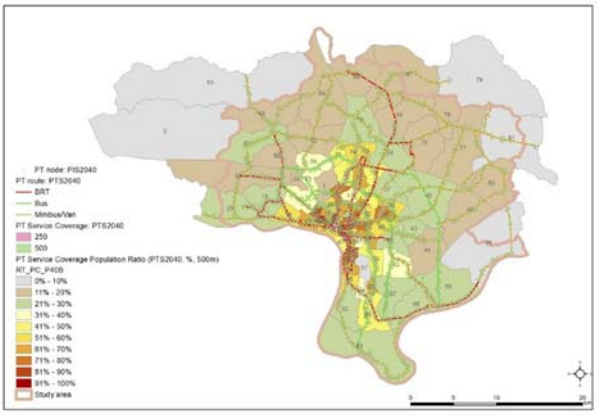
No	Indicators/ Activities	Year 2019	Short (-2027)	Middle (-2032)	Long (-2040)
1	Public transport share	1.4%	10.0%	20.0%	30.0%
2	Population coverage of 500 m catchment areas from public transport terminals and stops	45.9%	50.0%	55.0%	60.0%

Note: Population coverage in 2019 was calculated based on assumption that songteo and vans stop anywhere along the routes
Source: JICA Expert Team



Source: JICA Expert Team

Figure 11.3-3 Population Coverage in 2019



Source: JICA Expert Team

Figure 11.3-4 Population Coverage in 2040

In the 2008 MP, the target for the public transport share by 2025 was set at 40%. However, according to demand forecasts conducted in this study, it has become evident that even with various measures proposed in this MP (excluding behavior changes), the modal share would remain around 15% by the year 2040. To enhance the public transport share, a significant shift in the behavior of Vientiane's residents is essential, and continuous efforts from related institutions in Vientiane are required. Therefore, considering the public transport share in foreign cities and the policies of MPWT comprehensively, a realistic target of 30% by the year 2040 has been set and agreed by the JCC.

1) Incremental Public Transport Improvement to Enhance the Level of Services

A step-by-step approach for the improvement of public transport services will be essential for the realization of sustainable, comfortable, and attractive public transport. In the case of Vientiane, the decline in the service level of public transport resulting from changes brought by a motorcycle-led motorization and COVID-19 negatively altered the share of public transport, leading to the negative feedback loop and cementing its long-term decline. In order to achieve the establishment of an accessible and reliable public transport system in the future, it would be effective to start with an incremental approach for improving its LoS, rather than a radical approach. The combination of various efforts on the improvement would form a positive feedback loop of public transport usage, which would contribute to an increase in ridership and therefore the improvement of the profitability for public transport operators. The operators would enhance their financial capability for strategic investments for further improving the LoS, which would result in a further increase in the use of public transport.

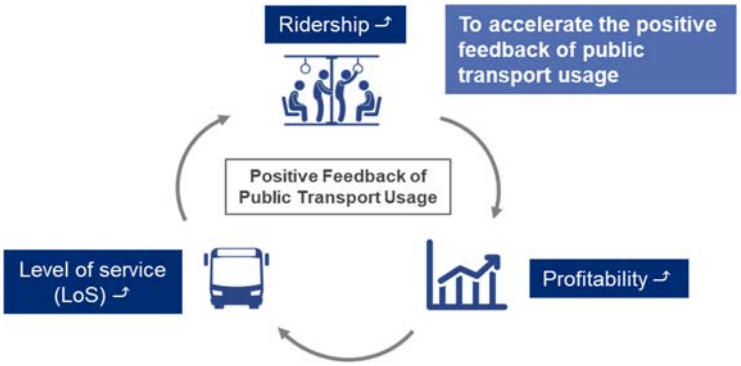
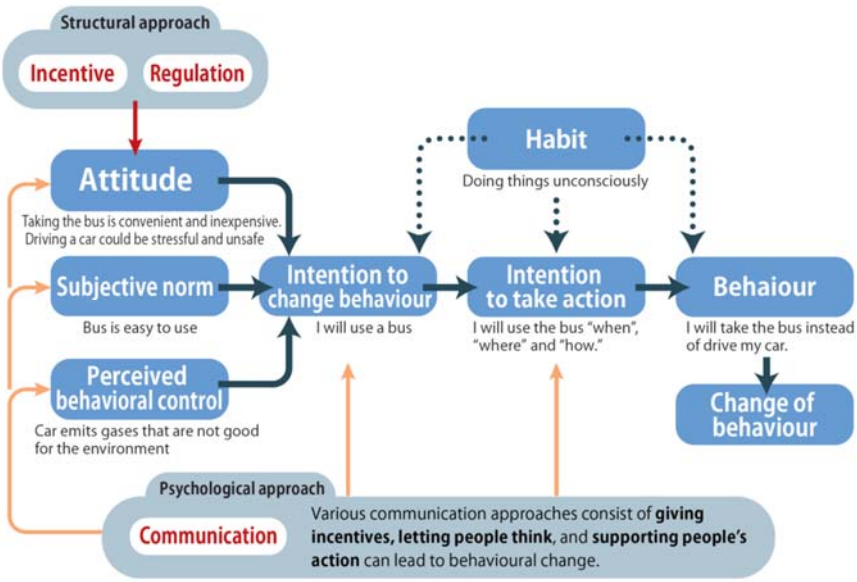


Figure 11.3-5 Positive Feedback of Public Transport Use

2) Strategic Mobility Management and Travel Demand Control Measures for Modal Shift to Public Transport

Strategic mobility management (MM) and travel demand control measures are set forth along with the incremental improvement of the level of public transport services in Vientiane.

MM is generally referred to as a communication-oriented measure which encourages people to change their mobility voluntarily to a more socially and individually desirable direction, and it is designed to nudge individuals into changing their transport-related perceptions and travel behavior by themselves through psychological approaches and strategic communication methods as illustrated in Figure 11.3-6.



Source: Mobility Management Handbook (JICA)

Figure 11.3-6 Mechanism of Mobility Management

MM programs in the MP target individuals who are likely to use private vehicles for traveling instead of public transport due to car-oriented or motorcycle-oriented habits. MM programs should aim to reinforce the positive feedback loop of public transport usage by approaching potential public transport users and captive car and motorcycle users, contributing to increasing the number of public transport users and improving the profitability of the operators, and leading to the further enhancement of the LoS.

3) Hierarchical Public Transport Network Based on BRT System and Service Integration

The proposed future public transport plan aims to gradually restructure and enhance the public transport system in Vientiane. This includes the development of a hierarchical network, expansion of services, and integration into a unified system. Currently, the bus lines in Vientiane primarily serve as trunk routes, connecting the city center to major suburbs through major arterial roads. However, the spatial coverage of these routes is limited, resulting in certain areas not being covered by public transport services without feeder and circular routes. Moreover, there is significant overlap between the existing bus routes and songteo routes, which can lead to unnecessary competition among public transport operators.

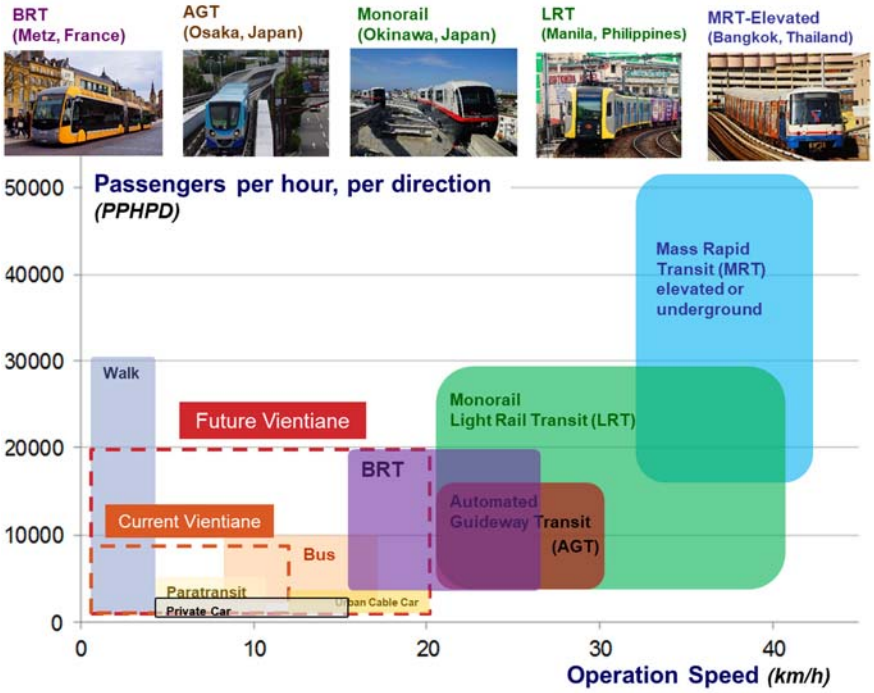


Figure 11.3-7 Comparison of Transport Modes with their Passenger Capacity and Operation Speed

As a result, as illustrated in Figure 11.3-7, the existing public transport system in Vientiane, comprised of paratransit and buses, proves inadequate when compared to private modes of transportation such as cars and motorcycles, particularly in low-density urban areas that require lower passenger capacity. The current public transport services exhibit a relatively limited operational speed in comparison to private cars, which contributes to the ongoing increase in motorization. To address these challenges, the future public transport plan in Vientiane aims to enhance service coverage in terms of passenger capacity and operational speed. This will be achieved through the implementation of a Bus Rapid Transit (BRT) system, this taking into account the city's population size and dispersed population distribution.

Future public transport lines should form a hierarchical network consisting of multiple service types with different service targets and functions based on the BRT system as a trunk transport system. The functional demarcation of public transport lines proposed in this future plan is described in Figure 11.3-8 for the short-, medium-, and long-term.

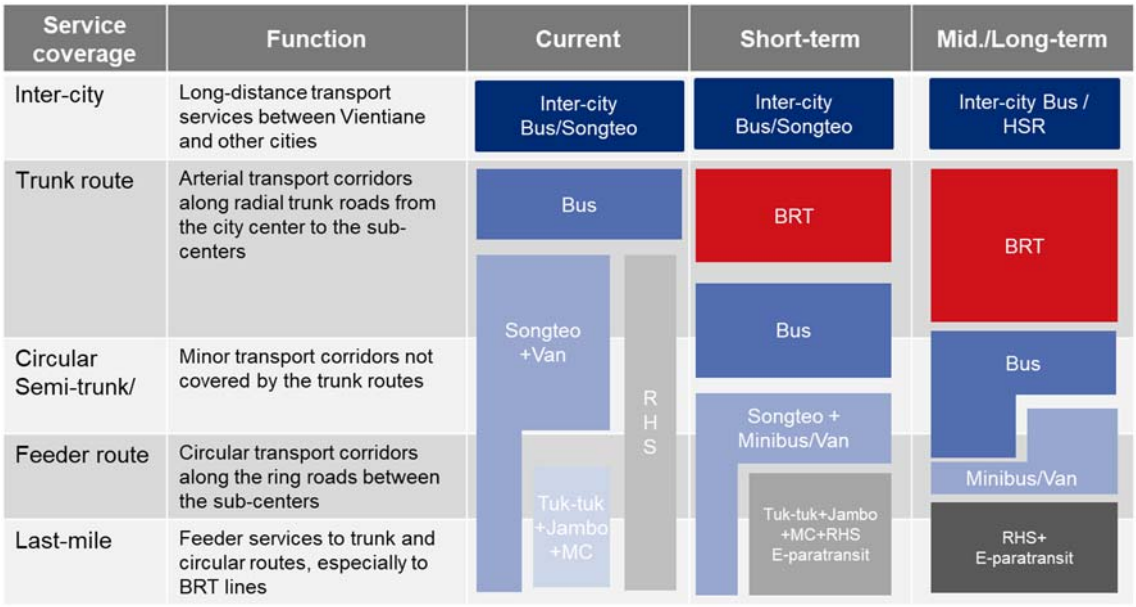


Figure 11.3-8 Functional Demarcation of Public Transport

In order to achieve this gradual transformation of public transport services, as illustrated in Figure 11.3-9, a step-by-step approach to develop and expand trunk public transport routes is proposed to spatially deliver the varied benefits of high-quality public transport system to a wider coverage. That aims to expand its service types and spatial coverages through sustainable modes of transport which are appropriate depending on travel demand and local contexts.

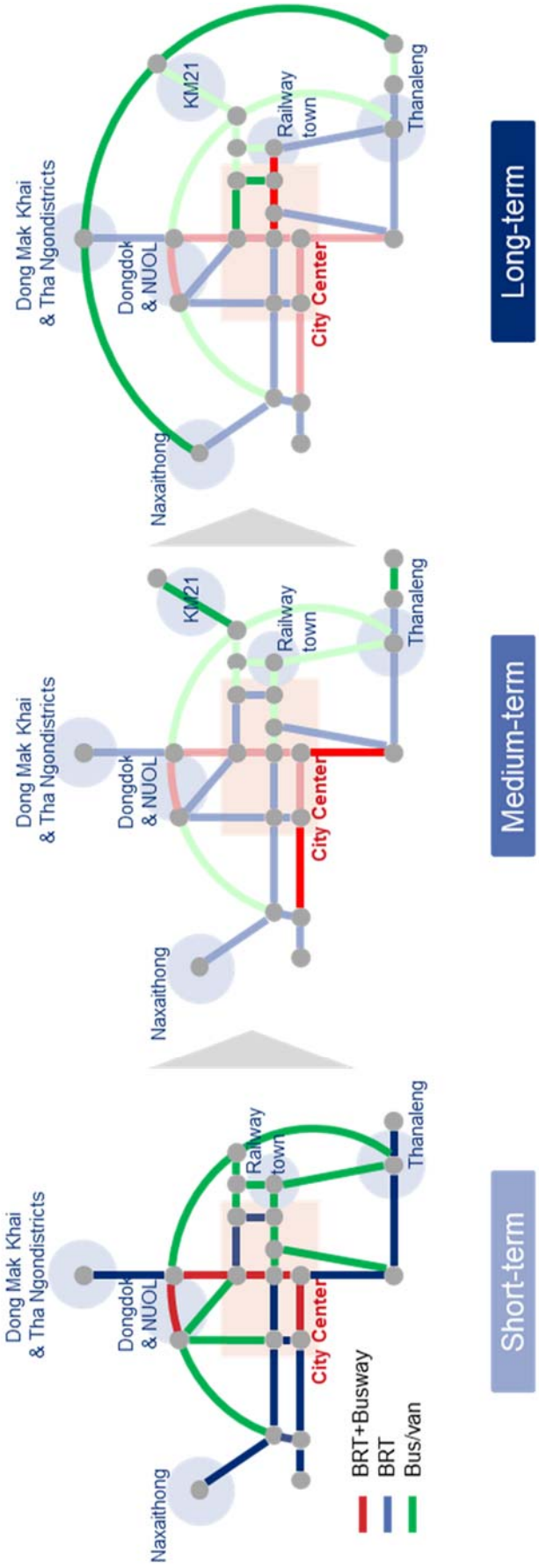


Figure 11.3-9 Step-by-step Development of Trunk Public Transport Routes

4) Proactive Cooperation with Paratransit and Expanded Public Transport Service Provision

Paratransit services, such as songteo, tuk-tuk, and jambo, provided by private and individual operators play an important role in delivering accessibility for residents in Vientiane on a demand-responsive operation manner. Specifically, this type of operation shows significant advantages in relatively low-density residential areas with lower transport demand. However, the impact of COVID-19 on urban travel patterns in Vientiane forced the number of vehicles registered in the paratransit associations to largely dropped because of their business vulnerability. That would lead to a decreasing LoS of paratransit services, and thus a lower LoS of the overall public transport system.

Proactive cooperation with paratransit service providers is necessary to sustain public transport services through its incremental formalization of the private operators. This cooperation needs to be led by the public side because the formal operator, VCSBE, also became financially vulnerable due to the severe decrease in ridership and their self-financing governance system. Therefore, as shown in Table 11.3-2, the incremental formalization of songteo operators to be integrated with the formal services is proposed in a step-by-step approach.

Table 11.3-2 Incremental Formalization Programs of Songteo Operators

Term	Step	Programs
Short-term	Step 1	Operational cooperation program with songteo operators - Fares, timetables, bus stops, route maps, etc.
Middle-term	Step 2	Service integration program of public transport with songteo using current songteo vehicles
Long-term	Step 3	Fleet renewal program of songteo vehicles, such as e-Songteo to provide comfortable and sustainable public transport

5) Sustainable Governance System of Public Transport Operation and Organizational Coordination

The institutional reform of public transport operation is necessary to realize a sustainable and affordable public transport system in Vientiane. Specifically, collaboration with the private sector under the appropriate control of the public sector is essential. Therefore, the institutional reform should not focus on VCSBE itself but cover the overall governance of public transport system in Vientiane. As illustrated in Figure 11.3-10, the establishment of three layers (Vientiane Model), regulators, management organization, and operators, is proposed in the future to manage public transport operators consisting of VCSBE, private operators, BRT operator(s), and RHS operator(s).

a) Regulators: Under the political initiatives of Mayor of Vientiane Capital and the Minister of MPWT, DPWT and Vientiane Capital should coordinate the overall infrastructure and property investment. They will collaborate among them to improve public transport services and operations based on the long-term plans included this MP.

b) Management organization: On this layer, the establishment of a new Management Entity is proposed to manage routes and schedule planning with operation management for the entire coverage of Vientiane. It also aims to monitor actual operational situations in accordance with appropriate concession agreement with public transport operators. This Management Entity is a key organization to integrate the public transport services into one single system in Vientiane. Institutional enhancement of the Management Entity to coordinate among relative agencies and operators is also essential to position it in the overall governance system of public transport in Vientiane.

c) Operators: VCSBE is planned to operate the majority of bus routes, which will be incrementally graded up to BRT services in the long term. It is proposed that BRT lines will be operated by PPP scheme through concession agreement managed by the Managing Entity. In addition, the gradual involvement of paratransit associations, especially the Songteo Association, is proposed

to collaborate with VCSBE as a part of the basic bus services in Vientiane. This operation is proposed to be managed by concession agreements in the same method as BRT lines. RHS operator(s) should also be actively involved with appropriate licenses managed by the Management Entity. This organizational system should involve RHS operator(s) as well to position them as an appropriate position of public transport services.

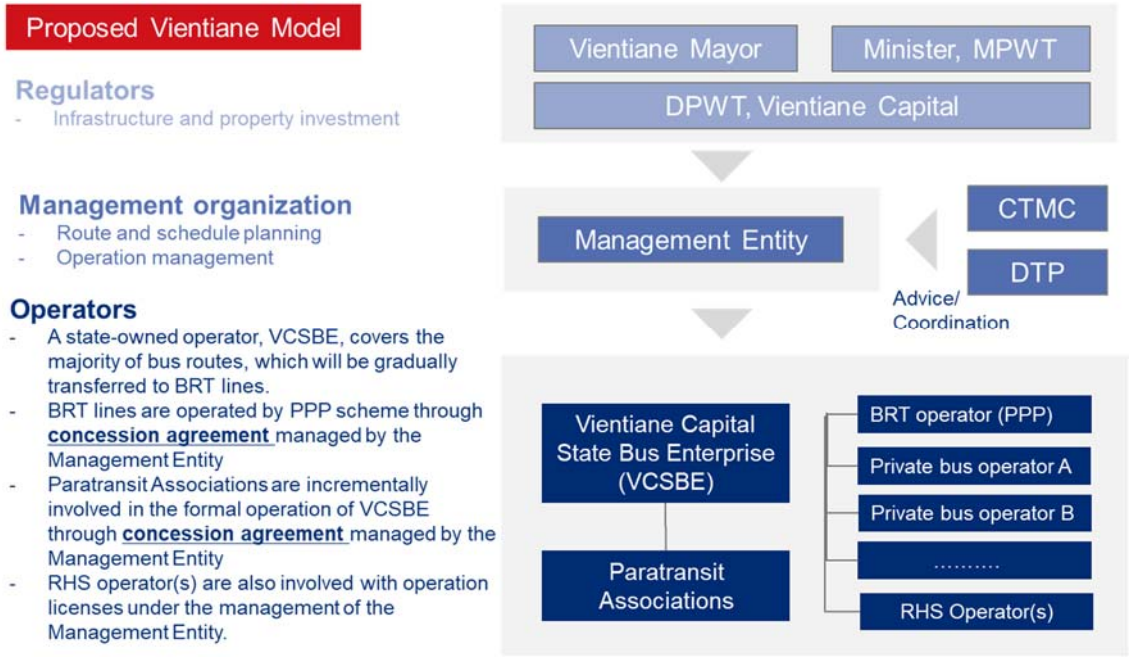


Figure 11.3-10 Proposed Institutional Framework of Public Transport System in Vientiane Capital

6) Inclusive Transit-Oriented Development (TOD) with Effective Land Use Planning

The compact urban form and development around public transport stops can contribute to an increase in ridership because residents are more likely to live in the vicinity of public transport. Additionally, it is also more likely for their preferable destinations, such as business and commercial facilities to also be located nearby public transport. Therefore, TOD can have the potential to rehabilitate and sustainably increase the profitability of public transport operators. They can invest in the enhancement of their LoS and reinforce further TOD in newly developed areas with BRT lines in Vientiane which deliver high-quality public transport services. As a result, as illustrated in Figure 11.3-11, TOD can become a powerful means to reverse the trend of public transport decline in Vientiane and to realize a positive feedback loop of its usage in the long term. Therefore, this MP proposes the realization of TOD harmonized with BRT investment in Vientiane, which is enabled by strategic urban and land use planning integration.

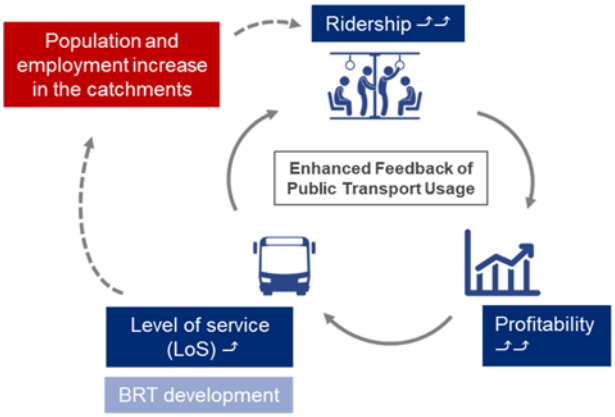


Figure 11.3-11 Enhanced Feedback of Public Transport Usage through TOD

11.3.3 Road Network and Traffic Management

(1) Goals

Goal 1: Accessible, Inclusive, and Reliable Transport Service Provision and Network Development

Accessible, inclusive, reliable, and high-quality transport services for all citizens of Vientiane will play an essential role in achieving social inclusion through its extended network development. Vientiane's current road network has missing links where some sections are underdeveloped, as well as sections that are not wide enough to encompass public transport services. In addition, there are sections where traffic capacity is reduced, and congestion occurs due to the lack of traffic management. To eliminate these bottlenecks that cause congestion, the road network needs to be improved in stages, along with gradual improvements, and strategic investments in the public transportation system.

Goal 2: Climate Resilient and Secure Transport Services

The effects of climate change are increasing and intensifying the damage caused by natural disasters worldwide. Safe, reliable, and resilient transportation services for all citizens of Vientiane play an essential role in achieving social inclusion through strategic network development. Vientiane has experienced flood damage in the past, often caused by typhoons. In order to avoid or mitigate the effects of climate change, network alternatives, as well as stable and resilient transport services need to be provided.

Goal 3: Mitigation of Environmental Impacts of Transport to Contribute to Global Sustainability

The introduction of a sustainable transportation system in Vientiane is expected to reduce the environmental burden of transportation on the planet and contribute to global sustainability and climate change mitigation. Vientiane has shifted from motorbike-oriented motorization to car-oriented motorization in the past decade, and the environmental burden of transportation, including the emission of greenhouse gasses (such as CO_2) and other air pollutants (such as NOx, and SOx) has continued to increase. Particularly, NOx and SOx emissions have a negative impact on residents' health in the medium term. In the case of greenhouse gasses, continuous long term increase contribute to global warming, and in the case of Vientiane, contribute to the frequency and intensification of natural disasters, such as floods. Therefore, the road transportation plan will seek to reduce or eliminate traffic congestion by improving the road network and increasing traffic capacity through intersection improvements. The plan also aims to promote non-motorized transportation, such as walking and bicycling, by improving sidewalks and bicycle paths, and to achieve a modal shift to environmentally friendly public transportation. Encouraging the introduction of electric vehicles will also be effective in reducing the direct impact of vehicle emissions.

Goal 4: Comfortable and Safe Walking Environment

A safe and comfortable walking environment will create a vibrant city and a walkable atmosphere for everyone, and furthermore, it will reduce the environmental burden caused by traffic on the planet. It is also expected to contribute to improving the health of Vientiane citizens. In the road traffic plan, sidewalks and other facilities will be developed to provide a comfortable and safe walking environment for all people, including pedestrians, people with disabilities, and the elderly. Additionally, to promote the use of public transportation, the environment at public transport hubs will be improved.

(2) Strategies

Four strategies have been identified in the field of road transport planning to achieve the vision, mission, and four goals set out in this MP. The relationship between goals and strategies is illustrated in the figure below. Details for each strategy are provided later in this section.

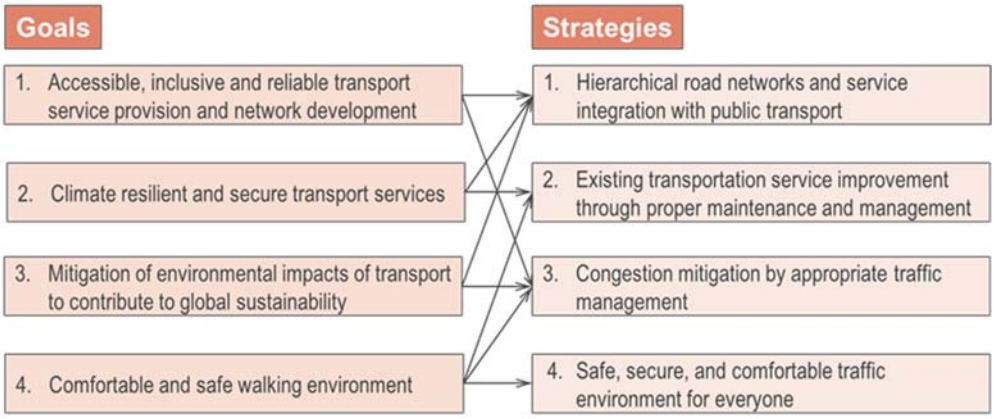


Figure 11.3-12 Relationship between Goals and Strategies

1) Hierarchical Road Networks and Service Integration with Public Transport

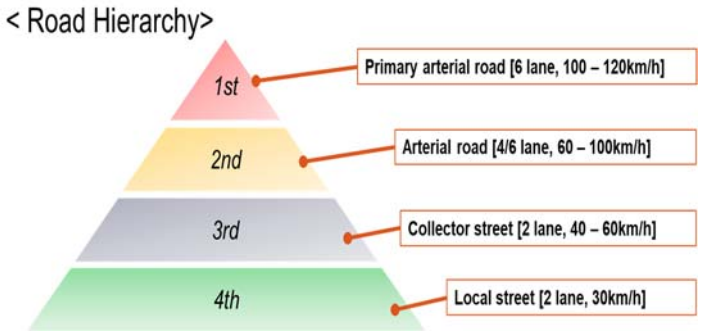


Figure 11.3-13 Road Hierarchy

In order to achieve sustainable, comfortable, and attractive transportation services, it is necessary to establish a hierarchical road network with clearly defined roles for road network development. Roads inherently have traffic, access, and spatial functions, and the development and connection of roads that suit these functions will provide a smoother road environment. In the case of Vientiane, the existence of missing links and inadequate traffic management have resulted in reduced traffic capacity and congestion. On the other hand, the share of public transportation has changed negatively in recent years, partly due to COVID-19 and other factors. To establish an accessible and reliable transportation system and a better transportation environment in the future, a step-by-step approach, rather than a radical one, is needed. For example, starting with an approach to improve the level of service (LoS) of public transportation, it would form a positive feedback of public transportation use, which would achieve an increase in the number of users and, eventually, profitability of public transportation operators. In the road network development, it is necessary to promote a step-by-step approach to realize attractive transportation services, in line with the development of public transportation systems.

2) Existing Transportation Service Improvement through Proper Maintenance and Management

Improving existing road services through proper management and maintenance of roads can ensure road safety and comfortable driving space. Currently in Vientiane, the deterioration of pavement, fading of road markings, and a lack of proper road drainage, not only reduce the traffic capacity of the roads, but also hinder the safe and comfortable use of the roads by all users, including road users, motorists, motorcyclists, and pedestrians. Properly maintained roads are necessary for sustainable, comfortable, and attractive transportation services.

Source: JICA Expert Team

Figure 11.3-14 Unclear Road Markings

Source: JICA Expert Team

Figure 11.3-15 Insufficient Road Drainage

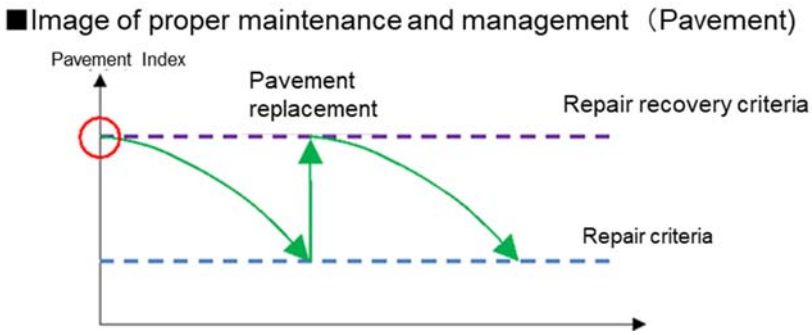


Figure 11.3-16 Image of Proper Pavement Maintenance and Management

3) Congestion Mitigation by Appropriate Traffic Management

With proper traffic management and road improvements, alleviation of traffic congestion is possible. Currently, in Vientiane, there are numerous areas where vehicles are illegally parked, obstructing not only the streets but also the sidewalks, leading to traffic congestion. Moreover, inadequate installation and operation of traffic signals at intersections also contribute to this problem. Poor traffic management not only reduces the traffic capacity of the road, but also hinders the safe and comfortable use of the road by all users, motorists, motorcyclists, and pedestrians. Proper road traffic management and road improvements are necessary to achieve sustainable, comfortable, and attractive transport services.

Source: JICA Expert Team

Figure 11.3-17 Illegal Parking at Bus Stop

Source: https://www.leicestermercury.co.uk/news/local-news/rising-parking-charges-shops-once-7691110

Figure 11.3-18 Increase Parking Fee

4) Safe, Secure, and Comfortable Transportation Environment for Everyone

Prioritizing pedestrians and non-motorized users can create vibrant, comfortable, and safe walking/riding spaces. A sustainable, comfortable, and attractive transportation environment must be safe and comfortable not only for automobiles, but also for the users of other modes of transport, such as pedestrians, bicycles, and public transport. Furthermore, it should also accommodate all people, including the disabled, elderly, children, and women. Currently in Vientiane, the sidewalks are insufficient, and there is a lack of well-developed nodal points for public transportation. Efforts must be made to ensure comfortable and safe walking/riding spaces by improving sidewalks that are easy for everyone to use, creating green and other relaxing sidewalk spaces, and providing handicapped people with easy access to public transportation.

Source: https://www.grahamfrp.com/en/application/architectural-construction/

Figure 11.3-19 Sheds and Tree Plantings

Source: https://www.mlit.go.jp/common/001301650.pdf

Figure 11.3-20 Pedestrian-Only Streets

Source: https://www.seikitokyu.co.jp/business/products/264/

Figure 11.3-21 Bicycle Lane

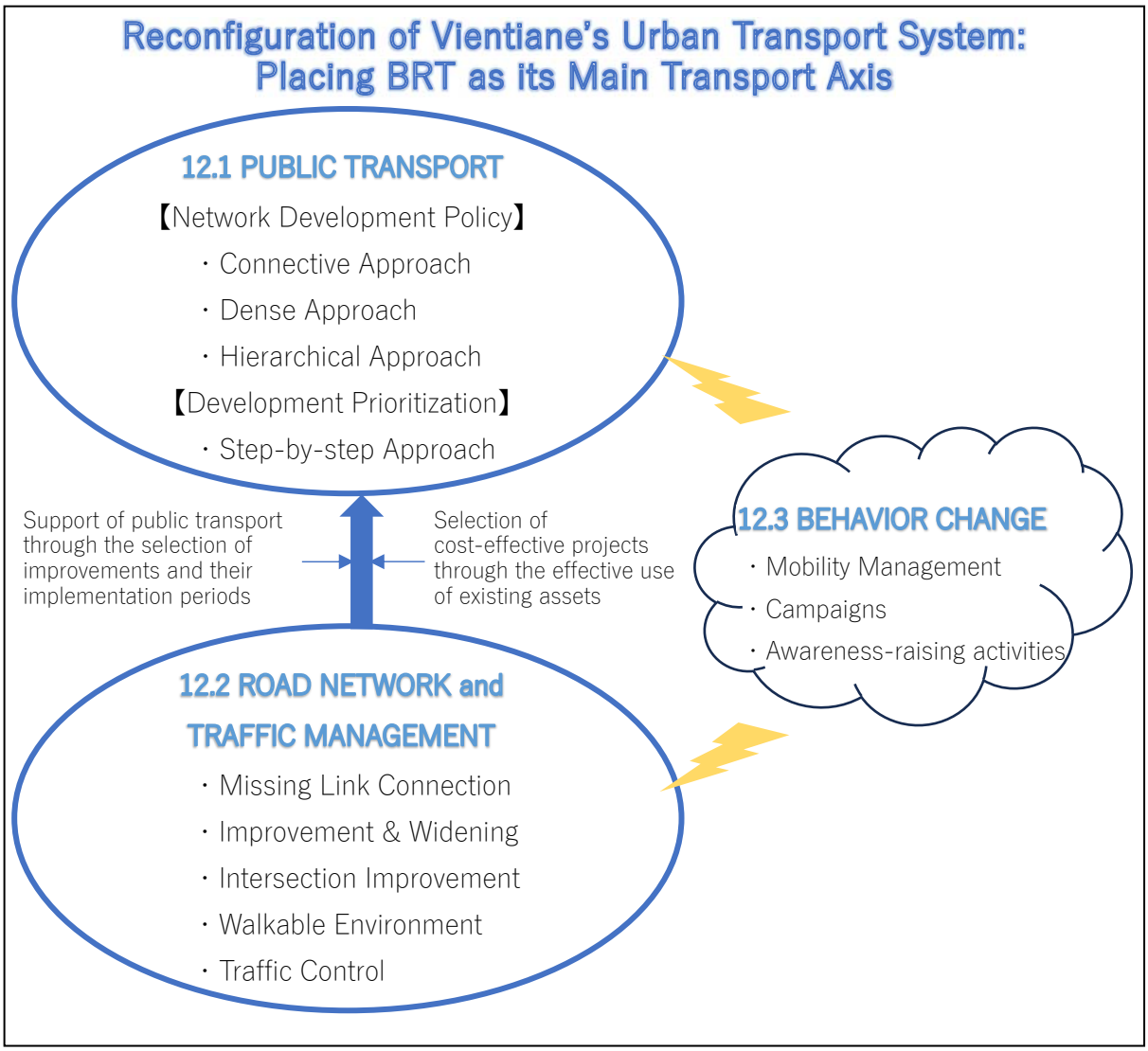
Source: http://www.l-scapecon.org/arts_tenji.html

Figure 11.3-22 Blind Guidance Blocks

CHAPTER 12 PROJECTS AND ACTION PLAN

In this chapter, the strategies introduced in the previous chapter are presented as specific projects along with the corresponding planning period of their implementation.

As described in the previous chapter, the central pillar of Vientiane's transport strategy is the reconfiguration of the urban transport system to place BRT as its main axis. Therefore, development policy relevant to the public transport sector is first introduced, followed by a description of the necessary contributions from the road and traffic management sectors, and ending with a discussion of the behavioral changes that are key to ensuring the sustainability of the new urban transport system.



12.1 PUBLIC TRANSPORT

12.1.1 Public Transport Development Plan

(1) Basic Approach to Future Public Transport Network Development Plan

The basic approach for formulating the future public transport network development plan is set to enhance three points of view; 1) Connective (Connectivity), 2) Dense (Densification), and 3) Hierarchical (Hierarchy) approach. These approaches are designed to realize a long-term network vision as illustrated in Figure 12.1-1.

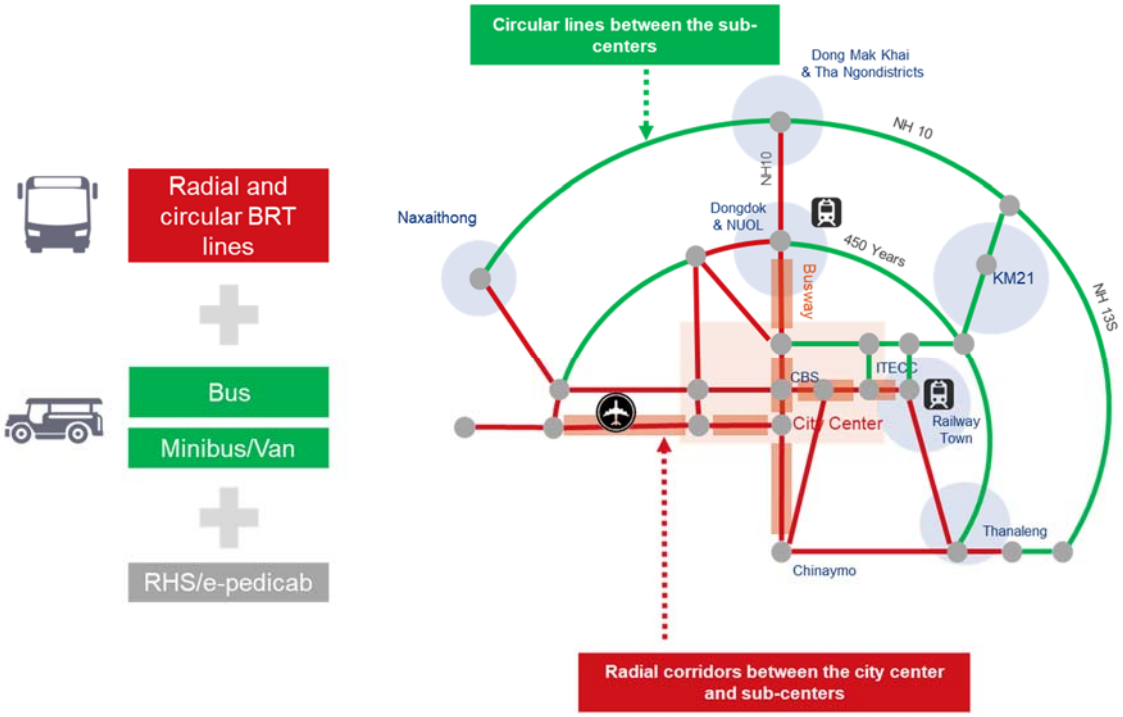


Figure 12.1-1 Long-term Network Vision of Future Public Transport Network

1) Connective Approach (Connectivity)

The Connective Approach aims to enhance transport connectivity between key destinations in Vientiane, namely the city center, special economic zones (SEZs), and new sub-centers that are planned to be developed in the suburban areas.

First, this approach proposes gradual enhancements of radial transport corridors through the replacement of conventional bus lines to BRT lines to the city center, which are expected to deliver substantial travel demand especially for commuting to work and school. BRT routes with dedicated busways are designed to cover four transport corridors passing through the CBD in the city center. With this approach, the connection between the city center and surrounding sub-centers will be reinforced to alleviate traffic saturation along the arterial transport corridors through the promotion of a modal shift from private motorcycles and vehicles. Second, this approach proposes the gradual installment of circular and semi-trunk routes to connect between the new sub-centers, namely Naxaithong, Dong Pak Khai and Tha Ngon, KM21, Railway Town, and Thanaleng. This urban relocation with new suburban cores is designed to transform from the current monocentric urban structure to the poly-centric one by dispersing socio-economic opportunities to these new centers. Third, this approach also includes modal connectivity with inter-city transport services including inter-city bus and Songteo, Lao-China Rail and Lao-Thai Rail. Trunk public transport services based on BRT routes will be designed to also serve fundamental access modes to those inter-city services. Facility development for enabling seamless transfers between the inter-city and urban services is also essential to enable inter-modality in Vientiane.

2) Dense Approach (Densification)

The Dense Approach aims to realize dense public transport routes in the city center and surrounding areas. This approach will enable meaningful participation in economic and social activities in the central part of the city, thus becoming a driving force of sustainable development in Vientiane.

Public transport access is a key factor to drive social and economic viability in the city center, especially in central business districts (CBD). The densification of public transport routes in the city center basically contributes to shortening the last mile trip from stops expected to have higher ridership, resulting in the expansion of the potential coverage of public transport services. This dense network will also promote tourism movement in the city center by public transport, in which tourists used to traveling on foot or by tuk-tuk or taxi will have access to public transportation. This will enhance the attractiveness of Vientiane as a tourist destination through the improvement of travelers' satisfaction. This approach proposes the grid-shaped network of trunk routes, especially through BRT routes, to spatially expand public transport station catchments for better mobility in the city center. In order to realize this grid-shaped network, multiple BRT routes will be proposed to pass through the city center and surrounding areas in different routes and to cross between each other.

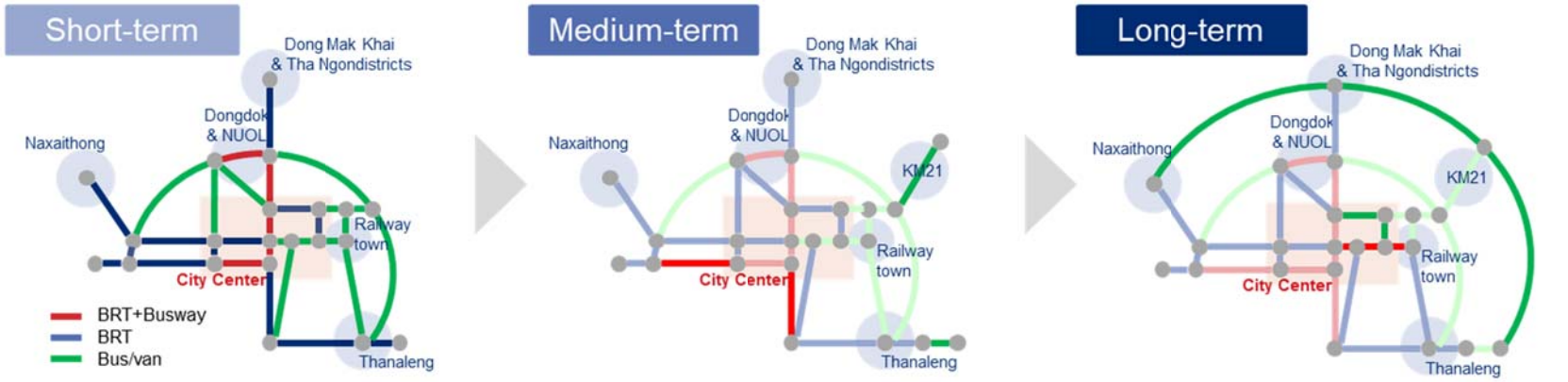
3) Hierarchical Approach (Hierarchy)

The Hierarchical Approach is designed to form the functional demarcation of trunk, semi-trunk, circular, and feeder routes to spatially distribute public transport access across the whole coverage of the city. This approach will contribute to the realization of an inclusive transport system accessible for all citizens in Vientiane.

The benefit of BRT-led trunk routes would be spatially confined without circular routes to connect between them and feeder services to expand public transport catchment coverage. Such supplemental bus routes for the trunk services are essential to spatially deliver transport accessibility by public transport. This approach proposes to establish a hierarchical public transport network consisting of the trunk and supplemental routes with appropriate functional classification, which depends on the surrounding built environment of its corridor, future development plans, and expected travel demand. A wide range of transport options such as appropriate vehicle sizes, service frequency, and operation methods to be applied to each route will rely on the urban contexts of its transport corridor.

(2) Functional Classification of Public Transport Routes

Based on the functional demarcation of public transport routes proposed in this future plan which is illustrated in Figure 12.1-2, a step-by-step approach to develop and expand trunk public transport routes is proposed to spatially deliver the varied benefits of high-quality public transport system to a wider coverage. A detailed description of the improvement in the short-, middle-, and long-term is shown as follows.



- Radial corridors to connect the city center and sub-centers
- 1st circular route to connect some of the sub-centers and surrounding area of the city center
- Feeder routes to expand the service coverage

- Enhanced radial corridors to connect the city center and sub-centers
- Feeder routes to expand the service coverage

- Enhanced radial corridors to connect the city center and sub-centers
- Grid-shaped network of trunk routes in the city center
- 2nd circular lines to connect between the sub-centers

Figure 12.1-2 Step-by-step Development of Trunk Public Transport Route

1) Short-term

In the short term, as BRT routes will serve on trunk routes covering the Western, Southern and Northern areas of Vientiane, some bus services are intended to change their routes to semi-trunk routes and to expand the service coverage. In addition, feeder routes for trunk services are proposed to be operated mainly by songteo to suburban areas with relatively low population density.

2) Middle term

In the middle term, new BRT routes are proposed to cover other transport corridors to expand trunk route coverage that are not served by BRT routes. The BRT corridors will serve as a backbone of the urban transport, which will form a hierarchical network consisting of semi-trunk, ring, and feeder routes in the whole conurbation of Vientiane. Instead of a service expansion of the BRT, new bus routes are set for additional semi-trunk and circular routes to enhance the connectivity between the sub-centers and surrounding areas. As a public initiative to incrementally replace conventional songteo vehicles with electric vehicles equivalent to new paratransit (hereinafter, referred to as "e-Songteo"), it is also recommended to gradually formalize their service model. It is effective to ensure the sustainability of business opportunities by private operators with the financial assistance of this replacement from the public side, and to use this opportunity to formally incorporate it as a public transport service at the same time.

3) Long-term

In the long term, the enhancement of the hierarchical network with new branching BRT routes as semi-trunk routes is proposed to enlarge the service coverage of the high-quality public transport and to deliver its spillover benefit in the vicinity of the arterial transport corridors. These semi-trunk routes aim to densify its spatial network in the city center and surrounding areas and also to deliver direct transport service to the city center from suburban areas given the advantage of a BRT system as a bus-based transport system. In accordance with the functional expansion of BRT routes, bus services are proposed to extend the circular routes which are expected to meet increasing travel demand between the suburban sub-centers. Additional feeder routes mainly using minibus and e-Songteo vehicles are planned to cover newly developed areas in the suburban and peripheral areas.

(3) Operation Route and Frequency Setting

Based on the basic approach to future public transport network development plan, and estimated future passenger demand described in Chapter 6, operation routes settings in the short-, middle- and long-term are proposed as shown in Table 12.1-1, Figure 12.1-4, Figure 12.1-5, and Figure 12.1-6, respectively. Target frequency of public transport services by service type in the short-, middle-, and long-term is shown in Table 12.1-1. Incremental improvement of the service frequency is designed to foster a modal shift from private modes and strategically guide urban development in a sustainable way. Regarding service frequency of peak-hour and off-peak hour, in reference to the assumption on BRT Phase-1 of VCSBE, the service frequency of these routes during peak hours is assumed to double compared to that during off-peak hours. Here, peak and off-peak hours are defined as 6am-9am + 3pm-8 pm and 9am-3pm + 8pm-10pm, respectively.

Table 12.1-1 Route and Frequency Settings

Route ID	Origin	Destination	Transport Mode			Peak Hour Frequency			Length (km) *1	Remark
			Short-term	Middle-term	Long-term	Short-term	Middle-term	Long-term		
BRT-A1 *Upgraded from BL-05	ITECC	Nongteng	BRT	-	-	10	-	-	42.80	To be upgrade by BRT-A2
BRT-B1 *Upgraded from BL-23	Tat Thong	Tha Ngon	BRT	BRT	BRT	15	10	5	79.20	
BRT-B2 *Upgraded from BL-23	Tat Thong	Tha Ngon	BRT	BRT	BRT	60	60	60	86.20	
BRT-C *Upgraded from BL-05/08/14	Naxaythong	Buddha Park	BRT	BRT	BRT	10	10	10	83.20	
BRT-D *Upgraded from BL-29/31	FaNgumPark	NUOL	BRT	-	-	10	-	-	27.10	To be replaced by BRT-F
CR-00	CBS	NUOL	Bus	-	-	10	-	-	46.44	To be replaced by BRT-F
CR-01	NBT	Savang Village	Bus	Bus	Bus	10	10	10	55.98	
CR-02 *Replaced from BL-20	NBT	Nahai Village	Bus	Bus	Bus	10	10	10	60.16	
CR-03	NBT	Thanaleng	Bus	Bus	Bus	10	10	10	83.44	
FR-01	NUOL	National Defence College	Bus	-	-	15	-	-	38.22	To be upgraded by BRT-E
FR-02 *Replaced from BL-06	Mai Village	Sikhay	Songteo	Minibus	Minibus	15	15	15	22.58	
FR-03	FSB	National Defence College	Songteo	Minibus	Minibus	15	15	15	53.78	
FR-04	CBS	NBT	Bus	Bus	Bus	15	15	15	31.84	
FR-05	FSB	Vientiane Sta.	Songteo	Minibus	Minibus	15	15	15	51.70	
FR-06	NBT	Dong Village	Songteo	Minibus	Minibus	10	10	10	30.52	
FR-07	SBT	Namon Village	Songteo	Minibus	Minibus	10	10	10	38.64	
FR-08	ITECC	Naphasouk Village	Songteo	Minibus	Minibus	15	15	15	57.72	
BRT-A2	ITECC	West Nongteng	-	BRT	-	-	10	10	45.00	To be upgrade by BRT-A3
BRT-E	NUOL	National Defence College	-	BRT	BRT	-	10	10	38.22	
BRT-F	CBS	NUOL	-	BRT	BRT	-	10	5	46.44	
FR-09	ITECC	Sanghuabo Village	-	Minibus	Minibus	-	15	15	39.58	
FR-10	SBT	Thadindeng Village	-	Minibus	Minibus	-	15	15	46.08	
FR-11	CBS	KM21	-	Minibus	Minibus	-	15	15	52.22	
FR-12	SBT	Than Ngon	-	Minibus	Minibus	-	15	15	41.14	
FR-13	Airport	Friendship Bridge	-	Bus	Bus	-	10	10	57.86	
FR-14	SBT	Naxaythong	-	Minibus	Minibus	-	15	15	32.26	
FR-15	CBS	KM21	-	Minibus	Minibus	-	15	15	53.22	
BRT-A3	Thanaleng	West Nongteng	-	-	BRT	-	-	15	91.80	
CR-04	FSB	Than Ngon	-	-	Minibus	-	-	15	69.24	
CR-05	Sikhay	Than Ngon	-	-	Minibus	-	-	15	43.98	
FR-16	NBT	Than Ngon	-	-	Minibus	-	-	15	61.78	

Note that the actual hourly fluctuation of the frequency with the setting of first and last services depends on surrounding land uses (e.g., commercial, residential, industrial areas) and the characteristics of major facilities around stops (school, university, shopping mall).

*1: The length of each route is calculated as round-trip distance

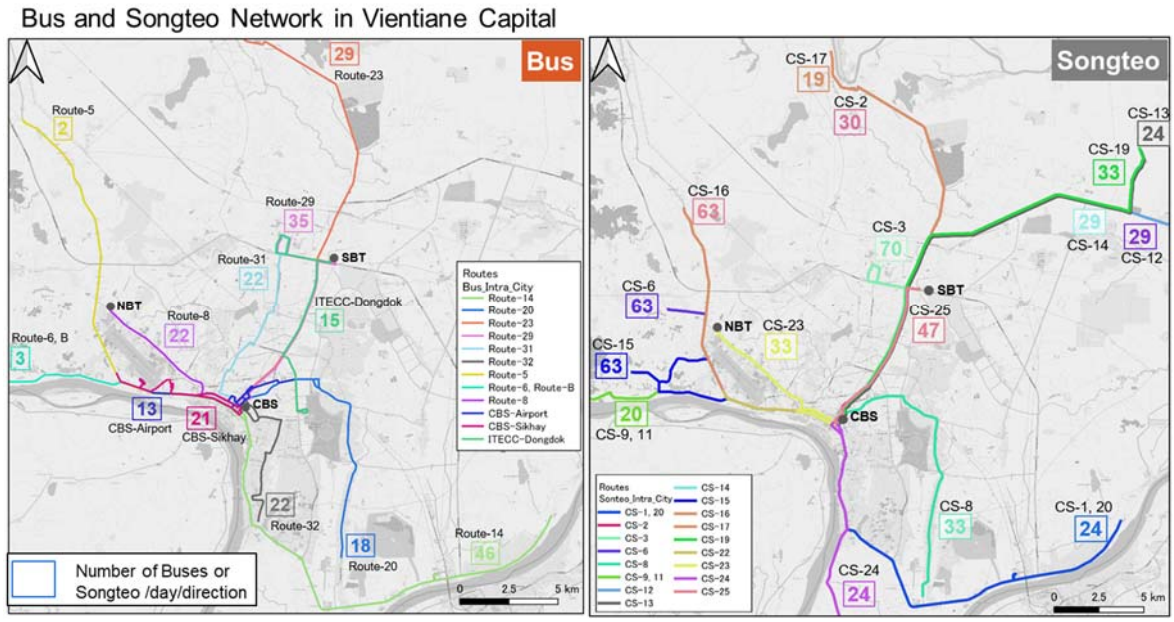


Figure 12.1-3 Current Public Transport Network (2019)

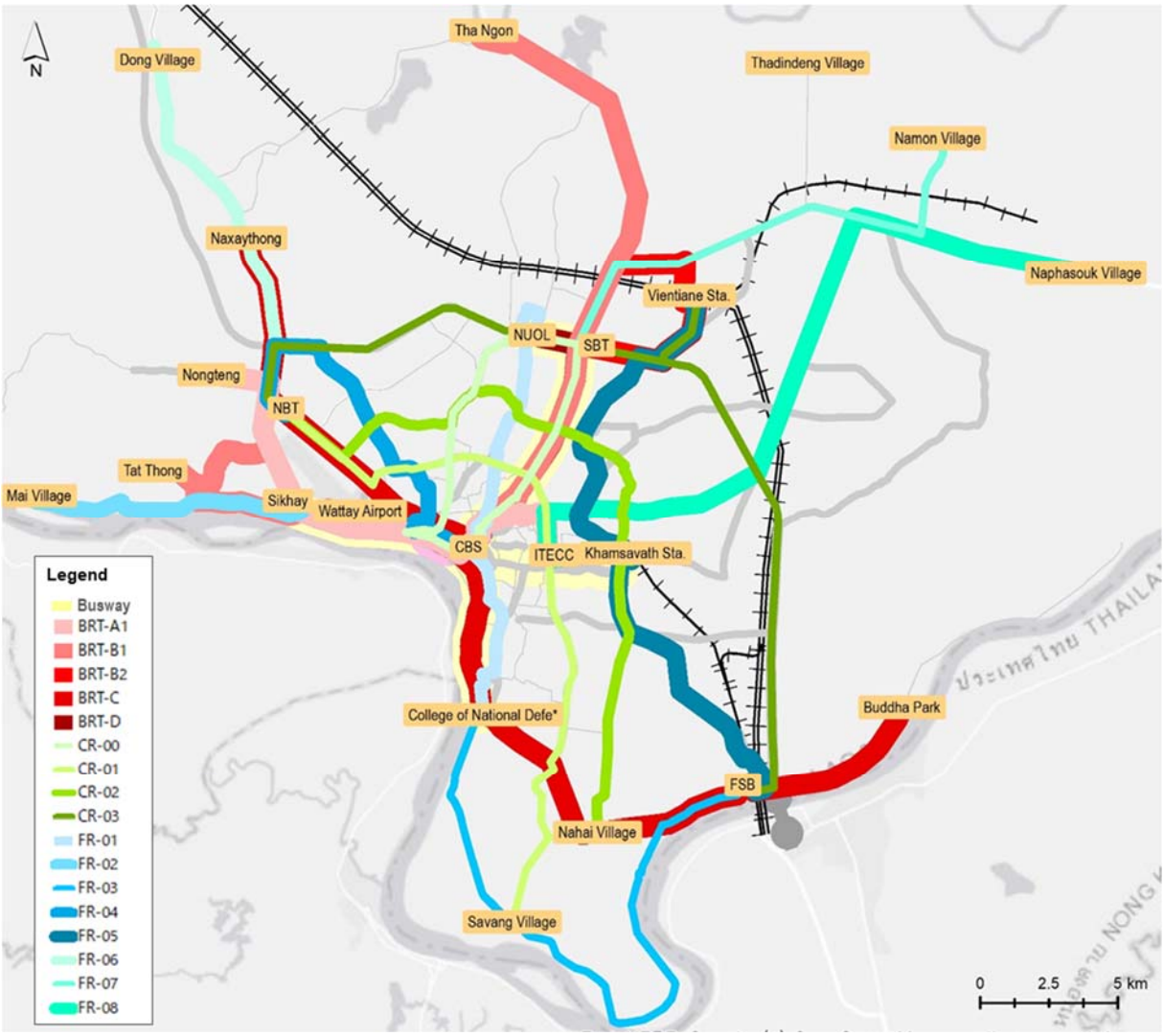
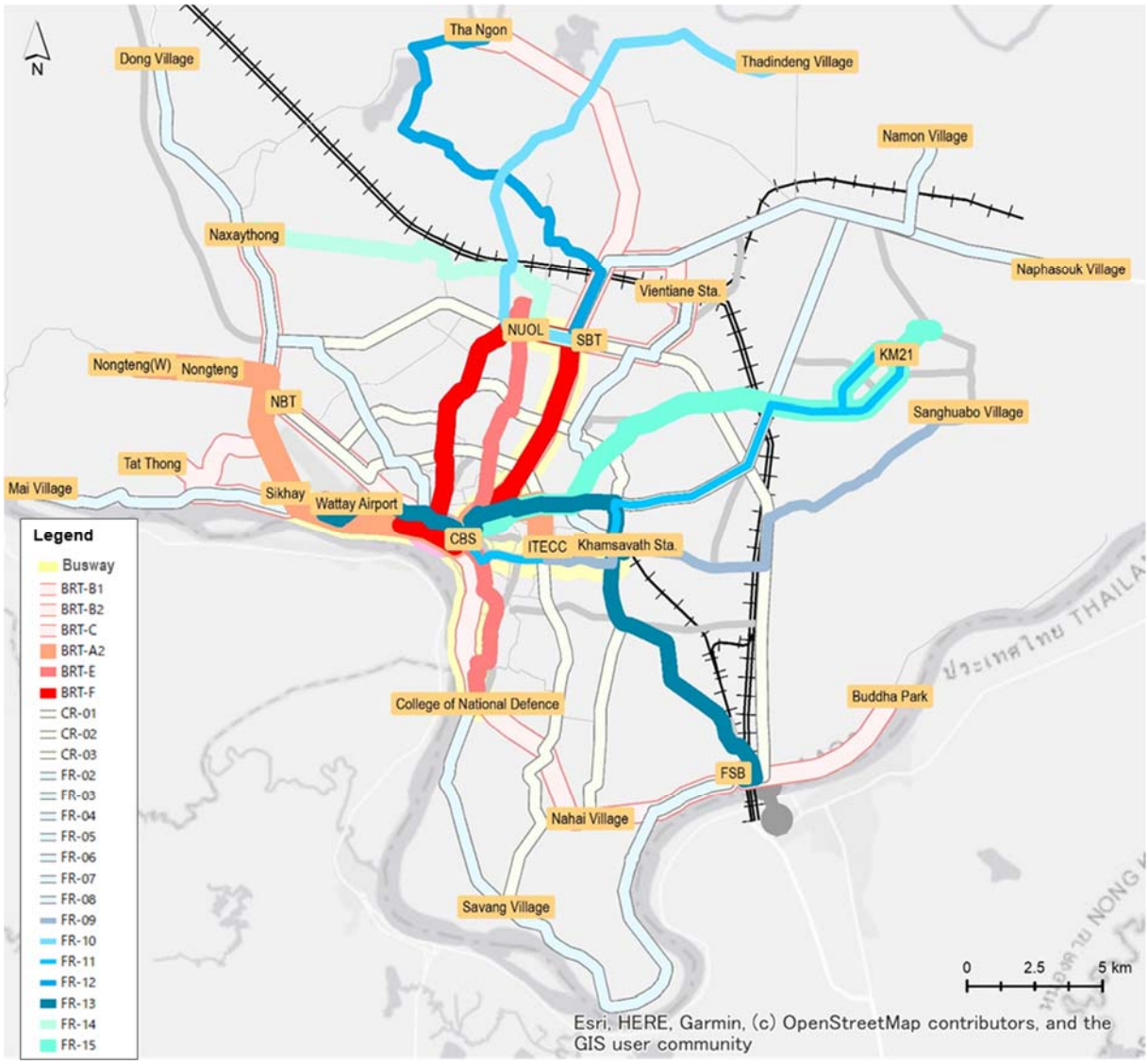
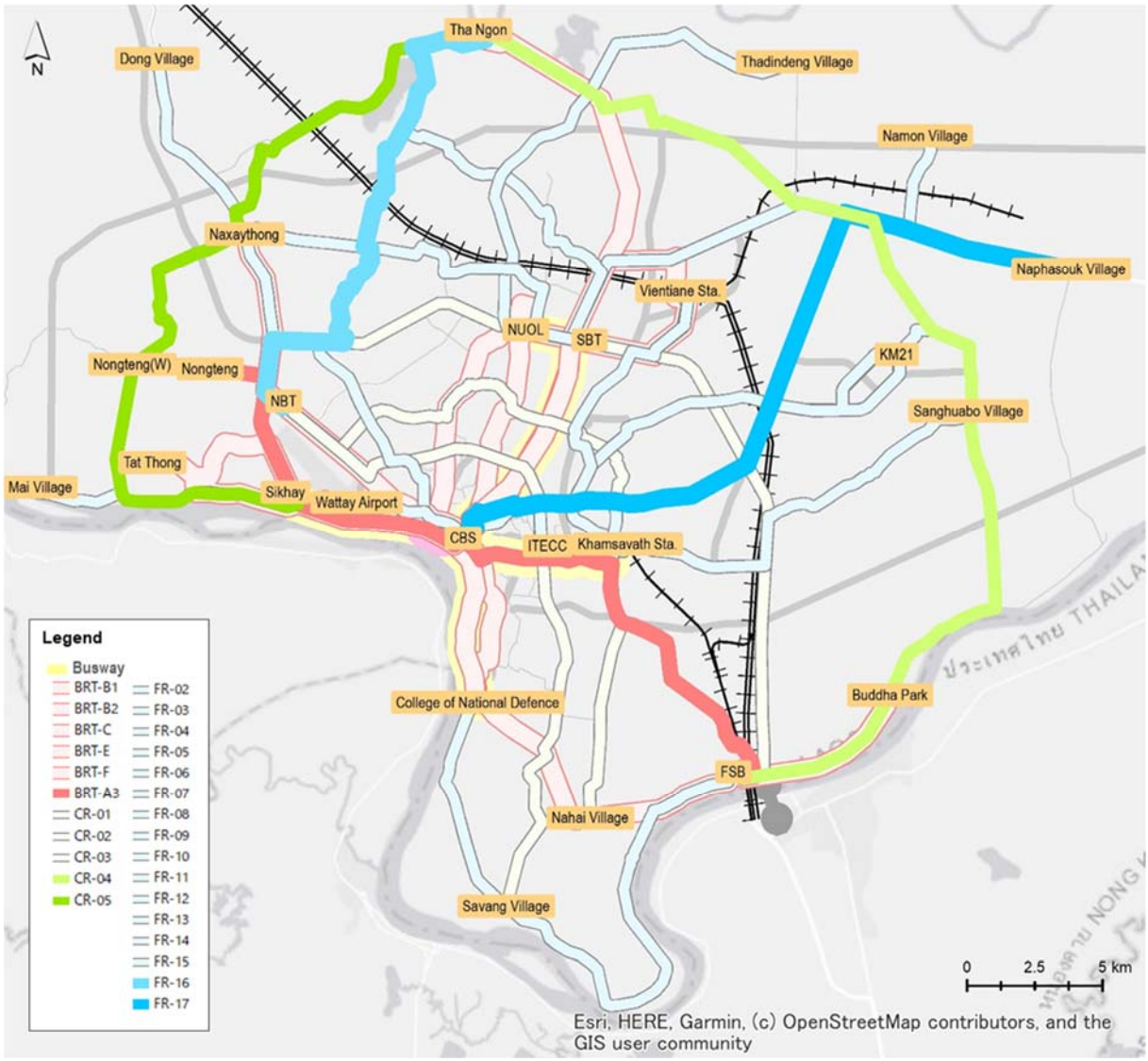


Figure 12.1-4 Phased Development of Public Transport Network in the Short-term (2027)



Note: Solid lines indicate newly installed public transport routes during the medium-term project period, while faint-colored double lines indicate pre-existing public transport routes.

Figure 12.1-5 Phased Development of Public Transport Network in the Middle term (2032)



Note: Solid lines indicate newly installed public transport routes during the long-term project period, while faint-colored double lines indicate pre-existing public transport routes.

Figure 12.1-6 Public Transport Network in the Long-term (2040)

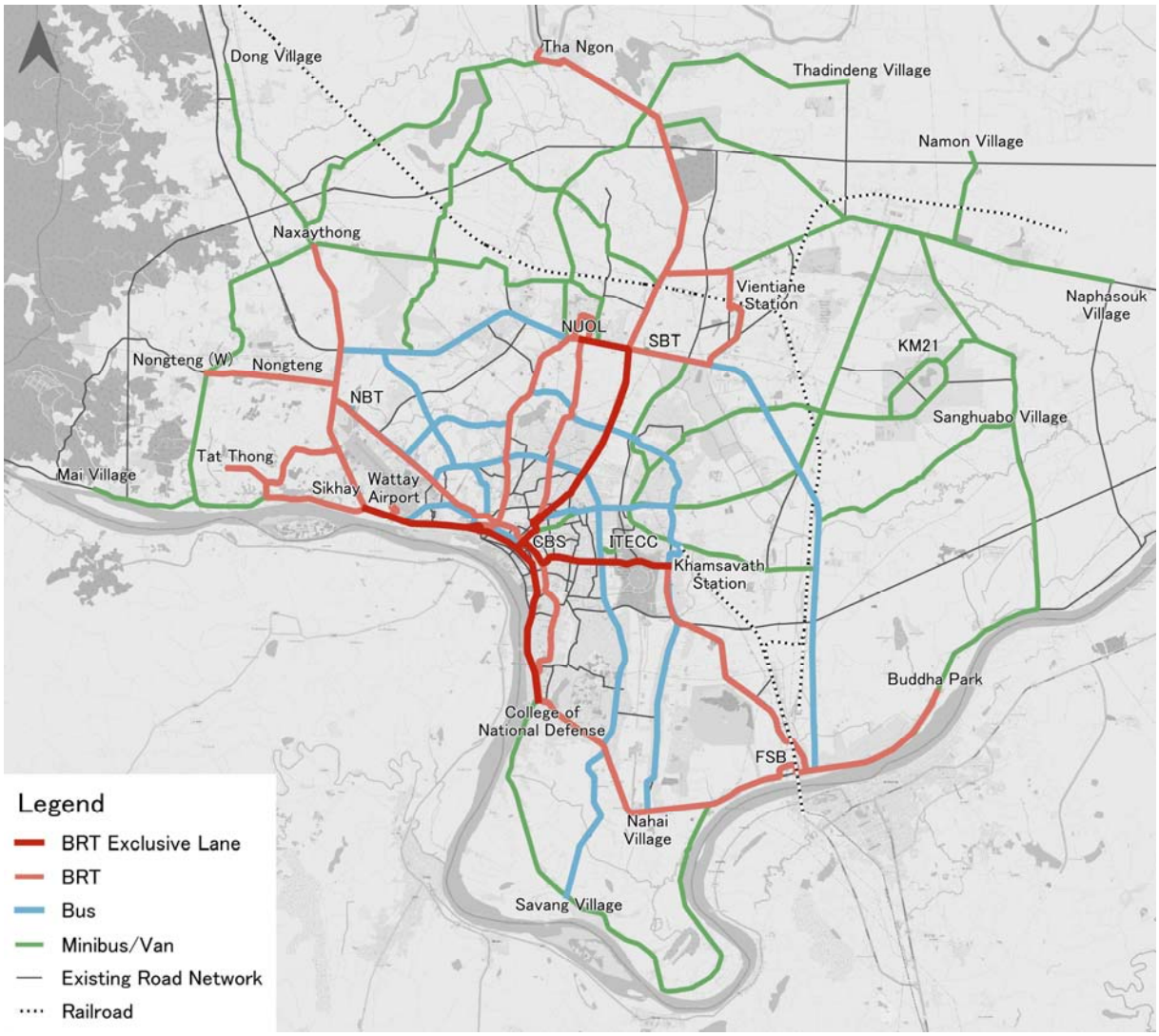


Figure 12.1-7 Completed Public Transport Network (2040)

(4) Fare Structure

This MP proposed a flat fare structure aligned with VCSBE's proposed BRT zonal fare structure for BRT and bus service in the target area. This is intended to ensure optimal and efficient operation of the entire public transport system in Vientiane as a single public transport system. The zonal fare system has been adopted in many cities, including Paris (France) and London (UK) and allows for lower costs on the part of operators. The fare is 3500 kip in Zone 1, 8000 kip in Zone 2, and 8000 kip when crossing Zones 1 and 2, as shown in Figure 12.1-8.

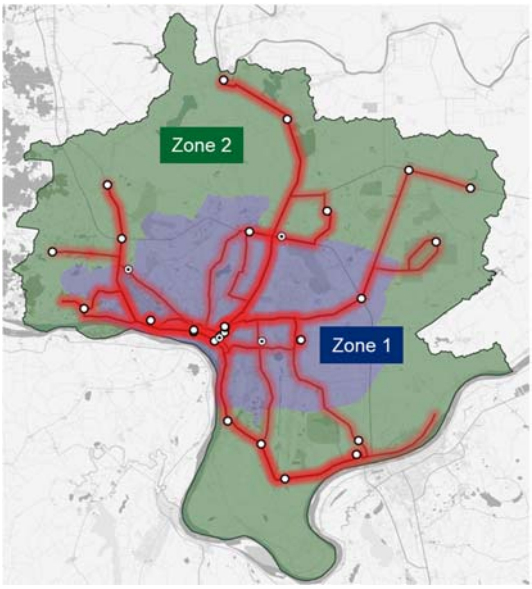


Figure 12.1-8 Fare Zone Structure

12.1.2 BRT Proposed Projects

The VSUTP (ongoing BRT Project), currently being implemented through co-financing by various institutions including ADB, EIB, OPEC Fund, EU-AIF, Global Environmental Facility (GEF), and the High-level Technology Fund, is experiencing delays due to the impact of the COVID-19 pandemic. Nevertheless, it remains highly viable and stands as the backbone of the urban transport network in Vientiane Capital. Presently, activities including detailed design, establishment of the operational framework, and the obtaining necessary approvals for the forthcoming services. In this context, VSUTP aims to commence the operation of BRT-A1, B1, B2, and D in 2024.

In this MP, as an additional BRT operation to meet the goal of the MP, the operation of BRT-C is proposed to be carried out by 2027. By 2032, BRT-A1 will be extended to BRT-A2, and the operation of BRT-E and F will start. Additionally, the operation of BRT-D will be replaced in conjunction with the operation of BRT-F. By 2040, BRT-A2 will be extended to BRT-A3. Planned routes for each term are identified in Table 12.1-2. These BRT routes will form radial corridors between the city center and sub-centers, while simultaneously closely connect the city center. It should be noted that the effective operation of BRT will require strict traffic enforcement, which needs the proactive collaboration between Traffic Police in Vientiane, the Management Entity, and BRT operator.

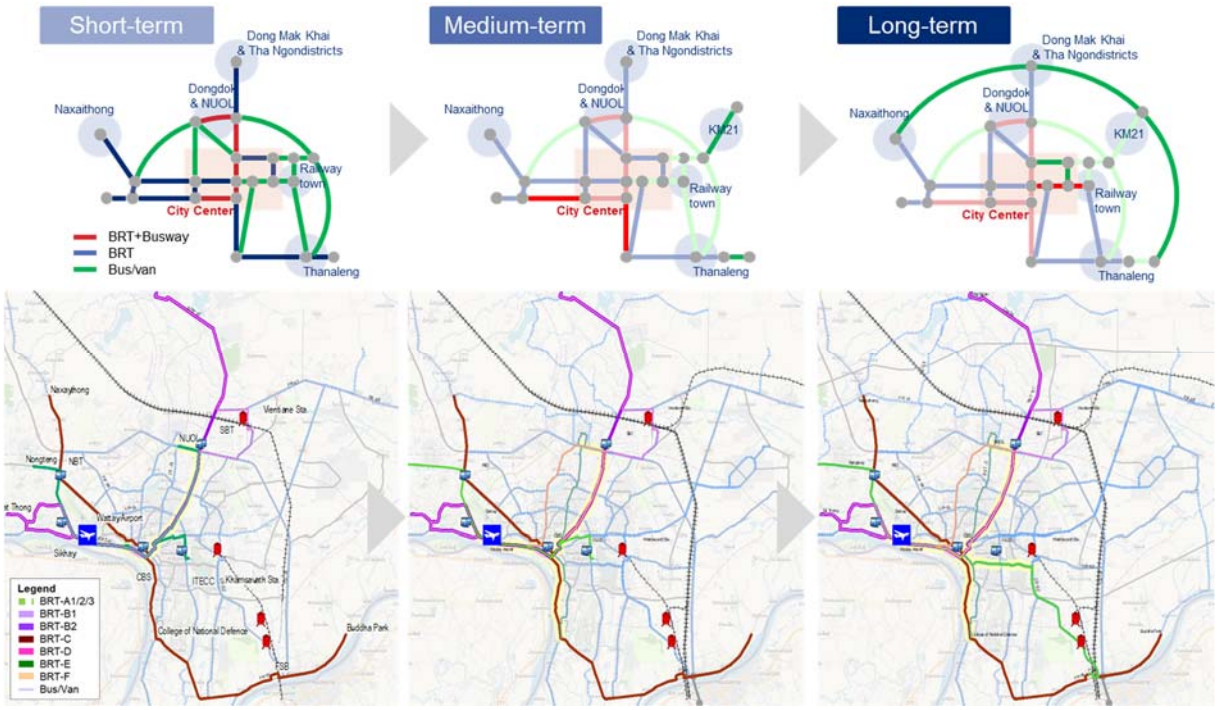
Table 12.1-2 BRT Routes in the Short, Middle and Long-term

Line ID	Origin	Destination	Transport Mode			Length (km)	Remark
			Short-term	Middle-term	Long-term		
BRT-A1 (*1)	ITECC	Nongteng	V	-	-	42.80	Upgrade to BRT-A2
BRT-B1 (*1)	Tat Thong	Tha Ngon	V	V	V	79.20	
BRT-B2 (*1)	Tat Thong	Tha Ngon	V	V	V	86.20	
BRT-C	Naxaythong	Buddha Park	V	V	V	83.20	
BRT-D (*1)	FaNgumPark	NUOL	V	-	-	27.10	Replaced by BRT-F
BRT-A2	ITECC	West Nongteng	-	V	-	45.00	Upgrade to BRT-A3

BRT-E	NUOL	National Defence College	-	V	V	38.22	
BRT-F	CBS	NUOL	-	V	V	46.44	
BRT-A3	Thanaleng	West Nongteng	-	-	V	91.80	

*1: The initial operating routes proposed by VSUTP

Based on the proposed public transport network, the network of future BRT routes as trunk route service in the long term is proposed as illustrated in Figure 12.1-9.



Source: JICA Expert Team

Figure 12.1-9 BRT Network in the Short-, Medium- and Long-term

Table 12.1.3 shows the list of BRT proposed projects and project costs in the Urban Transport Master Plan. A summary of each project is described later in this section.

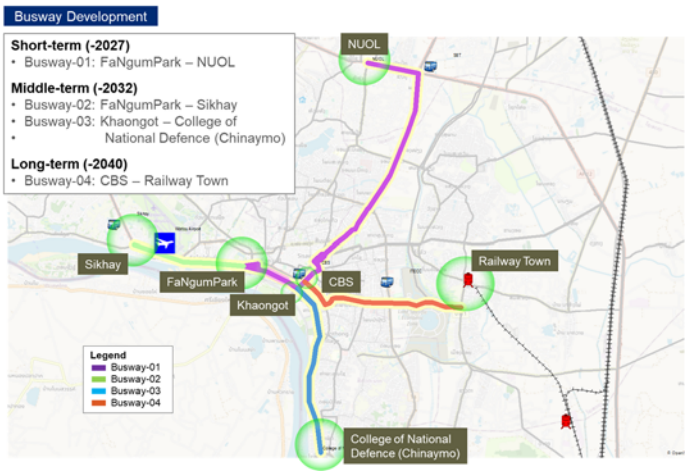
Table 12.1-3 BRT Proposed Projects

Proposed Project		Status	Implementing Authority	Short-term 2022~	Middle-term 2028~	Long-term 2033~	Initial Cost (USD)	Unit	Unit cost (USD)
BRT Projects									
BRT 1	Dedicated busway development	-						-	-
BRT 1-1	- Busway-01, 11.5km	Ongoing	VSUTP				The costs are included in new road constructions or widenings		
BRT 1-2	- Busway-02, 4.0 km	Middle	UTMS/DPWT						
BRT 1-3	- Busway-03, 6.2 km	Middle	UTMS/DPWT						
BRT 1-4	- Busway-04, 6.1 km	Long	UTMS/DPWT						
BRT 2	Traffic signaling System (PTPS)	-						-	-
BRT 2-1	- Busway-01, 11.5km	Ongoing	VSUTP				The costs are included in new road constructions or widenings		
BRT 2-2	- Busway-02, and 03	Middle	UTMS/DPWT						
BRT 2-3	- Busway-04	Long	UTMS/DPWT						
BRT 3	Procurement of new BRT vehicles and spare parts	-					114,850,000	-	-
BRT 3-1	- Line A1, B1, B2 and D by VSUTP	Ongoing	VSUTP				16,800,000	55	305,455
BRT 3-2	- Line C and additional vehicles for A1, B1, B2 and D	Short	UTMS/DPWT				23,520,000	77	305,455
BRT 3-3	- Line A2, E, and additional vehicles to increase frequencies	Middle	UTMS/DPWT				14,970,000	49	305,455
BRT 3-4	- Line A3, F, and additional vehicles to increase frequencies	Long	UTMS/DPWT				59,560,000	195	305,455
BRT 4	Transit facility development for BRT and information provision	-					7,440,000	-	-
BRT 4-1	- Short (Median Stations)	Ongoing	VSUTP				680,000	22	30,705
BRT 4-2	- Short (Curbside Stations)	Ongoing	VSUTP				250,000	5	50,900
BRT 4-3	- Short (Median Stations)	Short	UTMS/DPWT				60,000	2	30,705
BRT 4-4	- Short (Curbside Stations)	Short	UTMS/DPWT				3,980,000	199	20,000
BRT 4-5	- Middle (Median Stations)	Middle	UTMS/DPWT				860,000	28	30,705
BRT 4-6	- Middle (Curbside Stations)	Middle	UTMS/DPWT				1,240,000	62	20,000
BRT 4-7	- Long (Median Stations)	Long	UTMS/DPWT				370,000	12	30,705
BRT 5	Development of BRT depot & maintenance facilities and the Control Center						51,273,000	-	-
BRT 5-1	- Short (VSUTP)	Ongoing	VSUTP				7,500,000	1	
BRT 5-2	- Short	Short	UTMS/DPWT				10,500,000	1	
BRT 5-3	- Middle	Middle	UTMS/DPWT				6,682,000	1	
BRT 5-4	- Long	Long	UTMS/DPWT				26,591,000	1	
BRT 6	Intelligent Transport System and Station Services for BRT station						17,634,000	-	-
BRT 6-1	- Short (VSUTP)	Ongoing	VSUTP				6,900,000	27	
BRT 6-2	- Short	Short	UTMS/DPWT				511,000	2	
BRT 6-3	- Middle	Middle	UTMS/DPWT				7,156,000	28	
BRT 6-4	- Long	Long	UTMS/DPWT				3,067,000	12	
BRT 7	Automatic Fare Collection System						7,520,000	-	-
BRT 7-1	- Short (VSUTP)	Ongoing	VSUTP				1,100,000	55	20,000
BRT 7-2	- Short	Short	UTMS/DPWT				1,540,000	77	20,000
BRT 7-3	- Middle	Middle	UTMS/DPWT				980,000	49	20,000
BRT 7-4	- Long	Long	UTMS/DPWT				3,900,000	195	20,000
						Total	198,717,000		

(1) Dedicated Busway Development

In this MP, the full-scale BRT system consisting of a dedicated busway (closed system) with BRT stations will be introduced along each of the corridors to access the city center.

By 2024, VSUTP plans to develop the North corriror (Busway-01: FaNgumPark-NUOL). In this MP, as additional busway developments, corridors in the West (Busway-02: FaNgumPark-Sikhay) and East (Busway-03: Khaongot-College of National Defence) will be developed by 2032, while the corridor in the South (Busway-04: CBS – Railway Town) is targeted for development by



Source: JICA Expert Team

Figure 12.1-10 Dedicated busway development

2040. These BRT-exclusive services can promote a modal shift from private modes to public modes, especially during peak hours. Also, these transport corridors can treat a high concentration of transport demand, expected to continue to increase in the future. The typical cross-section of busways and construction costs are summarized in the section relevant to roads of this MP.

(2) Traffic Signaling System (PTPS) along Busways

Even if the BRT utilizes exclusive busways, the BRT operation is disrupted at intersections. This can cause significant delay for BRT buses, and it may cause queues of BRT buses. Thus, the Public Transport Priority System (PTPS) is proposed for a smooth operation of the BRT. The location and cost of PTPS installation is described in the traffic management section. The PTPS to be procured by the VSUTP and those that need to be additionally procured are summarized in Table 12.1.3.

(3) Procurement of New Vehicles and Spare Parts

The BRT buses in Vientiane are assumed to be vehicles with platform-level doors on the left side and ground-level doors on the right side, as they need to be able to run on two types of road sections: dedicated busway sections and road sections with mix traffic. Therefore, the cost of the BRT vehicles assumed in this MP is based on the double-sided type of vehicles that will be procured in the VSUTP project, with a service life of 10 years, assuming that proper maintenance is implemented. The vehicles to be procured by the VSUTP and those that need to be additionally procured are summarized in Table 12.1.3.

(4) Transit Facility Development for BRT and Information Provision

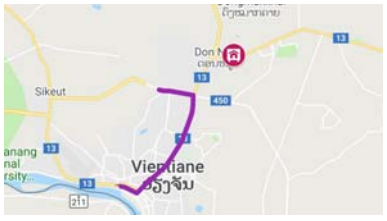
BRT stations on the dedicated busways are equipped with platforms for smooth boarding and alighting. Off-board fare collection is also a key function of the BRT as it also allows smooth boarding and alighting. The BRT stations also should have clear, organized signage systems to guide passengers. Barrier free facilities such as slopes and benches are also required to provide accessibility to all residents, including people with limited mobility. In the road sections where the semi-BRT (open system) will operate, bus shelters are proposed to be designed in a way in which they can be shared with regular buses. Bus shelters are foreseen to be equipped with roofs and waiting seats to protect passengers from rain and strong sunlight so that passengers can wait for buses comfortably. It is also proposed for bus shelters to be relatively inexpensive facilities with no platforms, allowing passengers to get on and off at the same level as the road. The transit facility to be developed by the VSUTP and those that need to be additionally developed are summarized in Table 12.1.3.

Source: VSUTP BRT Station Architecture Design, 2021

Figure 12.1-11 Conceptual Design of BRT Station

(5) Development of BRT Depot & Maintenance Facilities and the Control Center

A bus depot and maintenance facilites should be situated as close as possible to the origin point of one or more BRT routes to minimize the distance that buses need to travel from the corridor to the depot. The reduction of these "dead kilometers" should be a significant objective in the selection of depot and/or BRT corridor sites, as operating buses incurs costs, and dead kilometers do not generate fare revenue to offset these expenses. Presently, MPWT possesses land for a potential new depot along Route 13 South near Don Noun. Although the Don Noun depot would be around 8 kilometers away from the commencement of the BRT trunk corridor, there are several BRT routes that originate near the



Source: VSUTP, 2021

Figure 12.1-12 Depot Location

planned depot. The depot, maintenance facilities and control center to be developed by the VSUTP and those that need to be additionally developed are summarized in Table 12.1.3.

(6) Intelligent Transport System and Station Service for BRT Station

To effectively manage and monitor BRT operations, it is essential to intorduce the Intelligent Transportation System (ITS) that includes entrance control at stations, installation of ticket vending machines, display of BRT arrival times and transfer information on information boards, deployment of surveillance cameras, and the establishment of an information monitoring system in coordination with the aforementioned control center. Furthermore, by accumulating such data, optimizing operational contracts and facilitating troubleshooting become more feasible. This ITS and station service to be developed by the VSUTP and those that need to be additionally developed are summarized in Table 12.1.3.

(7) Automatic Fare Collection System

The same as urban bus services in many countries, off-board fare collection should be applied for the BRT to avoid fare collection in buses. Typically, an integrated circuit (IC) card is often utilized for fare transaction. In addition to reducing transaction time and improving the convenience of passengers, the card can be utilized for other transactions, such as urban bus service, parking fee payment, as well as non-transport purposes such as shopping. This can generate revenues from transaction fees. The automatic fare collection system to be procured by the VSUTP and those that need to be additionally procured are summarized in Table 12.1.3.

Source: VSUTP Handbook

Figure 12.1-13 Image of Automatic Fare Collection System

12.1.3 Bus and Minibus Proposed Projects

Table 12.1-4 shows the list of bus and minibus-related proposed projects and project costs in this MP. A summary of each project is described later in this section.

Table 12.1-4 Bus and Minibus Proposed Projects

Proposed Project		Status	Implementing Authority	Short-term 2022~	Middle-term 2028~	Long-term 2033~	Initial Cost (USD)	Unit	Unit cost (USD)
Bus and Minibus Projects									
Bus 1	Rearrangement of bus lines for BRT						180,000	-	-
Bus 1-1	- Short	Short	VCSBE/UTMS				50,000	5	10,000
Bus 1-2	- Middle	Middle	VCSBE/UTMS				50,000	5	10,000
Bus 1-3	- Long	Long	VCSBE/UTMS				80,000	8	10,000
Bus 2	Procurement of new Bus vehicles and spare parts						31,350,000	-	-
Bus 2-1	- Short: Buses	Short	VCSBE/MPWT				13,420,000	122	110,000
Bus 2-2	- Middle: Buses	Middle	VCSBE/MPWT				4,510,000	41	110,000
Bus 2-3	- Long: Buses	Long	VCSBE/MPWT				13,420,000	122	110,000
Bus 3	Procurement of new Minibus vehicles and spare parts						70,440,000	-	-
Bus 3-1	- Short: Minibuses	Ongoing	MPWT-DOT				1,830,000	52	35,191
Bus 3-2	- Middle: Minibuses	Middle	MPWT-DOT				16,700,000	167	100,000
Bus 3-3	- Long: Minibuses	Long	MPWT-DOT				15,800,000	158	100,000
Bus 4	Bus Driver Training - Driving Simulator + Training	Ongoing	MPWT-DOT				100,000	1	100,000
Bus 5	Transit facility development for Bus and information provision	-					11,420,000	-	-
Bus 5-1	- Short	Short	VCSBE				7,800,000	390	20,000
Bus 5-2	- Middle	Middle	VCSBE				1,500,000	75	20,000
Bus 5-3	- Long	Long	VCSBE				2,120,000	106	20,000
Bus 6	Renovation of existing bus terminals (CBS)	Ongoing	Vientiane Capital				47,500,000	-	-
Bus 7	Bus location system for public buses						902,000	-	-
Bus 7-1	- Short	Short	VCSBE				194,000	174	
Bus 7-2	- Middle	Middle	VCSBE				228,000	208	
Bus 7-3	- Long	Long	VCSBE				480,000	280	
Bus 8	Automatic Fare Collection System		VCSBE				13,240,000	-	-
Bus 8-1	- Short	Short	VCSBE				3,480,000	174	20,000
Bus 8-2	- Middle	Middle	VCSBE				4,160,000	208	20,000
Bus 8-3	- Long	Long	VCSBE				5,600,000	280	20,000
						Total	175,132,000		

(1) Rearrangement of Bus Routes for BRT

Every time the BRT routes are extended and overlap with existing bus and paratransit routes, these routes need to be reorganized to ensure effective BRT operations. Since BRT routes serve as trunk services and cover arterial corridors with high passenger demand, the routes of other road-based public transport should be consolidated and converted to feeder services for BRT routes. In addition, other transport resources, such as buses and paratransit vehicles, will be reassigned to new routes to which public transport services are currently not available. This reassignment will contribute to avoiding unnecessary competition with the BRT and semi-trunk bus services. The size of public transport services should be changed depending on the actual travel demand to minimize possible impacts on road traffic.

(2) Procurement of New Bus Vehicles and Spare Parts

The number of buses required to achieve the bus network and service frequency proposed in this MP was calculated and proposed as a bus procurement project. Considering the issues arising from aging buses, including accidents, air pollution, and decreased fuel efficiency, the service life of the buses has been established at 10 years, assuming that proper maintenance is conducted. Furthermore, a reserve fleet of 10% of the overall vehicle count has been taken into account.

(3) Procurement of New Minibus Vehicles and Spare Parts

As same as the aforementioned procurement of new bus vehicles and spare parts, the number of minibuses required to achieve the minibus network and service frequency proposed in this MP was calculated and proposed as a minibus procurement project. Due to the issues associated with aging vehicles, such as accidents, air pollution, and reduced fuel efficiency, it is crucial to address this through adequate maintenance and replacement. Thus, we have established a useful service life of 10 years, assuming that proper maintenance practices are implemented. Additionally, a reserve fleet of 10% of the total vehicles has been taken into consideration.

Source: JICA Expert Team

Figure 12.1-14 New minibus vehicles donated by Japanese government

(4) Bus Driver Training

Despite the efforts made by VCSBE and technical cooperation projects funded by JICA, as well as support from other donors, there are still identified issues regarding the driving behavior of bus drivers and safety of buses. Training of new drivers and further capacitation of existing drivers is identified as an area requiring improvements. To address this, the Japanese government has decided to provide a driving simulator to VCSBE in 2023. As a result, a driver training project has been proposed to maximize the utilization of this simulator.

(5) Transit Facility Development for Bus and Information Provision

Transit facilities are proposed to be developed in the same way as road sections where the semi-BRT (open system) is to be introduced. This consisting of bus shelters with roofs and waiting seats to protect passengers from rain and strong sunlight and allow them to wait for buses comfortably. Furthermore, the MP proposes to expand the improvement of bus shelters that have already been introduced in the central part of Vientiane and have received good feedback from users to the entire Study Area (SA).

(6) Renovation of Existing Bus Terminals

Since the 2008 MP, there has been strong requests for improvement of the Central Bus Terminal (CBS) due to its aging facilities, limited waiting space for vehicles, and vehicle maneuvering issues. On multiple occasion, bids for renovation projects have been received and concession contracts have been assigned. However, a recurring issue has been the repeated suspensions of these concession projects due to budget problems of contractors. Therefore, the completion of renovation works of CBS at the same scale of previous renovation project is included as part of the Action Plan in this MP.

(7) Bus Location System for Public Buses

VCSBE uses a bus location system to manage the buses in operation and provide information to users. Therefore, a project is proposed to install the same bus location system on all new buses and minibuses purchased for VCSBE network.

Source: Website of Lao-Bus Navi.

Figure 12.1-15 Image of Bus Location System

(8) Automatic Fare Collection System

By introducing the same IC card system used for BRT to buses, the aim is to create an integrated fare collection system among different public transport services. In addition to reducing payment time and increasing passenger convenience, IC cards can also be used for

non-transportation purposes, such as urban bus services, parking fee payments, and shopping. This will generate income from payment fees.

12.1.4 School Bus Proposed Projects

Table 12.1-5 shows the list of school bus proposed projects and project cost in this MP. A summary of each project is described later in this section.

Table 12.1-5 School Bus Proposed Projects

Proposed Project		Status	Implementing Authority	Short-term 2022~	Middle-term 2028~	Long-term 2033~	Initial Cost (USD)	Unit	Unit cost (USD)
School Bus Project									
SB 1	Procurement of new School Bus vehicles and spare parts						35,000,000	-	-
SB 1-1	- Short	Short	MPWT-DOT				5,000,000	50	100,000
SB 1-2	- Middle	Middle	MPWT-DOT				10,000,000	100	100,000
SB 1-3	- Long	Long	MPWT-DOT				20,000,000	200	100,000
						Total	35,000,000		

(1) Procurement of New School Bus Vehicles and Spare Parts

It is crucial to prioritize the development of reliable public transport options for students, as highlighted in Chapters 4 and 10. Implementing a school bus service can significantly reduce the number of vehicles used for student pick-ups and drop-offs, while encouraging students to use public transport. This initiative would be particularly effective in alleviating traffic congestion for the case of schools located near the city center, as suggested by the "Research & Experiment on School Bus System to Reduce Traffic Congestion Around School" (DPWT and JICA, 2022). If schools are located far from public transport stops, a feeder service specialized for students can transport them from these stops to schools. Additionally, the operator can aim to ensure additional profit from this kind of school transport services as well.

12.1.5 Paratransit Proposed Projects

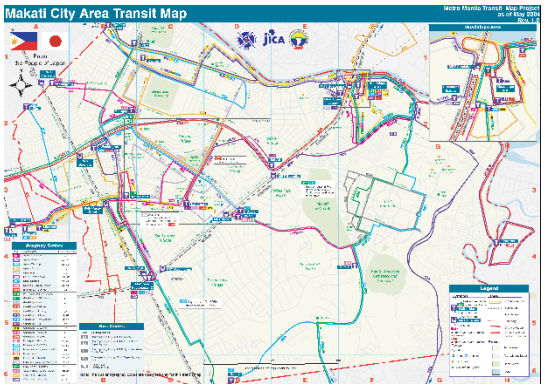
Table 12.1-6 shows the list of paratransit proposed projects and project cost foreseen in this MP. A summary of each project is described later in this section.

Table 12.1-6 Paratransit Proposed Projects

Proposed Project		Status	Implementing Authority	Short-term 2022~	Middle-term 2028~	Long-term 2033~	Initial Cost (USD)	Unit	Unit cost (USD)
Paratransit Projects									
PT 1	Songteo operational cooperation program (Step 1)	Short	Songteo Asso./VCSBE				50,000	5	10,000
PT 2	Songteo service integration program (Step 2)	Middle	Songteo Asso./VCSBE				50,000	5	10,000
PT 3	Songteo fleet renewal program (Step 3)	Middle	Songteo Asso./VCSBE				50,000	5	10,000
PT 4	Procurement of new NMT vehicles (E-Pedi cab)	Ongoing	VSUTP				460,000	150	3,067
PT 5	Regulation revision of new public transport operation	Ongoing	MPWT/VCSBE				30,000	3	10,000
						Total	640,000		

(1) Songteo Operational Cooperation Program (Step 1)

In Step 1, a cooperaton program is planned to collaborate with private songteo operators in terms of operational aspects, such as fare system, opeation schedules, bus stops, and integrated information provision. An example of integrated bus and paratransit timetables and bus route map from the Philippines is shown in Figure 12.1-16. Comission agreements (operating contracts) are to be established with the private operators to ensure operation services in accodance with designated conditons. This program will contribute to reducing unnecessary competiton among the formal bus operator and private songteo operators.



Source: JICA

Figure 12.1-16 Example of a bus map including paratransit (Philippines)

(2) Songteo Service Integration Program (Step 2)

In Step 2, a service integration program will be planned to officially formalize private songteo operators as a part of the public transport system in Vientiane. Concession agreements (operation consignment) will be established with the representative association or directly with private operators for the provision of public transport services through an operation license. Benefits of the integration would be greater financial benefits for operators in the form of travel distance-based payments, instead of the more variable payments based on fare collection or passenger numbers. This improvement could enhance the LoS of the network while simultaneously support the financial stability of the private operators.

(3) Songteo Fleet Renewal Program (Step 3)

In Step 3, the fleet renewal program is planned to replace deteriorated vehicles with new electric vehicles, namely e-Songteo, which are foreseen to enhance comfort and environmental sustainability. The public sector can financially subsidize the procurement of e-Songteo vehicles by private operators through lease programs or other equivalent agreements. This program is designed to fully formalize the operation of Songteo-type vehicles whilst it aims to ensure financial sustainability and job opportunities of private operators.

(4) Procurement of New Non-Motorized Transport (NMT) Vehicles (E-Pedicab)

Through the Vientiane Sustainable Urban Transport Project (VSUTP) 150 e-pedicabs will be procured and made available in non-motorized transport (NMT) areas as a project in the short-term for citizens and visitors. A conceptual image of NMT vehicles from VSUTP's Project Implementation Consultant (PIC) team is shown in Figure 12.1-17. The e-pedicab consists of a tricycle that can operate by pedaling or through the simultaneous combination of pedaling and the use of an electric motor assistance. It is designed to carry 2-3 passengers and compared to current tuk-tuk vehicles, e-pedicabs are considered a safer and healthier transport mode with lower CO_2 emissions and no noise pollution.

Source: VSUTP PIC Updated Project Conceptual Design, 2019

Figure 12.1-17 Conceptual Image of NMT Vehicles (E-pedicab)

(5) Regulation Revision of New Public Transport Operations

As is the case in many countries, new transport services, such as ride-hailing services (RHS), face many institutional and operational challenges. Therefore, it is necessary for the public side to review regulations to prevent

uncontrolled expansion of services and to ensure that they are operated properly. For this reason, a project for the revision of regulation related to new public transport operations is proposed in the short-term.

12.1.6 Governance System and Organizational Coordination Projects

Table 12.1-7 shows the list of proposed projects and the costs foreseen in this MP for projects related to governance systems and organizational coordination. A summary of each project is described later in this section.

Table 12.1-7 Governance System and Organizational Coordination Projects

Proposed Project		Status	Implementing Authority	Short-term 2022~	Middle-term 2028~	Long-term 2033~	Initial Cost (USD)	Unit	Unit cost (USD)
Governance System and Organizational Coordination Projects									
GS 1	Capacity development program of Management Entity (UTMS)	Short	UTMS	→			3,080,000	-	-
GS 2	Integration program of public transport services (MaaS) organizational coordination		Private				180,000	-	-
GS 2-1	- Short	Short	VCSBE/Private	→			50,000	5	10,000
GS 2-2	- Middle	Middle	VCSBE/Private		→		50,000	5	10,000
GS 2-3	- Long	Long	VCSBE/Private			→	80,000	8	10,000
						Total	3,260,000		

(1) Capacity Development Program of the Management Entity

As discussed in chapter 12, "Strategy 5: Sustainable governance system of public transport operation and organizational coordination", the establishment of the management entity as an intermediate body between the regulators and operators is proposed to manage public transport operations through one single entity. VSUTP, through its project activities, has started the establishment of a management entity for this purpose, namely the Urban Transport Management Sector (UTMS). Therefore, as a first step, as a priority project in the short-term is proposed to implement a capacity development program for UTMS, to ensure that the components planned in VSUTP are properly implemented.

(2) Integration Program on Organizational Coordination for Public Transport Services

In the future, implementation of Mobility as a Service (MaaS) is proposed to integrate conventional public transport and shared mobility services in Vientiane. MaaS is designed to offer a single application to integrate "various forms of transport services into a single mobility service accessible on demand. This MP proposes that a management entity should be in charge of the MaaS application through the role of an intermediate entity, with the aim of controlling the interests of all public transport operators in Vientiane. As of 2022, the current situation of the public transport integration in Vientiane could be categorized as Level 0, this considering that each of the transport operators deliver their own service independently and users are forced to experience fragmented information and separated transport services. Through the above-mentioned step-by-step integration programs, namely the 1. Operational Cooperation Program, 2. Service Integration Program, and 3. Fleet Renewal Program, the service integration for transport users will be incrementally geared up to a future implementation of MaaS. Furthermore, a parallel gradual implementation of other measures, such as real-time operational information, transferring of information, multilingualization of operational information, network-based cyclic timetable, among other measures are proposed to further support improvement efforts of public transport.

Source: Sochor et al., 2017

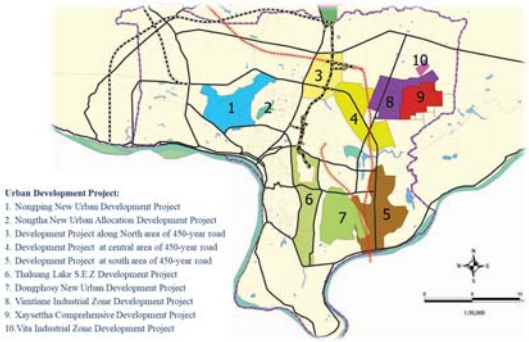
Figure 12.1-18 Five-level Topology of MaaS

12.1.7 Transit-Oriented Development (TOD) Projects

(1) Transit-Oriented Development (TOD) Harmonized with BRT Investment

In the study area, a comprehensive study has been conducted, leading to the proposal of ten urban development projects outlined in the General Urban Land Use Plan of Vientiane Capital 2030. While the specific details of each project have not been finalized within the study period, and thus have not been included in the project cost analysis. However, it is crucial to integrate public transport development with land development to meet one of the six strategies outlined in Chapter 11 of the public transportation plan, titled "Inclusive TOD[1] with effective land use planning." Based on this context and the technical discussions held within working group in the MP, the following ten areas have been selected as proposed locations for TOD projects.

1. Nongping New Urban Development Project
2. Nongtha New Urban Allocation Development Project
3. Development Project along North area of 450-year road
4. Development Project at central area of 450-year road
5. Development Project at south area of 450-year road
6. Thaluang Lake S.E.Z Development Project
7. Dongphosy New Urban Development Project
8. Vientiane Industrial Zone Development Project
9. Xaysettha Comprehensive Development Project
10. Vita Industrial Zone Development Project



Source: General Urban Land Use Plan of Vientiane Capital 2030.

Figure 12.1-19 Area of TOD Proposed Projects

(2) Reform of Urban Planning and Land Use Laws to Enable TOD

For TOD projects to be effective, a legal revision of the overall urban planning and land use planning system will be required. Particularly, the following spatial control indicators will need modifcations.

(a) Urbanized areas
(b) FAR (Floor area ratio)
(c) Permitted building heights
(d) Land use
(e) Building use
(f) Development and building permission

[1] TOD refers to urban development or development along rail lines that is built on the premise of using public transportation, rather than relying on cars. Urban development and urban transportation need to be considered in a comprehensive manner.

12.2 ROAD NETWORK AND TRAFFIC MANAGEMENT

12.2.1 Proposed Road Network and Road Projects

In accordance with "Scenario 2: Public Transport Intensive", the road network which support the reconfiguration of the urban transport system is proposed. Figure 12.2-1 shows the proposed road network.

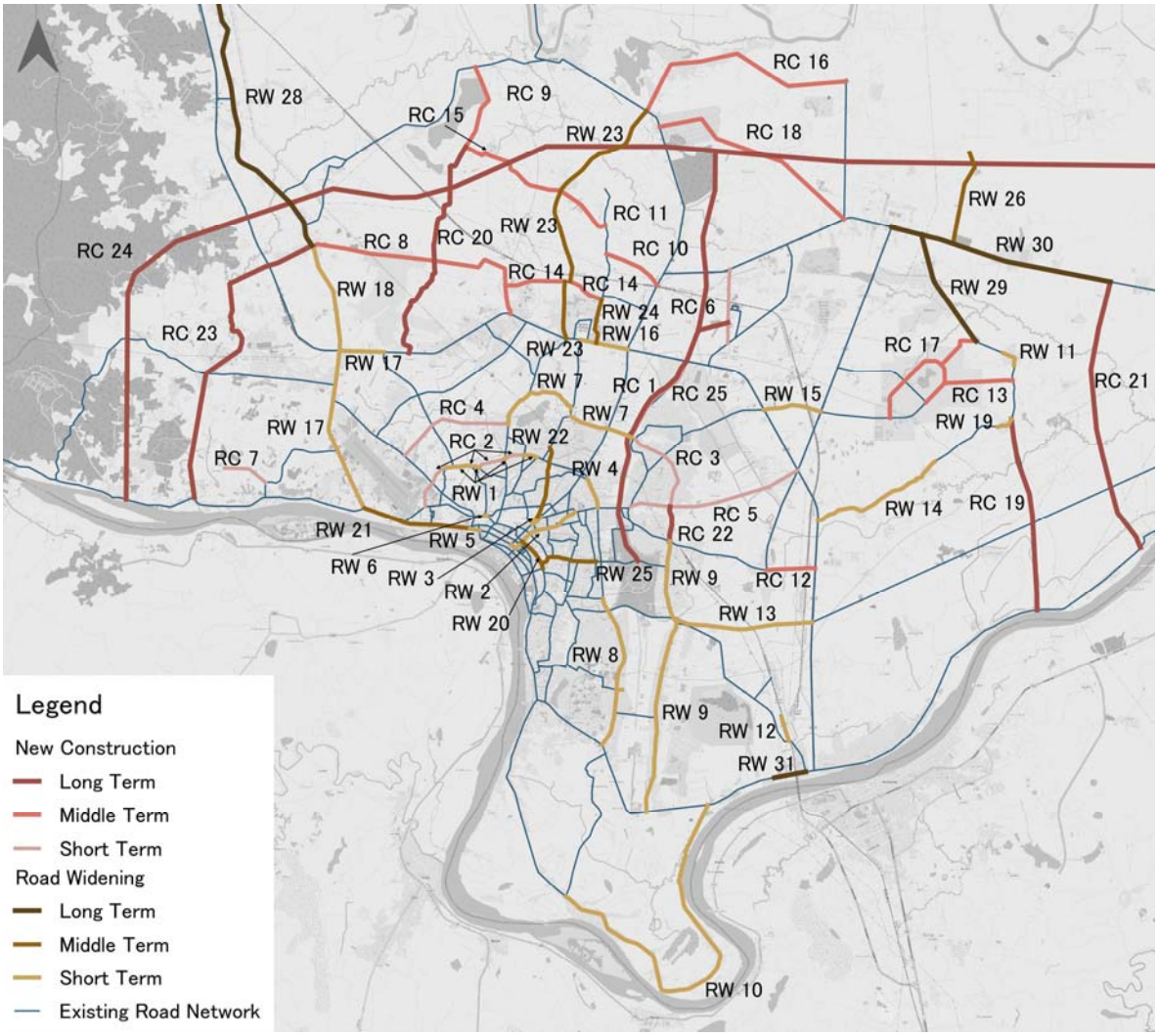


Figure 12.2-1 Proposed Road Network

Construction of new roads and missing links, as well as widening of existing roads are needed in order to the develop the proposed road network. Figure 12.2-2 and Figure 12.2-3 schematically illustrate missing links and the sections to be widened, respectively.

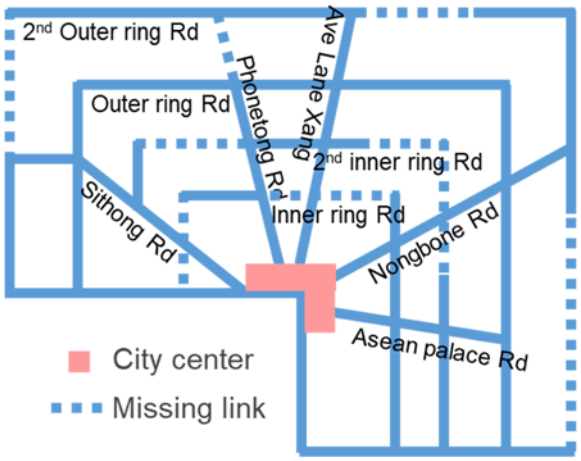


Figure 12.2-2 Missing Link Connection

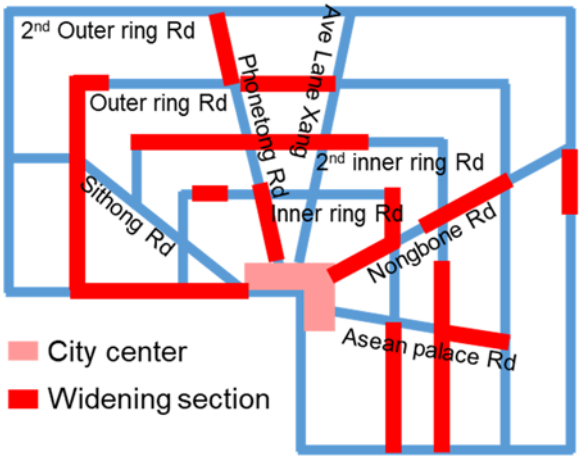


Figure 12.2-3 Road Widening Section

Actual locations of the proposed missing link construction and road widening are shown in Figure 12.2-4 and Figure 12.2-5, respectively. In order to enable the operation of the planned public transportation system, the existing road network and lane widths are insufficient. To facilitate the functioning of public transportation, it is necessary to construct required road segments and widen sections with inadequate lane widths. Additionally, to ensure the necessary road traffic capacity, it is imperative to develop and expand the aforementioned key arterial ring roads and major radial roads, along with widening road widths.

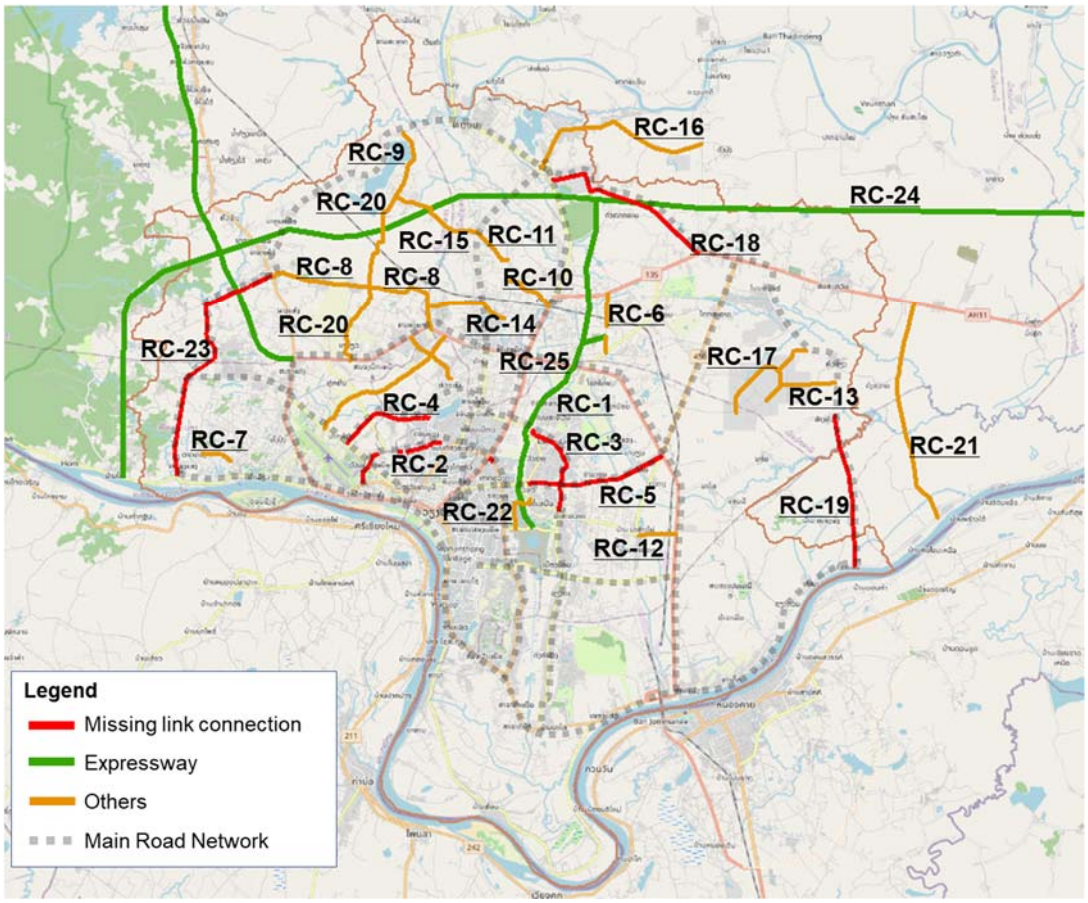


Figure 12.2-4 Location of Missing Link Development

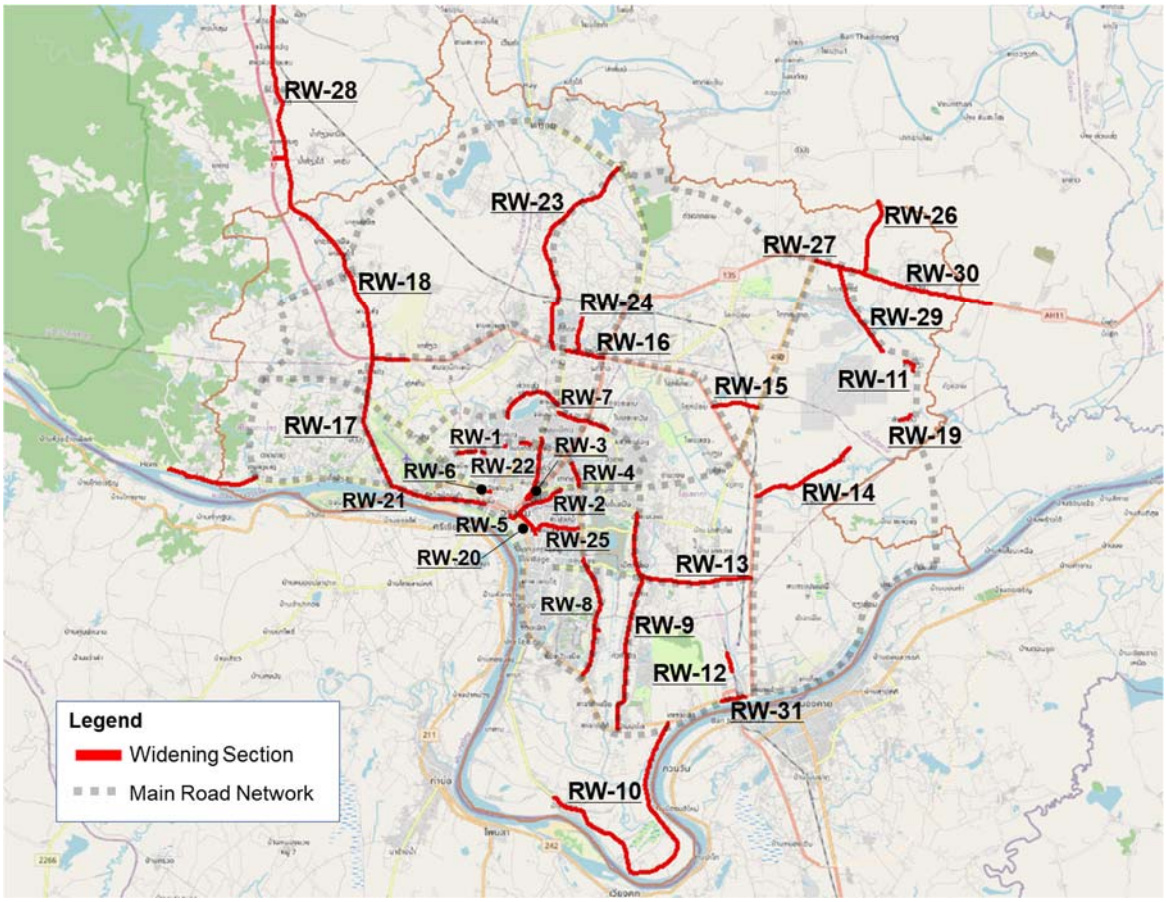


Figure 12.2-5 Location of Road Widening Sections

The outlines of these missing link construction and road widening projects, such as section length, cost estimation, and the term to be implemented, are listed in Table 12.2-1.The numbers of projects shown in Figures 12.2-3 and 12.2-4 correspond to the projects numbers shown in Table 12.2-2.

Table 12.2-1 List of New Road Construction Project

Proposed project		Status	Implementing authority	Short (2022-2027)	Middle (2027-2032)	Long (2032-2040)	Length (km)	Cost (USD)
Road Construction Projects								
RC	New Road Construction							
RC 1	The project to build a road parallel to the Kaisone Rd - That Luang Lake Special Economic Zone - Nongnieng - 450 Year Rd -	Short	DPWT				3.7	2,674,000
RC 2	Inner Ring Road	Short	DPWT				3.9	20,874,000
RC 3	2nd Inner ring Rd. No.1	Short	DPWT				3.6	2,778,000
RC 4	2nd Inner ring Rd. No.2	Short	DPWT				4.7	3,617,000
RC 5	Radial Road between Inner ring Rd. and Outer ring Rd.	Short	DPWT				5.2	2,623,000
RC 6	Development with Lao-China Railway Station	Ongoing	MPWT				4.9	2,647,000
RC 7	Collector street between Outer ring Rd. and 2nd Outer ring Rd.	Short	MPWT				1.7	760,000
RC 8	Road Construction project from Dongluang village (R. 13 N)-Dong Xieng Di- Nongphaya	Middle	DPWT				9.5	4,110,000
RC 9	Asphalt Road Construction project from KM29 (R.13 South)-Dong Khwai - Simano (R.11 South).	Middle	DPWT				3.4	1,468,000
RC 10	Concrete Road Construction Project from Donnoun-Huay Dan Muang	Middle	DPWT				2.5	1,049,000
RC 11	Concrete Road Construction Project from Huay Dan Muang - DonTiew (Road No. 10).	Middle	DPWT				2.3	996,000
RC 12	Connection Rd. from 450years Rd. to No.3	Middle	DPWT				1.9	865,000
RC 13	Connection Rd. between KM21 and 2nd Outer ring Rd.	Middle	DPWT				3.6	2,047,000
RC 14	Collector street between Outer ring Rd. and 2nd Outer ring Rd.	Middle	DPWT				3.8	1,782,000
RC 15	Collector street between central and Outer ring road	Middle	DPWT				6.6	2,854,000
RC 16	Collector street outside of Outer ring road	Middle	DPWT				17.8	9,672,000
RC 17	Inner roads in KM21	Middle	DPWT				6.0	1,272,000
RC 18	2nd Outer Ring Rd. No.3 (Northern Part)	Middle	MPWT				7.4	4,301,000
RC 19	2nd Outer Ring Rd. No.2 (Eastern Part)	Long	MPWT				8.7	5,057,000
RC 20	Asphalt Road Construction project from KM29 (R.13 South)-Dong Khwai - Simano (R.11 South).	Long	DPWT				9.4	4,404,000
RC 21	Construction of Concrete Road from Nong Buek traffic light-Dong Bong - Tha Savang-Hai village, Xaithany district	Long	DPWT				10.7	4,068,000
RC 22	2nd Inner ring Rd. No.3	Long	DPWT				1.4	1,048,000
RC 23	2nd Outer Ring Rd. No.4 (Western Part)	Long	MPWT				9.3	4,928,000
RC 24	Expressway project (east direction)	Long	MPWT				82.1	69,467,000
RC 25	Expressway project (north direction)	Long	MPWT				18.1	14,320,000
								169,681,000

Table 12.2-2 List of Road Widening Project

Proposed project		Status	Implementing authority	Short (2022-2027)	Middle (2027-2032)	Long (2032-2040)	Length (km)	Cost (USD)
Road Construction Projects								
RW	Road Widening							
RW 1	Inner Ring Rd. No.1	Short	DPWT				1.6	4,371,000
RW 2	Nongbone Road	Short	DPWT				2.8	7,780,000
RW 3	Roundabout around Around Patousay	Short	MPWT				1.0	2,015,000
RW 4	Inner ring Rd. No.2	Short	DPWT				1.2	3,000,000
RW 5	Settathilath Rd.	Short	MPWT				0.5	1,431,000
RW 6	Asean Rd.	Short	DPWT				0.1	732,000
RW 7	2nd Inner ring Rd. No.2	Short	DPWT				6.0	4,637,000
RW 8	Inner ring Rd. No.3 (south)	Short	DPWT				6.1	22,088,000
RW 9	2nd Inner ring Rd. No.3 (Widening)	Short	DPWT				12.9	9,855,000
RW 10	Riverside Rd. south	Short	DPWT				15.0	10,392,000
RW 11	2nd Outer ring Rd. No.2 (Widening)	Short	MPWT				0.3	242,000
RW 12	Road in front of Thanaleng station	Short	DPWT				1.0	555,000
RW 13	Asean palace Rd.	Short	DPWT				5.4	3,316,000
RW 14	Radial Rd. from Outer ring Rd. to 2nd Outer ring Rd.	Short	DPWT				6.0	4,134,000
RW 15	Radial Rd. from Outer ring Rd. to 450 Khoksa-Ath Rd.	Short	DPWT				2.2	1,619,000
RW 16	Outer ring Rd. No.1 from Ave. Lang Xang to NUOL	Short	MPWT				1.8	1,877,000
RW 17	Outer ring Rd. No.2 (west)	Short	MPWT				10.3	7,883,000
RW 18	NH13 from Vang Vieng Expw. entrance to north	Short	MPWT				4.2	3,246,000
RW 19	Radial Rd. from 2nd Outer ring Rd. to Outer ring Rd.	Short	DPWT				0.7	467,000
RW 20	Khouvieng Rd. in front of CBS for BRT project	Middle	DPWT				1.3	3,374,000
RW 21	Settathilath Rd. west to the airport direction for BRT project	Middle	MPWT				5.4	9,685,000
RW 22	Phonetong Rd.	Middle	DPWT				2.3	7,471,000
RW 23	Radial Rd. north from Outer ring to 2nd Outer ring Rd.	Middle	DPWT				10.5	4,940,000
RW 24	Radial Rd. north from the east side of NUOL	Middle	DPWT				1.7	809,000
RW 25	Rue. Dongpayna for BRT project	Middle	DPWT				2.2	6,948,000
RW 26	Radial Rd. outside of 2nd Outer ring Rd.	Middle	DPWT				3.7	1,590,000
RW 27	2nd Outer Ring Rd. No.1 (Widening)	Long	MPWT				1.2	903,000
RW 28	NH13 north extention from Vang Vieng expressway entrance	Long	MPWT				15.2	11,630,000
RW 29	2nd Outer ring Rd. No.3 (east)	Long	MPWT				4.6	3,553,000
RW 30	Radial Rd. from 2nd Outer ring Rd.	Long	MPWT				7.5	5,716,000
RW 31	Outer ring Rd. close to Thanaleng border checkpoint	Long	MPWT				1.2	2,910,000
								149,169,000

The road projects as presented above are proposed to be implemented in short-term (- 2027), middle-term (2028 - 2032), and long-term (2033 - 2040), depending on the status of planned road construction projects and plans for the public transport in each term. Road construction projects in each term are shown in Figures 12.2-5, 12.2-6, and 12.2-7, respectively.

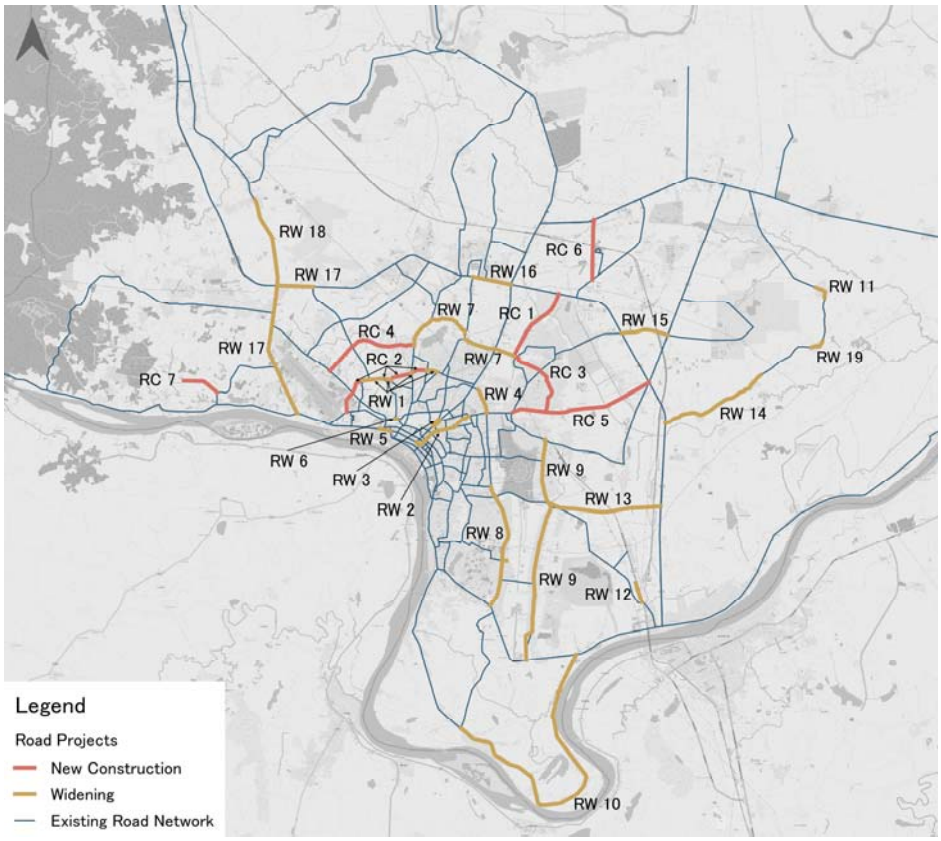


Figure 12.2-6 Missing Link Construction and Road Widening Projects of the Short-Term (2027)

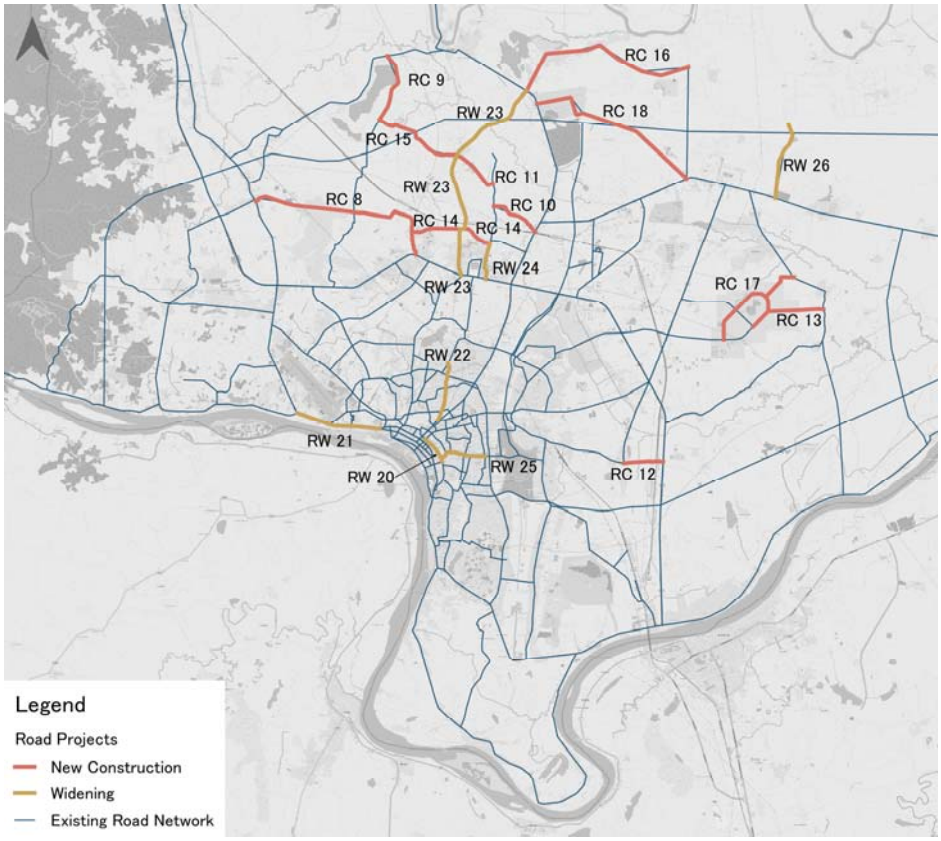


Figure 12.2-7 Missing Link Construction and Road Widening Projects of the Middle-Term (2032)

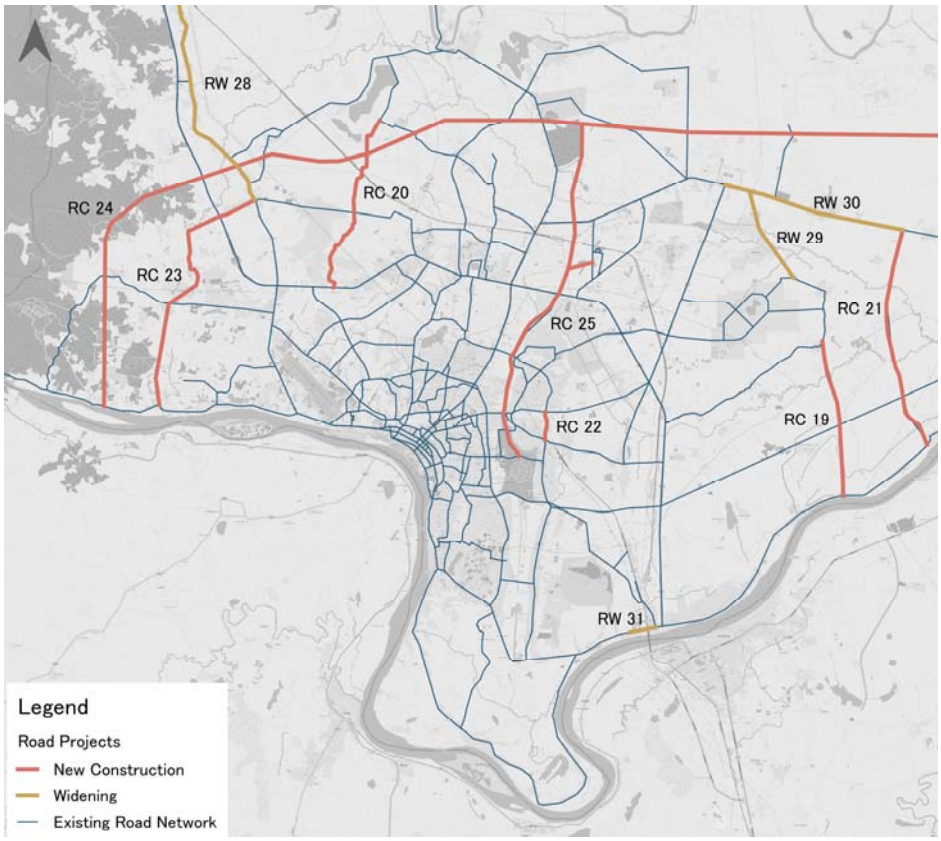


Figure 12.2-8 Missing Link Construction and Road Widening Projects of the Long-Term (2040)

Table 12.2-2 shows breakdown of the cost estimation smr. The basic assumptions for the cost estimation are summarized below:

a. Construction cost:

Unit price of construction was estimated based on the actual construction of the recent projects in Vientiane. In calculating these unit prices, global trends, such as the rise in oil prices, labor, and materials were taken into consideration. Since the unit cost is based on the standard construction cost of 7 m width, the number of units is calculated by converting the road width to 7 m in the calculation. The cost of each road project includes the cost of bus facilities and improving sidewalks.

b. Land acquisition cost:

Based on the decree of land acquisition price in Vientiane, land acquisition cost for constructing new roads and road-widening can be divided into two prices and defined as follows.

1. Unit land acquisition cost related to projects in urban areas close to main roads in Vientiane is 2,000,000 LAK/m^2.

2. Unit land acquisition cost related to projects in a suburban area of Vientiane is 2,000 LAK/m^2.

The border dividing urban and suburban areas is determined by the Inner Ring Road.

Table 12.2-3 Cost Breakdown of Proposed Road Projects

Proposed project		Status	Length (km)	Cost (USD)	Unit	Unit cost (USD)
Road Construction Projects						$/km*7m
RC	New Road Construction					
RC 1	The project to build a road parallel to the Kaisone Rd - That Luang Lake Special Economic Zone - Nongnieng - 450 Year Rd -	Short	3.7	2,674,000	10.2	261,420
RC 2	Inner Ring Road	Short	3.9	20,874,000	11.4	261,420
RC 3	2nd Inner ring Rd. No.1	Short	3.6	2,778,000	10.6	261,420
RC 4	2nd Inner ring Rd. No.2	Short	4.7	3,617,000	13.8	261,420
RC 5	Radial Road between Inner ring Rd. and Outer ring Rd.	Short	5.2	2,623,000	10.0	261,420
RC 6	Development with Lao-China Railway Station	Ongoing	4.9	2,647,000	10.1	261,420
RC 7	Collector street between Outer ring Rd. and 2nd Outer ring Rd.	Short	1.7	760,000	2.9	261,420
RC 8	Road Construction project from Dongluang village (R. 13 N)-Dong Xieng Di- Nongphaya	Middle	9.5	4,110,000	15.7	261,420
RC 9	Asphalt Road Construction project from KM29 (R.13 South)-Dong Khwai - Simano (R.11 South).	Middle	3.4	1,468,000	5.6	261,420
RC 10	Concrete Road Construction Project from Donnoun-Huay Dan Muang	Middle	2.5	1,049,000	4.0	261,420
RC 11	Concrete Road Construction Project from Huay Dan Muang - DonTiew (Road No. 10).	Middle	2.3	996,000	3.8	261,420
RC 12	Connection Rd. from 450years Rd. to No.3	Middle	1.9	865,000	3.3	261,420
RC 13	Connection Rd. between KM21 and 2nd Outer ring Rd.	Middle	3.6	2,047,000	7.8	261,420
RC 14	Collector street between Outer ring Rd. and 2nd Outer ring Rd.	Middle	3.8	1,782,000	6.8	261,420
RC 15	Collector street between central and Outer ring road	Middle	6.6	2,854,000	10.9	261,420
RC 16	Collector street outside of Outer ring road	Middle	17.8	9,672,000	36.9	261,420
RC 17	Inner roads in KM21	Middle	6.0	1,272,000	4.8	261,420
RC 18	2nd Outer Ring Rd. No.3 (Northern Part)	Middle	7.4	4,301,000	16.4	261,420
RC 19	2nd Outer Ring Rd. No.2 (Eastern Part)	Long	8.7	5,057,000	19.3	261,420
RC 20	Asphalt Road Construction project from KM29 (R.13 South)-Dong Khwai - Simano (R.11 South).	Long	9.4	4,404,000	16.8	261,420
RC 21	Construction of Concrete Road from Nong Buek traffic light-Dong Bong - Tha Savang-Hai village, Xaithany district	Long	10.7	4,068,000	15.5	261,420
RC 22	2nd Inner ring Rd. No.3	Long	1.4	1,048,000	4.0	261,420
RC 23	2nd Outer Ring Rd. No.4 (Western Part)	Long	9.3	4,928,000	18.8	261,420
RC 24	Expressway project (east direction)	Long	82.1	69,467,000	216.9	319,501
RC 25	Expressway project (north direction)	Long	18.1	14,320,000	44.7	319,581
				169,681,000		
RW	Road Widening					
RW 1	Inner Ring Rd. No.1	Short	1.6	4,371,000	4.8	261,420
RW 2	Nongbone Road	Short	2.8	7,780,000	9.2	261,420
RW 3	Roundabout around Around Patousay	Short	1.0	2,015,000	2.8	261,420
RW 4	Inner ring Rd. No.2	Short	1.2	3,000,000	3.4	261,420
RW 5	Settathilath Rd.	Short	0.5	1,431,000	1.7	261,420
RW 6	Asean Rd.	Short	0.1	732,000	0.2	261,420
RW 7	2nd Inner ring Rd. No.2	Short	6.0	4,637,000	17.7	261,420
RW 8	Inner ring Rd. No.3 (south)	Short	6.1	22,088,000	17.4	261,420
RW 9	2nd Inner ring Rd. No.3 (Widening)	Short	12.9	9,855,000	37.6	261,420
RW 10	Riverside Rd. south	Short	15.0	10,392,000	39.7	261,420
RW 11	2nd Outer ring Rd. No.2 (Widening)	Short	0.3	242,000	0.9	261,420
RW 12	Road in front of Thanaleng station	Short	1.0	555,000	2.1	261,420
RW 13	Asean palace Rd.	Short	5.4	3,316,000	12.7	261,420
RW 14	Radial Rd. from Outer ring Rd. to 2nd Outer ring Rd.	Short	6.0	4,134,000	15.8	261,420
RW 15	Radial Rd. from Outer ring Rd. to 450 Khoksa-Ath Rd.	Short	2.2	1,619,000	6.2	261,420
RW 16	Outer ring Rd. No.1 from Ave. Lang Xang to NUOL	Short	1.8	1,877,000	7.2	261,420
RW 17	Outer ring Rd. No.2 (west)	Short	10.3	7,883,000	30.1	261,420
RW 18	NH13 from Vang Vieng Expw. entrance to north	Short	4.2	3,246,000	12.4	261,420
RW 19	Radial Rd. from 2nd Outer ring Rd. to Outer ring Rd.	Short	0.7	467,000	1.8	261,420
RW 20	Khouvieng Rd. in front of CBS for BRT project	Middle	1.3	3,374,000	4.0	261,420
RW 21	Settathilath Rd. west to the airport direction for BRT project	Middle	5.4	9,685,000	17.4	261,420
RW 22	Phonetong Rd.	Middle	2.3	7,471,000	6.7	261,420
RW 23	Radial Rd. north from Outer ring to 2nd Outer ring Rd.	Middle	10.5	4,940,000	18.9	261,420
RW 24	Radial Rd. north from the east side of NUOL	Middle	1.7	809,000	3.1	261,420
RW 25	Rue. Dongpayna for BRT project	Middle	2.2	6,948,000	6.8	261,420
RW 26	Radial Rd. outside of 2nd Outer ring Rd.	Middle	3.7	1,590,000	6.1	261,420
RW 27	2nd Outer Ring Rd. No.1 (Widening)	Long	1.2	903,000	3.4	261,420
RW 28	NH13 north extention from Vang Vieng expressway entrance	Long	15.2	11,630,000	44.4	261,420
RW 29	2nd Outer ring Rd. No.3 (east)	Long	4.6	3,553,000	13.6	261,420
RW 30	Radial Rd. from 2nd Outer ring Rd.	Long	7.5	5,716,000	21.8	261,420
RW 31	Outer ring Rd. close to Thanaleng border checkpoint	Long	1.2	2,910,000	11.1	261,420
				149,169,000		

12.2.2 Intersection Improvement (Signalized Intersection and Flyover)

A traffic survey targeting major intersections which have heavy traffic within the city of Vientiane during peak hours was conducted. As a result, congested intersections were identified, and two types of congestion alleviation measures were proposed for each of these congested intersections. The first approach involves signalizing the intersections or optimizes signalized intersections. The other approach involves the utilization of a flyover bridge, serving as a bypass. Introducing signal control at intersections that have high traffic volume or where signal control has not been optimized is an effective way to mitigate traffic congestion. Signalized intersections in Vientiane will need to accommodate private vehicles, as well as public transport and in some cases BRT. Furthermore, flyovers are proposed at intersections where major radial and ring roads intersect, as these intersections pose greater challenges to traffic management, even with the use of signal control. Candidate locations for these improvements are shown in Figure 12.2-9.

Figure 12.2-10 shows an example of a signalized intersection while Figure 12.2-11 shows the concept of intersections with synchronized signal control . Figure 12.2-12 shows an example of an intersection with flyover. of Kaysone Phomvihane Avenue and Inner Ring Road (Kamphengmeuang Road) is illustrated in Figure 12.2-13.

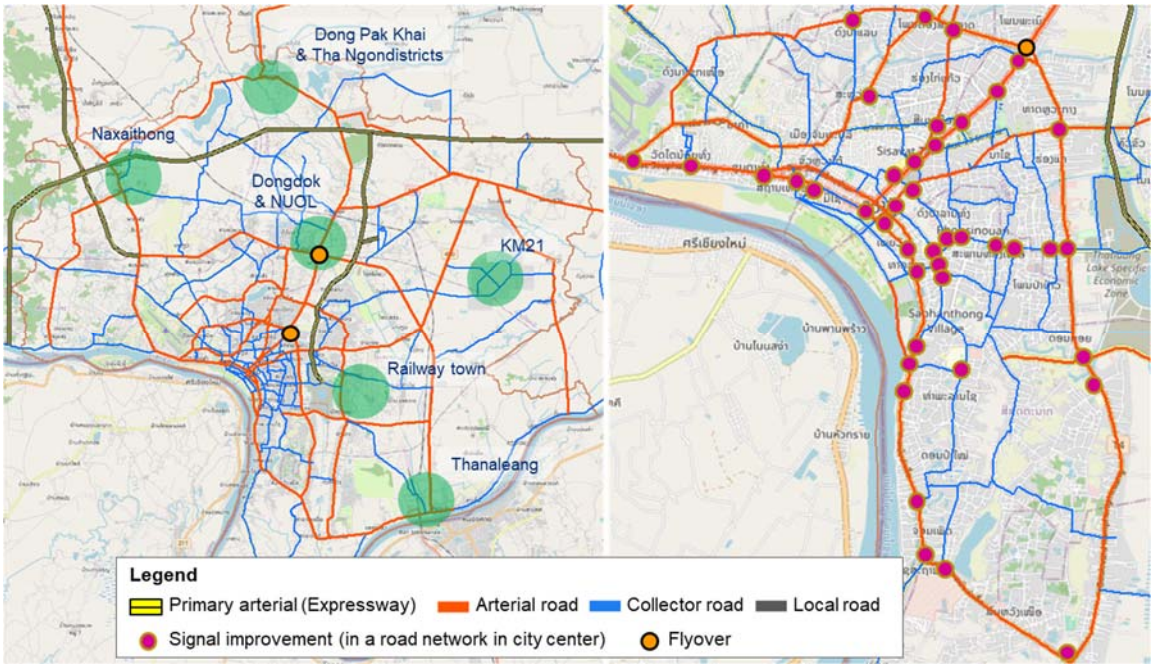
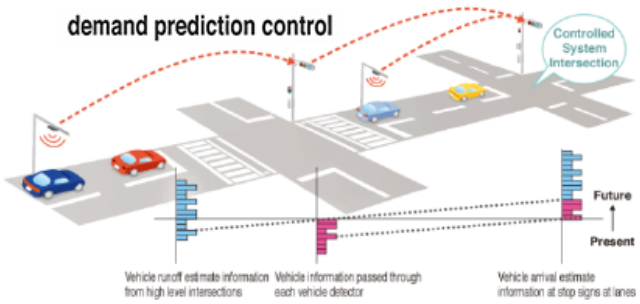


Figure 12.2-9 Candidate Intersections for Improvement

Source: Japan Society of Civil Engineering HP

Figure 12.2-10 Example of Signalized Intersection

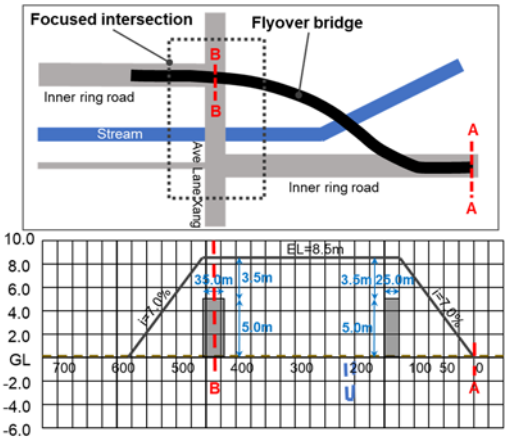


Source: https://www.seiss.co.jp/en/products/its/traffic_control/

Figure 12.2-11 Synchronized Signal Control

Source: Tokyo Metropolitan Government HP

Figure 12.2-12 Example of Intersection with a Flyover



Source: JICA Expert Team

Figure 12.2-13 Scheme of Flyover at Inner Ring Road – Kaysone Phomvihane Avenue Intersection

12.2.3 Proper Road Maintenance and Management

There are challenging issues regarding road conditions in Vientiane. As Figure 12.2-14 shows, the existence of malfunctioning drainage, broken pavement, and worn-out and invisible road markings are found in many road sections. Proper maintenance, based on periodical inspection is essential not only for comfortable ride but also for smooth traffic flow and traffic safety. Figure 12.2-16 illustrates the concept of periodical pavement rehabilitation which is required in order to maintain the pavement condition in adequate condition.

Cold asphalt mix used in one of the pilot projects of VTMP, does not require special equipment for the repair of potholes and has proven to have good workability. This material is expected to contribute to better road maintenance.

Figure 12.2-14 Road Condition in Vientiane Capital

Figure 12.2-15 Properly Maintained Road

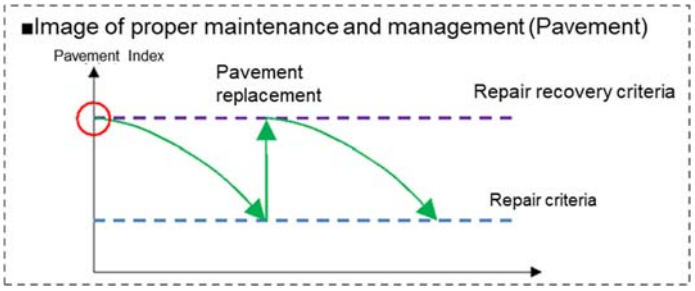


Figure 12.2-16 Illustration of Concept of Periodical Pavement Rehabilitation

12.2.4 Traffic Control and Demand Management

Cases of traffic violations involving drunk driving and over-speeding have been long-time issues in Vientiane. Therefore, traffic enforcement needs to be properly implemented. Given the situation, the capacity development of Traffic Police needs to be prioritized. The number of modern equipment for traffic enforcement in terms of road safety, such as alcohol detectors shown in the left side of Figure 12.2-17), is considered to be insufficient and sufficient number needs to be secured.

Moreover, since UTMS will be in charge of parking management around BRT dedicated lines in the city center, capacity development of UTMS will be important to ensure appropriate parking management and proper enforcement in the designated parking spaces.

A closely related topic is the adequate management of road capacity. The widespread issue of illegal on-street parking in the city area significantly reduces traffic capacity on the existing roads, necessitating stricter enforcement measures. As additional deterrence measures, higher parking fines may be also an effective method for reducing illegal on-street parking. In the particular case of RHS, it is important to effectively control RHS service needs as this service will be widespread .

The photo on the right side of Figure 12.2-17, shows enforcement of speed limits. Figure 12.2-18 presents major illegal on-street parking areas in Vientiane, while Figure 12.2-19 provides an example of the removal of illegally parked vehicles.

Source: The Times of India

Source: Grimsby Live

Figure 12.2-17 Equipment for Traffic Enforcement

Source: JICA Expert Team

Figure 12.2-18 Illegal On-Street Parking Area

Source: Totally Motor UK (Access link: https://totallymotor.co.uk/where-to-store-your-car-in-london/)

Figure 12.2-19 Removal of Illegally Parked Car

Table 12.2-4 Proposed Traffic Maintenance and Management Projects

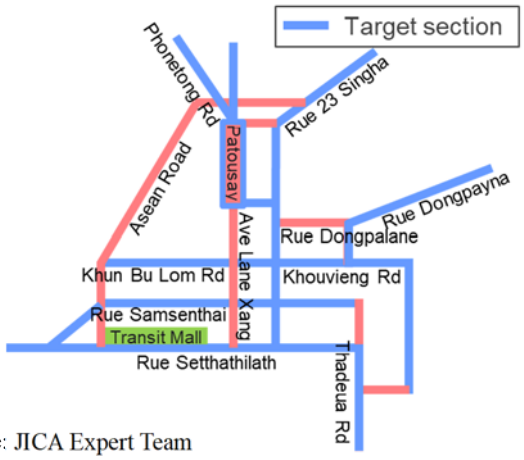
Proposed project		Status	Implementing authority	Short (2022-2027)	Middle (2027-2032)	Long (2032-2040)	Length (km)	Cost (USD)
Traffic Management Projects								
TM 1	Intersection Improvement							
TM 1-1	Signalization of intersections including signal system improvement	Short	MPWT/DPWT	➡			-	550,000
TM 1-2		Middle	MPWT/DPWT		➡			1,000,000
TM 1-3		Long	MPWT/DPWT			➡		1,000,000
TM 2	Flyover bridge construction							
TM 2-1	Intersection crossed by Kaysone Phomvihane Avenue and Inner Ring Road (First term)	Short	MPWT/DPWT	➡			1.6	7,600,000
TM 2-2	Intersection crossed by Kaysone Phomvihane Avenue and Outer Ring Road	Long	MPWT/DPWT			➡	1.6	7,600,000
TM 3	Capacity development of traffic police	Short	DPT	➡			-	4,000,000
TM 4	Frequent police enforcement against illegal parking	All term	DPT	➡	➡	➡	-	-
TM 5	Staggered work hours, Work from home, Carpool	All term	MPWT/DPWT	➡	➡	➡		180,000
TM 6	Increase parking fee	All term	MPWT/DPWT	➡	➡	➡		-
TM 7	Increase parking fine	All term	DPT	➡	➡	➡		-
							Total	**21,930,000**

12.2.5 Pedestrian Facilities and Environment

Several road sections in the city lack adequate sidewalk facilities, which hinders pedestrians from enjoying safe and comfortable walking. Poor environment of walking may lead pedestrians walking carriageway which, in turn result in hinderance to smooth and safe operation of the public transport. Consequently, it is imperative to improve certain sidewalk sections as depicted in Figure 12.2-20. An improvement example is outlined in Figures 12.2-21 and 12.2-22.

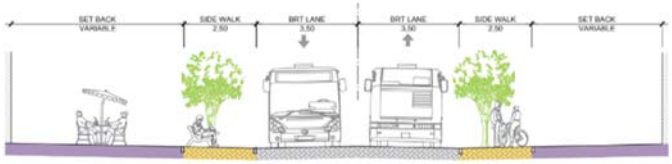
Additionally, a transit mall as shown in Figure 12.2-21 is proposed as a part of BRT. Figure 12.2-22 shows an example of a street where only pedestrians and public transport vehicles are permitted to transit. In addition, it is necessary to implement automobile speed control measures such as the use of speed humps and speed restrictions, as illustrated in Figure 12.2-23, on the road intersections in the transit mall.

New construction of sidewalk is also important. In most cases, provision of sidewalks is expected to effectively support the public transport performing its function. Currently, there are many sections along which public transport is going to be operated but have no sidewalks.



Source: JICA Expert Team

Figure 12.2-20 Sidewalk Improvement Sections



Source: MPWT Vientiane Sustainable Urban Transport Project (VSUTP)

Figure 12.2-21 Improved Cross Section in Transit Mall

Source: MPWT General Urban Plan of Vientiane Capital 2030

Figure 12.2-22 Example of Sidewalk Improvement

Source: American Planning Association HP

Figure 12.2-23 Transit Mall Example

Source: https://stock.adobe.com/jp/search?k=speed

Source: https://www.plataformaurbana.cl/archive/2013/01/18/campana-30-kmh-por-unas-

Figure 12.2-24 Automobile speed control methods

12.2.6 Promoting Non-Motorized Transport (NMT)

Promoting Non-Motorized Transport (NMT), specifically bicycles, is highly desirable considering its environmental friendliness and positive impact on people's health. In order to encourage NMT, it is crucial to provide appropriate bicycle-related infrastructure and facilities. Figure 12.2-25 shows potential locations for the installation of bicycle lanes/paths. In addition, provision of bicycle parking and bus-bicycle intermodal connection facilities around transportation hubs is essential, as it facilitates the seamless transition between bicycle commuting and public transportation, as well as short-range movement within the city center. Figure 12.2-26 shows examples of intermodal connection facility and bicycle parking.

Moreover, educational initiatives, such as bicycle riding classes, are vital to ensure safe and responsible bicycle usage. Additionally, the availability of bicycle sharing services will significantly contribute to the promotion of bicycle use. Examples of bicycle education programs and bicycle sharing services can be observed in Figure 12.2-27.

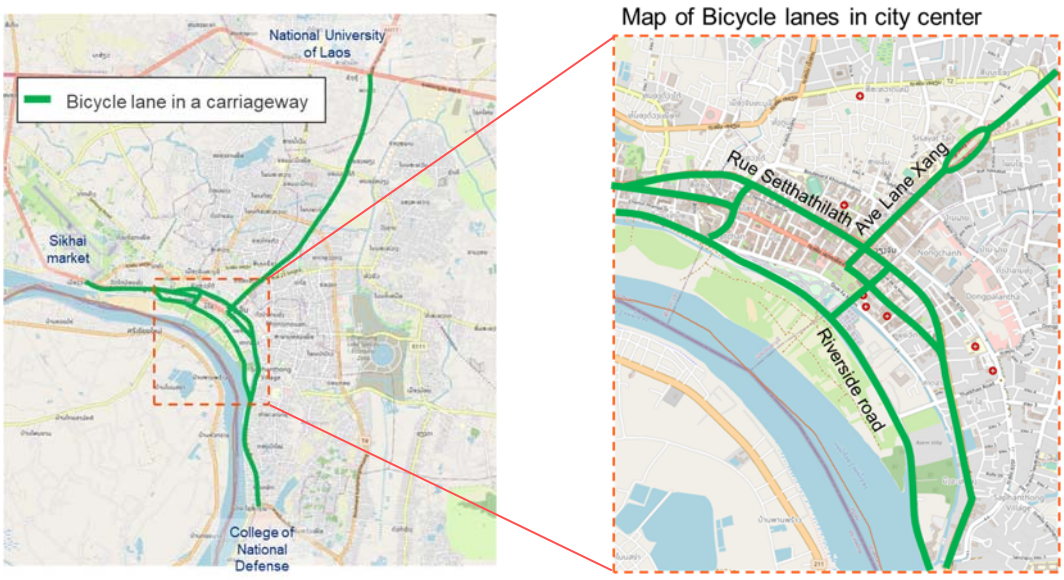


Figure 12.2-25 Locations for the installation of bicycle lane/paths

Source: https://bouldercounty.gov

Source: https://cycle-works.com/products/junior-bike-parking/

Figure 12.2-26 Intermodal Connection Facility and Bicyclarking and

Source: https://roadsafewestgate.org.au

Source: https://onbikeshare.com

Figure 12.2-27 Examples of bicycle education and sharing services

12.2.7 Barrier-Free Access around Major Transport Hubs

The development of barrier-free access in and around major transportation hubs is important to ensure comfortable and safe public transportation for everyone. The current conditions of the public transport facilities, as illustrated in Figures 12.2-28 and 12.2-29, poses challenges for both public transport users and operators. In addition, it is necessary to improve existing facilities into barrier-free ones. Figure 12.2-29, 12.2-30, and 12.2-31 provide examples of barrier-free access and wide sidewalks that can enhance accessibility and improve the overall transit use.

Figure 12.2-28 On-Street Parking Along Roads with Future Plans for Public Transport

Figure 12.2-29 On-Street Parking at a Bus Shelter

Source: JICA Expert Team

Figure 12.2-30 Sidewalk with Guidance Blocks

Source: World Bank

Figure 12.2-31 Barrier-Free Access at a Transport Hub

Source: Minato-city

Figure 12.2-32 Wide Sidewalk in Tokyo

Table 12.2-7 Proposed Projects for Barrier-Free Access

Proposed project		Status	Implementing authority	Short (2022-2027)	Middle (2027-2032)	Long (2032-2040)	Length (km)	Cost (USD)
Road Safety and Creating Comfortable Walking Environments Projects								
RS 1	Improvement of equipment for traffic enforcement	Short	DPT				-	1,000,000
RS 2	Legislation for demand responsive transport	Middle/Long	MPWT				-	-
RS 3	New sidewalks	All term	MPWT/DPWT				The costs are included in new road constructions or widenings	
RS 4	Existing sidewalk improvement	All term	MPWT/DPWT					
RS 5	Automobile speed control (humps, speed restriction)	Short	DPWT				-	7,000
RS 6	Bicycle lanes/paths	Short/Middle	DPWT				30	479,000
RS 7	Bicycle parking and riding facilities	Short/Middle	DPWT				-	7,000
RS 8	Bicycle share system	All term	DPWT				-	-
RS 9	Educational activities	All term	DPT				-	-
RS 10	Barrier free access around major transport hubs	All term	DPWT				-	329,000
RS 11	Legislation for Barrier free access	Short	MPWT				-	-
							Total	**1,822,000**

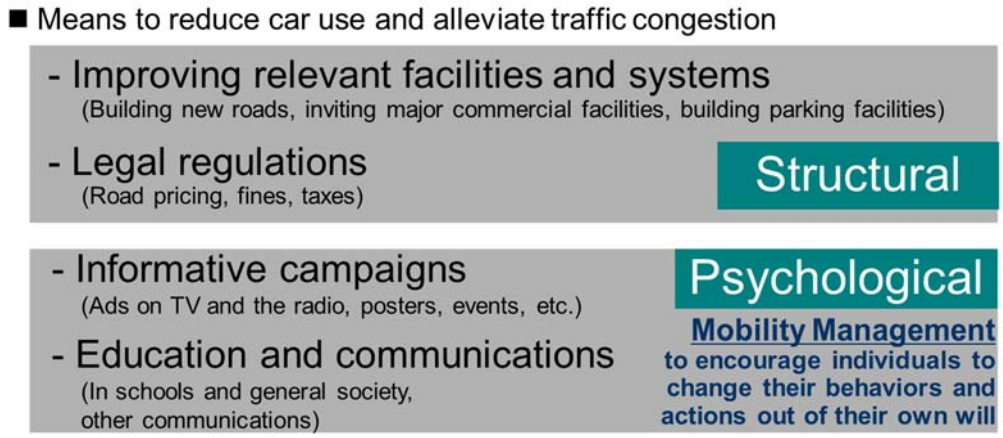
12.3 BEHAVIOR CHANGE

(1) Concept of Behavior Change and Mobility Management

VTMP puts significant emphasis on the importance of behavior change, alongside the improvement of the public transport system and road network in Vientiane, in fully realizing the vision of VTMP.

Figure 12.3-1 shows the factors affecting behavior change in the context of transport. Since behavior change is influenced by structural and psychological factors, focusing on structural improvements alone would be insufficient in inducing behavior change, so it is important to integrate a psychological approach known as mobility management (MM).

MM refers to a set of psychological approaches centered around communications that aims to encourage individuals to voluntarily change their behavior and actions (i.e., mobility) in a way favorable to both to themselves and the society as a whole. This behavior change entails a shift from excessive use of cars towards the increased use of public transportation and non-motorized transportation modes, which would alleviate traffic congestion and lead to other benefits.



Source: Prof. Ayako Taniguchi, University of Tsukuba

Figure 12.3-1 Factors that Affect Behavior Change

The key components of MM are as follows:

- Motivation

This refers to the aspect of encouraging and motivating individuals to use public transportation instead of cars or motorbikes. It involves highlighting the benefits and advantages of using public transport and creating a positive attitude towards it. It is important to determine which types of motivation are effective for each individual. For example, factors such as lower risk of traffic accidents, cost and travel time savings, and health benefits resulting from reduced air pollution and increased physical activity associated with public transport usage could serve as motivational factors.

- Information provision

This focuses on providing comprehensive and accurate information about public transportation options. It includes details about routes, schedules, fares, accessibility, and any other relevant information to help individuals make informed decisions about using public transport. Preparation of information provision materials, including bus maps, brochures, and advertisements, utilizing both traditional and online channels, as well as conducting MM seminars/workshops and posting on social media platforms, are recommended.

- Behavioral plan (action plan)

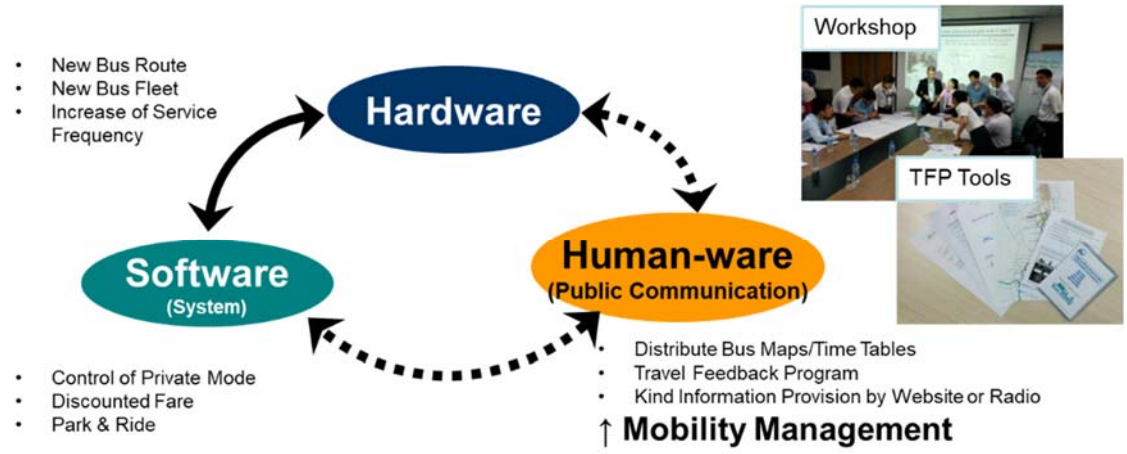
This entails developing a customized behavioral plan or action plan to facilitate a shift towards public transport usage. The plan should take into account individual circumstances, including

the proximity of one's residence and workplace/school, personal activities, individual characteristics and the accessibility of public transportation in the area.
This can be done effectively through a Travel Feedback Program (TFP), which was proposed by Prof. Taniguchi et al (2000) in Japan as a method of modifying travel behavior from the use of private modes to public transport. It involves interactive communication directly between MM coordinators and individuals or households. It entails providing motivation booklets (in terms of environment, health, traffic safety, community building, etc.) to participants, advising on each issue and giving feedback on the behavioral plan to ensure that it is feasible and beneficial to the individual or household in the long run.

- Image building strategy for public transport

This involves shaping an overall positive perception and image of public transportation through highlighting its benefits to the individual and the society as a whole. This is achieved through a branding strategy, which may involve various communication and marketing techniques, public campaigns, partnerships with relevant stakeholders, and other initiatives aimed at improving the perception of public transport in the Vientiane.

Figure 12.3-2 shows the mechanism of behavior change, which involves “hardware”, “software” and “human-ware” (public communication). It is important to note that solely relying on the "software" side, such as implementing MM measures, has its limitations and may not be effective. It is important to consider both the "hardware" aspect, which involves the development of public transport infrastructure, and the “software” side, which is a combination of regulatory measures to restrict car and motorbike ownership and use. This comprehensive approach requires a shift in mindset from both politicians and government officials who are responsible for transportation policies (top-down) and citizens themselves (bottom-up). The top-down approach involves promoting and investing in infrastructure to provide high-quality public transport services, while citizens can be engaged through MM initiatives.



Source: Prof. Ayako Taniguchi, University of Tsukuba

Figure 12.3-2 Mechanism of Behavior Change

(2) Mobility Management (MM) Programs (for Residents, Workers, and Students)

MM programs in Vientiane are planned to be targeted towards residents, workers and students using the key components of MM outlined in Section 12.3(1), which include motivation, information provision, behavioral/action plan and image building strategies.

1) MM for residents (MM Residents)

MM for residents is the most basic approach to local residents typically living in residential areas consisting of varying socio-economic attributes (e.g., age group, gender, occupation, vehicle ownership, household income). Residents living in specific areas could encounter similar transport issues such as poor access to public transport stops and less affordable public transport services, etc. Yet, it is essential to understand their socio-economic diversity and to consider different travel purposes and needs in the MM programs.

Source: JICA Expert Team

Figure 12.3-3 Example of MM

It would be quite effective to strategically implement these MM programs along with the improvement measures of public transport routes, such as new route openings, increased services, and other special programs to improve the level of service (LoS).

2) MM for workers (MM Workplace)

MM for workers is designed to target the commuting behavior of employees to their workplaces typically during the peak hours. This approach aims to alleviate traffic congestion by private cars and motorcycles during those hours and nudge them into a modal shift to public transport modes. The proactive participation and understanding of private companies or public authorities is essential for realizing successful MM programs through incentives provided to employees and persuasive communication with them.

It would be significantly effective to implement these MM programs in parallel with future urban development including commercial and business facilities and harmonize investment of public transport routes, such as BRT services.

3) MM for students (MM School)

MM for students is an approach to communicating with school students (e.g., primary, secondary, and university students) as a part of their educational programs. This could be in the form of incorporating MM as part of their curriculum and conducting MM seminars or workshops that educate about the benefits and importance of public transportation.

This approach recognizes that these students currently do not have their own means of transportation and thus the primary objective of MM for students is to understand the long-term and sustainable impacts of MM programs, focusing on shaping their future travel choices rather than solely addressing immediate and short-term goals like alleviating traffic congestion. Incorporating the active participation of family members, particularly parents, in these programs is highly encouraged. Parents play a significant role in influencing their children's mode of transportation based on factors such as economic conditions, safety concerns, and other considerations. By involving parents in MM initiatives, the programs can effectively address the various factors influencing students' travel choices and promote more sustainable and suitable modes of transportation.

(3) Projects for Branding Public Transport Services

Implementing integrated design programs for public transport services that involve residents and users will contribute to enhancing the brand image and improving user perceptions of public transportation. These programs will encompass various elements and aspects that are visible and accessible to users, such as bus vehicles, bus stops, route maps, timetables, social networking services (SNS), websites, and more. By taking a comprehensive approach to design and incorporating the input and feedback of residents and users, public transport services can be enhanced in a way that resonates with the community and meets the needs and preferences of the users. This, in turn, can lead to improved user satisfaction, increased usage, and a positive perception of public transportation as a whole.

(4) Modal Shift Programs With MM

In order to maximize the effectiveness of the aforementioned MM program, a modal shift program will be introduced in conjunction with it. This modal shift program will involve several initiatives, including revising the commuting allowance policy to include coverage for public transportation, implementing school bus services, conducting public relations activities, and operating commuter buses. These measures should be implemented with flexible modifications according to the MM being implemented.

(5) Park and Ride (P&R) Facility Development, and Promotion Program

In order to facilitate a shift from private transportation modes to public transport, the development of park and ride (P&R) facilities, along with a comprehensive promotion program is essential. The concept of park and ride enables car and motorcycle users to travel by private vehicles to public transport terminals and stops. While transport-oriented development (TOD) is widely recognized as an effective approach to achieving economically and environmentally sustainable cities and transportation systems, it requires time to alter the urban structure accordingly. During the early stages of developing a public transport system, park and ride initiatives play a vital role in promoting the transition to public transportation. The location and cost considerations for the development of P&R facilities, as well as details of the promotion program, can be found in the traffic management sections.

(6) Transit Mall/Pedestrianized Street for Walkability at the CBD

To promote use of public transport, projects to create a walkable environment through the introduction of a transit mall (as part of the BRT project) and improvement of sidewalks in the central business district (CBD) are proposed. The transit mall will provide a designated space for pedestrians, cyclists, and public transport users, making it easier and safer for people to access various modes of public transportation. Meanwhile, the improvement of sidewalks will ensure better walkability, making it more appealing and convenient for individuals to choose walking as a means of commuting within the CBD. These projects are described in the Roads section.

Source: VSUTP Overview.

Figure 12.3-4 Example of Transit Mall in Denver, Colorado

Table 12.3-1 Behavior Change Projects

Behavior Change Projects									
BC 1	Mobility management programs	-					180,000	-	-
BC 1-1	- Short	Short	MPWT/DPWT/ VCSBE				50,000	5	10,000
BC 1-2	- Middle	Middle	MPWT/DPWT/ VCSBE				50,000	5	10,000
BC 1-3	- Long	Long	MPWT/DPWT/ VCSBE				80,000	8	10,000
BC 2	Branding public transport services Projects) (integrated design, resident and user program, education program	-					180,000	-	-
BC 2-1	- Short	Short	MPWT/DPWT/ VCSBE				50,000	5	10,000
BC 2-2	- Middle	Middle	MPWT/DPWT/ VCSBE				50,000	5	10,000
BC 2-3	- Long	Long	MPWT/DPWT/ VCSBE				80,000	8	10,000
BC 3	Modal shift programs with MM (Commuting allowance policy revision, commuting bus operations, school bus operations, public events)	-					180,000	-	-
BC 3-1	- Short	Short	MPWT/DPWT/ VCSBE				50,000	5	10,000
BC 3-2	- Middle	Middle	MPWT/DPWT/ VCSBE				50,000	5	10,000
BC 3-3	- Long	Long	MPWT/DPWT/ VCSBE				80,000	8	10,000
BC 4	Park and Ride (P&R) facility development, and promotion program	Short	MPWT/DPWT/ VCSBE				3,730,000	10	373,000
BC 4-1	Facility development - Short	Short	MPWT/DPWT/ VCSBE				1,490,000	4	373,000
BC 4-2	Facility development - Middle	Middle	MPWT/DPWT/ VCSBE				1,490,000	4	373,000
BC 4-3	Facility development - Long	Long	MPWT/DPWT/ VCSBE				750,000	2	373,000
BC 4-4	Promotion program - Short	Short	MPWT/DPWT/ VCSBE				50,000	5	10,000
BC 4-5	Promotion program - Middle	Middle	MPWT/DPWT/ VCSBE				50,000	5	10,000
BC 4-6	Promotion program - Long	Long	MPWT/DPWT/ VCSBE				80,000	8	10,000
BC 5	Transit mall/ Pedestrianized street for walkability at the CBD	Ongoing	VSUTP				60,000	1	57,564
						Total	4,330,000		

12.4 ACTION PLAN

12.4.1 Short-Term Phase (up to 2027)

In a short period of less than five years after the formulation of VTMP2040, Vientiane's urban transport system will be reconfigured to place BRT as its main axis. This marks a major change in Vientiane's transport policy and thus this phase is characterized by key choices and a particular need for focus. As described in Chapter 11, in order to make the new urban transport system sustainable, three changes are needed: a systematic change, behavior change of both the government and citizens, as well as a change in the allocation of road space.

Within the short-term phase, a group of projects aimed at reconfiguring the public transport network with BRT and feeder buses is positioned as Priority Project Package A. This based on the Connectivity and Hierarchical Approaches presented in section 12.1.

Additionally, from the perspective of the Dense Approach, Priority Project Package B is a group of projects that aims to develop public transport services in a wide area and promotes the use of the entire system by creating a circular bus route along the Inner Ring Road (CR-01).

(1) Priority Project Package A（PT System with BRT as its Main Transport Axis）

- The establishment and capacity strengthening of the implementation body (UTMS) is an urgent challenge that needs to be overcome since it will be responsible for comprehensibly developing this project.
- After the establishment of UTMS, procurement of BRT and feeder bus vehicles, construction of the BRT system and reconfiguration of bus networks, establishment of depots, as well as the recruitment and training of drivers should be advocated in order to make feasible the BRT's start of operations.
- Preparations for BRT lines with higher business maturity, Lines A1, B1, B2, and D, are to proceed in parallel, while Line C will aim to open in the latter half of this phase.
- On the other hand, in order to secure sufficient users for stable operations at the time of opening, it is necessary to plan the promotion of public transport use through measures that foster behavior change, such as MM measures, parking management, and strengthening of traffic control along the BRT corridors to be opened.
- Particularly, the strengthening of crackdowns on illegal parking and drunk driving is essential as a push measure to promote public transport use. Therefore, technical support is considered to be a key factor for success in Traffic Police being able to carry out efficient operations.
- In addition to securing BRT dedicated lines that contribute to the improvement of bus services, developing bus terminals and bus stations, and creating a toll collection system and bus location system, measures to expand road capacity are also important and are placed in the latter half of this phase.

Table 12.4-1 Priority Project Package-A（PT system with BRT）

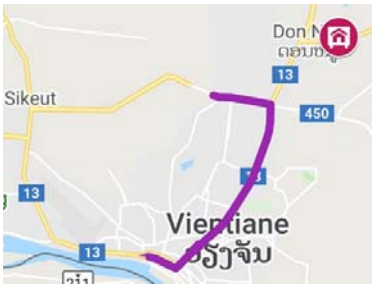
Projects/Activities	ID	Short Term (up to 2027) / BRT opening year (2024)
Capacity development program of Management Entity (UTMS)	GS 1	Establishment; Capacity Development
Regulation revision of new public transport operation	PT 5	
Procurement of BRT/ Bus/ Minibus vehicle	BRT 3-1/3-2 Bus 2-1/3-1	BRT Line A1, B1, B2, D and Minibus; BRT Line C and Bus
Rearrangement of Bus /Songteo lines for BRT	Bus 1-1 PT 1	
Development of depot & maintenance facilities and the Control Center	BRT 5-1/5-2	
Bus driver training	Bus 4	
Installation of Busway and transit facilities	BRT 1-1 BRT 4-1/4-2 Bus 5-1	Transit mall (Samsenthai); Fa Ngum Park to NUOL, CBS
PTPS, station service, fare system development	BRT 2-1 BRT 6-1/6-2 BRT 7-1/7-2	
Enhancement of traffic management/enforcement (Capacity development)	TM 3/4	Preparation/announcement; Implementation
Improvement of walking environment (barrier free)	RS 10/11	Improvement of the existing including the transit mall; New installation (start from lane configuration re-arrangement)
Mobility management programs	BC 1-1	
Branding public transport services Projects	BC 2-1	
Modal shift programs with MM	BC 3-1	

Description of Priority Project Package-A:

Public Transport	
GS 1	**Capacity Development Program of the Management Entity (UTMS)**
• Establishment of the management entity as an intermediate body between the regulators and operators is proposed to manage public transport operations through one single entity. • VSUTP, through its project activities, has started the establishment of a management entity for this purpose, namely the Urban Transport Management Sector (UTMS). • Therefore, as a first step, a priority project in the short-term is proposed to implement a capacity development program for UTMS, to ensure that the components planned in VSUTP are properly implemented. • Implementing body: UTMS (DPWT) • 3-5 years (2024-2027)/USD 3,080,000	
PT 5	**Regulation Revision of New Public Transport Operations**
• As is the case in many countries, new transport services, such as ride-hailing services (RHS), face many institutional and operational challenges. • It is necessary for the public side to review regulations to prevent uncontrolled expansion of services and to ensure that they are operated properly. • For this reason, a project for the revision of regulation related to new public transport operations is proposed in the short-term. • Implementing body: MPWT/VCSBE • Ongoing/USD 10,000	
BRT 3-1/3-2	**Procurement of new BRT vehicles and spare parts**
• The BRT buses in Vientiane are assumed to be vehicles with platform-level doors on the left side and ground-level doors on the right side, as they need to be able to run on two types of road sections: dedicated busway sections and road sections with mix traffic. • Implementing body: UTMS (DPWT) • BRT 3-1 (Line A1, B1, B2, D): 55 vehicles/USD 16,800,000 (ongoing) • BRT 3-2 (Line C): 77 vehicles/USD 23,520,000 (2025-2027)	
Bus 2-1/3-1	**Procurement of New Bus/Minibus Vehicles and Spare Parts**
• The number of buses/minibuses required to achieve the bus network and service frequency proposed in this MP was calculated and proposed as a bus procurement project. • Considering the issues arising from aging buses, including accidents, air pollution, and decreased fuel efficiency, the service life of the buses has been established at 10 years, assuming that proper maintenance is conducted. • A reserve fleet of 10% of the overall vehicle count has been taken into account. • Implementing body: VCSBE • Bus 2-1 (Bus network): 122 vehicles/USD 13,420,000 (2025-2027) • Bus 3-1 (Minibus network): 52 vehicles/USD 1,830,000 (Donated by Embassy of Japan in 2023)	
Bus 1-1/PT1	**Rearrangement of Bus /Songteo lines for BRT**
• Every time the BRT routes are extended and overlap with existing bus and paratransit routes, these routes need to be reorganized to ensure effective BRT operations. • Since BRT routes serve as trunk services and cover arterial corridors with high passenger demand, the routes of other road-based public transport should be consolidated and converted to feeder services for BRT routes. • In addition, other transport resources, such as buses and paratransit vehicles, will be reassigned to new routes to which public transport services are currently not available. • This reassignment will contribute to avoiding unnecessary competition with the BRT and semi-trunk bus services. • The size of public transport services should be changed depending on the actual travel demand to minimize possible impacts on road traffic. • Implementing body: UTMS/VCSBE/Songteo Association • Bus 1-1 (Bus network): USD 50,000 (2024-2027) • PT 1 (Songteo operational cooperation program/Step 1): USD 50,000 (2024-2027)	

BRT 5-1/5-2	Development of depot & maintenance facilities and the Control Center

- A bus depot should be situated as close as possible to the origin point of one or more BRT routes to minimize the distance that buses need to travel from the corridor to the depot.
- Presently, MPWT possesses land for a potential new depot along Route 13 South near Don Noun. Although the Don Noun depot would be around 8 kilometers away from the commencement of the BRT trunk corridor, there are several BRT routes that originate near the planned depot.



- Implementing body: UTMS (DPWT)
- BRT 5-1 (Line A1, B1, B2, D): USD 7,500,000 (ongoing)
- BRT 5-2 (Line C): USD 10,000,000

Bus 4	Bus Driver Training

- Training of new drivers and further capacitation of existing drivers is identified as an area requiring improvements. To address this, the Japanese government has provided a driving simulator to VCSBE in 2023.
- A driver training project is proposed to maximize the utilization of this simulator.
- Implementing body: VCSBE
- USD 100,000 (including a driving-simulator donated by Embassy of Japan in 2023)

BRT 1-1	Installation of Busway

- The full-scale BRT system consisting of a dedicated busway (closed system) with BRT stations will be introduced along each of the corridors to access the city center. Corridors in the West, North, East, and South are introduced.
- Implementing body: UTMS(DPWT)
- Busway-01: Fa Ngum Park - NUOL (L=11.5km)
- USD 1,710,000 (USD 60,000 for Transit mall)

BRT 4-1/4-2 Bus 5-1	Transit Facility Development for BRT/Bus and Information Provision

- BRT stations on the dedicated busways are equipped with platforms for smooth boarding and alighting. Off-board fare collection is also a key function of the BRT as it also allows smooth boarding and alighting.
- The BRT stations also should have clear, organized signage systems to guide passengers. Barrier free facilities such as slopes and benches are also required to provide accessibility to all residents, including people with limited mobility.
- In the road sections where the semi-BRT (open system) will operate, bus shelters are proposed to be designed in a way in which they can be shared with regular buses.
- Bus shelters are foreseen to be equipped with roofs and waiting seats to protect passengers from rain and strong sunlight so that passengers can wait for buses comfortably.
- It is also proposed for bus shelters to be relatively inexpensive facilities with no platforms, allowing passengers to get on and off at the same level as the road.
- Implementing body: UTMS(DPWT)/VCSBE
- BRT 4-1: 22 median stations/USD 680,000 (ongoing)
- BRT 4-2: 5 curbside stations/USD 250,000 (ongoing)
- Bus 5-1: 390 bus shelters: USD 7,800,000

BRT 2-1 **BRT 6-1/6-2** **BRT 7-1/7-2**	**Traffic Signaling System (PTPS) along Busways** **Intelligent Transport System (ITS) and Station Service for BRT Station** **Automatic Fare Collection (AFC) System**

- Even if the BRT utilizes exclusive busways, the BRT operation is disrupted at intersections. Thus, the Public Transport Priority System (PTPS) is proposed for a smooth operation of the BRT.
- Off-board fare collection should be applied for the BRT to avoid fare collection in buses. Typically, an integrated circuit (IC) card is often utilized for fare transaction.
- In addition to reducing transaction time and improving the convenience of passengers, the card can be utilized for other transactions, such as urban bus service, parking fee payment, as well as non-transport purposes such as shopping. This can generate revenues from transaction fees.
- Implementing body: UTMS(DPWT)
- BRT 2-1 (PTPS/Busway-01): USD 70,000,000 for 14 intersections (Fa Ngum Park – NUOL)
- BRT 6-1 (ITS/Line A1, B1, B2, D): USD 6,900,000 for 27 stations (ongoing)
- BRT 6-2 (ITS/Line C): USD 511,000 for 2 stations
- BRT 7-1 (AFC/Line A1, B1, B2, D): USD 1,100,000 for 55 units (vehicles) (ongoing)
- BRT 7-2 (AFC/Line C): USD 1,540,000 for 77 units (vehicles)

Road Network

TM 3/4	**Enhancement of Traffic Management/Enforcement (Capacity Development)**

- Aiming to promote the use of public transportation, improve traffic safety, facilitate road traffic, and improve the pedestrian environment, a technical cooperation project that will contribute to improving the capacity of traffic police to crack down on illegal parking, drunk driving, and traffic management at intersections will be implemented.
- The project includes education and campaigns for drivers and citizens, and the provision of equipment for traffic enforcement.
- Implementing body: Vientiane Traffic Police Department
- TM 3 (Capacity development of traffic police): 3-5 years (2024-2027)/USD 4,000,000
- TM 4 (Frequent police enforcement against illegal parking)

RS 10/11	**Barrier Free Access around Major Transport Hubs (BRT Stations)**

- Install and improve sidewalks to create a safe and comfortable walking environment and promote the use of public transportation.
- Barrier-free sidewalks around the BRT stations will be installed in conjunction with the BRT development. This will include the conversion of Setthathilath Street into a transit mall.
- Establishment of a legal system is highly required to steadily promote barrier-free access.
- Implementing body: MPWT/DPWT
- RS 10 (Barrier-free access around major transport hub): USD 110,000 for 14 locations
- RS 11 (Legislation for Barrier-free access): USD 30,000

Behavior Change

BC 1-1	**Mobility Management Programs**

- VTMP puts significant emphasis on the importance of behavior change, alongside the improvement of public transport system and road network, in fully realizing the vision of VTMP.
- Since behavior change is influenced by structural and psychological factors, focusing on structural improvements alone would be insufficient in inducing behavior change, so it is important to integrate a psychological approach known as mobility management (MM).
- MM programs in Vientiane are planned to be targeted towards residents, workers and students using the key components of MM: motivation, information provision, behavioral/action plan and image building strategies.
- Specific MM measures should be implemented under the leadership of government agencies with creative ideas, based on the results of interviews with BRT users and behavioral analysis.
- Implementing body: MPWT/DPWT/VCSBE
- USD 50,000 (5 years)

BC 1-2	**Branding Public Transport Services Projects**

- Implementing integrated design programs for public transport services that involve residents and users will contribute to enhancing the brand image and improving user perceptions of public transportation. These programs will encompass various elements and aspects that are visible and

accessible to users, such as bus vehicles, bus stops, route maps, timetables, social networking services (SNS), websites, and more. • By taking a comprehensive approach to design and incorporating the input and feedback of residents and users, public transport services can be enhanced in a way that resonates with the community and meets the needs and preferences of the users. This, in turn, can lead to improved user satisfaction, increased usage, and a positive perception of public transportation as a whole. • Implementing body: MPWT/DPWT/VCSBE • USD 50,000 (5 years)	
BC 1-3	**Modal Shift Programs with MM**
• In order to maximize the effectiveness of the aforementioned MM program, a modal shift program will be introduced in conjunction with it. • This modal shift program will involve several initiatives including revising the commuting allowance policy to include coverage for public transportation, implementing school bus services, conducting public relations activities, and operating commuter buses. • These measures should be implemented with flexible modifications according to the MM being implemented. • Implementing body: MPWT/DPWT/VCSBE • USD 50,000 (5 years)	

(2) Priority Project Package B (Circular Bus Route along Inner Ring Road [CR-01])

- This package is intended to be implemented in addition to or in parallel with Priority Project Package A and thus the following table only shows the additional components.
- Package B consists of missing link development, road widening, and flyover construction. However, top priority is placed in making the ring road fully accessible through the development of missing links.
- After the opening of the BRT system, a transition from private vehicles to public transport is foreseen to gradually take place, therefore, in the meantime it is expected that Vientiane's central area will experience traffic congestion due to the conversion of Samsenthai Road into a transit mall. Since this project package serves as a solution to this issue, it is desirable for the development of missing links and the widening of roads in Western Vientiane to be completed before the BRT system starts operating.
- As a next step, road widening and flyover construction in Southern Vientiane is planned to be carried out in order to secure smooth operations and improve bus services.
- The areas targeted for flyover construction are currently already experiencing congestion, and with the implementation of the BRT system, intersection capacity is expected to decrease, leading to a worsening of traffic congestion. Since the completion of the flyovers will take time, it is desirable to initiate construction works as early as possible.

Table 12.4-2 (2) Priority Project Package-B (Circular Bus Route along Inner Ring Road/ CR-01)

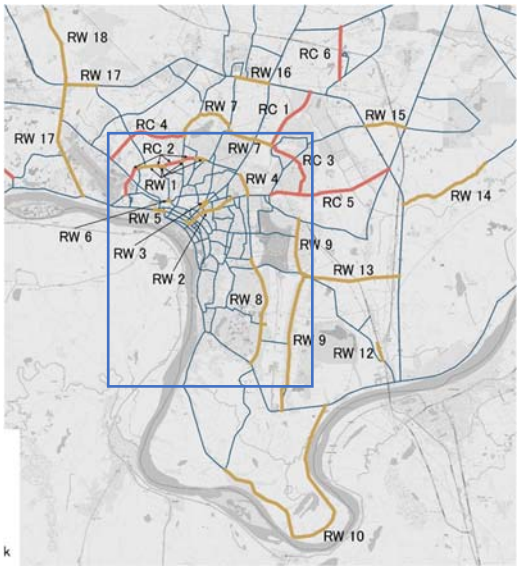
Projects/activities	ID	Short term (up to 2027) ▼BRT opening year
New construction of Inner Ring Road (missing link connection)	RC 2	
Widening of Inner Ring Road (West side)	RW 1	
Widening of Inner Ring Road (ASEAN Rd., Riverside Rd. South)	RW 4/8	
Flyover bridge construction (Inner Ring Road and Kaysone Phomvihane Avenue)	TM 2-1	

Description of Priority Project Package-B:

Road Network

RC 2 — **New construction of Inner Ring Road (missing link connection)**

- Asean Road to Dongnasok
- Nong Ping to Phonthong Chommany
- L = 3.9 km
- 4-lane carriageway with sidewalks
- W = 20.5 m
- Implementing body: DPWT
- USD 20,874,000

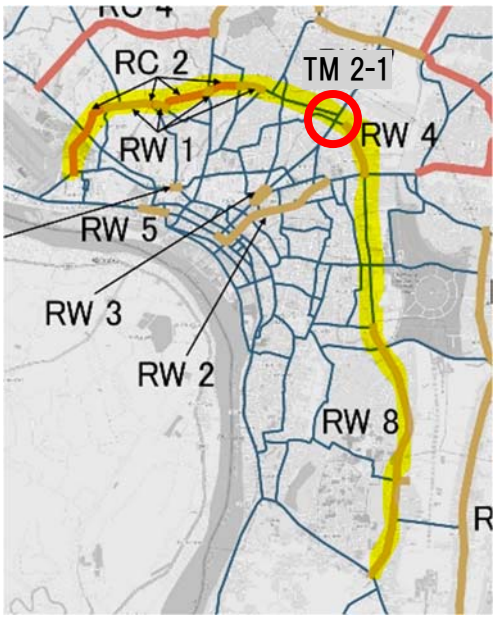


RW 1 — **Widening of Inner Ring Road (West side)**

- Dongnasok to Nong Ping
- Phonthong Chommany to Phontong Temple
- L = 1.6 km
- 4-lane carriageway with sidewalks
- W = 20.5 m
- Implementing body: DPWT
- USD 4,370,000

RW 4 — **Widening of Inner Ring Road (East side)**

- Kamphengmeuang Road (Kaysone Phomvihane Avenue to Nongbone Road)
- L = 1.2 km
- 4-lane carriageway with sidewalks
- W = 20.5 m
- Implementing body: DPWT
- USD 3,000,000

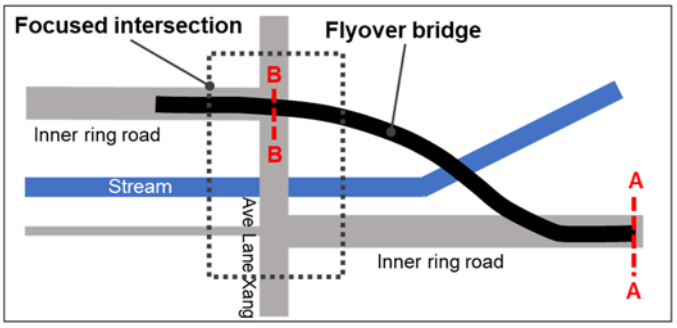


RW 8 — **Widening of Inner Ring Road (South side)**

- Khamphengmeuang Road (Rue Phonpapao to Thadeua Road)
- L = 6.1 km
- 4-lane carriageway with sidewalks
- W = 20.5 m
- Implementing body: DPWT
- USD 22,090,000

TM 2-1 — **Flyover bridge construction (Inner Ring Road and Kaysone Phomvihane Avenue)**

- At-grade intersection with insufficient traffic capacity for the traffic demand due to the staggered shape of intersection is to be converted to a multi-level junction.
- 4-lane flyover without sidewalk
- Social considerations are necessary because of the land acquisition involved
- Implementing body: DPWT
- USD 15,200,000



(3) Other Measures

Short-term measures other than the above-mentioned Priority Project Packages A and B are also important in building a hierarchical public transport network. However, it is considered to be a significant challenge to complete all the projects by 2027 due to limitations on human resources, budget, and other relevant factors. Therefore, if there are projects that cannot be completed, a review of the action plan will be conducted at the end of the short-term phase, and they will be incorporated into the first half of the middle term phase.

12.4.2 Middle-Term Phase (up to 2032)

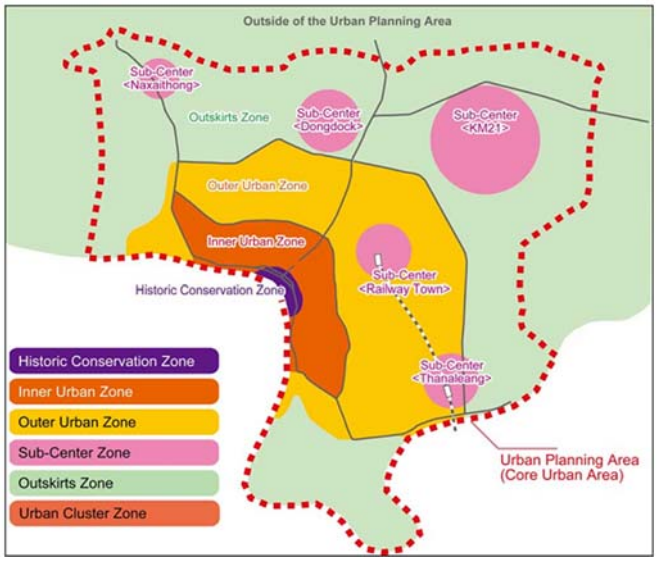
The middle term phase focuses on expanding the core transportation system established in the short-term phase and strengthen the system's connectivity, densification, and hierarchy. Accordingly, the necessary vehicle procurement, recruitment of drivers, reconfiguration of routes and frequencies, infrastructure development, and behavior change measures including traffic control, will be carried out in a similar way as in the short-term phase.

On the other hand, in the middle term, there are plans for several extensions to suburban areas (BRT -A2, FR-09, FR-10, among others). However, there are limitations to constructing a dense feeder network in suburban areas and thus it is important to incorporate the development of parking lots and bicycle parking facilities for Park and Ride (P&R) purposes into the package.

Additionally, due to the anticipated shortage of human resources for parking management and traffic enforcement, it is necessary to make efficient use of IT. This should be planned in advance during the short-term phase under "Enhancement of traffic management/enforcement (Capacity development)".

12.4.3 Long-Term Phase (up to 2040)

In this phase, the urban transport system within the Inner Urban Zone and the Outer Urban Zone will be completed. Transport systems that contribute to the development of Outskirts Zone, such as start of operations of CR-04 and CR-05, will become the main challenges to tackle.



Source: JICA Expert Team

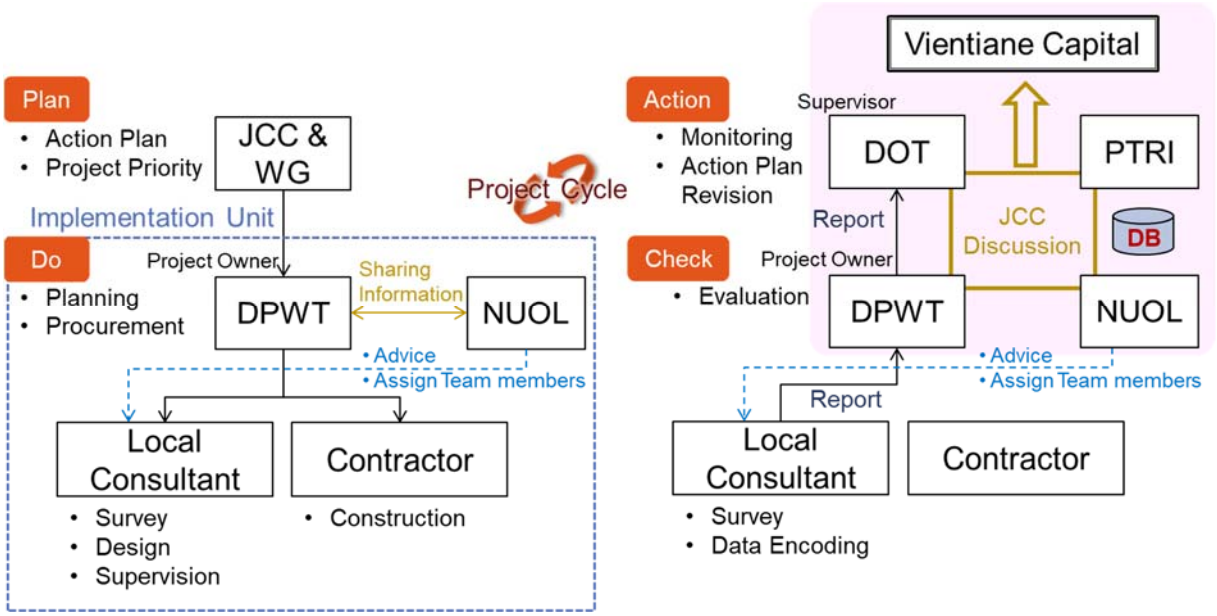
Figure 12.4-1 Planning Zones in the Core

Due to significant uncertainties surrounding suburban development and the potential impact of the construction status of intercity expressways passing through the Sub-Center Zones on traffic congestion within the target area, it is important to evaluate the progress of actual urban development, population distribution, and the achievement of urban transportation project goals at the end of the middle-term phase, approximately 10 years after VTMP2040's formulation. This evaluation will facilitate the redefinition of goals and a reassessment of strategies to ensure their relevance and effectiveness.

12.4.4 Monitoring and Minor Update on VTMP2040

The status of implementations of the proposed projects will be reviewed by the Lao organizations involved in the preparation of the master plan. The JCC meetings that have been held during the development of the master plan should continue to be held jointly, and reports should be made to Vientiane Capital once around every six months.

Minor updates, such as changes in the implementation year, should be made as the implementation progresses. The PDCA cycle should be implemented by the organization at the time this master plan is prepared, and updates should be made as appropriate. The organizations involved are shown in the figure below.



Source: JICA Expert Team

Figure 12.4-2 Project Management Cycle and Organization in Charge

12.4.5 Project List

	Proposed Project	Implementing Authority	Cost (USD)	Unit		Unit cost (USD)	Note
Ongoing Projects							
BRT Projects							
BRT 1-1	Dedicated busway development - Busway-01, 11.5km	VSUTP	-	-		-	The costs are included in new road constructions or widenings
BRT 2-1	Traffic signaling System (PTPS) - Busway-01, 11.5km	VSUTP	-	-		-	The costs are included in new road constructions or widenings
BRT 3-1	Procurement of new BRT vehicles and spare parts - Line A1, B1, B2 and D by VSUTP	VSUTP	16,800,000	55	nos	305,455	10% of operating BRT vehicles is assumed as reserve vehicles. O & M cost is assumed as 6,936
BRT 4-1	Transit facility development for BRT and information provision - Median Stations	VSUTP	680,000	22	nos	30,705	Champa Flower
BRT 4-2	Transit facility development for BRT and information provision - Curbside Stations	VSUTP	250,000	5	nos	50,900	Half basket-a
BRT 5-1	Development of BRT depot & maintenance facilities and the Control Center	VSUTP	7,500,000	1	nos	7,500,000	
BRT 6-1	Intelligent Transport System and Station Services for BRT station	VSUTP	6,900,000	27	nos	256,000	
BRT 7-1	Automatic Fare Collection System	VSUTP	1,100,000	55	nos	20,000	
Bus and Minibus Projects							
Bus 3-1	Procurement of new Minibus vehicles and spare parts	MPWT-DOT	1,830,000	52	nos	35,191	10% of operating BRT vehilces is assumed as reserve vehicles. O & M cost is assumed as 4,232
Bus 4	Bus Driver Training (Driving Simulator + Training)	MPWT-DOT	100,000	1	nos	100,000	Simulator was donated in 2023
Bus 6	Renovation of existing bus terminals (CBS)	Vientiane Capital	47,500,000	-	LS	-	Assumed past CBS PJ amounts
Paratransit Projects							
PT 4	Procurement of new NMT vehicles (E-Pedi cab)	VSUTP	460,000	150	nos	3,067	
PT 5	Regulation revision of new public transport operation	MPWT/V	30,000	3	nos	10,000	RHS, BRT, e-pedicab, etc.
Road Construction Projects							
RC 6	Development with Lao-China Railway Station	MPWT	2,647,000	4.7	km	563,191	
Behavior Change Projects							
BC 5	Transit mall/ Pedestrianized street for walkability at the CBD	VSUTP	60,000	1	LS	57,564	Repavement Cost
	Total		85,857,000	-		-	

	Proposed Project	Implementing Authority	Cost (USD)	Unit		Unit cost (USD)	Note
Short-term 2022 - 2027							
BRT Projects							
BRT 3-2	Procurement of new BRT vehicles and spare parts - Line C and additional vehicles for A1, B1, B2 and D	UTMS/ DPWT	23,520,000	77	nos	305,455	
BRT 4-3	Transit facility development for BRT and information provision - Median Stations	UTMS/ DPWT	60,000	2	nos	30,705	excl. stations by VSUTP
BRT 4-4	Transit facility development for BRT and information provision - Curbside Stations	UTMS/ DPWT	3,980,000	199	nos	20,000	Normal Bus stop with roof and bench
BRT 5-2	Development of BRT depot & maintenance facilities and the Control Center	UTMS/ DPWT	10,500,000	1	nos	10,500,000	The cost was estimated by proportional calculation based on VSUTP's estimated costs
BRT 6-2	Intelligent Transport System and Station Services for BRT station	UTMS/ DPWT	511,000	2	nos	256,000	The cost was estimated by proportional calculation based on VSUTP's estimated costs
BRT 7-2	Automatic Fare Collection System	UTMS/ DPWT	1,540,000	77	nos	20,000	The cost was estimated by proportional calculation based on VSUTP's estimated costs
Bus and Minibus Projects							
Bus 1-1	Rearrangement of bus lines for BRT	VCSBE/UTMS	50,000	5	years	10,000	
Bus 2-1	Procurement of new Bus vehicles and spare parts	VCSBE/ MPWT	13,420,000	122	nos	110,000	10% of operating BRT vehilces is assumed as reserve vehicles. O & M cost is assumed as 4,232
Bus 5-1	Transit facility development for Bus and information provision	VCSBE	7,800,000	390	nos	20,000	
Bus 7-1	Bus location system for public buses	VCSBE	194,000	174	nos	1,000	
Bus 8-1	Automatic Fare Collection System	VCSBE	3,480,000	174	nos	20,000	The cost was estimated by proportional calculation based on
School Bus Project							
SB 1-1	Procurement of new School Bus vehicles and spare parts	MPWT-DOT	5,000,000	50	nos	100,000	
Paratransit Projects							
PT 1	Songteo operational cooperation program (Step 1)	Songteo Asso./ VCSBE	50,000	5	years	10,000	
Governance System and Organizational Coordination Projects							
GS 1	Capacity development program of Management Entity (UTMS)	UTMS	3,080,000	-	LS	-	
GS 2-1	Integration program of public transport services (MaaS) organizational coordination	VCSBE/Private	50,000	5	years	10,000	

Road Construction Projects							
RC 1	The project to build a road parallel to the Kaisone Rd - That Luang Lake Special Economic Zone - Nongnieng - 450 Year Rd -	DPWT	2,674,000	3.7	km	Unit costs are based on construction costs for a 7-meter width, calculated for each width, plus site acquisition costs. See Table 12.2-3 for calculations.	
RC 2	Inner Ring Road	DPWT	20,874,000	3.9	km		
RC 3	2nd Inner ring Rd. No.1	DPWT	2,778,000	3.6	km		
RC 4	2nd Inner ring Rd. No.2	DPWT	3,617,000	4.7	km		
RC 5	Radial Road between Inner ring Rd. and Outer ring Rd.	DPWT	2,623,000	5.2	km		
RC 7	Collector street between Outer ring Rd. and 2nd Outer ring Rd.	MPWT	760,000	1.7	km		
Road Widening Projects							
RW 1	Inner Ring Rd. No.1	DPWT	4,371,000	1.6	km	Unit costs are based on construction costs for a 7-meter width, calculated for each width, plus site acquisition costs. See Table 12.2-3 for calculations.	
RW 2	Nongbone Road	DPWT	7,780,000	2.8	km		
RW 3	Roundabout around Around Patousay	MPWT	2,015,000	1.0	km		
RW 4	Inner ring Rd. No.2	DPWT	3,000,000	1.2	km		
RW 5	Settathilath Rd.	MPWT	1,431,000	0.5	km		
RW 6	Asean Rd.	DPWT	732,000	0.1	km		
RW 7	2nd Inner ring Rd. No.2	DPWT	4,637,000	6.0	km		
RW 8	Inner ring Rd. No.3 (south)	DPWT	22,088,000	6.1	km		
RW 9	2nd Inner ring Rd. No.3 (Widening)	DPWT	9,855,000	12.9	km		
RW 10	Riverside Rd. south	DPWT	10,392,000	15.0	km		
RW 11	2nd Outer ring Rd. No.2 (Widening)	MPWT	242,000	0.3	km		
RW 12	Road in front of Thanaleng station	DPWT	555,000	1.0	km		
RW 13	Asean palace Rd.	DPWT	3,316,000	5.4	km		
RW 14	Radial Rd. from Outer ring Rd. to 2nd Outer ring Rd.	DPWT	4,134,000	6.0	km		
RW 15	Radial Rd. from Outer ring Rd. to 450 Khoksa-Ath Rd.	DPWT	1,619,000	2.2	km		
RW 16	Outer ring Rd. No.1 from Ave. Lang Xang to NUOL	MPWT	1,877,000	1.8	km		
RW 17	Outer ring Rd. No.2 (west)	MPWT	7,883,000	10.3	km		
RW 18	NH13 from Vang Vieng Expw. entrance to north	MPWT	3,246,000	4.2	km		
RW 19	Radial Rd. from 2nd Outer ring Rd. to Outer ring Rd.	DPWT	467,000	0.7	km		
Maintenance and Road Management Projects							
RM 1-1	Proper road pavement maintenance and management (Resurfacing & Reconstruction)	MPWT/DPWT	69,000	1	km	57,564	Unit cost of road resurfacing is 57564$/m*10m width
RM 2-1	Proper road pavement maintenance and management (Cleaning)	VUDAA	15,000	49	km	300	Unit cost of cleaning road is
RM 3-1	Proper road marking maintenance and management	MPWT/D	4,000	3	km	1,596	Unit cost of road marking is
RM 4-1	Proper road drainage maintenance and management	MPWT/D	48,000	1	km	60,000	Unit cost of road drainage is
Traffic Management Projects							
TM 1-1	Signalization of intersections including signal system improvement	MPWT/DPWT	550,000	11	nos	50,000	Unit cost of signal system is 50,000$/intersection
TM 2-1	Flyover bridge construction Intersection crossed by Kaysone Phomvihane Avenue and Inner Ring Road (First term)	MPWT/DPWT	7,600,000	1	nos	7,600,000	Preparation wrok in short time which consists of 5% of total construction cost. Concrete
TM 3	Capacity development of traffic police	DTP	4,000,000	1	LS	4,000,000	
TM 4	Frequent police enforcement against illegal parking	DTP	-	-		-	
TM 5	Staggered work hours, Work from home, Carpool	MPWT/DPWT	50,000	5	years	10,000	Unit cost of PR material is 10,000$/year
TM 6	Increase parking fee	MPWT/DPWT	-	-		-	
TM 7	Increase parking fine	DTP	-	-		-	
Road Safety and Creating Comfortable Walking Environment Projects							
RS 1	Improvement of equipment for traffic enforcement	DTP	1,000,000	1	LS	1,000,000	Unit cost of total equipments for traffic enforcement is 1,000,000$.
RS 3	New sidewalks	MPWT/DPWT	-	-		-	The cost is included road construction fee
RS 4	Existing sidewalk improvement	MPWT/DPWT	-	-		-	The cost is included road construction fee
RS 5	Automobile speed control (humps, speed restriction)	DPWT	7,000	20	nos	350	Unit cost of automobile speed control is 350$/installment.
RS 6	Bicycle lanes/paths	DPWT	239,000	30	km	7,980	Unit cost of a bicycle lane is
RS 7	Bicycle parking and riding facilities	DPWT	105,000	150	nos	700	Unit cost of a bike parking & facility is 700$/installment.
RS 8	Bicycle share system	DPWT	-	-		-	Related law will be issued.
RS 9	Educational activities	DTP	5,000	5	times	1,000	Unit cost of PR material is
RS 10	Barrier free access around major transport hubs	DPWT	110,000	14	nos	7,840	Unit cost of barrier free access is 7840$/hub (30m long).
RS 11	Legislation for Barrier free access	MPWT	30,000	3	nos	10,000	
Behavior Change Projects							
BC 1-1	Mobility management programs - Short	MPWT/DPWT/VCSBE	50,000	5	years	10,000	
BC 2-1	Branding public transport services Projects - Short	MPWT/DPWT/VCSBE	50,000	5	years	10,000	
BC 3-1	Modal shift programs with MM - Short	MPWT/DPWT/VCSBE	50,000	5	years	10,000	
BC 4-1	Park and Ride (P&R) facility development	MPWT/DPWT/VCSBE	1,492,000	4	nos	373,000	Unit cost of parking construction is 373,000$/parking (1ha)
BC 4-4	Park and Ride (P&R) promotion program	MPWT/DPWT/VCSBE	50,000	5	years	10,000	
Total			211,725,000	-		-	

Proposed Project		Implementing Authority	Cost (USD)	Unit		Unit cost (USD)	Note
Middle-term 2028 - 2032							
BRT Projects							
BRT 1-2	Dedicated busway development - Busway-02, 4.0 km	UTMS/ DPWT	-	-		-	The costs are included in new road constructions or widenings
BRT 1-3	Dedicated busway development - Busway-03, 6.2 km	UTMS/ DPWT	-	-		-	The costs are included in new road constructions or widenings
BRT 2-2	Traffic signaling System (PTPS) - Busway-02, and 03	UTMS/ DPWT	-	-		-	The costs are included in new road constructions or widenings
BRT 3-3	Procurement of new BRT vehicles and spare parts - Line A2, E, and additional vehicles to increase frequencies	UTMS/ DPWT	14,970,000	49	nos	305,455	
BRT 4-5	Transit facility development for BRT and information provision - Median Stations	UTMS/ DPWT	860,000	28	nos	30,705	Champa Flower of VSUTP
BRT 4-6	Transit facility development for BRT and information provision - Curbside Stations	UTMS/ DPWT	1,240,000	62	nos	20,000	Normal Bus stop with roof and bench
BRT 5-3	Development of BRT depot & maintenance facilities and the Control Center	UTMS/ DPWT	6,682,000	1	nos	6,682,000	
BRT 6-3	Intelligent Transport System and Station Services for BRT	UTMS/ DPWT	7,156,000	28	nos	256,000	
BRT 7-3	Automatic Fare Collection System - Middle	UTMS/ DPWT	980,000	49	nos	20,000	
Bus and Minibus Projects							
Bus 1-2	Rearrangement of bus lines for BRT - Middle	VCSBE/UTMS	50,000	5	years	10,000	
Bus 2-2	Procurement of new Bus vehicles and spare parts	VCSBE/ MPWT	4,510,000	41	nos	110,000	
Bus 3-2	Procurement of new Minibus vehicles and spare parts	MPWT-DOT	16,700,000	167	nos	100,000	
Bus 5-2	Transit facility development for Bus and information provision	VCSBE	1,500,000	75	nos	20,000	
Bus 7-2	Bus location system for public buses	VCSBE	228,000	208	nos	1,000	
Bus 8-2	Automatic Fare Collection System	VCSBE	4,160,000	208	nos	20,000	
School Bus Project							
SB 1-2	Procurement of new School Bus vehicles and spare parts	MPWT-DOT	10,000,000	100	nos	100,000	
Paratransit Projects							
PT 2	Songteo service integration program (Step 2)	Songteo Asso./ VCSBE	50,000	5	years	10,000	
PT 3	Songteo fleet renewal program (Step 3)	Songteo Asso./ VCSBE	50,000	5	years	10,000	
Governance System and Organizational Coordination Projects							
GS 2-2	Integration program of public transport services (MaaS) organizational coordination	VCSBE/Private	50,000	5	years	10,000	
Road Construction Projects							
RC 8	Road Construction project from Dongluang village (R. 13 N)-Dong Xieng Di- Nongphaya	DPWT	4,110,000	9.5	km	Unit costs are based on construction costs for a 7-meter width, calculated for each width, plus site acquisition costs. See Table 12.2-3 for calculations.	
RC 9	Asphalt Road Construction project from KM29 (R.13 South)-Dong Khwai - Simano (R.11 South).	DPWT	1,468,000	3.4	km		
RC 10	Concrete Road Construction Project from Donnoun-Huay Dan Muang	DPWT	1,049,000	2.5	km		
RC 11	Concrete Road Construction Project from Huay Dan Muang - DonTiew (Road No. 10).	DPWT	996,000	2.3	km		
RC 12	Connection Rd. from 450years Rd. to No.3	DPWT	865,000	1.9	km		
RC 13	Connection Rd. between KM21 and 2nd Outer ring Rd.	DPWT	2,047,000	3.6	km		
RC 14	Collector street between Outer ring Rd. and 2nd Outer ring Rd.	DPWT	1,782,000	3.8	km		
RC 15	Collector street between central and Outer ring road	DPWT	2,854,000	6.6	km		
RC 16	Collector street outside of Outer ring road	DPWT	9,672,000	17.8	km		
RC 17	Inner roads in KM21	DPWT	1,272,000	6.0	km		
RC 18	2nd Outer Ring Rd. No.3 (Northern Part)	DPWT	4,301,000	7.4	km		
Road Widening Projects							
RW 20	Khouvieng Rd. in front of CBS for BRT project	DPWT	3,374,000	1.3	km	Unit costs are based on construction costs for a 7-meter width, calculated for each width, plus site acquisition costs. See Table 12.2-3 for calculations.	
RW 21	Settathilath Rd. west to the airport direction for BRT project	MPWT	9,685,000	5.4	km		
RW 22	Phonetong Rd.	DPWT	7,471,000	2.3	km		
RW 23	Radial Rd. north from Outer ring to 2nd Outer ring Rd.	DPWT	4,940,000	10.5	km		
RW 24	Radial Rd. north from the east side of NUOL	DPWT	809,000	1.7	km		
RW 25	Rue. Dongpayna for BRT project	DPWT	6,948,000	2.2	km		
RW 26	Radial Rd. outside of 2nd Outer ring Rd.	DPWT	1,590,000	3.7	km		
Maintenance and Road Management Projects							
RM 1-2	Proper road pavement maintenance and management (Resurfacing & Reconstruction)	MPWT/DPWT	1,537,000	27	km	57,564	Unit cost of road resurfacing is 57564$/m*10m width
RM 2-2	Proper road pavement maintenance and management (Cleaning)	VUDAA	320,000	1,068	km	300	Unit cost of cleaning road is
RM 3-2	Proper road marking maintenance and management	MPWT/DPWT	85,000	53	km	1,596	Unit cost of road marking is 1596$/km
RM 4-2	Proper road drainage maintenance and management	MPWT/DPWT	1,068,000	18	km	60,000	Unit cost of road drainage is 60,000$/km
Traffic Management Projects							
TM 1-2	Signalization of intersections including signal system improvement	MPWT/DPWT	1,000,000	20	nos	50,000	Unit cost of signal system is 50,000$/intersection
TM 4	Frequent police enforcement against illegal parking	DTP	-	-		-	
TM 5	Staggered work hours, Work from home, Carpool	MPWT/DPWT	50,000	5	years	10,000	Unit cost of PR material is 10,000$/year
TM 6	Increase parking fee	MPWT/DPWT	-	-		-	
TM 7	Increase parking fine	DTP	-	-		-	

Road Safety and Creating Comfortable Walking Environments Projects							
RS 2	Legislation for demand responsive transport	MPWT	-	-		-	Related law will be issued.
RS 3	New sidewalks	MPWT/DPWT	-	-		-	The cost is included road construction fee
RS 4	Existing sidewalk improvement	MPWT/DPWT	-	-		-	The cost is included road construction fee
RS 5	Bicycle lanes/paths	DPWT	239,000	30	km	7,980	Unit cost of a bicycle lane is
RS 6	Bicycle parking and riding facilities	DPWT	105,000	150	nos	700	Unit cost of a bike parking & facility is 700$/installment.
RS 7	Bicycle share system	DPWT	-	-		-	Related law will be issued.
RS 8	Preferential policies for bicycle commuting	DPWT	-	-		-	
RS 9	Educational activities	DTP	5,000	5	times	1,000	Unit cost of PR material is
RS 10	Barrier free access around major transport hubs	DPWT	110,000	14	nos	7,840	Unit cost of barrier free access is 7840$/hub (30m long).
Behavior Change Projects							
BC 1-2	Mobility management programs - Middle	MPWT/ DPWT/ VCSBE	50,000	5	years	10,000	
BC 2-2	Branding public transport services Projects) (integrated design, resident and user program, education program - Middle	MPWT/ DPWT/ VCSBE	50,000	5	years	10,000	
BC 3-2	Modal shift programs with MM - Middle	MPWT/ DPWT/ VCSBE	50,000	5	years	10,000	
BC 4-2	Park and Ride (P&R) facility development	MPWT/ DPWT/ VCSBE	1,492,000	4	nos	373,000	Unit cost of parking construction is 373,000$/parking (1ha)
BC 4-5	Park and Ride (P&R) promotion program	MPWT/ DPWT/ VCSBE	50,000	5	years	10,000	
Total			139,088,000	-		-	

Proposed Project		Implementing Authority	Cost (USD)	Unit		Unit cost (USD)	Note
Long-term 2033 - 2040							
BRT Projects							
BRT 1-4	Dedicated busway development - Busway-04, 6.1 km	UTMS/ DPWT	-	-		-	The costs are included in new road constructions or widenings
BRT 2-3	Traffic signaling System (PTPS) - Busway-04	UTMS/ DPWT	-	-		-	The costs are included in new road constructions or widenings
BRT 3-4	Procurement of new BRT vehicles and spare parts - Line A3, F, and additional vehicles to increase frequencies	UTMS/ DPWT	59,560,000	195	nos	305,455	
BRT 4-7	Transit facility development for BRT and information provision - Median Stations	UTMS/ DPWT	370,000	12	nos	30,705	Champa Flower of VSUTP
BRT 5-4	Development of BRT depot & maintenance facilities and the Control Center	UTMS/ DPWT	26,591,000	1	nos	26,591,000	
BRT 6-4	Intelligent Transport System and Station Services for BRT station	UTMS/ DPWT	3,067,000	12	nos	256,000	
BRT 7-4	Automatic Fare Collection System	UTMS/ DPWT	3,900,000	195	nos	20,000	
Bus and Minibus Projects							
Bus 1-3	Rearrangement of bus lines for BRT	VCSBE/UTMS	80,000	8	years	10,000	
Bus 2-3	Procurement of new Bus vehicles and spare parts	VCSBE/ MPWT	13,420,000	122	nos	110,000	
Bus 3-3	Procurement of new Minibus vehicles and spare parts	MPWT-DOT	15,800,000	158	nos	100,000	
Bus 5-3	Transit facility development for Bus and information provision	VCSBE	2,120,000	106	nos	20,000	
Bus 7-3	Bus location system for public buses	VCSBE	480,000	280	nos	2,000	
Bus 8-3	Automatic Fare Collection System	VCSBE	5,600,000	280	nos	20,000	
School Bus Project							
SB 1-3	Procurement of new School Bus vehicles and spare parts	MPWT-DOT	20,000,000	200	nos	100,000	
Governance System and Organizational Coordination Projects							
GS 2-3	Integration program of public transport services (MaaS) organizational coordination	VCSBE/Private	80,000	8	years	10,000	
Road Construction Projects							
RC 19	2nd Outer Ring Rd. No.2 (Eastern Part)	MPWT	5,057,000	8.7	km	Unit costs are based on construction costs for a 7-meter width, calculated for each width, plus site acquisition costs. See Table 12.2-3 for calculations.	
RC 20	Asphalt Road Construction project from KM29 (R.13 South)-Dong Khwai - Simano (R.11 South).	DPWT	4,404,000	9.4	km		
RC 21	Construction of Concrete Road from Nong Buek traffic light-Dong Bong - Tha Savang-Hai village, Xaithany district	DPWT	4,068,000	10.7	km		
RC 22	2nd Inner ring Rd. No.3	DPWT	1,048,000	1.4	km		
RC 23	2nd Outer Ring Rd. No.4 (Western Part)	MPWT	4,928,000	9.3	km		
RC 24	Expressway project (east direction)	MPWT	69,467,000	82.1	km		
RC 25	Expressway project (north direction)	MPWT	14,320,000	18.1	km		
Road Widening Projects							
RW 27	2nd Outer Ring Rd. No.1 (Widening)	MPWT	903,000	1.2	km	Unit costs are based on construction costs for a 7-meter width, calculated for each width, plus site acquisition costs. See Table 12.2-3 for calculations.	
RW 28	NH13 north extention from Vang Vieng expressway entrance	MPWT	11,630,000	15.2	km		
RW 29	2nd Outer ring Rd. No.3 (east)	MPWT	3,553,000	4.6	km		
RW 30	Radial Rd. from 2nd Outer ring Rd.	MPWT	5,716,000	7.5	km		
RW 31	Outer ring Rd. close to Thanaleng border checkpoint	MPWT	2,910,000	1.2	km		

12.5 EXPECTED FUTURE IMPROVEMENT IN TRAFFIC CONDITION

As a result of the consideration of potential development scenarios for the target area, "Scenario 2: Public Transport Intensive Scenario" was selected. Accordingly, this section presents the simulation of traffic demand forecast results showcasing the effects of implementing this scenario in the Urban Transport Master Plan.

For the forecast of traffic demand, a Four Step Modelling approach was used based on the data recollected from the surveys briefly summarized in Section 6.1.1 and STRADA version 4.0.7 was employed for the modelling and simulation procedures. Details on the modelling process have been summarized in the Technical Modelling Report.

12.5.1 Traffic Situation under Complete Implementation of Urban Transport Master Plan

The traffic situation as a result of the implementation of the Public Transport Intensive scenario in the Urban Transport Master Plan is presented in three periods: short (2027), middle (2032), and long (2040) term. Traffic conditions are showcased through the degree of congestion in each section of the network as measured by the ratio of traffic volume and road capacity. Road sections which are handling traffic volumes below their maximum capacity are shown in blue, while oversaturated roads are displayed in green, yellow, and red in accordance with the level of oversaturation as measured by the volume/capacity ratio. Furthermore, the width of roads in the network is used to represent traffic volumes.

Traffic conditions in the short term (2027), as presented by Figure 12.5-1 and Figure 12.5-2, showcase a clear functioning of the ring and axial roads proposed by the project, providing alternative routes to major arterial roads and effectively diverting traffic from lower capacity collector roads. On the other hand, results show congestion in some areas surrounding the section of Sethathirath Road, between Khun Bu Lom Road and Lane Xang Avenue, that is planned to be converted into the BRT Transit Mall.

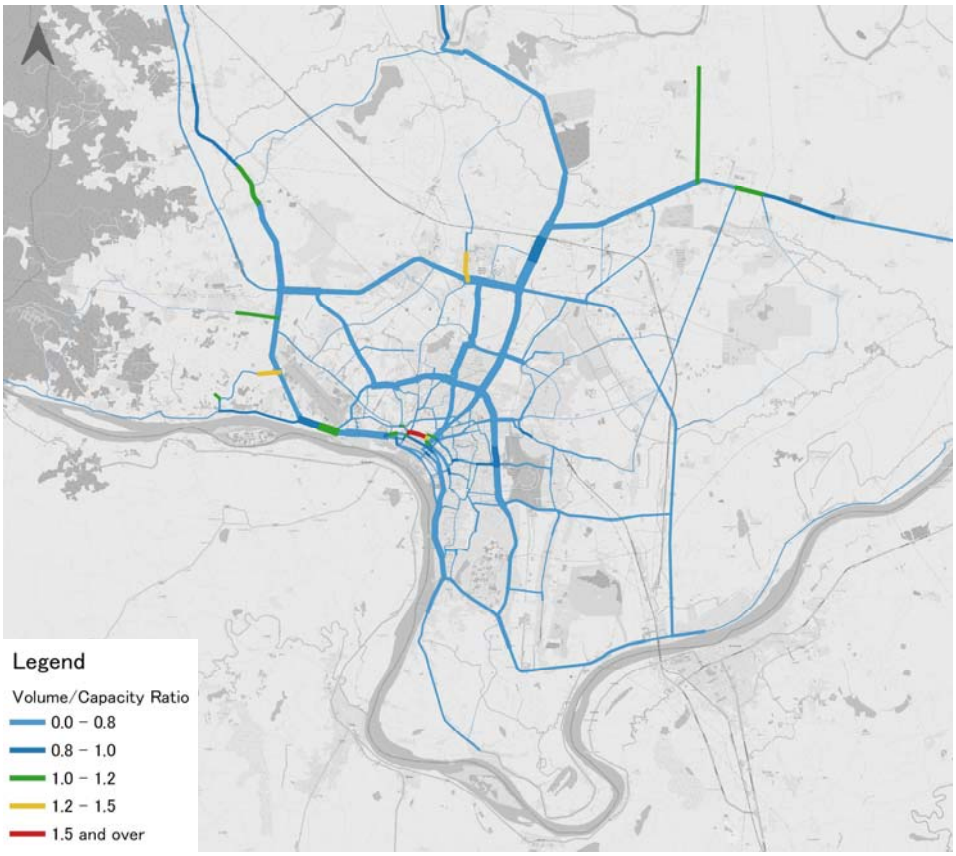
Figure 12.5-3 and Figure 12.5-4 present the traffic situation forecasted for the middle term (2032). In a similar way to short-term results, ring and axial roads are found to be effective in providing alternative routes and distributing traffic. Congestion prone areas are mainly situated in the surroundings of the BRT transit mall and along NR13N.

Regarding the long-term (2040) forecast results, showcased by a lower share of public transport than the one aimed by the project, in addition to a continuous decrease in the share of non-motorized mobility, contribute to an increase in the roads forecasted to be congested. Long-term results are showcased in Figure 12.5-5 and Figure 12.5-6, and a comparison of the modal share per transport mode at each of the target years is shown in Table 12.5-1. This highlights the importance of behavioral change measures included the Urban Transport Master Plan, without proper implementation of these measures the modal share of public transport is forecasted to fall short of the target figure of 30%.

Table 12.5-1 Modal Share by Target Year under Full Implementation of Master Plan

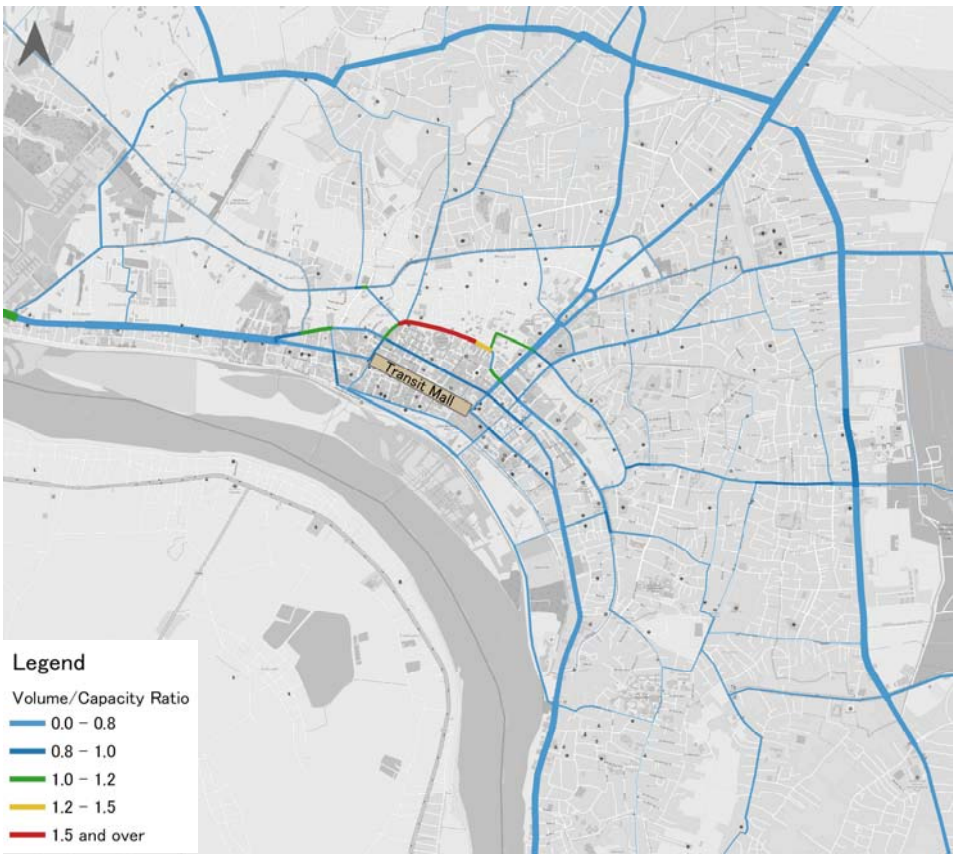
Transport Mode	Modal Share		
	Short Term (2027)	Middle Term (2032)	Long Term (2040)
NMT	8.0%	7.7%	7.3%
MT: Private Vehicles	81.1%	78.4%	78.5%
MT: Public Transport	10.9%	14.0%	14.2%
Total	100.0%	100.0%	100.0%

Notes: NMT: Non-Motorized Transport; MT: Motorized Transport.
Source: JICA Expert Team



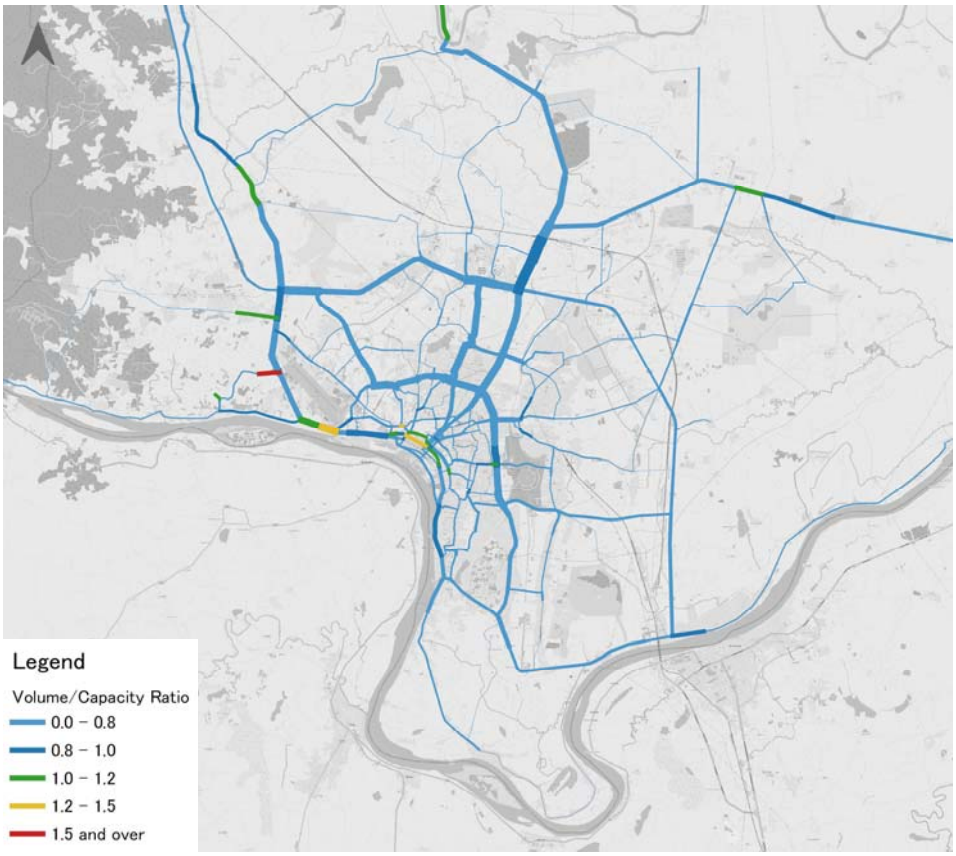
Source: JICA Expert Team

Figure 12.5-1 Traffic Situation in Vientiane (2027)



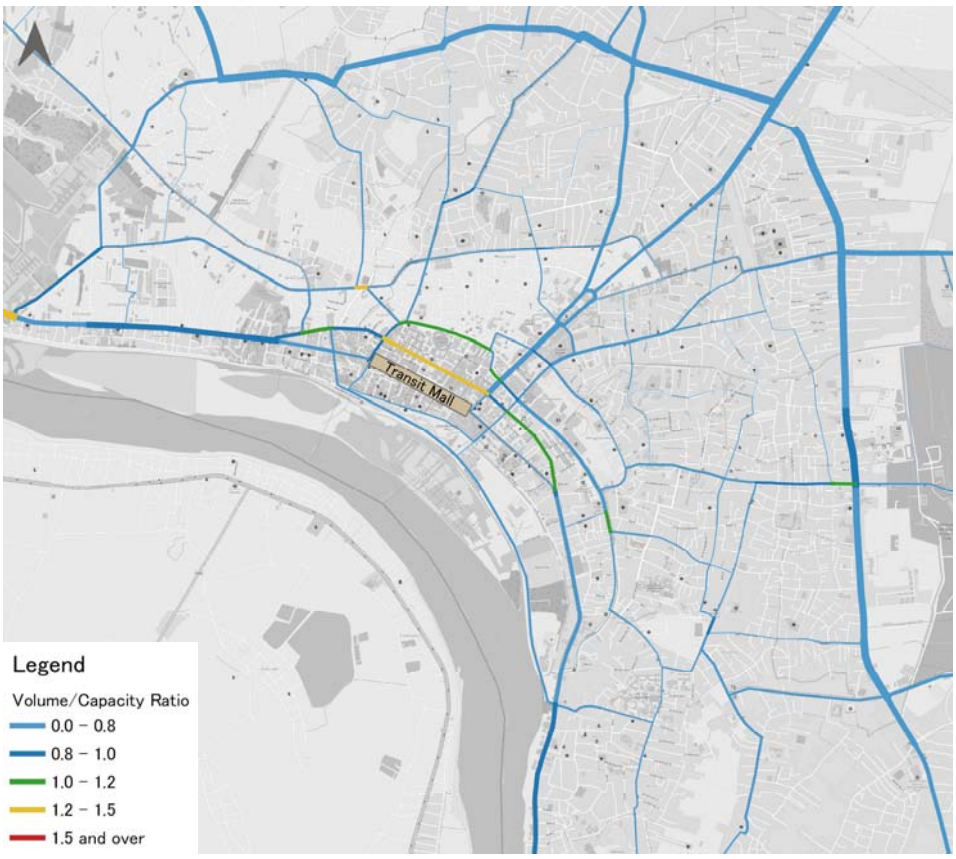
Source: JICA Expert Team

Figure 12.5-2 Traffic Situation in Central Vientiane (2027)



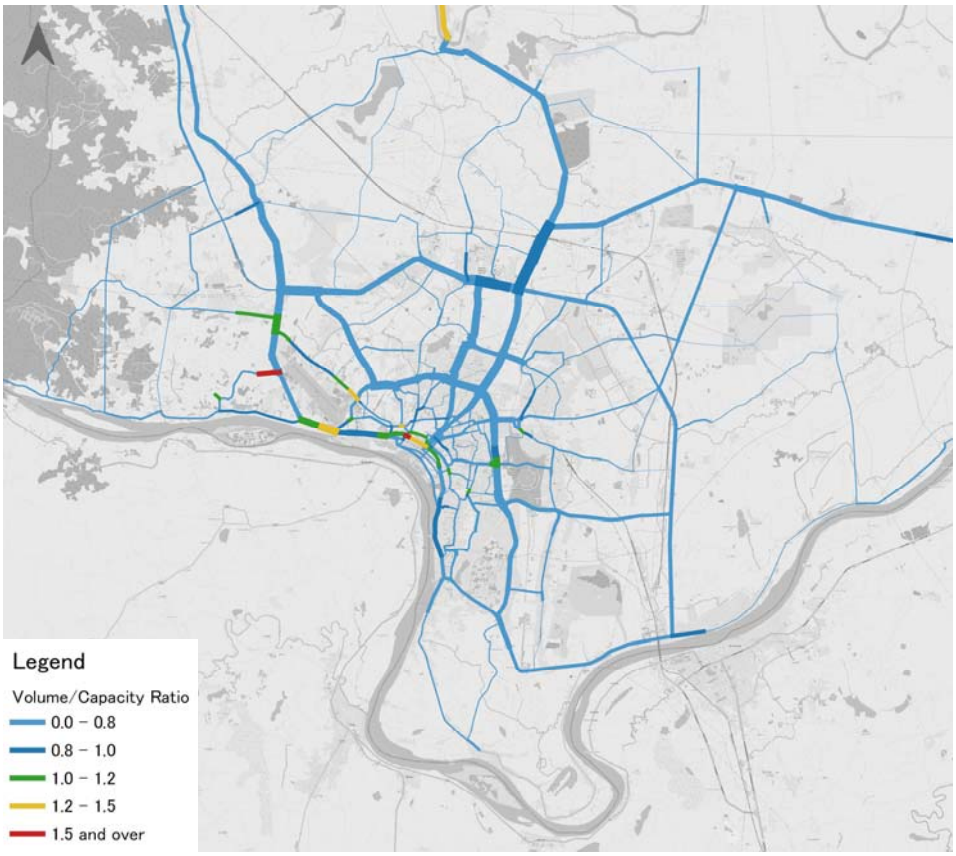
Source: JICA Expert Team

Figure 12.5-3 Traffic Situation in Vientiane (2032)



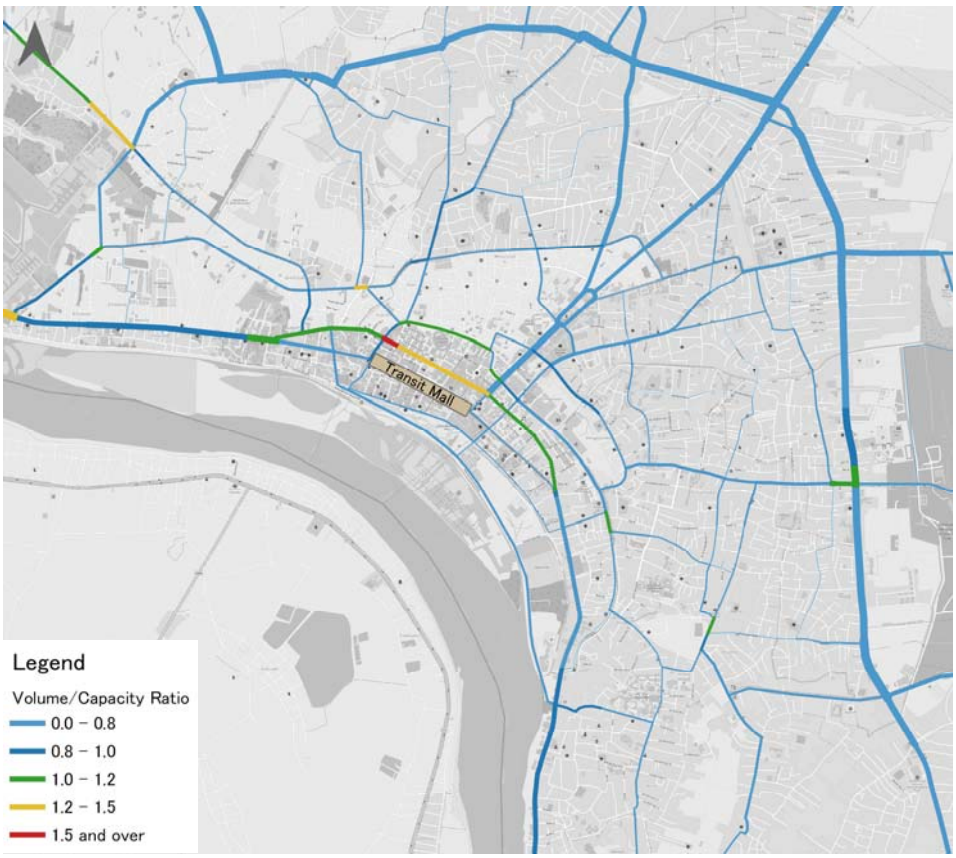
Source: JICA Expert Team

Figure 12.5-4 Traffic Situation in Central Vientiane (2032)



Source: JICA Expert Team

Figure 12.5-5 Traffic Situation in Vientiane (2040)



Source: JICA Expert Team

Figure 12.5-6 Traffic Situation in Central Vientiane (2040)

12.5.2 Traffic Situation under Minimum Network Improvements

To explore the case in which a full implementation of the Urban Transport Master Plan is not conducted, and instead only minimum network improvements are carried out, a simulation of future traffic conditions was performed for each of the target years based on the changes foreseen by "Scenario 1: Do-Minimum Scenario".

In the same way as the results showcased in Section 12.5.1, the degree of congestion in each section of the network is presented by the ratio of traffic volume and road capacity. Short-term (2027) results, given by Figure 12.5-7 and Figure 12.5-8, showcase a higher degree of congestion than the one forecasted in the short-term with full implementation of the master plan. Moreover, ring and axial roads are less effective due to missing links and the lack of the improvements being proposed by the master plan. This results in higher traffic volumes concentrating on major arterial roads. Additionally, the impact of the BRT transit mall is observed to be higher than the one forecasted if the Urban Transport Master Plan is fully implemented.

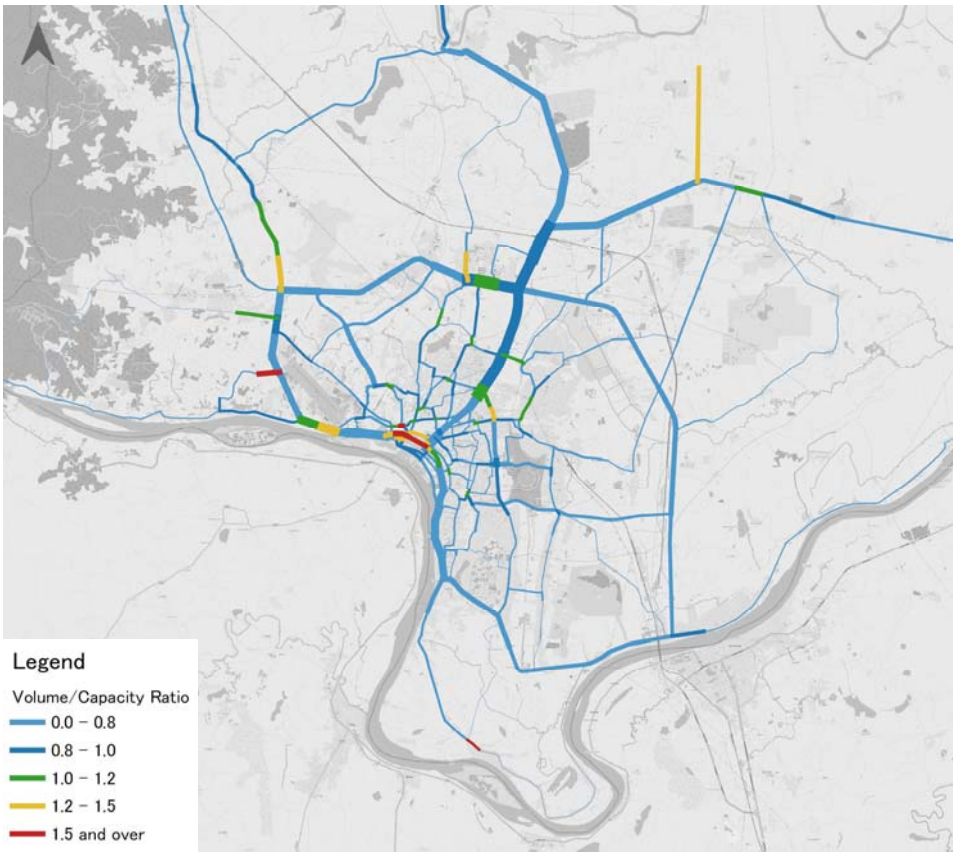
Middle term (2032) results, shown in Figure 12.5-9 and Figure 12.5-10, present similar patterns to the ones observed in the short-term. Overall, congestion is higher than the one forecasted for the equivalent middle term case under the master plan. Additionally, more collector roads present overcapacity in part due to ring and axial roads being less effective.

As for the long-term (2040) results, presented in Figure 12.5-11 and Figure 12.5-12, further worsening of congestion levels at both arterial and collector roads is forecasted. Moreover, regarding the modal share comparison, shown in Table 12.5-2, a further decrease in the share of public transport and non-motorized mobility is forecasted. In comparison to the full implementation of the master plan, the Do-Minimum Scenario results in a higher share of motorized vehicles, while the share of public transport is significantly lower. Therefore, results highlight the importance of fully implementing the Urban Transport Master Plan in order to avoid a higher dependence on the use of private vehicles for mobility needs and overall higher congestion levels in the network.

Table 12.5-2 Modal Share by Target Year:
Comparison of Full Master Plan Implementation and Do-Minimum Scenario

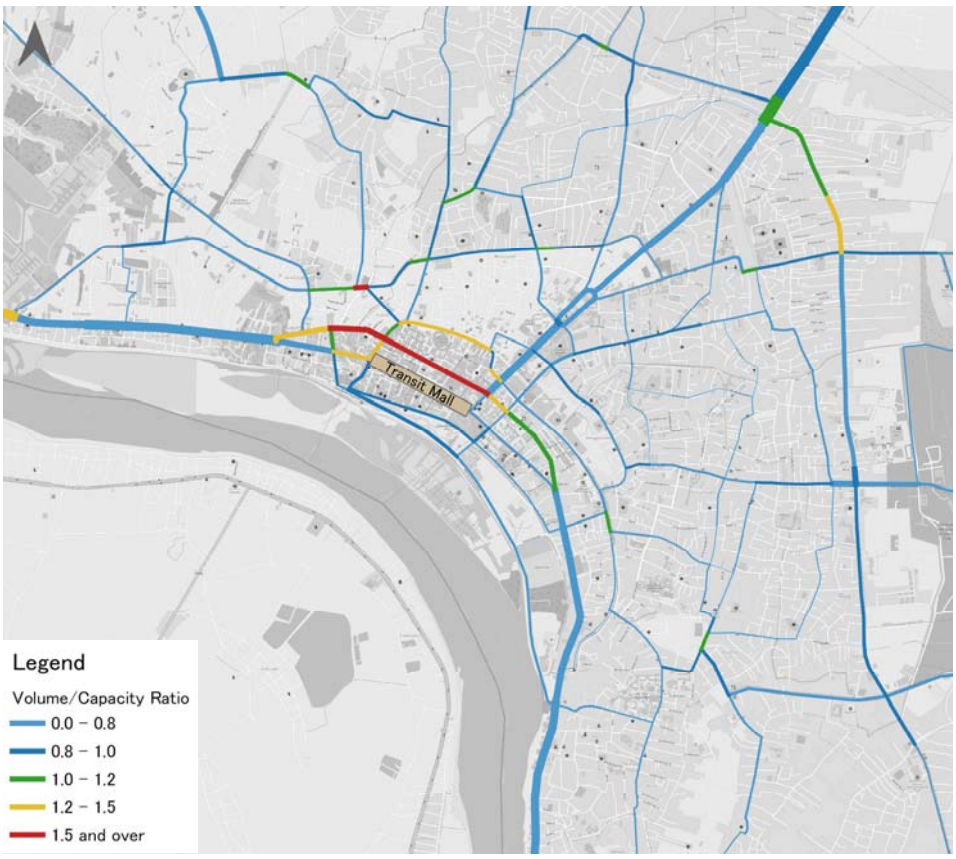
Transport Mode	Modal Share					
	Short Term (2027)		Middle Term (2032)		Long Term (2040)	
	S2	S1	S2	S1	S2	S1
NMT	8.0%	8.1%	7.7%	7.8%	7.3%	7.4%
MT: Private Vehicles	81.1%	86.9%	78.4%	87.4%	78.5%	88.0%
MT: Public Transport	10.9%	5.0%	14.0%	4.8%	14.2%	4.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Notes:
※ NMT: Non-Motorized Transport; MT: Motorized Transport.
※ Full implementation of the Urban Master Plan is foreseen by "Scenario 2: Public Transport Intensive Scenario".
※ Minimum implementation of network improvements is foreseen by "Scenario 1: Do-Minimum Scenario".
Source: JICA Expert Team



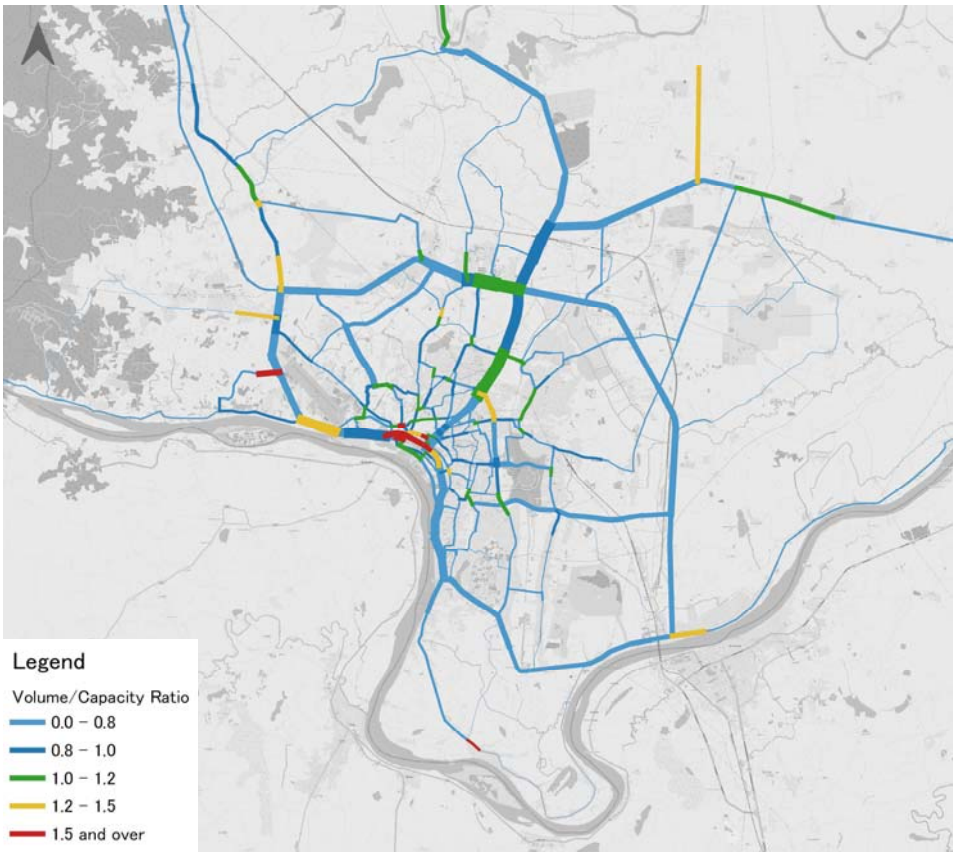
Source: JICA Expert Team

Figure 12.5-7 Traffic Situation in Vientiane: Do-Minimum Scenario (2027)



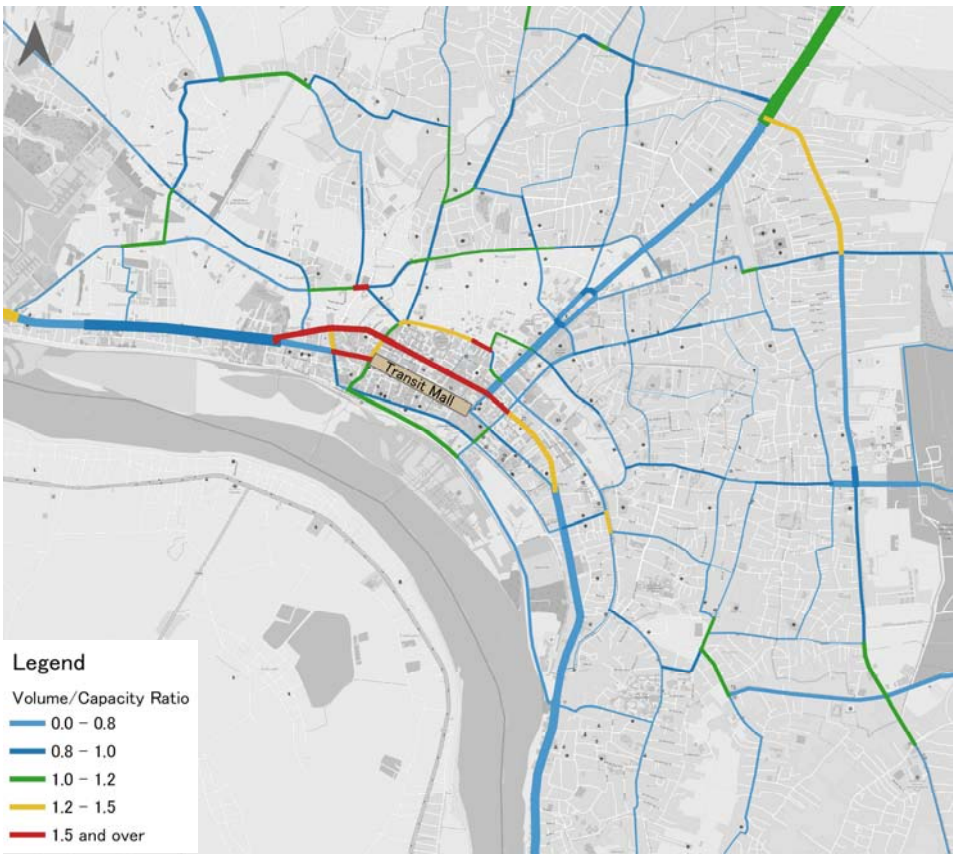
Source: JICA Expert Team

Figure 12.5-8 Traffic Situation in Central Vientiane: Do-Minimum Scenario (2027)



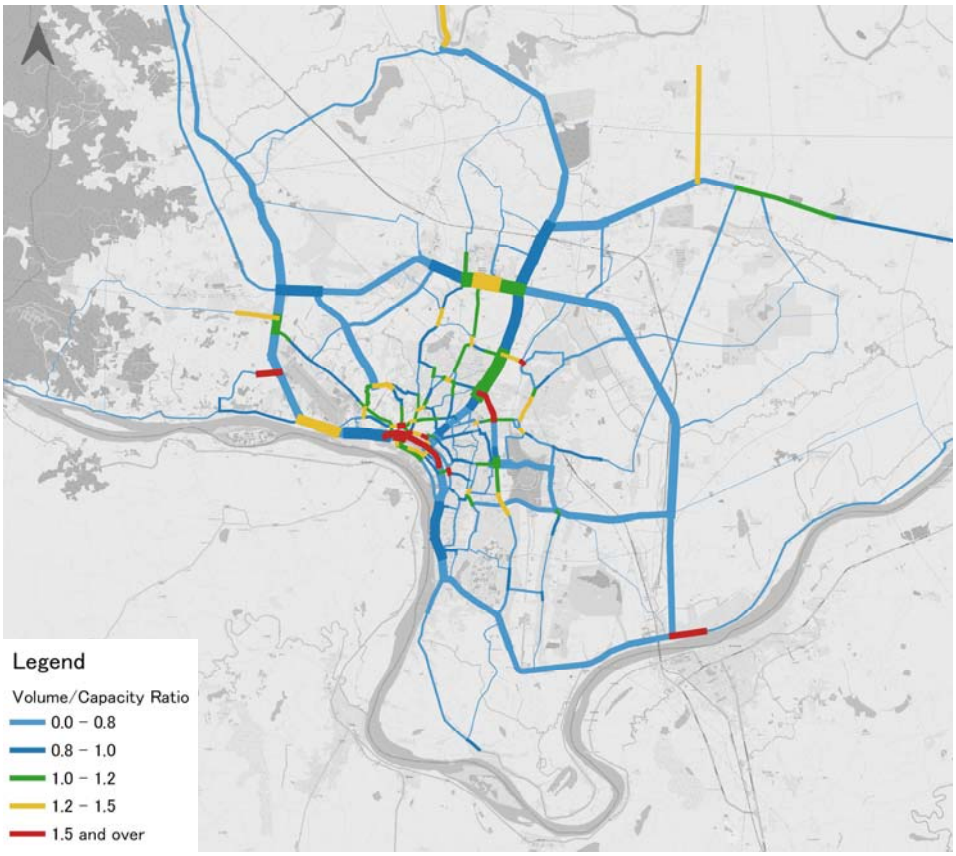
Source: JICA Expert Team

Figure 12.5-9 Traffic Situation in Vientiane: Do-Minimum Scenario (2032)



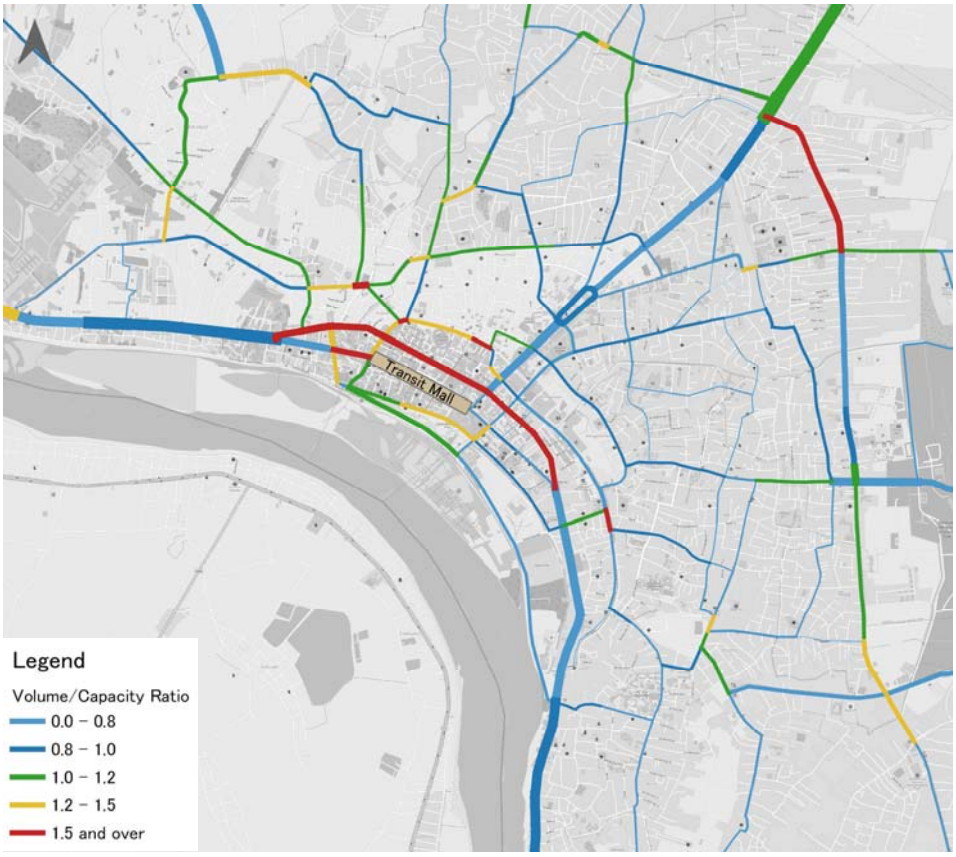
Source: JICA Expert Team

Figure 12.5-10 Traffic Situation in Central Vientiane: Do-Minimum Scenario (2032)



Source: JICA Expert Team

Figure 12.5-11 Traffic Situation in Vientiane: Do-Minimum Scenario (2040)



Source: JICA Expert Team

Figure 12.5-12 Traffic Situation in Central Vientiane: Do-Minimum Scenario (2040)

12.6 ECONOMIC EVALUATION

12.6.1 Overview

Economic internal rate of return (EIRR) was used as an indicator of the analysis which was calculated using the costs and benefits of the implementation of the Urban Transport Master Plan by comparing the with- and without-project cases. The evaluation period was set at 30 years from the estimated start of the Project in 2023, ending in 2052 and accounting for construction periods. The methodology and results are presented below.

12.6.2 Methodology

In the economic analysis, costs and benefits were estimated by comparing the with- and without-project cases. Two types of benefits quantified in the economic analysis include travel time cost (TTC) savings, and vehicle operating cost (VOC) savings, both of which are generally used in road projects. These benefits were calculated using the equations below:

$$(\text{TTC Savings}) = \text{TTC}_o - \text{TTC}_w$$

$$\text{TTC}_i = \sum_j \sum_i (Q_{js} \times T_{ijs} \times \alpha_j) \times 365$$

$$(\text{VOC Savings}) = \text{VOC}_o - \text{VOC}_w$$

$$\text{VOC}_i = \sum_j \sum_i (Q_{js} \times L_{is} \times \beta_{ij}) \times 365$$

Where,
TTCi : Travel time cost in case i (Rs./year)
VOCi : Vehicle operating cost in case i (Rs./year)
Qjs : Traffic volume of vehicle type j on section s (vehicle/day)
Tijs : Travel time of vehicle type j on section s in case i (hr)
Lis : Length of section s in case i (km)
αj : Unit value of TTC of vehicle type j (Rs./hr-vehicle)
βij : Unit value of VOC of vehicle type j in case i (Rs./vehicle-km)
i : Without-Project case (O) and With-Project case (W)
j : Vehicle types
s : Section

12.6.3 Result of FIRR

The financial analysis was performed based on revenue projections and financial expenses.
The FIRR could not be calculated due to the negative annual financial income for the period under evaluation.
The results indicate that even if income is obtained through various means we propose in this project, financial support such as subsidies from the central government or Vientiane Capital is essential for sustainable operations.

12.6.4 Investment Amounts Required for Project Implementation

The table below shows the initial investment and operation and maintenance costs required to implement the master plan. The initial investment required is estimated to be 640.5 USD, while the operation and maintenance costs are estimated to be 158.8 USD. As a result, the total investment is expected to be 799.3 USD.

Table 12.6-1 Initial Investment in Master Plan

(in: USD million)

Term	Period	Public Transportation	Road	Total
Short	2023-2027	156.4	76.6	233.0
Middle	2028-2032	69.3	57.0	126.3
Long	2033-2052	151.3	129.9	281.2
Total		377.0	263.5	640.5

Table 12.6-2 Operation and Maintenance Costs in Master Plan

(in: USD million)

Term	Period	Public Transportation	Road	Total
Short	2023-2027	8.6	0.1	8.7
Middle	2028-2032	14.7	4.7	19.4
Long	2033-2052	83.3	47.4	130.7
Total		106.6	52.2	158.8

Table 12.6-3 Total Investment Amount Required for Master Plan

(in: USD million)

Term	Period	Public Transportation	Road	Total
Short	2023-2027	165.0	76.7	241.7
Middle	2028-2032	84.0	61.7	145.7
Long	2033-2052	234.6	177.3	411.9
Total		483.6	315.7	799.3

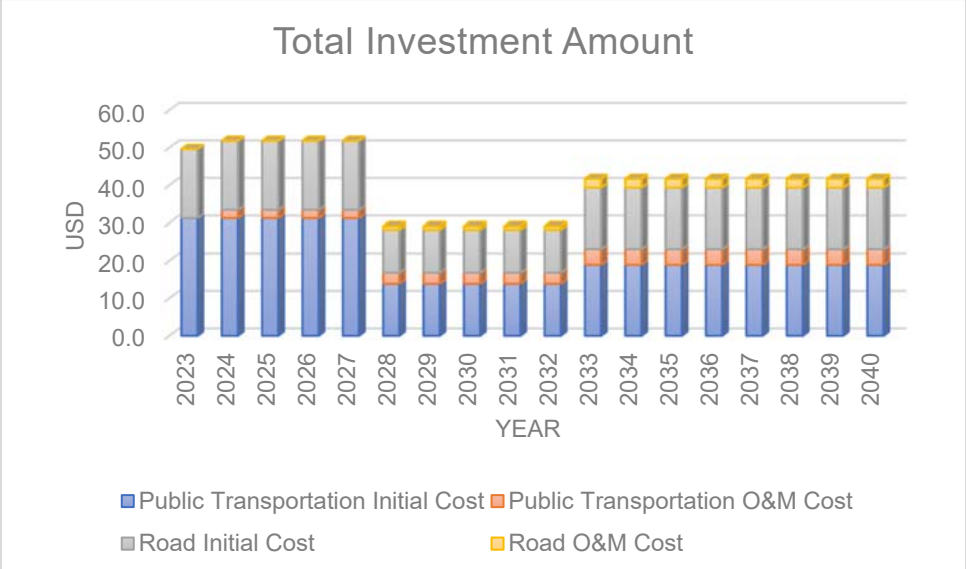


Figure 12.6-1 Total Investment Amount

This is a huge amount of the investment for the Lao People's Democratic Republic. Therefore, while it is important to ensure that the budget for public transport and roads is secured, it is important to take actions to secure financial resources through assistance from donors in other countries and through the PPP framework.

CHAPTER 13 GEOGRAPHIC INFORMATION SYSTEM (GIS)

Reliable transportation planning data is important to undertake efficient and effective transportation planning activities. Based on various maps and data prepared through the Project, GIS dataset was developed for integrated spatial analysis to support transport planning work.

13.1 GIS BASIC DATA

GIS basic data is fundamentals of GIS database; it normally includes administrative boundary, water bodies, transportation networks, costal line and so forth. GIS basic data is able to define as GIS-based structured digital topographic data which would be commonly used for various purpose and usually have only basic attribute information such as area, length, name or sometime no attribute information

13.2 GIS DATA

GIS data is not equal to GIS basic data, because GIS data is added additional data or information from other data sources to make data suitable for particular purpose by user. In other words, GIS data is value added GIS basic data to fit to user purpose. For example, VTMP first created GIS-based road data as GIS basic data of road. The road GIS data was prepared by integrating the number of lanes, road categories, etc. collected and prepared by the road planner.

In the VTMP, there are various GIS basic data/ GIS data are collected, and lots of non-spatial data, such as socio-economic data, are also collected. These GIS basic data and non-spatial data are integrated as much as possible to prepare necessary GIS data for VTMP planning activities. Based on these prepared data, the VTMP GIS dataset was prepared.

13.3 VTMP GIS DATASET

The formulation of this master plan requires a wide range of GIS data such as administrative boundaries, transport infrastructures and natural conditions, etc. Data were mainly collected from DPWT and PTI but data are also collected from some other sources such are Lao Statistics Bureau and open data via various Websites in various formats for further analysis. These collected data were standardized in GIS format and compiled as VTMP GIS Dataset divided in twelve (12) folders.

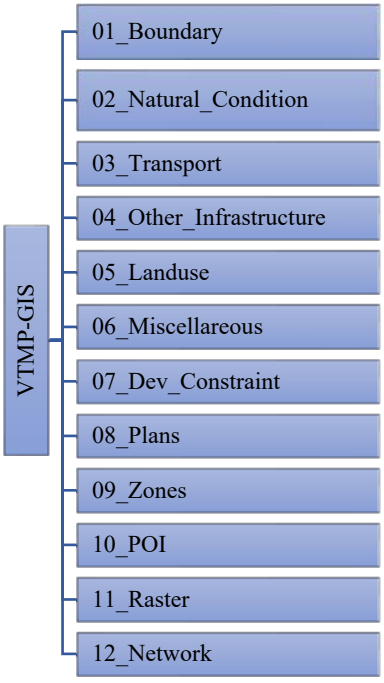


Figure 13.3-1 The Structure of VTMP GIS Dataset

Table 13.3.1 Major Contents of GIS Data by Category

	Folder Name	Major Contents	Remarks
1	01_Boundary	• Village boundary • District boundary • Provincial boundary • Study area boundary, etc.	Attribute data for village boundary data includes population data (2019 estimates) used in the VTMP
2	02_Natural_Condition	• Elevation • Contour • Waterbody, etc.	
3	03_Transport	• Road • Railway/ station • Bus stop/ routes • Airport, etc.	This folder is for base year data only
4	04_Other_Infrastructure	• Border control • SEZ	
5	05_Landuse	• Land use • Land use Plan (GLUP) • Land cover, etc.	GLUP most recently obtained from DPWT, July 2021 version
6	06_Miscellareous	• Map index • Religious place	
7	07_Dev_Constraint	• Protected area • Slope condition	
8	08_Plans	• Road network plan • Public transport plan	Includes Year 2027, 2032, 2040
9	09_Zones	• TAZ	Traffic Analysis Zone for VTMP
10	10_POI	• Point of interest	Source is OSM
11	11_Raster	• DEM (digital elevation model) • Shaded relief • Nighttime light, etc.	Use for background image
12	12_Network	• Network data for traffic demand forecast	These data were converted data from JICA STRADA format to ESRI shapefile

This data set will be handed over to the urban planning section of PTI. Although DPWT is the main counterpart for this project, DPWT does not have a GIS section, and it was confirmed through interviews that DPWT usually obtains GIS data from PTI's urban planning section, which is then used by DPWT. Therefore, it is appropriate to hand over the dataset to PTI, which plays the role of provider of GIS data to DPWT. In addition, the Urban Planning section of PTI is the counterpart to JICA's 2008 Master Plan and its subsequent projects and is the section to which the GIS datasets for these projects are handed over. Since this is the section that normally performs GIS-based work, the dataset for this project is also recommended to be handed over to the Urban Planning section of PTI.

CHAPTER 14 RECOMMENDATION

Recommendations for the implementation of this Master Plan are outlined below:

(1) Official Approval of the Master Plan

This Urban Transportation Master Plan has been formulated with consideration to Vientiane's future development plans and anticipated socio-economic growth, aiming to contribute to the city's healthy progression. Its implementation will require substantial funding, and potential negative social impacts, such as land acquisition, are expected. Therefore, political commitment is essential. It is strongly recommended that official procedures be followed for the approval of this Master Plan. The approval process, as clarified through this study, should be expediently and proactively executed by the relevant organizations and stakeholders.

(2) Ensured Implementation of Proposed Projects

The Master Plan centers around the introduction of BRT, enhancement of public transportation, and the strengthening of supporting road networks, along with proposed projects to achieve these goals. Additionally, it underscores the importance of initiatives to shift behavior from private vehicles to public transit. As these projects are vital to accomplishing the goals set out in this Master Plan, we strongly advocate for their assured implementation by the concerned agencies.

(3) Early Commencement of Priority Projects

In executing the Master Plan, securing the budget might take longer than anticipated. Even if the expected year of execution is exceeded, as Vientiane continues to develop and urbanize, acquiring land might become more challenging. Thus, it is recommended that high-priority projects be started as soon as possible.

(4) Review and Revise the Master Plan Based on Progress

This Master Plan targets the year 2040, with interim goals set for 2027 (short-term) and 2032 (mid-term). It is expected that stakeholders verify the progress of projects around these transitional periods and, if necessary, make revisions, ensuring that project implementation continues to progress appropriately.