PROJECT FOR COMPREHENSIVE URBAN TRANSPORT PLAN OF THE GREATER YANGON (YUTRA)

FINAL REPORT

SUMMARY

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ALMEC Corporation
Oriental Consultants Co., Ltd
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US$ 1.00 = MMK 1,000.00

Image of Inner Ring Road and BRT

Image of Elevated Railway and Yangon Station Development

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ABBREVIATION

ADB	Asia Development Bank
AH	Asian Highways
AWPT	Asia World Port Terminal
BIMSTEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
BLC	Bus line committees
BOC	Bus Operating Companies
BOT	Build-Operate-Transfer
BRT	Bus rapid transit
BRTA	Bus Rapid Transit Authority
BSC	Bus supervisory committees
BSW	Bo Aung Kyaw Wharf
CBD	Central Business District
DWT	Dead Weight Tonnage
EIA	Environmental impact assessment
EIRR	Equity internal rate of return
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GMS	Greater Mekong Subregion
HIA	Hanthawaddy International Airport
HIS	Household Interview Survey
ICD	Inland Container Depots
IMF	International Monetary Fund
ITS	Intelligent Transport Systems
IWT	Inland Water Transport
JICA	Japan International Cooperation Agency
LRT	Light Rail Transit
MCTA	Myanmar Container Trucks Association
MEC	Myanmar Economic Corporation
METI	Ministry of Economy, Trade and Industry of Japan
MIP	Myanmar Industrial Port
MIPL	Myanmar Integrated Port Limited
MITT	Myanmar International Terminal Thilawa
MOC	Ministry of Construction
MOECF	Ministry of Environment Conservation and Forestry
MORT	Ministry of Rail Transportation
MOT	Ministry of Transport
MP	Master Plan
MPA	Myanmar Port Authority
MR	Myanma Railways
MRT	Mass Rapid Transit
MYT-Plan	The Survey Program for the National Transportation Development Plan in the Republic of the Union of Myanmar
NMV	Non-Motorized Vehicle
OD	Origin-Destination
ORR	Outer Ring Road
PCU	Passenger Car Unit
PSP	Private Sector Participation

ROW	Right of Way
SEZ	Special Economic Zone
SPW	Sule Pagoda Wharves Terminal, Sule Pagoda Wharf
SUDP	Project for Strategic Urban Development Plan of the Greater Yangon, JICA (2013)
TEU	Twenty-foot equivalent units
TIA	Traffic Impact Assessment
TOD	Transit Oriented Development
UG	Union Government
UMRT	Urban Mass Rapid Transit
YCDC	Yangon City Development Committee
YIA	Yangon International Airport
YRG	Yangon Region Government
YUTA	Yangon Urban Transport Authority

ECECUTIVE SUMMARY

1 INTRODUCTION

Study Background

The Greater Yangon including Yangon City, with a population of about 5.7 million as of 2013, is the largest economic center of the nation, and experiences rapid urbanization and motorization as the nation's economic growth. The current rapid urbanization and motorization put more and more pressure on the existing transport infrastructure in Yangon City and its surrounding areas. The deteriorating urban transport situation has become a serious concern socially, politically and environmentally.

Under these circumstances, Yangon Region Government and JICA agreed to launch a project named "The Greater Yangon Urban Development Programme" in May 2012. Under the framework of this Programme, "The project for Strategic Urban Development Plan of the Greater Yangon (SUDP)" started in August 2012 focusing mainly on the urban development and land use aspects of the Yangon City. As the next step following this project, Yangon Region Government and JICA started this project named "The Project for Comprehensive Urban Transport Plan of the Greater Yangon (YUTRA)" to prepare a comprehensive urban transport plan in line with the above-mentioned strategic urban development plan.

Objectives

The objective of this project is to ensure mobility and accessibility to urban services for the Greater Yangon's people and society by an efficient and sustainable public transport system and road network. The outputs of the Project are:

(1) A comprehensive urban transport plan of the Greater Yangon, which includes a long term plan until 2035, a mid-term plan until 2025, and a short-term action plan until 2018;

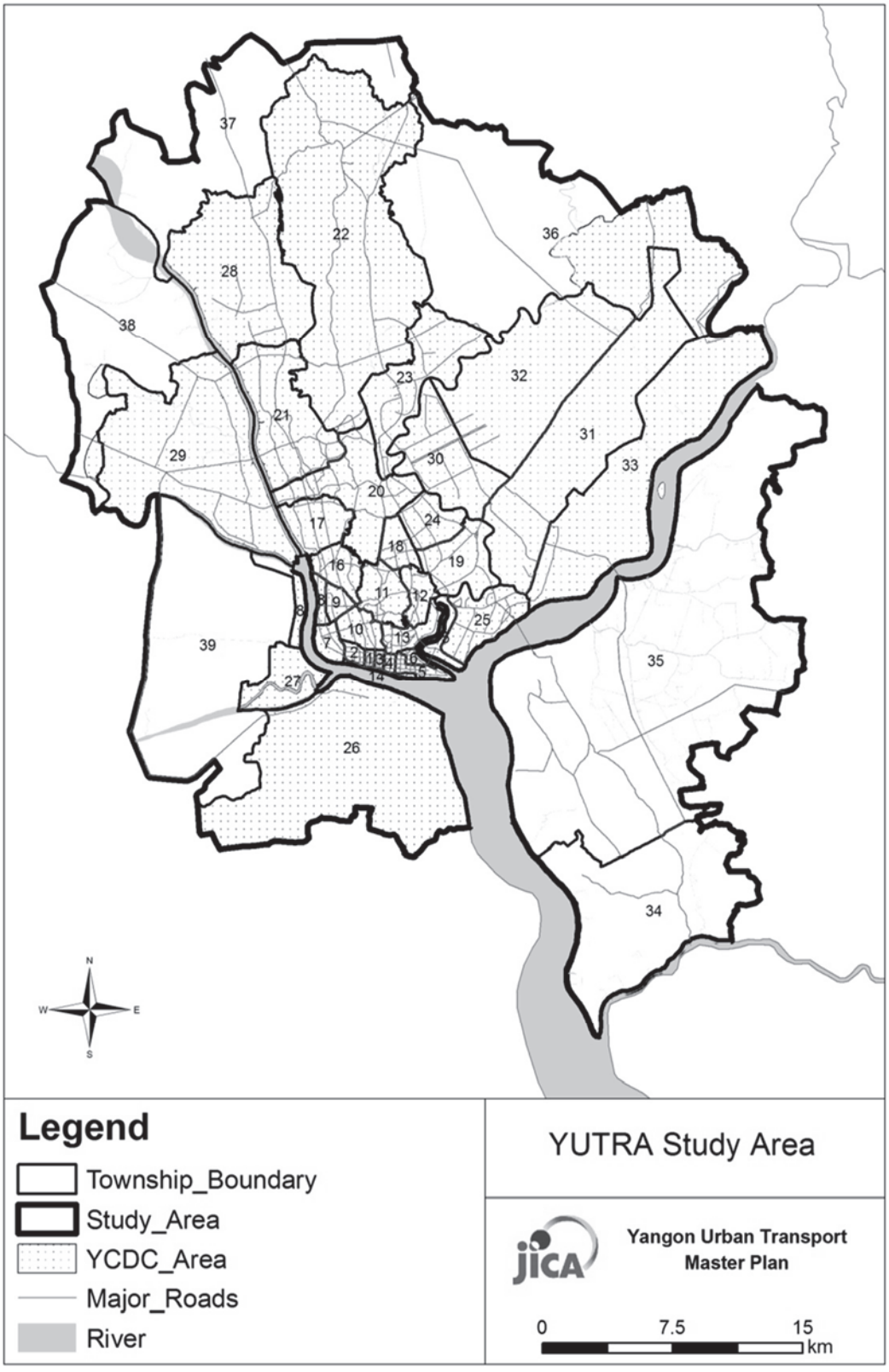
(2) Pre-Feasibility Study for the prioritized project (Construction of New Thaketa Bridge project that was selected by SUDP)

(3) Lessons from implementation of the pilot project (8-mile Intersection Improvement)

(4) Technology transfer to Myanmar counterparts through the Project;

Target Area

The target area of the Project is the Greater Yangon including Yangon City and a part of adjacent six townships (Thalyin, Hmawbi, Helgu, Htantabin, Twantay and Kyauktan). The total area is about 1,500 km^2 and the total population is about 5.7 million as of 2013. The Study Area is presented in Figure 1.1.



Source: YUTRA Project Team

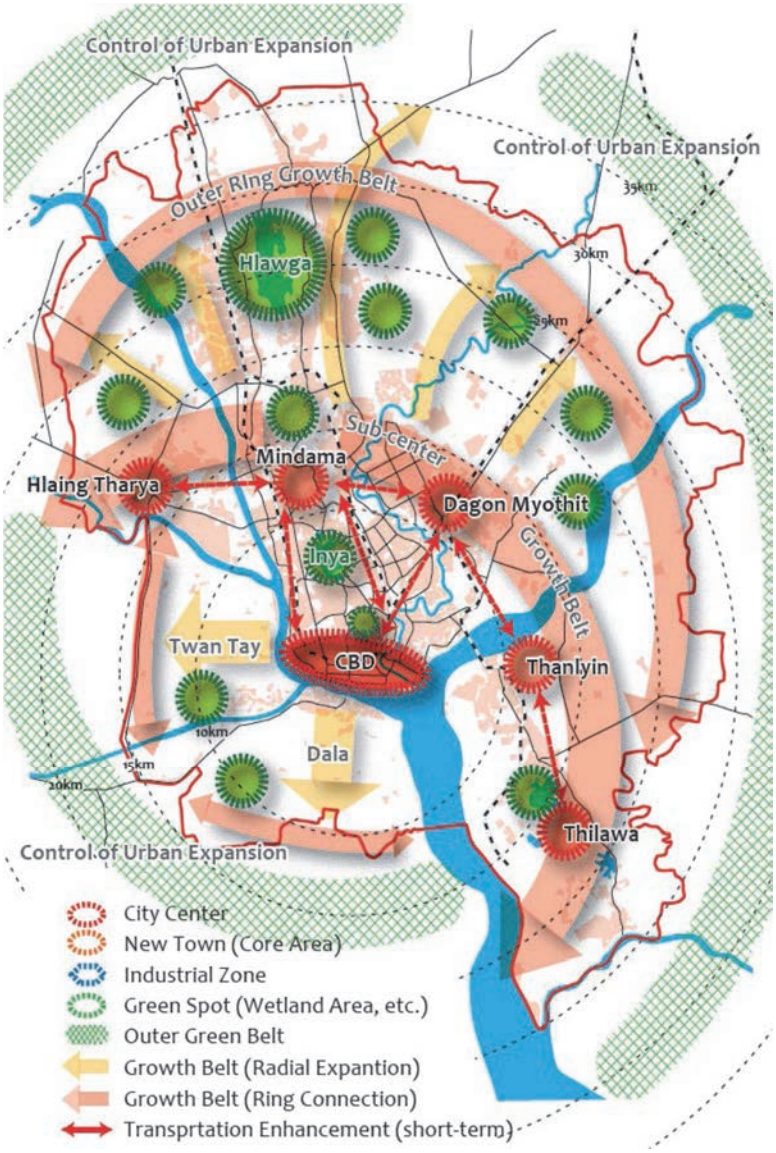
Figure 1.1 YUTRA Study Area

2 Pre-requisites of YUTRA Master Plan

Urban Structure of Greater Yangon

An urban development master plan until 2040 has been formulated in January 2013 by YCDC with the assistance from JICA. It was "The Project for the Strategic Urban Development Plan of the Greater Yangon" (SUDP). This master plan defined the development vision of Greater Yangon that is 1) international hub city; 2) comfortable city; 3) well-managed infrastructure city; and 4) city of good-governance.

SUDP defined the desirable future urban structure as "Sub-center with Green Isle System". This urban structure aims at decentralization of the functions of urban centers within a 10-15km radius of the present CBD as shown in Figure 2.1. This urban structure is one of the pre-requisites for YUTRA.



Source: SUDP, JICA, 2013

Figure 2.1 Proposed Urban Structure of Greater Yangon, "Sub-center with Green Isle System"

Socio-Economic Framework and Future Transport Demand

Based on the past trends, future land use planned by SUDP, national framework estimated by The Survey Program for the National Transportation Development Plan in the Republic of the Union of Myanmar (MYT-Plan, JICA, 2013) and a series of GIS analyses, future socio-economic framework, including nighttime/daytime population, number of workers by industry, number of students, average household income and car ownership ratio, was prepared by traffic zone in YUTRA[1].

Travel demand estimates were made for a single urban development scenario as stipulated by the JICA SUDP study. The estimate of travel demand is summarised in Table 2.1.

The table reflects a rapid growth in travel demand with almost constant population growth rate of just over 2.4% per annum. The demand forecast growth in trip rate is reflective of rapid growth in mechanised trips. The high growth in mechanised trips is caused by increase in vehicle owning household from some 12% of the population to over 34% of all households by 2035. The mechanised person trips are forecast to almost double from 4.9 million trips in 2013 to 9.5 million trips by 2035. The tendency of household to use the vehicle for all trips, by all members of the household, once a vehicle is available. This is a common phenomenon in the developing countries, where purchase of a vehicle is major step towards 'status' in the society, and then its maximum use is inevitable as there is various restraints (parking availability/charges, road user charges, etc.).

Table 2.1 Growth in Total Travel by All Modes, Person Trips ('000)

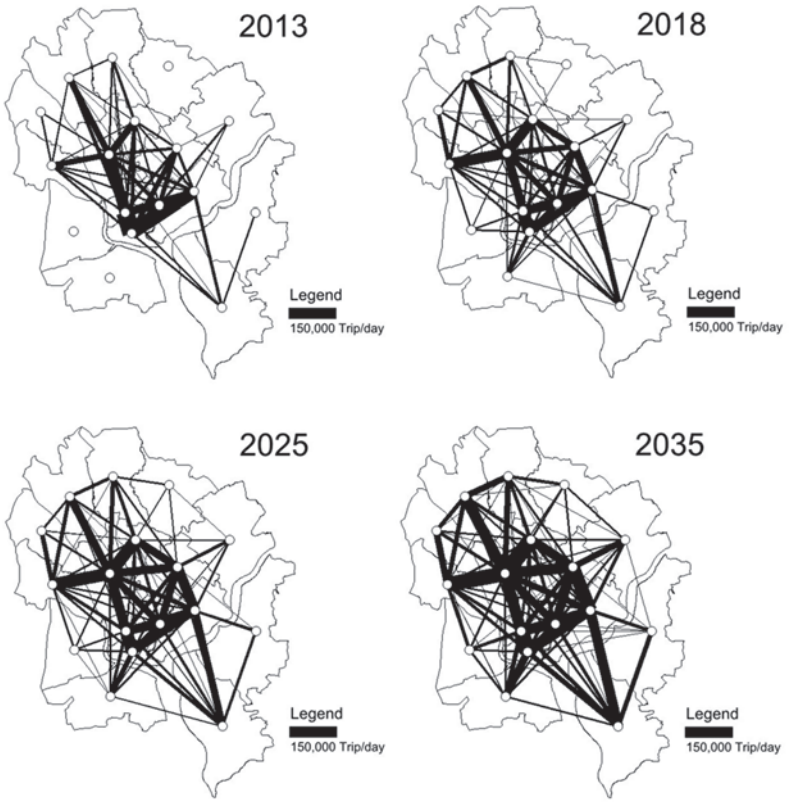
Description	2013	2018	2025	2035
Walk	4,778	5,238	6,072	7,403
Bicycle	1,472	1,661	1,981	2,704
Mechanized	4,935	5,862	7,185	9,477
% of mechanized	44.1%	45.9%	47.2%	48.4%
Total Trips	11,185	12,761	15,238	19,584
Population	5,716	6,437	7,616	9,712
Trip Rate (No. of Trips/person/day)	1.96	1.98	2.00	2.02

Source: YUTRA Project Team

The next stage in the demand forecast process is to distribute the estimated trip ends between origin and destinations. The resulting trip distribution patterns are illustrated by the desire-line diagrams for base and forecast years in Figure 2.2. It is evident that the demand for travel from the new town centers spread around the central core of the Yangon City would grow considerably.

Travel demand to and from areas outside the YUTRA area (External Trips) was estimated exogenously, and added to the above described estimated demand. The forecast external travel demand was then compared with the MYT-Plan, and controlled to the MYT-Plan travel demand to/ from Yangon and those pass through YUTRA area by private and public mode also for the goods vehicles.

[1] 156 zones in the study area. See Chapter 3, YUTRA Final Report Vol I.



Source: YUTRA Project Team

Figure 2.2 Current and Forecast Trip Distribution Patters in YUTRA Areas

Table 2.2 summarises the total travel demand in the study area by mode of travel and by commercial vehicles. In 2035, total travel demand is twice as high as 2013. Especially that of Car & Van increases rapidly in 4.3 times as high. On the other hand, the number of bicycle and motorcycle trips decreases between 2013 and 2018. It is because passengers would use public transport more for long travel instead of two-wheelers as the road network being developed.

Table 2.2 Total Travel Demand in YUTRA Study Area

Summary of Trip Totals by Mode (Inter-zonal)					% Growth			% Growth p.a.		
Total Trips	**2013**	**2018**	**2025**	**2035**	**2013-2018**	**2018-2025**	**2025-2035**	**2013-2018**	**2018-2025**	**2025-2035**
Bicycle	598,500	422,900	504,200	688,900	-29.3	19.2	36.6	-6.7	2.5	3.2
Motorcycle	304,500	208,200	246,100	320,300	-31.6	18.2	30.2	-7.3	2.4	2.7
Car & Van	628,400	1,201,300	1,771,300	2,728,000	91.2	47.4	54.0	13.8	5.7	4.4
Taxi	595,000	756,200	909,200	1,173,100	27.1	20.2	29.0	4.9	2.7	2.6
Bus / Train/ Ferry	3,065,900	3,915,400	4,560,400	5,672,600	27.7	16.5	24.4	5.0	2.2	2.2
Total Person Trips	**5,192,300**	**6,504,000**	**7,991,200**	**10,582,900**	**25.3**	**22.9**	**32.4**	**4.6**	**3.0**	**2.8**
% by Public (Taxi, Bus, Ferry & Train)	70.5	71.8	68.4	64.7						
Goods Vehicle PCU	**110,900**	**151,200**	**205,200**	**301,600**	36.3	35.7	47.0	6.4	4.5	3.9

Source: YUTRA Project Team

Budget Envelop

Various international institutions projected long-term economic growth for Myanmar, subject to major reforms in macro-economic systems. The following growth scenarios were formulated:

(i) **Scenario 1: High Growth** - This scenario is based on McKinsey forecast an average GDP growth of 7.7% per annum with seven economic sectors driving national economic development. Myanmar Government also proposes this scenario under the approved first five-year national development plan for FY2011/12 to 2015/16.

(ii) **Scenario 2: Medium Growth** - In this scenario, the annual GDP growth rate will be about 7% as estimated by IMF and based on the ADB forecast of 7%-8% growth in its report entitled "Myanmar in Transition".

(iii) **Scenario 3: Low Growth** - This scenario is based on the IMF's debt sustainability analysis of Myanmar in 2013. In the IMF analysis, annual GDP growth rates from 2014 to 2031 are set at 6.0%.

After estimating the public investment and transport sector allocation for the entire Myanmar, transport sector budget envelope was estimated. For FY2011/12 to FY2012/13, Yangon Region's economic contribution was about 22% of the country's GDP. In the Interim Report (2013) of the MYT-Plan, the GRDP estimates of Yangon Region are: 25% in the medium-term and 30% in the long-term.

On this basis, the Greater Yangon transport budget envelopes are assumed to be equal to the GRDP estimates. Table 2.3 presents the expected budget allocation for Greater Yangon transport requirements. The estimated budget envelope limits the total cost of all projects proposed by YUTRA. Plans that greatly exceed the budget envelope is judged unrealistic.

Table 2.3 Greater Yangon Transport Sector Budget Envelopes

(US$ Billion at 2013 Prices)

Fiscal Year	Greater Yangon Transport Investment		
	High (McKinsey)	Medium (ADB)	Low (IMF)
FY2014-2017	2.748	2.702	2.637
FY2018-2025	8.675	8.234	7.656
FY2026-2035	21.314	19.048	16.252

Source: YUTRA Project Team

3 YUTRA Overall Transport Development Strategy

Future Yangon should be livable as well as globally competitive and attractive for industries, leading Myanmar's international trade, and the transport sector must be designed to make this a possibility. The overall goal of urban transport is the following:

"Ensure mobility and accessibility to urban services that are vital for the people and the society, by providing a transport system characterized by safety, amenity, and equity and

sustained by an efficient public transport system".

A combination of supply-type and demand-type strategies is required to maintain the present advantage of high modal share of public transport of more than 60%. YUTRA has identified a series of transport development strategies as stated below in Table 3.1. The main focuses or features of the Master Plan exist on the following points:

1. **Strengthening of Public Transport:** development of sustainable public transport system, taking advantage of the present high share of public transport trips.
2. **Improvement of Regional Competitiveness of the City:** Construction of efficient transport system that supports 10-million multi-core hub city.
3. **Realization of Well-managed Environment-friendly City:** introduction of innovative institutional/operational schemes that enables world-class transport integration with living environment.
4. **Adoption of Immediate Congestion Mitigation Measures:** implementation of less expensive measures against traffic congestion that brings quick outcome.

In YUTRA, the following eight objectives were established with identified transport development strategies. The inter-relationship between these objectives and the identified strategies is illustrated in Figure 3.1.

Table 3.1 Identified transport development strategies

A. Promotion of Social Understanding about Urban Transport Problems and Issues	A1. Conduct of consecutive transport campaigns;
	A2. Expansion of transport education;
	A3. Strengthening of transport studies;
	A4. Information disclosure.
B. Effective Management of Urban Growth and Development	B1. Policy coordination within the Greater Yangon area;
	B2. Authorization of City and Transport Master Plans;
	B3. Development of hierarchical road network and road classifications to guide design (and parking provision);
	B4. Promotion of integrated urban and transport development, particularly Transit-Oriented Development (TOD).
C. Promotion and Development of Attractive Public Transport	C1. Development of a hierarchal mass transit system;
	C2. Early introduction of an integrated public transport system (BRT) in the effort to maintain public transport share;
	C3. Upgrading the present rail system;
	C4. Development and improvement of bus transport system, including reform of management systems and the business model;
	C5. Promotion of public transport use and expansion of services.
D. Efficient Traffic Control and Management	D1. Establishment of comprehensive traffic management system balanced with better facilities for essential NMT modes such as cycling and walking;
	D2. Strengthening of traffic regulation, enforcement and management;
	D3. Management of freight transport;
	D4. Establishment of parking policy and controls;
	D5. Development of well-coordinated traffic control system.
E. Effective Transport Demand Management	E1. Integrating urban development and transport (TOD);
	E2. Providing efficient public transport alternatives;

	(TDM)	E2. Regulating motorized vehicle access and proper charging of road use and parking.
F.	Comprehensive Development of Transport Space and Environment	F1. Improvement of a safe transport environment for pedestrians and cyclists;
		F2. Redistribution of transport space and improvement of traffic environment in the city centre;
		F3. Establishment of township transport development strategy.
G.	Enhancement of Traffic Safety	G1. Establishment of traffic safety audit system;
		G2. Elimination of traffic accident black spots;
		G3. Improvement of licensing and vehicle inspection system;
		G4. Strengthening of traffic enforcement system;
		G5. Strengthening of first aid response system.
H.	Strengthening of Transport Sector Administrative and Management Capacities	H1. Reform of transport- related organizations;
		H2. Promotion of private sector participation;
		H3. Strengthening of planning and management capacity;
		H4. Securing of development funds.

Source: YUTRA Project Team

Source: YUTRA Project Team

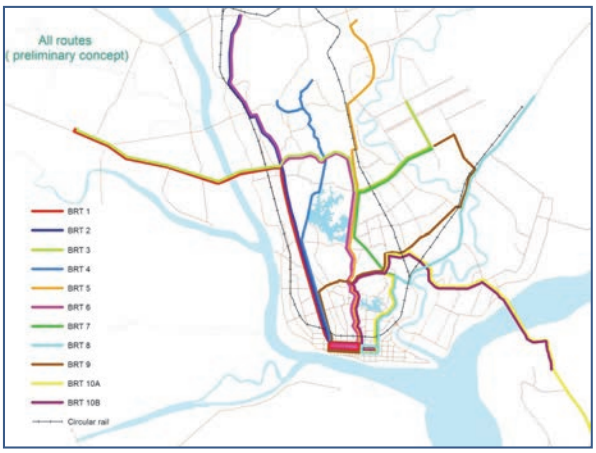
Figure 3.1 Main Features and Strategies of YUTRA Master Plan

4 MASTER PLAN 2035

Strengthening of Public Transport

To cope with the forecast future traffic demand, YUTRA proposes the introduction of public transport network that integrates Myanmar Railway lines, proposed Urban Mass Rapid Transit (UMRT) lines, medium capacity transit such as Bus Rapid Transit (BRT) and the conventional bus. The advantage of mass transit such as high capacity, high operating speed and low environmental load should be maximized. The target modal share is over 60 % out of which 20% or more should be shouldered by mass transit such as UMRT, Myanma Railway and BRT.

BRT: In order to maintain the present high share of public transport (about 61 % except for walk), BRT should be developed and introduced at an early stage. The network of existing buses should be reviewed and rationalized. The number of planned BRT routes is 11 and the total route length and road length is 244.9 km and 127.9 km, respectively. BRT network and image are shown in Figure 4.1 and Figure 4.2.



Source: YUTRA Project Team

Figure 4.1 Proposed BRT routs (Master Plan)

Source: YUTRA Project Team

Figure 4.2 Image of BRT

Myanmar Railway: Stations, tracks, trains and operation of the existing Myanmar Railway (MR) urban sections should be modernized in the short term to improve travel speed, safety and comfort. The effect will be immediate because the area alongside the railway is already urbanized with a high population density. Moreover the project cost is inexpensive due to the use of existing assets. Transit Oriented Development (TOD) should be pursued for the integrated development of the railway, station and related areas so that the station area becomes attractive socially and commercially.

For short-term (2013-2018), it is planned to enhance transport capacity of V shape line connecting Danyingone station with Ywa Tar Gyi station via Yangon Central station by improving Yangon Circular Railway Western Half and Yangon-Mandalay Line. In addition, yard redevelopment projects along these lines will be conducted in parallel in order to increase railway user and enhance ability to attract customers. Furthermore, relocation and integration of existing depots and workshops, which is required in connection with yard development, will be implemented simultaneously.

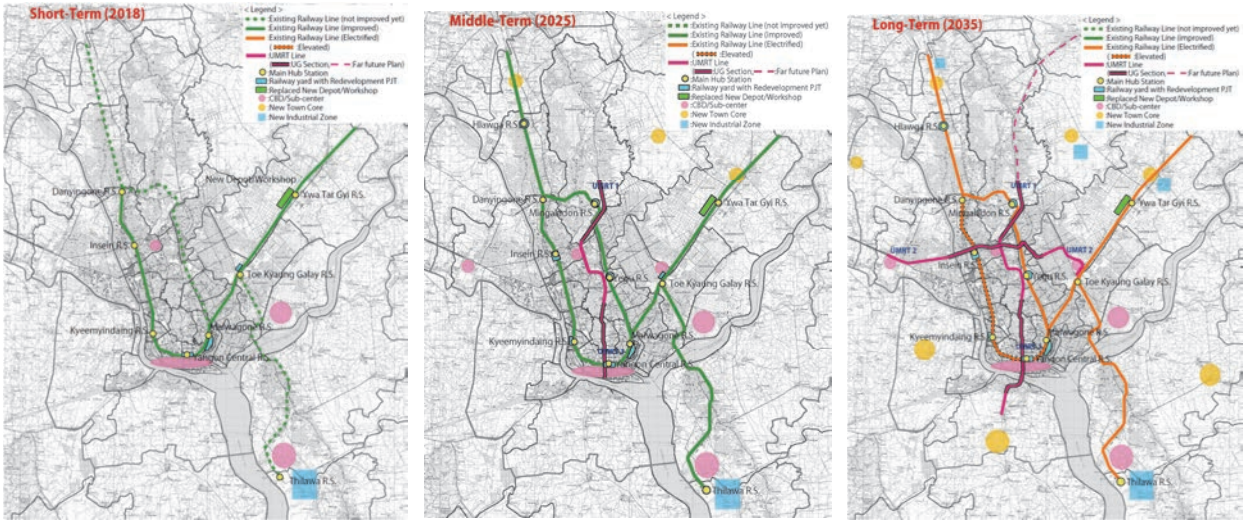
For middle-term (2018-2025), it is planned to improve the remaining sections of the existing lines (Yangon Circular Railway Eastern Half, Yangon-Pyay line suburban section, Thilawa access line), and to conduct projects for yard redevelopment and land development along these lines in parallel in order to fulfill further increasing railway user and enhancing ability to attract customers. Expansion of the new integrated depot and workshop will be implemented simultaneously in connection with yard development.

For Long-term (2025-2035), it is planned to electrify and partially elevate existing lines which were improved as first step in short or middle term, in order to fulfill further transport capacity enhancement and speed-up, and reducing operation cost.

UMRT: UMRT Line1 which is named as North-South Line connecting CBD with Yangon International Airport via Yangon Central station and Mindama sub-center will be installed as first metro in Yangon. In order to minimize initial cost, it is planned underground section is minimized as much as possible, and elevated section is applied maximally. The construction of UMRT1 should be completed in the middle-term (2025). In long-term, UMRT Line2 is installed as East-West axis with 26.0km length.

Proposed project location maps for short-, middle-, and long-term are shown in Figure 4.3.

As to the conventional bus system, service improvement projects should be implemented in the short-term, including bus network rerouting, service enhancement, development of terminals and transfer stations, and prioritization of bus traffic, in order to solve the present problems.



Source: YUTRA Project Team

Figure 4.3 Proposed Project Networks for Short-, Middle-, and Long-term

Improvement of Regional Competitiveness of the City

Yangon, one of the major metropolises in the Southeast Asia, must compete with other cities such as Bangkok, Jakarta and Manila, and needs to build a unique position socially and economically. Thus Yangon must grow as a multi-core city that has regional hub functions satisfying global standards in terms of transport infrastructure and services.

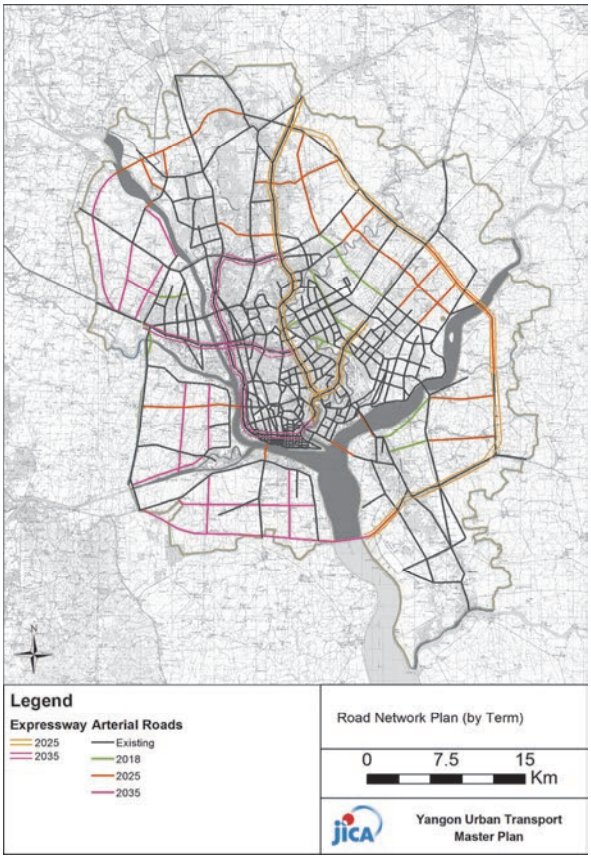
Road: Road infrastructure should be developed to meet the increase of future traffic

demand. Construction and improvement of arterial roads is essential. Urban expressway should be constructed strategically.

YUTRA master plan should pursue the following targets; average volume/capacity ratio is less than 0.5 in 2035 (about 0.3 at present), average travel speed is more than 20 kph in 2035 (about 30 kph at present), and is fully equipped with facilities to improve mobility, accessibility, comfort and safety.

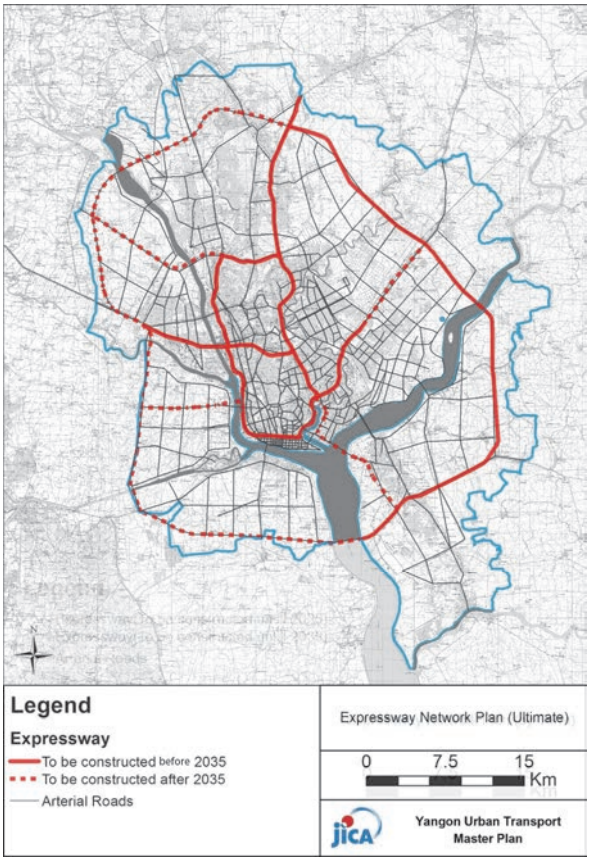
In the short-term (2013-2018), road network planning aims to promote distribution of urban functions to the north and the east, and to improve accessibility to/from the Thilawa industrial area, as well as to detour the truck routes from the CBD. In the middle-term (2018-2025), YUTRA aims to support urban development toward the north and the east, to accelerate development of sub-centers such as Thilawa, Dagon Myothit, Hlaing, and Tharaya, and to extend arterial roads to the new town centers such as Hlegu, Hmawbi, and East Dagon. In the long-term (2025-2035), expansion of urban functions to the west and the south and extension of the arterial road network to new town centers including Thanlyin, Dala, Twanty and Htantabinare is proposed. (See Figure 4.4)

Expressway: Construction of a north-south section of the Inner Ring Road (expressway), where traffic demand is large, is planned in the middle-term. Also the eastern half of the Outer Ring Road (expressway) is planned in the middle-term to form the national north-south freight corridor by improving the access to/from Thilawa. The Inner Ring Road will be completed in the long-term with its connector to the west. (See Figure 4.5 and Figure 4.6)



Source: YUTRA Project Team

Figure 4.4 Arterial Road Network by Target Year



Source: YUTRA Project Team

Figure 4.5 Expressway Network (Ultimate)

Source: YUTRA Project Team

Figure 4.6 Image of Inner Ring Road (Expressway)

TOD: Transit Oriented Development (TOD) should be implemented near major railway stations taking advantage of the existing property of the government including Myanmar Railway. TOD projects aim to improve the convenience and comfort of public transport users and to promote people to use public transport more, as well as to enhance land use efficiency (see Figure 4.7). TOD has a great economic potential and is expected to yield a large profit as a potential financial source also for transport development. Both Union and Yangon Region Government should identify candidate sites such as Yangon Central Station and promote TOD projects.

Source: YUTRA Project Team

Figure 4.7 Image of TOD at the Yangon Central Station

Optimization of Management

YUTRA has proposed management projects in the field of traffic management, traffic demand management (TDM), education and institutional improvement. Their objective is to promote the use of public transport by restraining the use of private modes such as

passenger cars. The final target is to construct a public transport oriented society.

Yangon CBD Traffic Congestion Mitigation Project: Objective of the project is to mitigate traffic congestion with comprehensive measures including physical improvement, management enhancement and public relations activities. Project components are; modernization of the signal system, removal of on-street parking from congested road sections, provision of sufficient number of off-road parking spaces to less-congested sections , introduction of parking fee charging system (including parking meter), removal of street vendors from sidewalk, development of hawker centers, and improvement of pedestrian environment, provision of bus-bays and taxi-bays, and implementation of Mobility Management and transport Demand Management (TDM measures).

Major Roads Traffic Congestion Mitigation Project: This project tackles the existing congestion problems on the main roads with comprehensive measures to provide a smooth and safe traffic flows. Project components are; installation and upgrading of traffic signal control system, improvement of intersection geometries, installation of road signs, pavement marking, installation of traffic monitoring system, provision of pedestrian bridges, and development of bus interchanges/stops.

Yangon Parking Development Project: Parking development and control is generally difficult to implement because it incurs disputes among stakeholders due to its complex implications with people's daily behavior. YUTRA proposes as the first step to collect various data and to formulate a Parking Master Plan. The data should cover present parking use, parking demand and laws/regulations. Plan will include sites for new public parking development, technical guideline, basic design, cost, operation/maintenance and legal/institutional arrangements. The second step is the implementation of this plan.

Traffic Safety: Currently, there is no proper organizational setup for the comprehensive traffic safety intervention. Only traffic police is playing the role through ad-hoc enforcement activities. The first step is to formulate a 5-year traffic safety program. This five-year program aims (1) to develop an institution for the comprehensive traffic safety activities including establishment of Traffic Safety Committee, and (2) to implement a series of traffic safety activities. The second step includes development of traffic accidents database, implementation of traffic safety projects and capacity development of related organizations including the Traffic Safety Committee.

Capacity Development on Traffic Planning and Management: Traffic management policy is one of the significant urban transport policies to enhance the efficiency of road network system and to control traffic demand. However, there is no specialized organization responsible for the traffic management in Yangon. This project aims to establish 'Traffic Planning and Management Unit' under Engineering Department of YCDC and to enhance their knowledge and implementation capabilities (This unit is assumed to be a part of the proposed YUTA later). Furthermore, comprehensive traffic database on traffic volume, vehicle registration and so on should be developed in order to grasp and analyze traffic condition changing every moment.

BRT Agency (BRTA): BRT will shoulder an important role to maintain the present high modal share of public transport in the future. YUTRA proposes to establish a BRT Agency (BRTA) that will be responsible for planning and managing the BRT network. BRTA

requires a number of new human resources from inside/ outside of Myanmar Government.

Yangon Urban Transport Authority (YUTA)：The purpose of establishing YUTA is to provide such a strategic policymaking umbrella to improve coordination of urban development and transport and to improve planning within urban transport itself. YUTA could be an agency that can take various technical/ financial supports from international donors. It is essential to support the establishment of YUTA by providing a regulatory authority under the Urban Transport Department of Ministry of Railway Transportation (MORT) that make a decision on the planning regarding YUTA and ensure the budget for YUTA, etc.

5 Project Cost and Evaluation

Project Cost

The total amount of all proposed projects' cost is about 24.8 billion USD as of 2013. It includes the cost that private sector can pay in Public Private Partnership (PPP) scheme. Thus, the cost to the Myanmar Government is estimated to about 16.3 billion USD or about 2/3 of the total amount as shown in Table 5.1.

On the other hand, the cost does not include their original maintenance cost such as required investment to infrastructures in local areas or the cost of rolling stocks. Assumed that those cost accounts for 60% of the transport sector's budget, the Myanmar Government can bear only 60 to 80 % of the cost of Master Plan. (See Table 5.2)

For this reason, the Myanmar government needs to find a new source of revenue aggressively. The most potential fund sources is surplus revenues from on-/off-street parking operation and urban expressways, and profit of TOD together with effective use of unused government lands, and traffic impact assessment fees.

Project Evaluation

Economic Evaluation： The range of EIRRs for the BRT projects were high, 15% to 31%. Railway projects also recorded enough level of EIRRs, which were 13-19% for Yangon Circular Railways projects, 12-13% for UMRT projects, 15% over for the suburban line projects. Quite high EIRRs were recorded for many of road development projects, and the overall EIRR of this sector was 27%. Especially, the EIRRs of a new bridge construction project and improvement of arterial road project were higher than 30%.

Environmental Evaluation：Among the five project types (Road, BRT, Bus, Railway and Traffic Management), railway and traffic management projects have higher scores, while road projects are lower scores. This is mostly due to contribution of lower scores by criteria of air pollution and global warming, which are lower values of rating for road project.

Table 5.1 Investment Requirement for Major Master Plan Projects

Sector	Category	Estimated Cost (USD Mill.)			Cost to Government (USD Mill.)			
		Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035	% to Capital	Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035
Public Transport	MR Lines Upgrading and Capacity Development	629	1,874	2,778	100	629	1,874	2,778
	UMRT Development	0	2,253	3,423	100	0	2,253	3,423
	TOD/Depot Relocation	4,026	2,684	0	0	0	0	0
	BRT Development	472	0	0	55	212	0	0
	Bus Transport	108	0	0	-	78	0	0
	Sub-Total	**5,235**	**6,811**	**6,201**	**-**	**919**	**4,127**	**6,201**
Road	Arterial Roads and Bridges	253	1,516	1,049	100	253	1,516	1,049
	Expressways	0	1,591	1,700	30	0	477	510
	Traffic Control/ITS, etc.	33	26	26	-	15	26	26
	Sub-Total	**286**	**3,133**	**2,776**	**-**	**268**	**2,019**	**1,585**
Traffic Management	Congestion Management	157	0	0	-	17	0	0
	Traffic Safety	22	0	0	-	20	0	0
	Sub-Total	**179**	**0**	**0**	**-**	**37**	**0**	**0**
Freight Transport	Truck Terminal	0	150	0		0	150	0
	Sub-Total	**0**	**150**	**0**	**-**	**0**	**150**	**0**
TOTAL		**5,700**	**10,094**	**8,977**	**-**	**1,224**	**6,296**	**7,786**

Source: YUTRA Project Team

Table 5.2 Investment Requirement vs. Fund Availability

Item	Amount (USD Bill.)			
	Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035	Total for MP Period
(1) Investment Requirement for Master Plan (Cost to Government)	**1.2**	**6.3**	**7.8**	**15.3**
(2) Budget Envelope (Low-High Case)				
a. Transport Sector Total	2.6-2.7	7.7-8.7	16.3-21.3	26.5-32.7
b. 40% of Transport Sector Total (excluding cost for maintenance, secondary road and other local transport facility development, and vehicles, etc.)	**1.05-1.10**	**3.1-3.5**	**6.5-8.5**	**10.6-13.1**

Source: YUTRA Project Team

6 RECOMMENDATIONS

1) Authorize and get this master plan approved by the concerned agencies of both Union and Region government, and disseminate its contents to all stakeholders.

2) Setup Yangon Urban Transport Authority (YUTA) to make decisions on various transport projects. Allocate implementation responsibilities by project clearly to government agencies. The proposed YUTA will oversee and monitor the implementation of these projects. The establishment of YUTA is crucial for Yangon to have the basis to absorb various types of technical and financial assistance from

donor organizations.

3) Raise funding capability of the government by seeking various additional revenue sources and optimising current revenue sources under the institutional arrangements of the government. The most feasible fund source seems to exist in the TOD (Transit Oriented Development). Since the Government has a number of vast unused land lots in strategic places in Yangon, this could be a good seed for launching “urban cum transport” development projects where cross-subsidy can be expected from urban development (business/commercial/residential) to public transport development. Some of other initiatives that could be expanded further in Yangon could include the revenue from the proposed parking development and restriction.

4) Take necessary actions as soon as possible to launch the short-term projects proposed in the master plan. Particularly for those projects that needs feasibility study or prior coordination among relevant organizations, initiatives from the Myanmar government to donor or other related organizations should be exerted immediately.

5) Regarding the proposed BRTs, future patronage will change depending on the development progress of the proposed UMRTs or MR lines. In this case, the affected BRT should adjust its operation. Its disused road space could be reconverted to carriageway for other vehicles, or more preferably, the space could be converted to green promenade for pedestrians and cyclists taking into account the future vision of Yangon.

6) In this master plan, the toll rate for expressway was assumed to be the same as the current level of Yangon-Mandalay expressway, and the fare of Myanmar Railway lines, UMRTs and BRTs was set at the current level as well. Although the rate was assumed to increase in the future in proportion to per capita GDP, it is still very low compared to the international level and the level cannot be raised easily due to the sensitive elasticity of demand against toll/fare rate. This is one of the reasons of the poor financial performance revealed in Section 6.3 of this report. Considering the promotion of private sector participation and the possible magnitude of public subsidy, however, the toll/fare rate should be carefully looked into in the feasibility study.

7) This master plan assumes that “normal” situation will continue for a long period of time (20 years or more). If abnormal situation occurs, such as long financial panic and war, this master plan cannot be used and will lose its validity. On the contrary, this master plan could be updated periodically if normal situation continues and a series of traffic surveys are conducted again (except for the person-trip survey, in principle). The conclusion and methodology of the master plan could be handed over to the future with periodical updating (basically every 5 years).

1 INTRODUCTION

1.1 Study Background and Objectives

Yangon City, with a population of about 5.1 million as of 2011, is the largest economic center of the nation, and experiences rapid urbanization and motorization as the nation's economic growth. The current rapid urbanization and motorization put more and more pressure on the existing transport infrastructure in Yangon City and its surrounding areas. The deteriorating urban transport situation has become a serious concern socially, politically and environmentally.

Under these circumstances, JICA conducted a fact-finding survey in March 2012 and reviewed present conditions of Yangon city and its surrounding areas. This survey suggested the need of a comprehensive urban development plan of the Greater Yangon, which covers not only Yangon City but also adjoining townships affected by the current urbanization. Based on this finding, Yangon Region Government and JICA agreed to launch a project named "The Greater Yangon Urban Development Programme" in May 2012. Under the framework of this Programme, "The project for Strategic Urban Development Plan of the Greater Yangon (SUDP)" started in August 2012 focusing mainly on the urban development and land use aspects of the Yangon City. As the next step following this project, Yangon Region Government and JICA agreed in September 2012 to start this project named "The Project for Comprehensive Urban Transport Plan of the Greater Yangon (YUTRA)" to prepare a comprehensive urban transport plan in line with the above-mentioned strategic urban development plan, so as to provide efficient, safe, comfortable and environmentally friendly transport services to the people in the Greater Yangon, in order to contribute to its balanced, inclusive and sustainable growth.

1.2 Study Objectives

The objective of this project is to ensure mobility and accessibility to urban services for the Greater Yangon's people and society by an efficient and sustainable public transport system and road network. For this objective, this project aims to formulate an urban transport master plan for Greater Yangon up to the year 2035 (the long-term target year of "The Project for the Strategic Urban Development plan of the Greater Yangon" was 2040, but its project identification was up to 2035) as well as to conduct pre-feasibility studies for identified priority projects. Capacity development for Myanmar counterpart staff was done during the course of the project.

The outputs of the Project are:

(1) A comprehensive urban transport plan of the Greater Yangon, which includes a long term plan until 2035, a mid-term plan until 2025, and a short-term action plan until 2018;

(2) Pre-Feasibility Study for the prioritized project;

(3) Lessons from implementation of the pilot project;

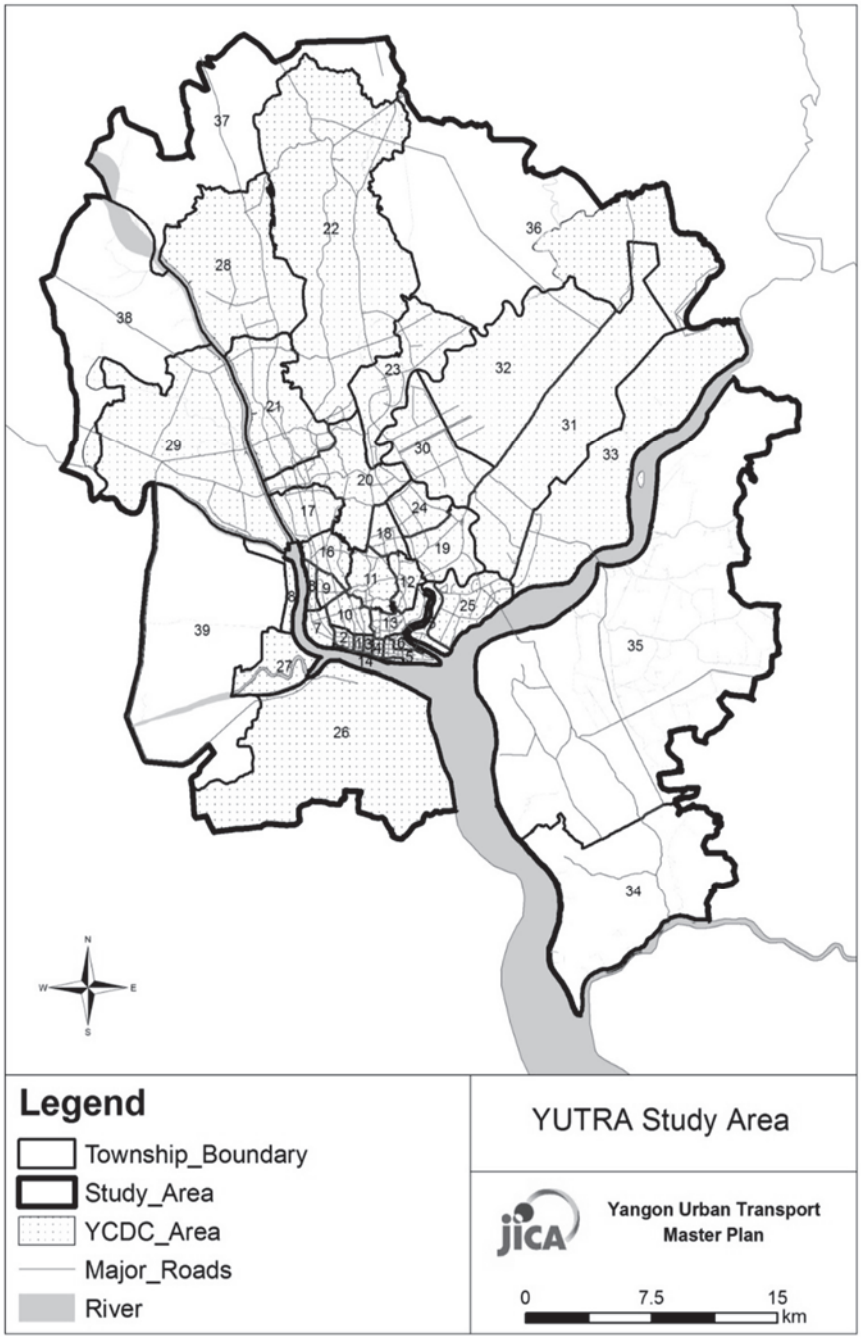
(4) Technology transfer to Myanmar counterparts through the Project;

In this Project, the prioritized project mentioned above was "The Feasibility Study for the Project for Construction of New Thaketa Bridge". This was selected from the short-term

projects identified by SUDP due to its urgent needs for reconstruction of the obsolete bridge. The pilot project was identified as intersection improvement at the “8-mile Intersection”. This location was selected from a number of congested intersections after traffic surveys and analyses.

1.3 Study Area

The target site of the Project is the Greater Yangon including Yangon City and a part of adjacent six townships (Thalyin, Hmawbi, Helgu, Htantabin, Twantay and Kyauktan). The total area is about 1,500 km^2 and the total population is about 5.7 million as of 2013. The Study Area is presented in Figure 1.3.1.

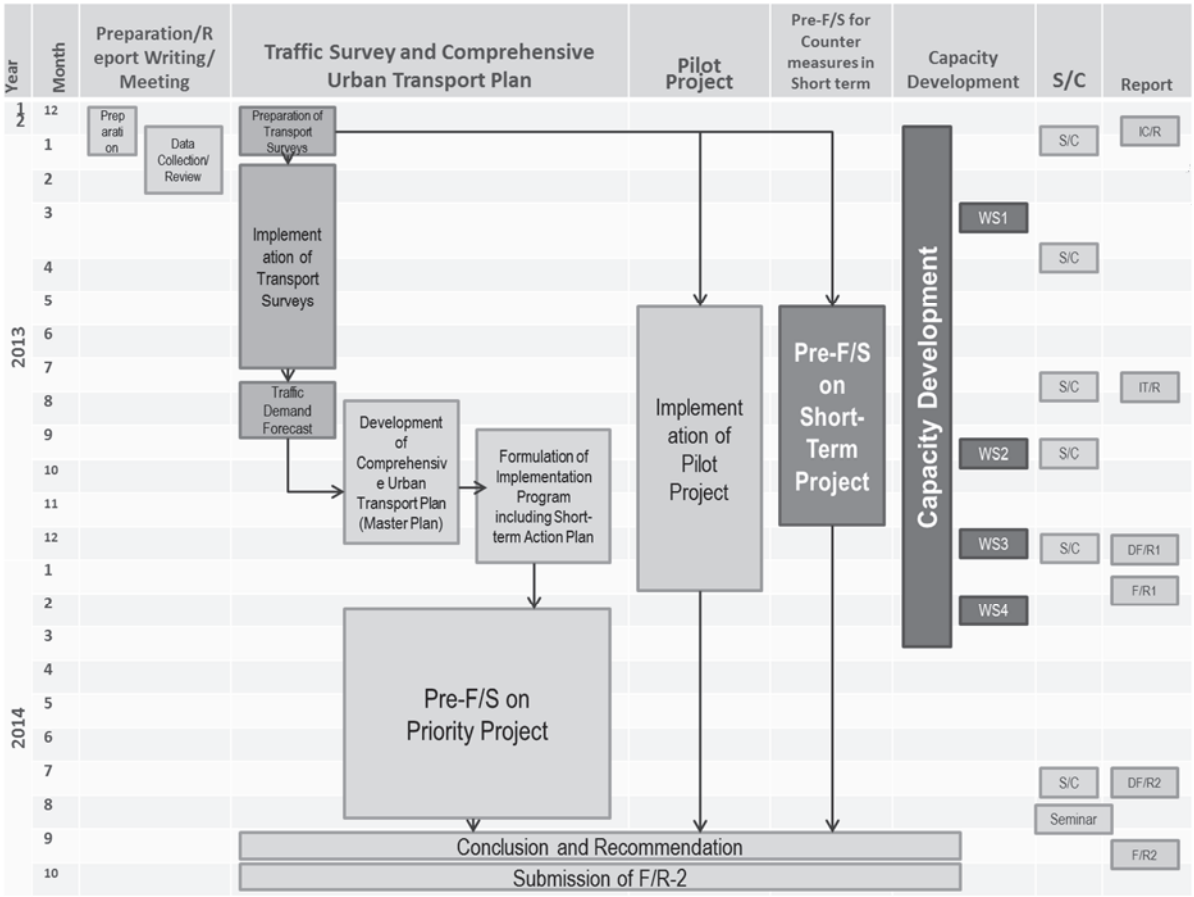


Source: YUTRA Project Team

Figure 1.3.1 YUTRA Study Area

1.4 Study Schedule & Framework

The overall project framework is shown in Figure 1.4.1.



Note: S/C: Steering Committee. IC/R: Inception Report. IT/R: Interim Report. DF/R: Draft Final Report. F/R: Final Report. WS: Workshop. F/S: Feasibility Study.
Source: YUTRA Project Team

Figure 1.4.1 Project Framework

This is the final report of YUTRA covering the urban transport master plan for the Greater Yangon. YUTRA will further continue up to October 2014 for the pre-feasibility study identified as the priority project.

1.5 Composition of YUTRA Reports

The entire YUTRA Final Report I is composed of the following.

(i) Summary;

(ii) Volume I: main text of Urban Transport Master plan for Greater Yangon

(iii) Volume II: covering traffic surveys, transport demand forecast, environmental and social considerations, capacity development, pilot project, and transport database.

Note that for “The Feasibility Study for the Project for Construction of New Thaketa Bridge”, a separate report will be prepared.

1.6 Project Organization

Figure 1.6.1 presents the project organization of YUTRA. The Joint Project Team is a combination of Myanmar Working Group (counterpart staff) and JICA Project Team.

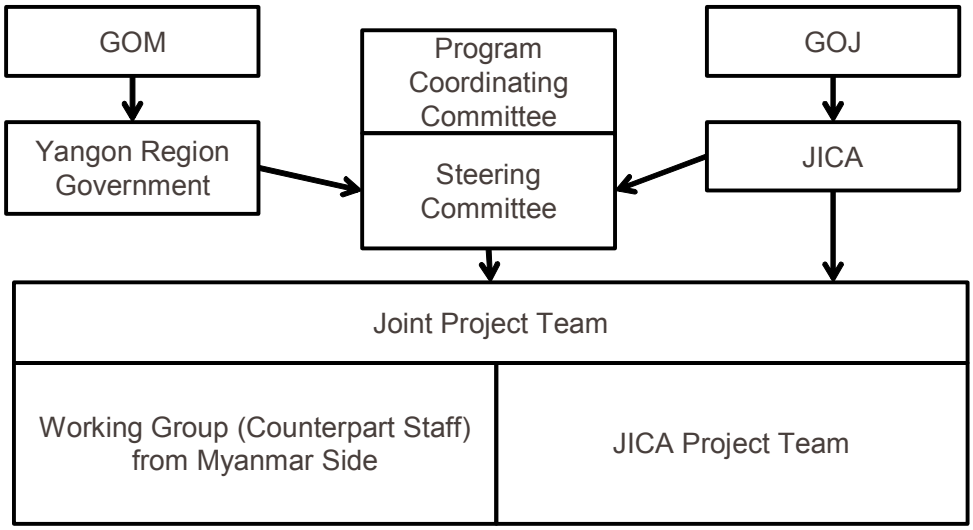


Figure 1.6.1 Project Organization of YUTRA

2 CURRENT TRANSPORT SITUATION, PROBLEMS AND ISSUES

2.1 General

Urban growth is mainly observed on the north direction from the CBD because Yangon is surrounded by the river on three sides until 1980s, but after 1990s, the urbanization is extended to east-west axis also. Industrial area has been mixed in the residential area, but they have been relocated to the east and north, and west of the Hlaing River after 1990s.

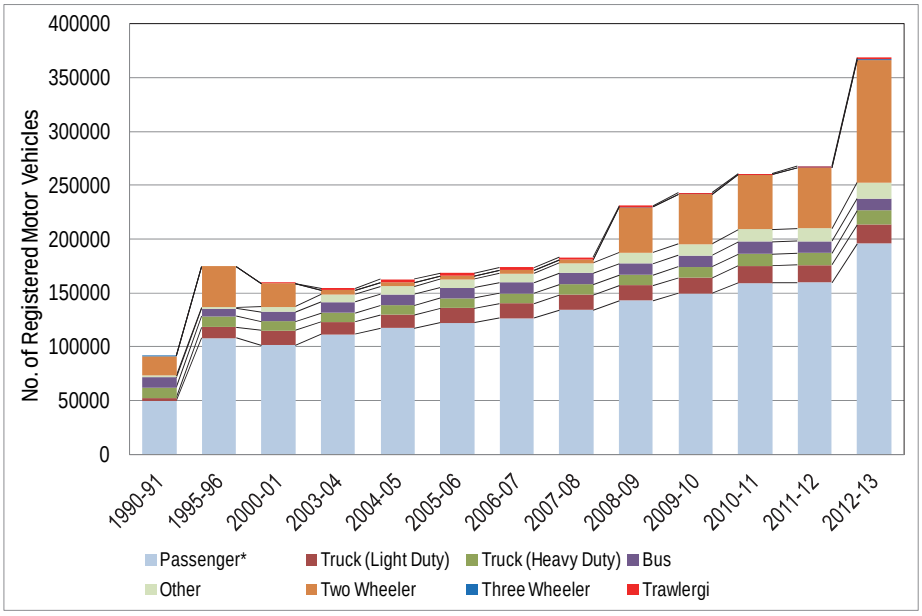
Population in YCDC is 5.1 million and average annual growth rate in YCDC is 2.6%. Population density in the CBD is very high, 36,500 persons/km2. About half of the residents is working (Refer to Table 2.1.1)

Table 2.1.1 Implementation Schedule of Public Transport Projects

Township	Population			Density (000 pers./ km2)	Area (km2)	No. of Workers	
	1998	2011	Annual Growth '98-'11			Total Workers	% to Total Pop.
CBD	255,685	252,391	-0.10%	36.5	6.9	118,297	46.9%
Inner City	689,081	778,156	0.94%	15.7	49.4	559,800	71.9%
Outer City	598,436	596,426	-0.03%	17.4	34.2	265,464	44.5%
Old Suburb	1,386,581	1,803,129	2.31%	5.2	345.1	1,048,538	58.2%
New Suburb	687,098	1,642,030	6.93%	4.1	404.9	575735	35.1%
YCDC Total	3,691,941	5,142,128	2.58%	6.2	829.0	2,611,977	50.8%
Periphery Total	N.A.	430,114	-	0.6	706.8	N.A.	-
Study Area Total	N.A.	5,572,242	-	3.6	1,534.9	N.A.	-

Source: SUDP, JICA (2013)

So far, since the per capita GDP is still low and import of foreign cars has been regulated by the government, car ownership rate in Myanmar, has been kept low. However, to facilitate the renewing of the old vehicle, deregulation is performed from September 2011. Then, new vehicle registration is rapidly increasing in Yangon (refer to Figure 2.1.1).



Source: Road Transport Administration Department, As of July 4, 2013

Figure 2.1.1 Registered Motor Vehicles by Type in Yangon Region

2.2 Main Transport Components

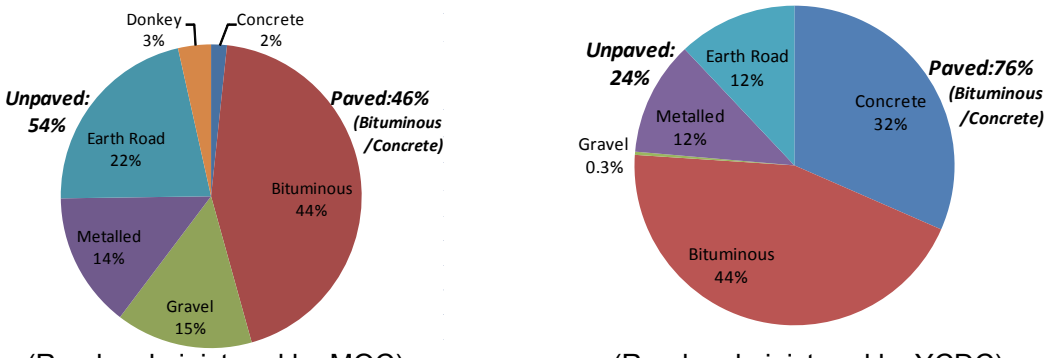
1) Road

Current Road Network

The Greater Yangon is connected with the neighbouring countries of GMS (The Greater Mekong Subregion) and BIMSTEC (Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation) through the Asian Highways (AH). Besides, the Yangon-Naypyitaw-Mandalay Expressway (586.2 km) became open in 2009, with 2 lanes per direction (total four (4) lanes) and the speed limit is at 100 km/hour. At present, no heavy trucks are allowed to use the expressway.

Road Length and Surface Conditions

Total road length in Myanmar is 148,690 km. In Yangon region, road length under MOC is 980 km, and under YCDC is 3,928 km. Figure 2.2.1 show the road length in Myanmar by responsible authority and by type of road surface. 54% of roads under control of MOC are still unpaved. On the other hand, 76% of roads under control of YCDC is paved.



(Roads administered by MOC) (Roads administered by YCDC)

Source: YUTRA Project Team, Department of Public Works, MOC, reported in 2012

Figure 2.2.1 Surface Condition of Roads under MOC and YCDC

2) Railway

Current Railway Network

Myanmar has total 5,878.16km railway network currently. Regarding the Study area, the network is composed of 8 lines (148.3km, 80 stations), which are 3 main lines (total 95.9km of Yangon Circular Railway, and urban sections of Yangon-Mandalay Main Line and Yangon-Pyay Main Line) and 5 branch lines (52.4km) including 1 exclusively freight line (9.9km). All three main lines except a part of Yangon-Pyay Main Line (86.3km) are double-tracked. All branch lines are in single track. No lines are electrified.

All railway operation and management in Myanmar is conducted by Myanmar Railways (MR) which is under the umbrella of Ministry of Rail Transportation (MORT). Railway in the Study area is controlled by Division 7 in Lower Myanmar Administration of MR.

The average daily passenger number of Yangon Circular Railway and the Suburban Lines is 90,620 pax/day in FY2011 and the daily number of operated train in the lines is 200

trains/day. The fare for Yangon Circular Railway and the Suburban Lines is 100Kyat (approx. USD 0.1) for 2 riding ticket bought at ticket window at getting-on station. The fares was raised 20 Kyats into 100 kyats at November, 2011.

Main Issues

The current MR lines in the Study area is in poor operation service and low transport capacity due to deteriorated infrastructures and lack of maintenance, etc., although there is some demand that people want to use railway more. The maximum speed is approximately 25 to 30km/hr even comparatively well maintained sections (Yangon-Mandalay Main Line and Yangon-Pyay Main Line) in the Study area. Branch lines are in poor condition and the speed is quite slow with approximately 5 – 10km/hr.

The peak hour is 7:00 to 9:00 in the morning (peak ratio: 11%) and 17:00 to 18:00 in the evening (peak ratio: 17%). Four trains/hour (15 minutes interval) are operated in the peak hour. 42% and 36% of railway passengers use railway for returning home and for working respectively. Main means to access station is walking (72% of all) due to poor feeder service. It is required to conduct continuous urban railway development including feeder service enhancement.

3) Traffic Management and Safety

Current Traffic Situation

Traffic situation in the urban area in Yangon has deteriorated due to the rapid motorization and insufficient signal operation among others. Cause of the congestion in CBD is more complex including on-street parking, illegal parking, street vendors, too many buses on duplicated bus lines, disordered bus parallel-parking queues which sometimes occupy even two lanes around the major bus stops, in addition to the rapid motorization and insufficient signal operation. On the other hand, in the outside of CBD, chaotic traffic situation can be observed in major intersections due to the concentrated traffic flows on the limited road network as well as insufficient signal operation.

Usage of Two-wheel vehicles is prohibited in the urban area, and NMV (non-motorized vehicle) are limited to the CBD, and truck routes are designated to mitigate traffic congestions in the urban areas. However, strict vehicle import regulation was eased in 2011 so that number of motorcars has increased rapidly in these days.

Main Issues

Lack of off-street public parking causes demand of on-street parking increase particularly in CBD and major commercial area outside of CBD. Moreover many of vehicle owners do not have sufficient space for their garage, thus they have no choice to park on the street.

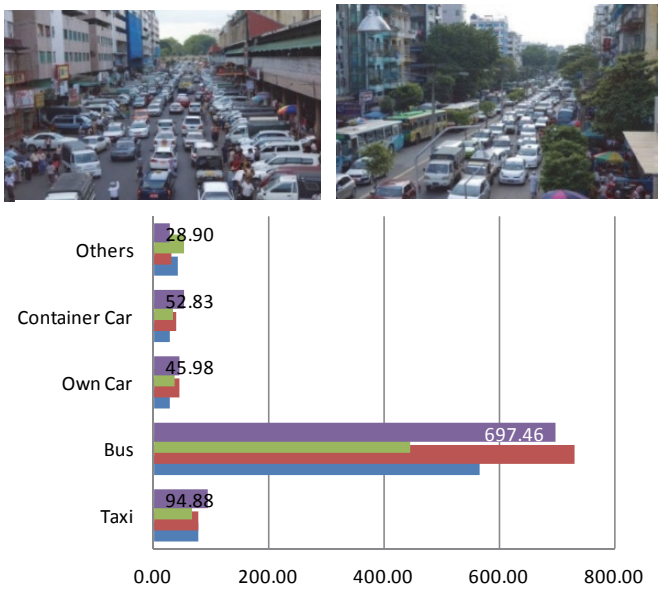
Traffic accident has been a social issue in Yangon. The number of total accident generally increased from 2008. Many accidents mainly involved buses and pedestrians. Particularly, accident related to buses per 10,000 vehicles shows an extremely high number (i.e., 697.5 in 2011) due to their operation system to pick up/drop passengers on the road side, fast driving speed and overloading passenger, etc. Traffic accidents in suburban area are involving two wheel vehicles mainly lack of safety consciousness of the drivers.

Traffic signal is installed at the most major intersections but as mentioned above the

function is outdated. While pavement marking and road sings are almost properly installed, the rainy season lasting for a long period and insufficient street sweeping deteriorate pavement marking, which difficult to mention it is well-maintained condition. Safe crossing with pedestrian signal or pedestrian bridge are very limited forcing people to cross in the gaps of busy traffic flows with high accident risk.

Source: YUTRA Project Team

Figure 2.2.2 Congested Intersections and Road Section



Source: YUTRA Project Team based on the data from Traffic Police

Figure 2.2.3 No. of Injured Accidents per 10,000 vehicles

4) Public Transport Services

Existing Situations

Buses can be considered as the main workhorse of public transportation in Yangon Region. Within Yangon City limits, it is illegal to drive trishaws, bicycles, and motorcycles. The bus transport, therefore, would continue to remain as the main mode of public transportation despite the facts that its level of service is not very satisfactory.

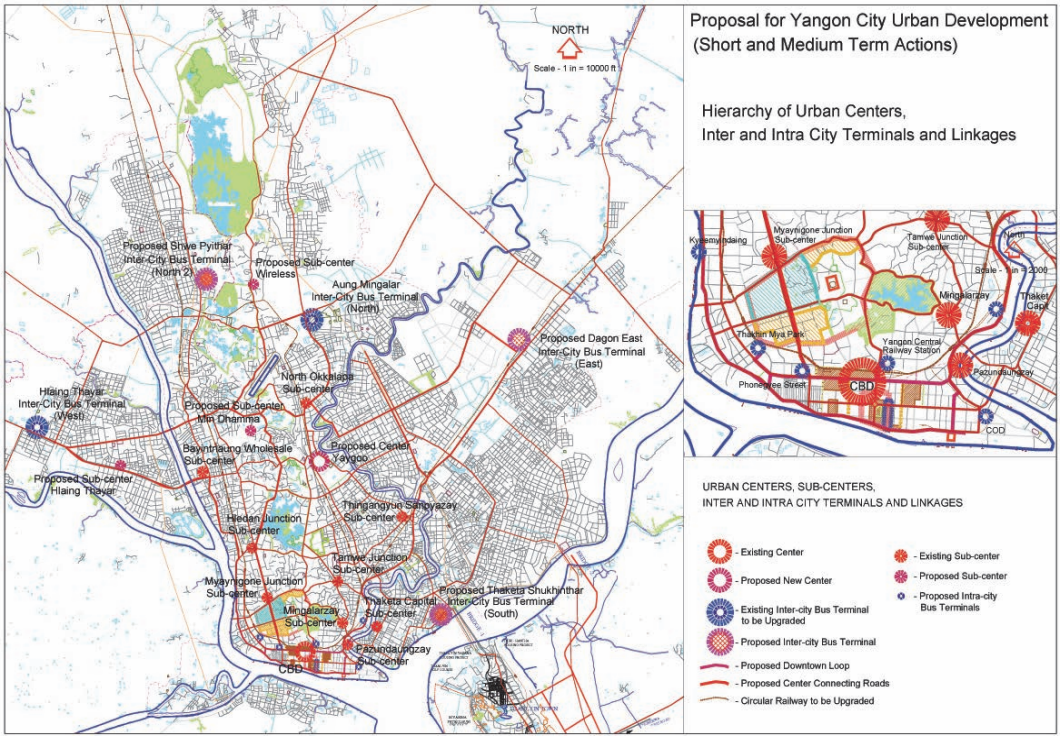
Currently bus services are provided through a multiplicity of mechanisms by a mix of public and private sector operators. Generally, it can be categorized as 3 main groups in the provision of bus services in Yangon Region. These are:

- Private bus companies: The private bus companies are large-scale bus operators who provide bus services with their own vehicles, drivers and conductors. At present, there are two private bus companies in Yangon.
- Individual private bus owners managed by Bus Supervisory Committees (BSC): BSCs are non-government organizations. The committees do not engage themselves in any bus service supply of their own vehicles rather they monitor and supervise bus operation and individual bus operators. They employ dispatchers, route supervisory staff and office staff. Their revenue comes mainly from the commission fee paid by

individual bus operators. Currently there are six BSCs in Yangon Region.

- Bus Line Committees (BLC): BLCs are also non-government organizations and similar function with Bus Supervisory Committees. There are 10 bus lines committees in Yangon Region. There are total 18 BLCs and all are under the supervision of Yangon Region Central Supervisory Committee for Motor Vehicles and Vessels (locally known as Ma-hta-tha-Central).

Figure 2.2.4 shows existing and proposed bus terminal planned by DHSHD, MOC. The location of proposed bus terminals is considered connection with future ring road. The connection with railway network is also important. Detailed plan with a view to railway network planned by YUTRA is required.



Source: DHSHD

Figure 2.2.4 Existing and Proposed Bus Terminals

Main Issues

Even though bus transport has a predominant share in people's travel, levels of service are not sufficient enough in terms of reliability of operation, comfort and safety. And bus related facilities such as bus stop shelter, and seating facilities are also in poor conditions. Nearly half of the commuters stated long waiting time and on-board crowding (SUDP, JICA, 2012).

Bus fare level is strictly regulated by the Yangon Region Government. The present bus fare in Yangon is at lower levels for benefit of people. However, bus operators must follow this government policy. Consequently, in order to maximize revenue from bus operation, uncomfortable, unreliable and unsafe travel is resulted.

A poorly planned system results in bus route overlapping; add to traffic congestion as well as on-road competition among the operators. The supply of buses does not keep up with

demand which leads to overcrowded on buses because of poor management of the fleets, lower maintenance standard, vehicle wear out due to poor road condition, lack of supply of spare parts and inadequate funds are available for fleet replacement.

5) Water Transport

Current Conditions

The main navigable inland waterways in Myanmar are composed of Ayeyarwady, Chindwin, Kaladan and Thanlwin systems, and these total network distance is 6,650 km. There are seven main inland waterway routes in the Study Area, namely Yangon River, Bago River, Hlaing River, Panhlaing River, Twante Canal, Pazundaung Creek and Khanaungto Creek. Inland waterway is the most fundamental transport mode in Myanmar.

IWT operates passenger ferry boats to/from CBD in the Yangon and plies five ferry routes, of which Pansodan Jetty-Dala Port Jetty Route is the main line to cross the Yangon River, and around 30,000 passengers (one-way) use ferry boats daily. The Study Team conducted passenger OD survey to obtain the number of ferry and small boat passengers across rivers and the trip information. As a result of OD survey, around 66,000 persons a day (one-way) use ferry or small boat, of which around 41,000 persons travel between Siekkan Township and Dala Township.

Issues

Water transport has following issues, and urgent measures or master plan to be solved is required, 1) Plying ships are generally inferior, improper hull form and without proper safety equipment, 2) Navigational facilities are inadequate, and 3) Jetty is decrepit due to inadequate maintenance. In line with the increase in traffic volume, bridges across main rivers will be constructed in the future. Water bus/taxi connecting with waterfront development areas, river cruising for sightseeing and prosperous cargo transport in Ayeyarwady Water System is expected in the future.

6) Goods Transport

Current Conditions

Routes (roads) for container trailers, log trucks and heavy trucks are designated by the Yangon Region Government. Many of trucks take Aung Zaya Bridge because it is more close and convenient to access to the industrial park located in the west bank of Yangon River. The trucks access to Tanlyin and Thilawa take mainly Dagon Bridge. Originally Tanlyin Bridge is developed for the rail access and Dagon Bridge is used as function of truck route. Highway No.3 is used for the trucks going to Bago direction. On the other hand, passenger cars and busses are taking Highway No.1 (Pyay Road) to access to Expressway and roads to Bago Direction.

Major freight-related traffic generators in the study area include industrial zones, commercial centres, traditional markets, ports, inland container depots (ICD), truck terminals and freight rail stations. Cargo throughput and traffic movement are analysed based on the statistics and direct interviews.

Main Issues

Problem and planning issue for major freight generators in the study area are summarized in Table 2.2.1 from the viewpoint of its traffic impact on the road network and the

surrounding land use.

Table 2.2.1 Traffic Impact assessment of Major Freight Generator

Activity Type	Assessment
Industrial Zones	Major cargo movement is observed between AWP and the Hlaing Tharyar industrial area. The traffic volume between the two areas may not be so significant according to the statistics from Myanmar Port Authority.
Commercial Centres	The number of large-scale commercial centres is very limited as of today. Some areas such as New Junction Square and Dagon Centre area (Myaynigone intersection) are congested by various traffic including buses, private cars, pedestrians, etc. A special traffic study is recommended for such particular congestion areas. There are several large-scale urban regeneration project proposals. It is recommended to conduct a comprehensive traffic impact assessment study on such proposals.
Traditional Markets	The number of traditional market is rather large, but their impacts in terms of traffic have not been identified as yet. It is recommended to carry out a traffic generation survey on some selected (sampled) traditional markets to understand their service coverage and access modes of transport.
Container to/from Ports / ICD in Yangon	About 380 thousand TEU of containers was handled at the ports in Yangon in 2011. Assuming all the container cargo are 20ft and carried by one container trailer, this figure is roughly translated into an average of 1,000 container truck traffic per day. Actually this figure is not so significant in terms of traffic volume, but the existing number of container truck heads might be not enough for efficient cargo movement in Yangon. Actually the number of containers carried by Container Trucks Association is less than 400 units per day in average.
YCDC Truck Terminal	About 1,000 truck long-distance traffic (general cargo) is generated to/from the YCDC truck terminal near Bayint Naung bridge. This amount of traffic is not so significant in terms of traffic impact to the surrounding roads. However, the roads to the terminal (Bayint Naung road and bridge) look congested. One of the reasons could be “aged truck vehicles” of which performance is very low (low speed, etc.). Another reason might be “mixed traffic” of various types of vehicles including trucks, truck trailers, pick-up trucks, buses, cars, and non-motorised modes of transport.
Freight Rail Station	The largest cargo handling station is Sat San station which handles about 700t of general cargo per day. Assuming all of this cargo is transported by medium truck (5t), the number of truck traffic is estimated 140 trips per day. This figure is quite small in terms of traffic impact to the surrounding roads.

Source: YUTRA Project Team (2013)

7) National Transport

Current conditions

The study area is the main base of domestic transport network as well as the international gateway. Major national transport system located in Yangon is: Yangon ports, Yangon International Airport, Hanthawady International Airport (out of the Study Area), Yangon Central Station, highway bus/truck terminal and Yangon-Madalay Expressway.

Planning Issues

In the Study Area, there are some projects which are to be developed as part of national transport system in terms of budget allocation. Corresponding planning issues are summarized in Table 2.2.2.

Table 2.2.2 Planning Issues on Implication with national Transport

Issues	Preliminary consideration
Increased handling capacity of the existing Yangon Ports	The existing container cargo handling volume at the existing Yangon ports is about 400,000 TEU per year, which will be increased slightly by the on-going port expansion projects. Accordingly container cargo traffic will increase, but its traffic impact may not be so significant in comparison with the current situation. However, it can be said that accessibility between from Hlaing Thayar industrial area and the ports needs to be improved as far as the ports exists as they are.
Regeneration of the existing ports	Sule Pagoda Wharves (SPW) in located at the one of the prime area of Yangon in terms of future regeneration. Relocation of the Sule Pagoda Whraves can be considered for more sophisticated use of the riverfront area.
Traffic generation to / from new ports (plots) in Thilawa area	Future movement pattern of cargo generated at the Thilawa area is unknown yet, however, through-traffic by heavy vehicles generated from the Thilawa area in downtown Yangon should be avoided by proper traffic management and provision of road facilities of higher standard with such heavy vehicles. More effective use of Dagon bridge and corresponding road improvement should be considered.
Regeneration of Yangon International Airport	Use of the existing Yangon International Airport area after completion of the Hanthawady International Airport is unkown. In a long-term perspective, several scenarios with regard to the regeneration of the YIA area and corresponding urban transport facilities needs to be considered.
Access to/from Hanthawaddy International Airport	There are no concrete project proposals with regard to the access development to the Hanthawady International Airport (HIA). A rail access between Yangon and HIA and a spur line from the expressway can be considered to serve the new international airport (See Figure 2.2.7.1).
Regeneration of Yangon station area	Investors will be invited to propose ideas of regeneration of the Yangon station area shortly according to Myanma Railway(MR), aiming at maximum utilization of the existing asset of MR. No concrete information about requirements of this project is available as of July 2013 (the JICA study team has not been informed). Regeneration of the Yangon station area requires high level planning work before actual design work, including improvement of MR main line, Circular rail line, track layout of the station, station building, accessibility to the station (from south), utilities, etc. It is highly recommended to make a comprehensive planning study about the regeneration of the station area.
Extension of the Expressway	Accessibility between downtown Yangon and the expressway needs to be improved. And extension of the expressway to Thilawa area can be considered to encourage investment in SEZ .

Source: YUTRA Project Team (2013)

2.3 Transport Demand Characteristics

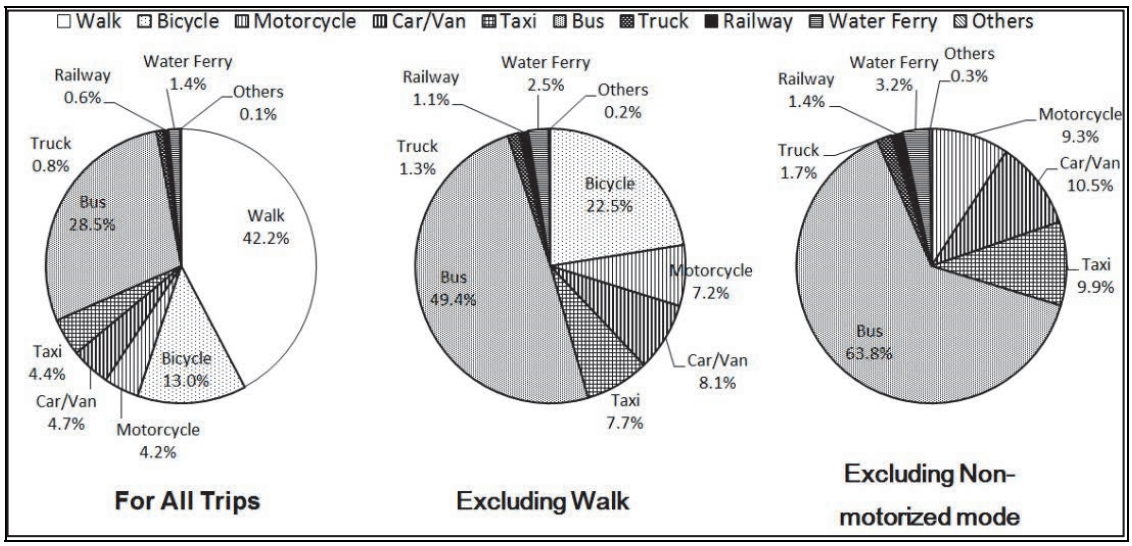
YUTRA conducted 11 traffic/ transportation surveys to grasp the traffic flow in the greater Yangon. The person trip survey, one of the surveys, targeted the travel dailies of 11,330 households in the study area. Approximately 11 million trips are made in weekday in 2013 as shown in Table 2.3.1. Walking accounts for relatively high ratio compared with the other modes, which is about 4.78 million trips or 42% of the total trips.

Modal shares is summarized in Figure 2.3.1. Excluding walking, bus has the largest share at 49.4 %, followed by bicycle (22.5 %), car/van (8.1%), taxi (7.7 %), motorcycle (7.2 %), etc. Rail accounts for only 1.1 %. The combined share of public transport (bus, taxi, railway and water ferry) is 60.7 % ("excluding walking").

Table 2.3.1 Number of Person Trips in the Study Area by Mode, 2013

Mode	Groups	The number of Trips (Trips /day)	Modal Share by Each Mode (%)			Modal Share by Group (%)		
			For all Trips	Excluding Walk	Excluding Non-Motorized Mode	For all Trips	Excluding Walk	Excluding Non-Motorized Mode
Walk	Walk	4,777,672	42.2	-	-	42.2	-	-
Bicycle	Bicycle	1,471,790	13.0	22.5	-	13.0	22.5	-
Motorcycle	Motorcycle	471,386	4.2	7.2	9.3	4.2	7.2	9.3
Car	Car/Van	440,759	3.9	6.7	8.7	4.7	8.1	10.5
Van		88,885	0.8	1.4	1.8			
Taxi	Taxi	501,689	4.4	7.7	9.9	4.4	7.7	9.9
Sc / Co Bus	Bus	603,674	5.3	9.2	11.9	28.5	49.4	63.8
Passenger Truck		390,923	3.5	6.0	7.7			
Small-Bus		377,662	3.3	5.8	7.5			
Large-Bus		1,856,273	16.4	28.4	36.7			
Pick-up	Truck	63,619	0.6	1.0	1.3	0.8	1.3	1.7
Medium-Truck		13,963	0.1	0.2	0.3			
Large-Truck		5,544	0.0	0.1	0.1			
Trailer		5,073	0.0	0.1	0.1			
Railway	Railway	71,215	0.6	1.1	1.4	0.6	1.1	1.4
Water Ferry	Water Ferry	160,200	1.4	2.5	3.2	1.4	2.5	3.2
Others	Others	12,858	0.1	0.2	0.3	0.1	0.2	0.3
Total		11,313,185	100	100	100	100	100	100

Source: YUTRA Person Trip Survey



Source: YUTRA Person Trip Survey

Figure 2.3.1 Modal Share, 2013

2.4 Environmental Conditions and Issues

In this chapter, environmental conditions and issues are summarized for 1) environmental policy and legislation and 2) social and natural environment. The descriptions in 2) are mostly based on the results of the Project for Strategic Urban Development programme (SUDP), JICA (2013).

1) Environmental Policy and Legislation

Laws and regulations relevant to urban transport environment

Major laws and regulations for transportation are the Road Transport and Inland Water Transport Law 1963 and Motor Vehicles Law 1964.

The Motor Vehicles Law 1963 covers the registration of motor vehicles, license of owning motor vehicles, insurance of motor vehicles, driving license, control of traffic speed, and offences and penalties for violation. In addition, Motor Vehicle Rules 1989 include registration of motor vehicles, vehicle maintenance, driving license, driving training school, terms and conditions of hired motor vehicles, and traffic rules for vehicles, pedestrians and cyclists. In addition, City of Yangon Development Law regulates usage of vehicles as well as construction and maintenance of roads and bridges. However, regulation of vehicle exhaust emissions and inspection system is not established until now.

Land acquisition and resettlement

According to the State Constitution (2008) the state is the ultimate owner of all lands. All private land tenure rights are essentially “usufruct”, which means that individuals and other entities may use land but cannot own it, and tenure rights vary depending on the type of land involved.

Definition of land are poorly defined in the legal framework and type of land can be classified into the following eleven categories; (i) Freehold Land, (ii) Grant Land, (iii) Agricultural Land, (iv) Garden Land, (v) Grazing Land, (vi) Cultivatable Land, Fallow Land and Waste Land, (vii) Forest Land, (viii) Town Land, (ix) Village Land, (x) Cantonment, and (xi) Monastery.

The Land Acquisition Act 1894 promulgated in the British Colonial Era is even now the core law for land acquisition and resettlement in Myanmar. The results of comparison between the JICA Guidelines/the World Bank’s safeguard policies and Myanmar legislation on land acquisition and involuntary resettlement indicate several gaps between them. For example, neither the avoidance and minimization of involuntary resettlement and loss of livelihood nor the requirement of preparation of Resettlement Action Plan is stated in any law. For the compensation only market value of the land is considered. No law is identified on the participation of project Affected Persons (PAPs) in public consultation in the land acquisition and resettlement procedures.

2) Social and Natural Environment

Land use

Urbanization tends to have expanded northwards and eastwards rather than southwards and westwards. As of 2012 the dominant land use type is agricultural area, which occupies about 51% of total area, followed by urbanized area, which consists of 22% of the built-up area and 9% of under-developing area.

The Protection of Wildlife, Wild Plants and Conservation of Natural Area Law was enacted in 1994. There are at present 40 protected areas in Myanmar including wildlife and bird sanctuaries, national parks, and nature reserves. Among them Hlawga Park is only one designated protected area and has an area of 2,342 ha which is managed strictly as Watershed Protection Forest in Greater Yangon.

Air pollution

Air pollution and noise are major concerns due to the increasing number of vehicles as well as the traffic congestion. The polluted level is unknown because no monitoring data on air pollution is available, but there is a high possibility of serious environmental issues caused by air pollution. Therefore, establishment of air quality monitoring system is urgently required as well as introduction of vehicle exhaust emission inspection system.

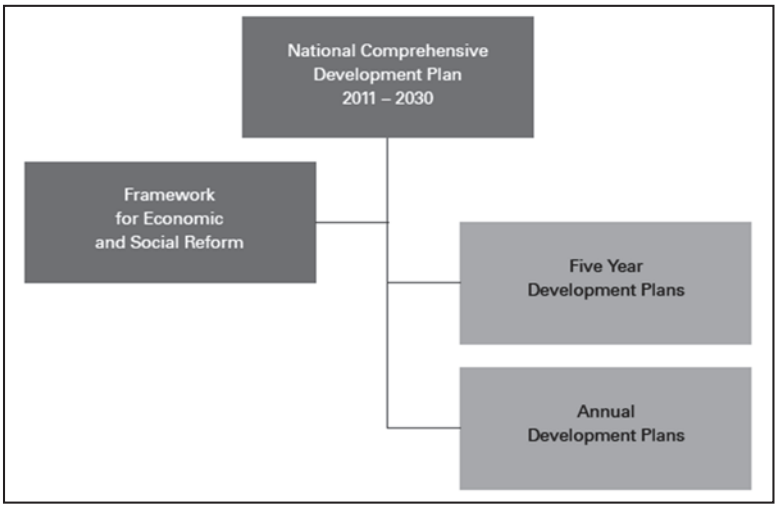
Solid waste problems

Numbers of scrapped vehicles are thought to be increasing, as the government introduced a program in 2011 to enable car owners to replace their old vehicles with newer models. Used vehicles and motor oils are typical industrial wastes relevant to urban transport, which are required of proper disposal and recycling for environmental conservation, although laws and regulations of industrial wastes are not established at present in Myanmar.

2.5 Public Sector Planning and Budgeting Systems

National Planning Framework

Figure 2.5.1 illustrates the National Planning Framework in Myanmar following the drafting of the Framework for Economic and Social Reforms, five-year National Plan from Fiscal Year 2011-2012 to 2015-2016, and envisaged long-term National Comprehensive Development Plan. Key institutions for national planning and budgeting are: National Parliament, Financial Commission, Planning Commission, National Economic and Social Advisory Council, Ministry of Finance and Ministry of National Planning and Economic Development, etc.



Source: Infrastructure in Myanmar, KPMG, 2013

Figure 2.5.1 Myanmar National Planning Framework

Financing of Transport Projects

Table 2.5.1 indicates the recent changes in financing indicators, including Gross Fixed Capital Formation (GFCF) in the transport sector (Column 5), proportion to the total national GFCF (Column 6). The double-digit ratios of Transport GFCF to total GFCF for FY2004/05 to FY2005/06 reflected the major construction works for the transfer of the capital to Nay Pyi Taw. Preliminary estimates based on the budget allocation under Union Budget Law FY2012-13 indicated that the ratio of Transport GFCF to Total GFCF could be between 8 to 10%, depending on the utilization of the capital.

Average investment levels on infrastructures and the transport sector in Myanmar were about 8% of GDP and 1% of GDP, respectively. This low investment ratio to GDP is comparable to the spending trends on road, railway and inland transport in advanced OECD countries at 0.85% of GDP, where transport capital assets had been well established for decades.

Table 2.5.1 Proportion of GFCF in the Transport Sector to Total

(Unit: MMK Billion)

Fiscal Year (0)	Nominal GDP (1)	Total Fixed Capital Formation (2)	Gov't Expenditure (3)	Gov't Capital Expenditure (4)	Fixed Capital Formation in the Transport Sector (5)	Transport to Total GFCF (5)/(2) (%)
2004-05	9,078.9	1,207.5	1,693.0	733.5	154.3	12.8
2005-06	12,286.8	1,867.6	2,353.9	906.5	269.3	14.4
2006-07	16,852.8	2,359.4	3,693.5	1,274.0	177.7	7.5
2007-08	23,336.1	3,710.4	4,901.5	1,890.0	255.9	6.9
2008-09	29,233.3	5,057.4	5,314.9	2,033.6	244.3	4.8
2009-10	33,894.0	7,151.6	6,260.6	2,840.8	381.7	5.3
2010-11	39,846.7	10,081.2	7,506.9	3,575.3	352.3	3.5

Source: Myanmar Statistical Yearbooks 2010 and 2011, Central Statistical Organization

2.6 Transport Sector Institutions and Administration

Overview

In light of the inauguration of the new Government in March 2011, institutional structure and administrative system in both central and regional governments have undertaken gradual reforms. Therefore, roles and responsibilities as well as coordination mechanism among the relevant agencies in the transport sector has not been clearly defined yet.

Currently, transport related responsibilities are shared between various ministries at union level as well as city development committees, and state-owned transport enterprises at regional level. Administrative organizations under the regional transport minister are not the organizations owned by the regional Government. They are acting as regional offices of the relevant union ministries. In fact, they are under double control, i.e. they have to get order from their own vertical administrative system, meanwhile they have to report to the regional minister.

Among the government agencies overseeing the transport sector, Ministry of Rail Transportation (MORT), Ministry of Transport (MOT), and Ministry of Construction (MOC) play pivotal roles.

Institutional and Administrative Issues

Recognizing that transport sector is under the responsibilities of several ministries and agencies of both central government and regional government, there is no single agency with clear oversight of the sector. Despite this multiplicity of agencies, the unclear and illogical division of responsibilities among them. The most essential points to note from institution and administrative system are as follows.

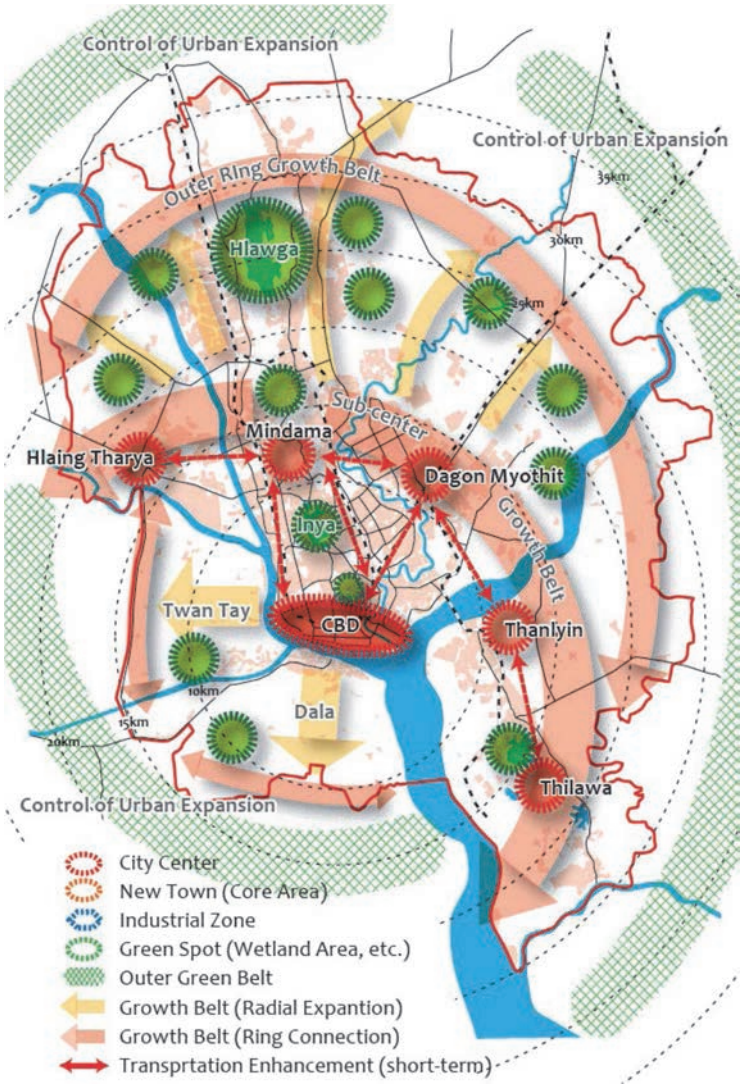
- Lack of clarity in defining roles and responsibilities for each ministry and other government agencies
- Lack of transparency and coordination among agencies in transport sector development and service delivery
- No clear lines of responsibility, for example, how do supervisory and reporting procedures take place between the government agencies
- No clear budgeting mechanisms
- Yangon Region Security and Smooth Transport Supervisory Committee and Yangon Region Traffic Rules Enforcement Supervisory Committee have been established. Nevertheless, it is not clear at what level this committee operates, or whether it meets regularly.
- Monopolistic control in some transport services, for example railway transportation
- Shortage of trained personnel able to fulfill the demands of government administration and operating the transport services due to Myanmar's long period of isolation since the 1980s and lack of international expertise, experience, and investment.

3 TRANSPORT DEMAND CONTEXT

3.1 Urban Development Scenario

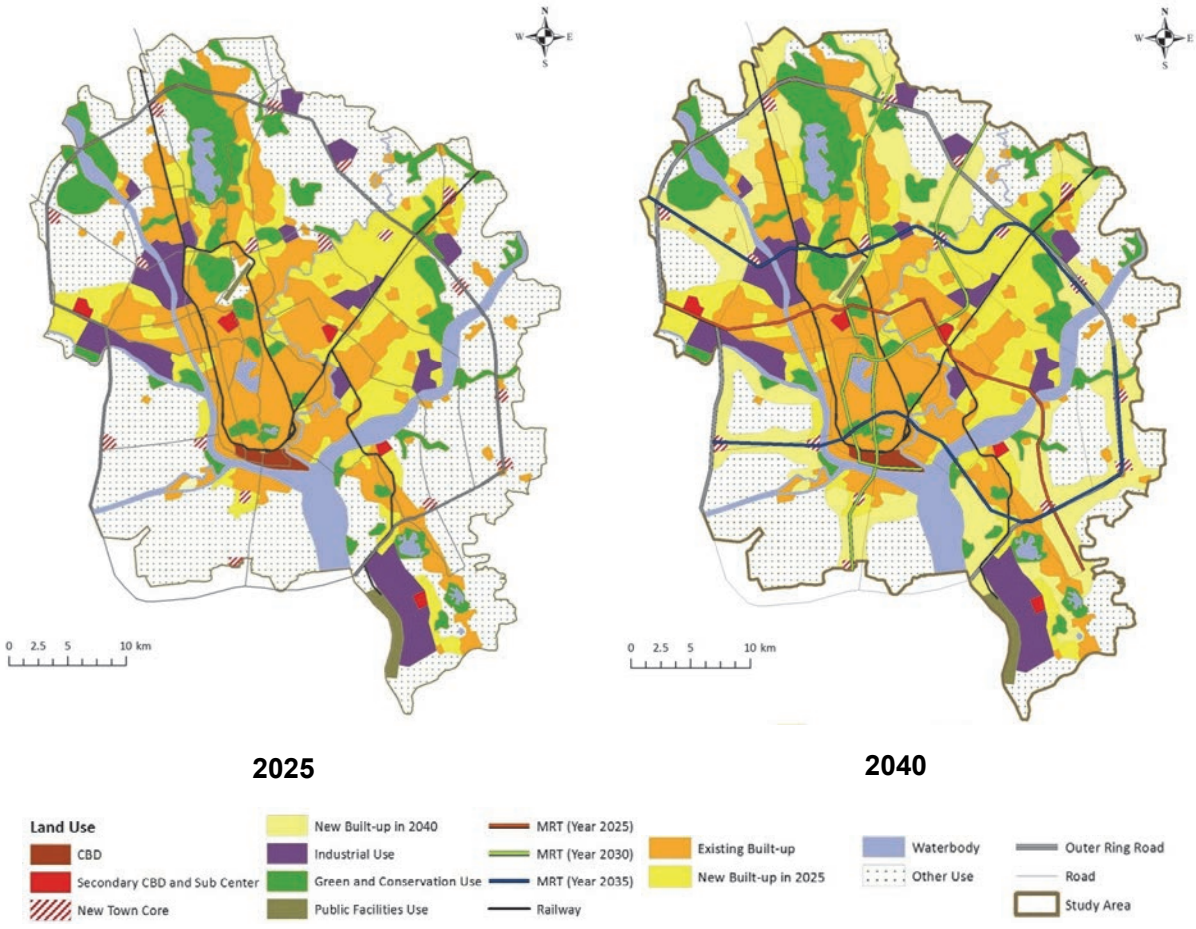
A master plan of urban development with the target year at 2040 was adopted by YCDC in January 2013. It was "The Project for the Strategic Urban Development Plan of the Greater Yangon" (SUDP) supported by JICA. This master plan defined the development vision of Greater Yangon which can be summarized into four main points: 1) international hub city; 2) comfortable city; 3) well-managed infrastructure city; and 4) city of good-governance.

SUDP defined the desirable urban structure as "Sub-center with Green Isle System (Decentralized Urban Pattern)". This urban structure aims at decentralization of the functions of urban center. A few sub-centers will be created at areas within 10-15 km radius from the CBD as presented in Figure 3.1.1. Future land use of mid-term (2025) and long-term (2040) was planned by SUDP on the basis of land suitability analyses as shown in Figure 3.1.2. YUTRA will follow the urban structure in SUDP.



Source: SUDP, JICA, 2013

Figure 3.1.1 Proposed Urban Structure of Greater Yangon, "Sub-center with Green Isle System"



Source: SUDP, JICA, 2013

Figure 3.1.2 Future Land Use Maps

3.2 Socio-Economic Framework and Future Transport Demand

Socio-economic Framework

Based on past trends, future land use planned by SUDP, national framework estimated by The Survey Program for the National Transportation Development Plan in the Republic of the Union of Myanmar (MYT-Plan, JICA, 2013) and a series of GIS analyses, future socio-economic framework was prepared by YUTRA. This covers the following indicators by traffic zone:

- Population (night-time and day-time)
- Employment by sector (night-time and day-time)
- No. of students (night-time and day-time)
- Household income
- Ratio of car-owning households

The following table summarizes the socio-economic framework for the Greater Yangon estimated by YUTRA.

Table 3.2.1 Summary Socio-economic Framework for Greater Yangon

			2013	2018	2025	2035	Annual Growth Rate			
							2013-2018	2018-2025	2025-2035	Average 2013-2035
Night-time Population ('000)	Workers	Primary	58	58	58	58	0.0%	0.0%	0.0%	0.0%
		Secondary	219	263	350	562	3.7%	4.2%	4.8%	4.4%
		Tertiary	2,263	2,601	3,214	4,470	2.8%	3.1%	3.4%	3.1%
		Total Workers	2,540	2,921	3,622	5,089	2.8%	3.1%	3.5%	3.2%
	Student at Residence		1,164	1,303	1,532	1,938	2.3%	2.3%	2.4%	2.3%
	Others		2,013	2,212	2,462	2,685	1.9%	1.5%	0.9%	1.3%
	Total Night-time Population		5,716	6,437	7,615	9,712	2.4%	2.4%	2.5%	2.4%
Day-time Population ('000)	Employment	Primary	58	58	58	58	0.0%	0.0%	0.0%	0.0%
		Secondary	244	289	378	595	3.4%	3.9%	4.6%	4.1%
		Tertiary	2,263	2,610	3,242	4,547	2.9%	3.1%	3.4%	3.2%
		Total Employment	2,565	2,956	3,678	5,200	2.9%	3.2%	3.5%	3.3%
	Student at School places		1,164	1,303	1,532	1,938	2.3%	2.3%	2.4%	2.3%
	Others		2,013	2,212	2,462	2,685	1.9%	1.5%	0.9%	1.3%
	Total Day-time Population		5,741	6,472	7,672	9,823	2.4%	2.5%	2.5%	2.5%
Household Income ('000 Kyat/month)			240.6	340.5	522.2	954.7	7.2%	6.3%	6.2%	6.5%
Household Car Ownership Ratio (%)			11.6	16.8	23.2	32.3	7.8%	4.7%	3.4%	4.8%

Source: YUTRA Project Team

Transport Demand Forecast

Base year travel demand analysis and the development of travel demand forecast models have been developed and described in detail in Volume II, Chapter 2 of this report. This section presents the travel demand forecast for the YUTRA study area for the Master plan development horizon years of 2016 (short term), 2025 (medium term) and 2035 (long term).

Travel demand estimates were made for a single urban development scenario as stipulated by the JICA SUDP study. The estimate of travel demand for the three years is summarised in the table below. It compares the growth in demand for each of the forecast years.

The table reflects a rapid growth in travel demand with almost constant population growth rate of just over 2.4% per annum. The demand forecast growth in trip rate is reflective of rapid growth in mechanised trips. The high growth in mechanised trips is caused by increase in vehicle owning household from some 12% of the population to over 34% of all households by 2035. The pace of growth is rather rapid in earlier years than later due to higher growth in car ownership in earlier years.

The mechanised person trips are forecast to almost double from 4.9 million trips in 2013 to 9.5 million trips by 2035. The share of walk trips and by bicycle would also grow steadily, albeit at slower pace as the vehicle ownership grows. The tendency of household to use the vehicle for all trips, by all members of the household, once a vehicle is available This is a common phenomenon in the developing countries, where purchase of a vehicle is major step towards ‘status’ in the society, and then its maximum use is inevitable as there is limited or restraint (parking availability/ charges, no road user charges).

Table 3.2.2 Growth in Total Travel by All Modes, Person Trips ('000)

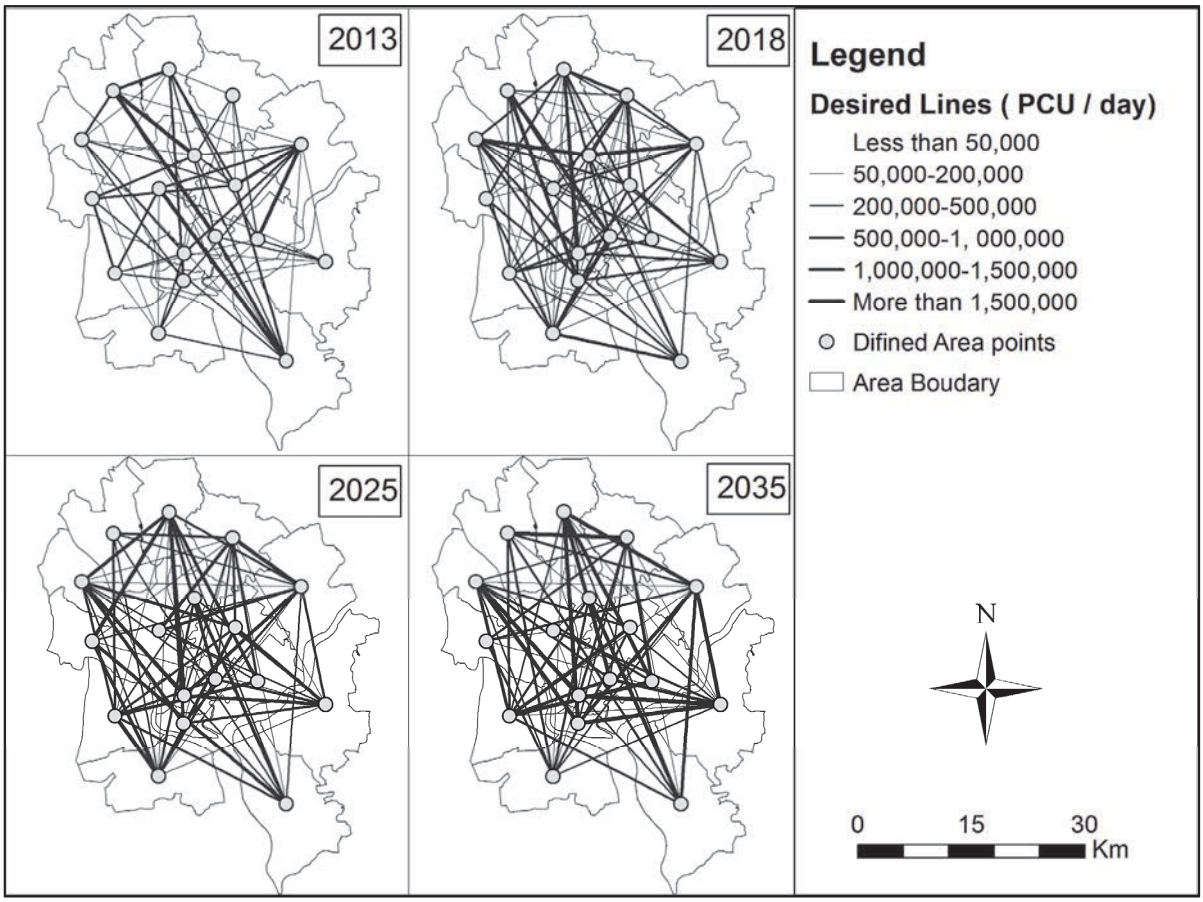
Description	2013	2018	2025	2035
Walk	4,778	5,238	6,072	7,403
Bicycle	1,472	1,661	1,981	2,704
Mechanised	4,935	5,862	7,185	9,477
% mechanised	44.1	45.9	47.2	48.4
Total Trips	**11,185**	**12,761**	**15,238**	**19,584**
Population	5,716	6,437	7,616	9,712
Trip Rate	1.96	1.98	2.00	2.02

Growth Indicator	Growth Rate % p.a.		
	2013-18	2018-25	2025-35
Walk	1.86	2.13	2.00
Bicycle	2.45	2.55	3.16
Mechanised	3.50	2.95	2.81
Total Trips	2.67	2.57	2.54
Population	2.40	2.43	2.46
Trip Rate	***0.26***	***0.13***	***0.08***

Source: YUTRA Project Team

The next stage in the demand forecast process is to distribute the estimated trip ends between origin and destinations. The resulting trip distribution patterns are illustrated by the desire-line diagrams for base and forecast years in Figure 3.2.1. It is evident that the demand for travel from the new town-centers spread around the central core of the Yangon City would grow considerably.

Travel demand to and from areas outside the YUTRA area (External Trips) was estimated exogenously, and added to the above described estimated demand. The forecast external travel demand was then compared with the MYT-Plan, and controlled to the MYT-Plan travel demand to/ from Yangon and those pass through YUTRA area by private and public mode also for the goods vehicles. Table 3.2.3 summarises the total travel demand in the study area by mode of travel and by commercial vehicles.



Source: YUTRA Project Team

Figure 3.2.1 Current and Forecast Trip Distribution Patters in YUTRA Areas

Table 3.2.3 Total Travel Demand in YUTRA Study Area

Summary of Trip Totals by Mode (Inter-zonal)					% Growth			% Growth p.a.		
Total Trips	**2013**	**2018**	**2025**	**2035**	**2013-2018**	**2018-2025**	**2025-2035**	**2013-2018**	**2018-2025**	**2025-2035**
Bicycle	598,500	422,900	504,200	688,900	-29.3	19.2	36.6	-6.7	2.5	3.2
Motorcycle	304,500	208,200	246,100	320,300	-31.6	18.2	30.2	-7.3	2.4	2.7
Car & Van	628,400	1,201,300	1,771,300	2,728,000	91.2	47.4	54.0	13.8	5.7	4.4
Taxi	595,000	756,200	909,200	1,173,100	27.1	20.2	29.0	4.9	2.7	2.6
Bus / Train/ Ferry	3,065,900	3,915,400	4,560,400	5,672,600	27.7	16.5	24.4	5.0	2.2	2.2
Total Person Trips	**5,192,300**	**6,504,000**	**7,991,200**	**10,582,900**	**25.3**	**22.9**	**32.4**	**4.6**	**3.0**	**2.8**
% by Public (Taxi, Bus, Ferry & Train)	70.5	71.8	68.4	64.7						
Goods Vehicle PCU	**110,900**	**151,200**	**205,200**	**301,600**	36.3	35.7	47.0	6.4	4.5	3.9

Source: YUTRA Project Team

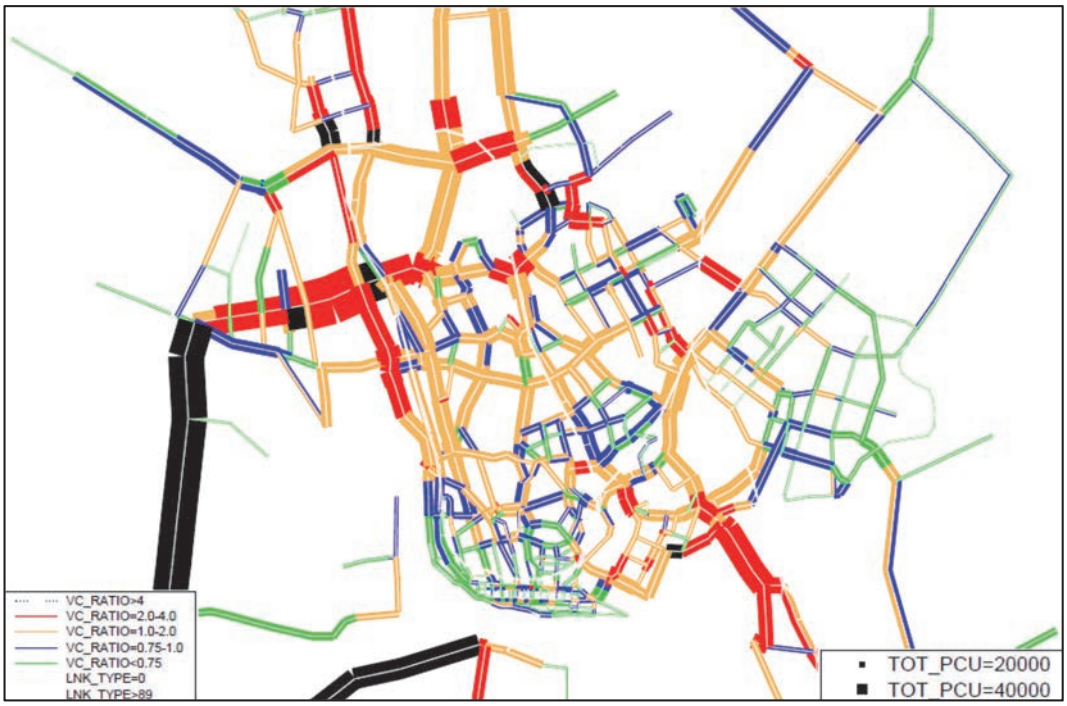
Figure 3.2.2 shows the current traffic volumes on the current road network in 2013 with the V/C ratios are illustrated by colour. The figure shows that there are relatively limited number of road sections which are above capacity. This network also reflects the impact of current rampant on-street parking, which is the main reason of congestion in the CBD area. Outside the CBD area some key links are at near capacity (blue links with V/C Ratio between 0.,75~1.0). Some bottle necks are also illustrated by the brown colour links.

Source: YUTRA Project Team

Figure 3.2.2 2013 Assigned Traffic Volume on Current Transport Network

Figure 3.2.3 shows the traffic volumes on the current road network in 2035 with the V/C ratios illustrated by colour. This shows so-called “Do-Nothing” situation in 2035. The figure clearly illustrates that if the current transport infrastructure is not improved congestion would worsen. The most severe impact would be the rapidly growing urban areas to the west and south of Yangon river, where V/C ratio exceeds 2.0 on arterial roads in the area. Congestion on the bridges from the west and from Bago area would be operating over the capacity most of the day. This illustrates the immediate need for addition Yangon and Bago river crossings.

The impact on the road network by 2035 under the stress of increase in total PCU to 2.3million would be unthinkable if the city is to grow and the transport infrastructure remains at the current 2013 level. The figure shows the projected 2035 traffic volume and illustrates the likely V/C Ratios on the network. It can be seen that on most of the network V/C ratio exceeds 1.0, and the brown, red and black colours show the intensity of the poor level of service. In fact the red and black colours imply the need for more doubling the current road capacity and an efficient mass transit system by 2035.



Source: YUTRA Project Team

Figure 3.2.3 2035 Assigned Traffic Volume on Current Transport Network

Assessment of Future Demand-Supply Gaps

Using the traffic assignment technique on 2013 transport network and 2013 & 2035 OD matrices, the gaps between transport demand and infrastructure supply were analysed in order to determine the future demand/supply gaps by location and direction. Based on this analysis, future transport network plans are prepared. The assessment was conducted in 17 mini screen lines set as illustrated in Figure 3.2.4.

At present, there is no screen line showing a transport demand greater than capacity (See Table 3.2.4). In the future, however, the demand will surpass the present transport capacity at many screen lines. Particularly at the Yangon River crossing between Yangon CBD and Dala, traffic demand will increase rapidly, and countermeasures are needed to ease this situation. Other critical screen lines include Hlain River, Bago River and Pazundaung Creek.

Source: YUTRA Project Team

Figure 3.2.4 Mini Screen Lines for Demand/Supply Gap Analysis

Table 3.2.4 Demand/Supply Gaps by Mini Screen Line, 2013 and 2035

Screen	A. 2013 Capacity (000 PCUs /day)	B. 2013 Demand (000 PCUs /day)	B/A	C. 2035 Demand (000 PCUs /day)	C/A
1	95.8	20.5	0.21	137.2	1.43
2	6.6	2.8	0.42	70.9	10.75
3	16.6	3.3	0.20	19.4	1.17
4	426.8	181.1	0.42	486.8	1.14
5	27.6	2.4	0.09	33.5	1.21
6	454.4	224.5	0.49	373.0	0.82
7	16.6	0.5	0.03	5.9	0.36
8	137.2	4.1	0.03	29.6	0.22
9	147.0	25.6	0.17	91.2	0.62
10	66.2	20.3	0.31	70.3	1.06
11	84.0	4.1	0.05	41.7	0.50
12	0.0	4.2	-	42.2	-
13	115.2	54.7	0.47	203.1	1.76
14	298.4	131.0	0.44	312.9	1.05
15	287.2	135.4	0.47	284.0	0.99
16	276.4	127.4	0.46	307.7	1.11
17	0.0	0.2	-	2.5	-
Total	2456.0	942.2	0.38	2511.8	1.02

Note: All public transport passengers were converted to PCUs assuming a ratio of 23 pax/PCU.
Source: YUTRA Project Team

4 TRANSPORT DEVELOPMENT STRATEGY

4.1 Overall Transport Policy

Current Urban Development Policy

The biggest constraint is funding. Hence, it must turn more and more to the private sector – especially in the provision of transport services.

Yangon's public transport is fortunate to have a high modal share presently. This advantage should be maintained or strengthened even further against the pressure of motorization.

A third constraint is weak institutional capability to cope with urban and transport challenges. One way to overcome the lack of funds is to improve government's ability to harmonize land use with transport development. This entails expertise and processes that are also scarce in the public sector.

New Policy Directions

A key feature of this new direction is greater reliance on the private sector in the building of transport infrastructure and operation of major transport functions, which is consistent with the national policy towards a market-based economy. Myanmar is already moving towards this end, but this will require various policy reforms and public sector practices.

For passenger transport services, the public sector also needs to increase its management role, while maintaining its regulatory role, in the delivery and outcome of transport services. This will require building skills and capacity in management; relying less on regulations alone to reach objectives and taking a more commercial approach to managing the structures of service delivery.

For city expansion, better urban controls are needed to preserve the ROW (specifically, alignment and width) for future roads, rather than just planning neat and elegant arrangement of land uses per-se. Designated ROWs will provide a clear signal to the private sector on where future growth shall be. Tax and other incentives can be used to encourage this kind of developments outside the CBD, rather than relying on the traditional instruments of administrative controls (such as grant or denial of building permits).

Inter-city and interagency collaboration will become increasingly necessary, as the urban development spreads outside traditional city boundaries thus requiring more coordinated and integrated transport solutions. A metropolitan-type of institution should be discussed and the need of an Urban Transport Authority seriously studied (see *Chapter 4.8*).

Aside from economic and technical viability, transport projects need to be planned for sustainability (maintained, operated, and supported with funds over its life), minimum dislocation, and environmental soundness.

YUTRA Overall Transport Development Strategy

Yangon of the future should be livable as well as globally competitive and attractive for industries, leading Myanmar's international trade, and the transport sector must be designed to make this a possibility. The overall goal of urban transport is the following:

"Ensure mobility and accessibility to urban services that are vital for the people and the

society, by providing a transport system characterized by safety, amenity, and equity and sustained by an efficient public transport system"

A combination of supply-type and demand-type strategies is required to maintain the present advantage of high modal share of more than 60%. YUTRA has identified a series of transport development strategies as stated above. The main focuses or features of the Master Plan exist on the following points:

1. **Strengthening of Public Transport:** development of sustainable public transport system, taking advantage of the present high share of public transport trips.
2. **Improvement of Regional Competitiveness of the City:** Construction of Efficient Transport System that supports 10-million multi-core hub city.
3. **Realization of Well-managed Environment-friendly City:** introduction of innovative institutional/operational schemes that enables world-class transport integration with living environment.
4. **Adoption of Immediate Congestion Mitigation Measures:** implementation of less expensive measures against traffic congestion that brings quick outcome.

In YUTRA, the following eight objectives were established with identified transport development strategies.

A. Promotion of Social Understanding about Urban Transport Problems and Issues

A1. Conduct of consecutive transport campaigns;

A2. Expansion of transport education;

A3. Strengthening of transport studies;

A4. Information disclosure.

B. Effective Management of Urban Growth and Development

B1. Policy coordination within the Greater Yangon area;

B2. Authorization of City and Transport Master Plans;

B3. Development of hierarchical road network and road classifications to guide design (and parking provision);

B4. Promotion of integrated urban and transport development, particularly Transit-Oriented Development (TOD).

C. Promotion and Development of Attractive Public Transport

C1. Development of a hierarchal mass transit system;

C2. Early introduction of an integrated public transport system (BRT) in the effort to maintain public transport share;

C3. Upgrading the present rail system;

C4. Development and improvement of bus transport system, including reform of management systems and the business model;

C5. Promotion of public transport use and expansion of services.

D. Efficient Traffic Control and Management

D1. Establishment of comprehensive traffic management system balanced with better facilities for essential NMT modes such as cycling and walking;

D2. Strengthening of traffic regulation, enforcement and management;

D3. Management of freight transport;

D4. Establishment of parking policy and controls;

D5. Development of well-coordinated traffic control system.

E. Effective Transport Demand Management (TDM)

E1. Integrating urban development and transport (TOD);

E2. Providing efficient public transport alternatives;

E2. Regulating motorized vehicle access and proper charging of road use and parking.

F. Comprehensive Development of Transport Space and Environment

F1. Improvement of a safe transport environment for pedestrians and cyclists;

F2. Redistribution of transport space and improvement of traffic environment in the city centre;

F3. Establishment of township transport development strategy.

G. Enhancement of Traffic Safety

G1. Establishment of traffic safety audit system;

G2. Elimination of traffic accident black spots;

G3. Improvement of licensing and vehicle inspection system;

G4. Strengthening of traffic enforcement system;

G5. Strengthening of first aid response system.

H. Strengthening of Transport Sector Administrative and Management Capacities

H1. Reform of transport- related organizations;

H2. Promotion of private sector participation;

H3. Strengthening of planning and management capacity;

H4. Securing of development funds.

The inter-relationship between these focuses and the identified strategies is illustrated below:

Source: YUTRA Project Team

Figure 4.1.1 Main Features and Strategies of YUTRA Master Plan

4.2 Budget Envelop

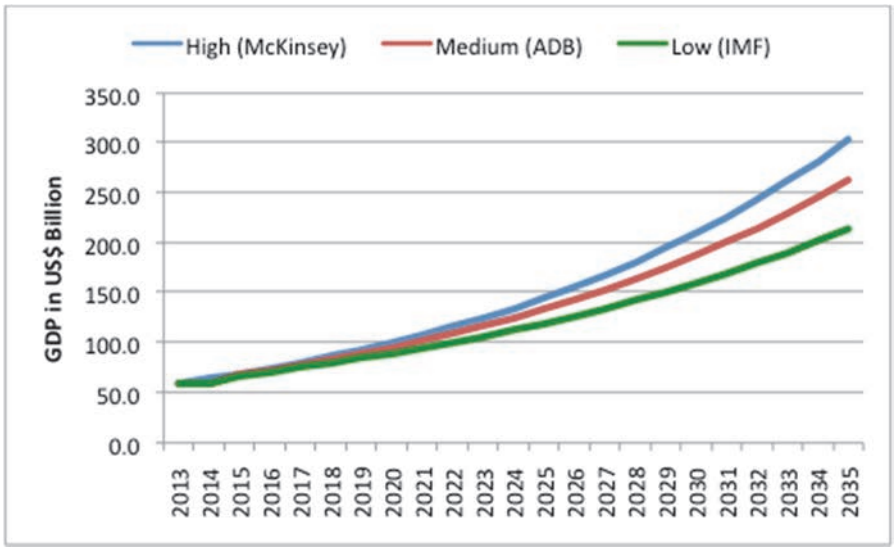
Various international institutions projected rapid, long-term economic growth for Myanmar, subject to major reforms in macro-economic systems. The following growth scenarios were formulated:

(i) **Scenario 1: High Growth** - This scenario is based on McKinsey forecast an average GDP growth of 7.7% per annum with seven economic sectors driving national economic development. Myanmar Government also proposes this scenario under the approved first five-year national development plan for FY2011/12 to 2015/16.

(ii) **Scenario 2: Medium Growth** - In this scenario, the annual GDP growth rate will increase to 7% as estimated by IMF and based on the lower figure in the 7%-8% growth forecasts of ADB in its report entitled “Myanmar in Transition”.

(iii) **Scenario 3: Low Growth** - This scenario is based on the IMF’s debt sustainability analysis of Myanmar in 2013. In the IMF analysis, annual GDP growth rates from 2014 to 2031 are set at 6.0%.

GDP forecasts under the three growth scenarios is shown below.



Source: YUTRA Project Team

Figure 4.2.1 Myanmar GDP Forecasts by Growth Scenarios

In estimating the transport funding envelope for Greater Yangon, the key principle in allocating Myanmar's resources is to invest in areas with the greatest potential to contribute to economic outputs.

After estimating the public investment and transport sector allocation for the entire Myanmar, transport sector budget envelope was estimated. For FY2011/12 to FY2012/13, Yangon Region's economic contribution is about 22% of the country's GDP. The Interim Report (2013) of the JICA Survey Program for the National Transport Development Plan (MYT-Plan), the GRDP estimates of Yangon Region are: 25% in the medium-term and 30% in the long-term. On this basis, the Greater Yangon transport budget envelopes are assumed to be equal to the GRDP estimates. Table 4.2.1 presents the expected budget allocation for Greater Yangon transport requirements.

Table 4.2.1 Greater Yangon Transport Sector Budget Envelopes

(US$ Billion at 2013 Prices)

Fiscal Year	Greater Yangon Transport Investment		
	High (McKinsey)	Medium (ADB)	Low (IMF)
FY2014-2017	2.748	2.702	2.637
FY2018-2025	8.675	8.234	7.656
FY2026-2035	21.314	19.048	16.252

Source: YUTRA Project Team

4.3 Land Use and Transport Integration

1) Strategic Urban Development Plan

The Project for the Strategic Urban Development Plan for the Greater Yangon (2013, JICA) (hereinafter called as SUDP) provides fundamental ideas of the future land use in the Greater Yangon area (Yangon and the surrounding areas). SUDP proposes a multi centric

and balanced development pattern as the major spatial structure of the Greater Yangon, which is expected to reduce excessive traffic concentration to/from the existing downtown area (see *Chapter 3*). SUDP recommends "Sub-centres with Green Isle System" development pattern (decentralized urban functions) as the most preferred option.

- "Sub-centres with Green Isle System"

  The recommended Sub-Centres with Green Isle System by SUDP forms a hierarchical urban structure, that is, CBD is the centre of the city, surrounded by sub-centres on the circumference of 10 – 15 km radius from CBD, and new town centres are located outskirts of sub-centres.

  - Removal and transfer of some major urban functions in the existing downtown areas (CBD) to newly designated sub-centres and new town centres.
  - Promotion of corridor development (called "sub-centre growth belt") between newly identified sub-centres
  - Urbanization shall be limited within the designated outer ring road (ORR), while the urbanization within the ORR shall be encouraged.
  - New sub-centres shall be developed on the circumference of around 10 – 15 km radius from CBD. Such sub-centres are Hlaing Tharya, Mindama, Dagon Myothit, Thanlyin, and Thilawa.
  - Designated conservation areas: Hlawga protected area, and Inya Lake
  - Development of "North – South Green Axis" using the existing conservation areas.
  - Removal and transfer of some major urban functions in the existing downtown areas (CBD) to newly designated sub-centres and new town centres.

- Hierarchical Centre System
  - Primary Centre: Central Business District (CBD)
  - Secondary Centres: Secondary CBD (Sub-centre) : Mindama, Thilawa, Bago Riverside, Dagon Myothit, Hlaing Tharya
  - Tertiary Centres: New Town Core Area in sub-urban area: Hlegu, Hmawbi, East Dagon, Thanlyin, Dala, Twanty, and Htanttabin

- Corresponding Transport Network

  This pattern of centre distribution suggests a corresponding network in a hierarchical manner as follows. This hierarchical network (or links) indicates necessary feature of transport facilities served along each link in terms of capacity, speed, and modes.

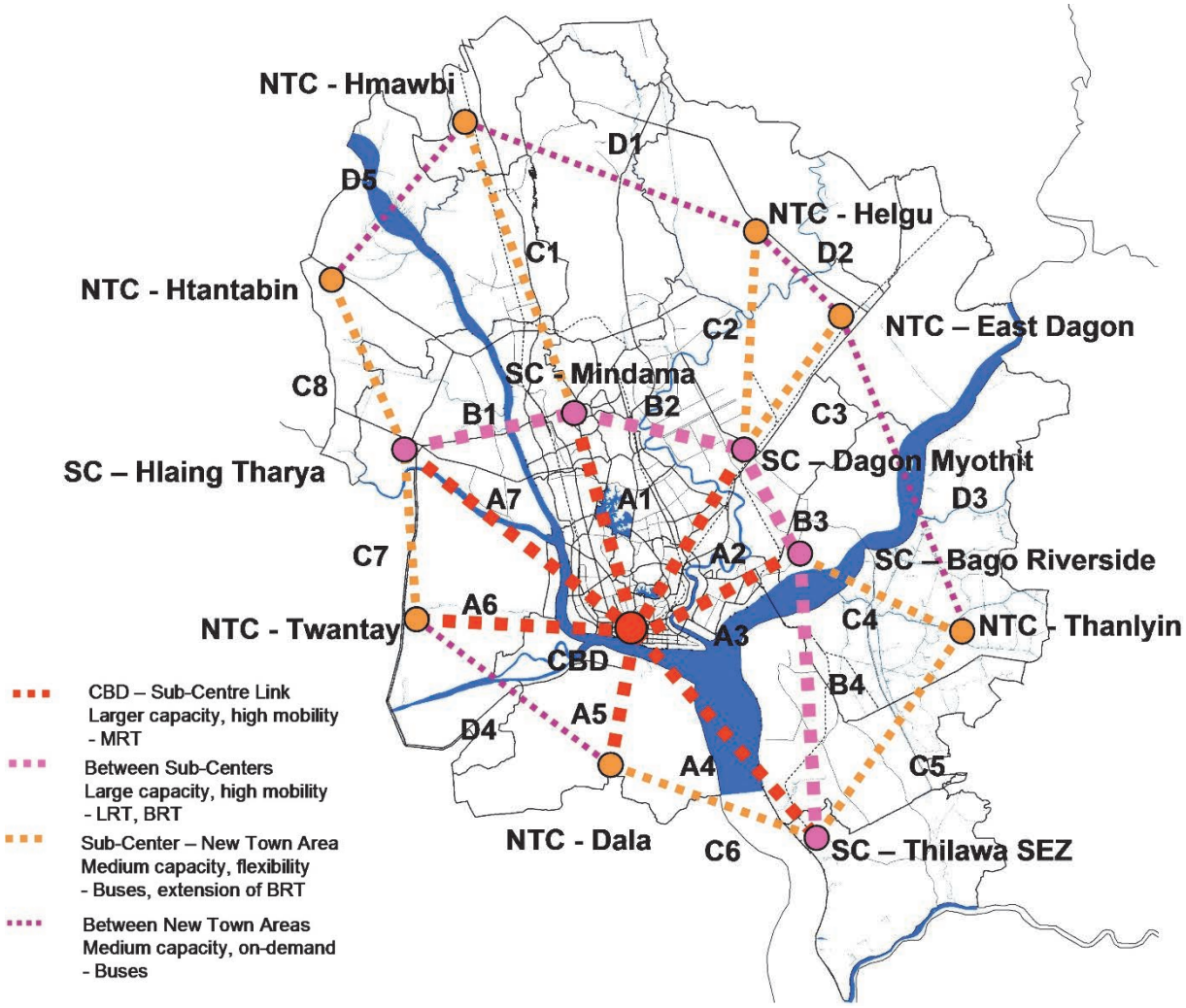
  - Link A: CBD – Sub-centre Link
  - Link B: Link between Sub-centres
  - Link C: Sub-centre – New Town Core area Link
  - Link D: Link between New Town Core areas

  Transit services should be provided for every link connecting centres, and such transit services shall also be provided in a hierarchical manner, which is supported by a

hierarchical rail and road network. UMRT is generally recommended to connect CBD and surrounding sub-centres, while extension of such high order public transport system to surrounding town centres and strategic destinations such as the airport and the port area in Yangon should be carefully considered from a demand point of view.

2) Evaluation of the existing network

Roads, railway, bus and ferry are evaluated to examine how the current transport network system would work in the future links between the proposed sub-centres in SUDP.



Source: YUTRA Project Team

Figure 4.3.1 SUDP Hierarchical Centre System and Corresponding Links

Current Network System

- Link A: CBD – Sub-Centre Link

  Table 4.3.1 summarizes link characteristics as of year 2013 in term of road capacity and available modes.

Table 4.3.1 CBD – Sub-centre Links, 2013

Link		Link between		Available Direct Network, 2013				
				Road	No of Lanes per direction	Myanma Railway	Water Transport	Major Road Links
CBD - Sub center Link	A1	CBD	SC-Mindama	○	12	×	×	Pyay Rd Kaba Aye Pagoda Rd.
	A2		SC-Dagon Myothit	○	4	○	×	No.2 Main Rd
	A3		SC-Bago Riverside	○	4	×	×	Yadanar Rd
	A4		SC-Thilawa SEZ	○	2	△	×	Kyaik Khouk Pagoda Rd
	A5		NTC-Dala	×	0	×	○	NA
	A6		NTC-Twantay	△	4	×	×	No.5 Main Rd Twantay Main Rd
	A7		SC-Hlaingtharyar	○	4	×	×	No.5 Main Rd

Note: ○: available, △: availabale,but limited, ×: not available

Source: YUTRA Project Team

- Link B: Link between Sub-Centres

  Only road network will work comparing the other transport networks. This is because the network connecting Link B should across rivers such as Yangon River or Bago River. The evaluation must depend on the capacity of bridges.

Table 4.3.2 Link between Sub-centres, 2013

Link		Link between		Available Direct Network, 2013				
				Road	No of Lanes	Myanma Railway	Water Transport	Major Road Links
Link Between Sub-cebters	B1	SC-Hlaingtharyar	SC-Mindama	○	6	×	×	Lanthit Rd
	B2	SC-Mindama	SC-Dagon Myothit	○	4	×	×	Pin Lon Rd Thanthumar Rd
	B3	SC-Dagon Myothit	SC-Bago Riverside	○	4	×	×	Ayer Wun Rd
	B4	SC-Bago Riverside	SC-Thilawa SEZ	○	6	△	×	Dagon bridge Thanlyin bridge

Note: ○: available, △: availabale,but limited, ×: not available

Source: YUTRA Project Team

- Link C: Link between Sub-Centre and New Town Area

  The existing national (union) highway network is available for Link C1 (NH 4), C3 (NH2), and C5 (NH6). There is no land transport connection nor water transport service for Link C6: NTC Dala and SC Thilawa SEZ at present. In general road connectivity in the suburban area, where these sub-centre – town centre links are expected, is very limited.

Table 4.3.3 Link between Sub-centre and Town Centre, 2013

Link		Link between		Available Direct Network, 2013				
				Road	No of Lanes per direction	Myanma Railway	Water Transport	Major Road Links
Sub-center and New Town Link	C1	NTC-Hmawbi	SC-Mindama	○	2	○	×	No.4 Main Rd
		Corridor inbetween C1 and C2		○	6	×	×	Pyay Rd
	C2	NTC-Hlegu	SC-Dagon Myothit	△	4	×	×	Min Yae Kyaw Swar Rd
	C3	NTC-East Dagon	SC-Dagon Myothit	○	4	○	×	No.2. Main Rd
	C4	NTC-Thanlyin	SC-Bago Riverside	○	4	×	×	Yangon Thilawar Rd
	C5	NTC-Thanlyin	SC-Thilawa SEZ	○	4	×	×	No.6 Main Rd
	C6	NTC-Dala	SC-Thilawa SEZ	×	0	×	×	-
	C7	NTC-Twantay	SC-Hlaingtharyar	△	2	×	×	Twantay Main Rd
	C8	NTC-Htantabin	SC-Hlaingtharyar	△	4	×	×	Amauk Pine University Rd

Note: ○: available, △: availabale,but limited, ×: not available

Source: YUTRA Project Team

- Link D: Link between New Town Areas

  Links between new town centres form a ring surrounding the future (planned) urbanized area of the Greater Yangon as informed by SUDP. The existing connectivity between the proposed town centre locations are generally very weak.

Table 4.3.4 Link between Town Centres, 2013

Link		Link between		Available Direct Network, 2013				
				Road	No of Lanes per direction	Myanma Railway	Water Transport	Major Road Links
Link Between New Towns	D1	NTC-Hmawbi	NTC-Hlegu	△	4	×	×	No.7 Main Rd
	D2	NTC-Hlegu	NTC-East Dagon	△	4	×	×	No.7 Main Rd
	D3	NTC-East Dagon	NTC-Thanlyin	×	0	×	△	-
	D4	NTC-Dala	NTC-Twantay	×	0	×	△	-
	D5	NTC-Htantabin	NTC-Hmawbi	△	2	×	×	No.4 Main Rd

Note: ○: available, △: availabale,but limited, ×: not available

Source: YUTRA Project Team

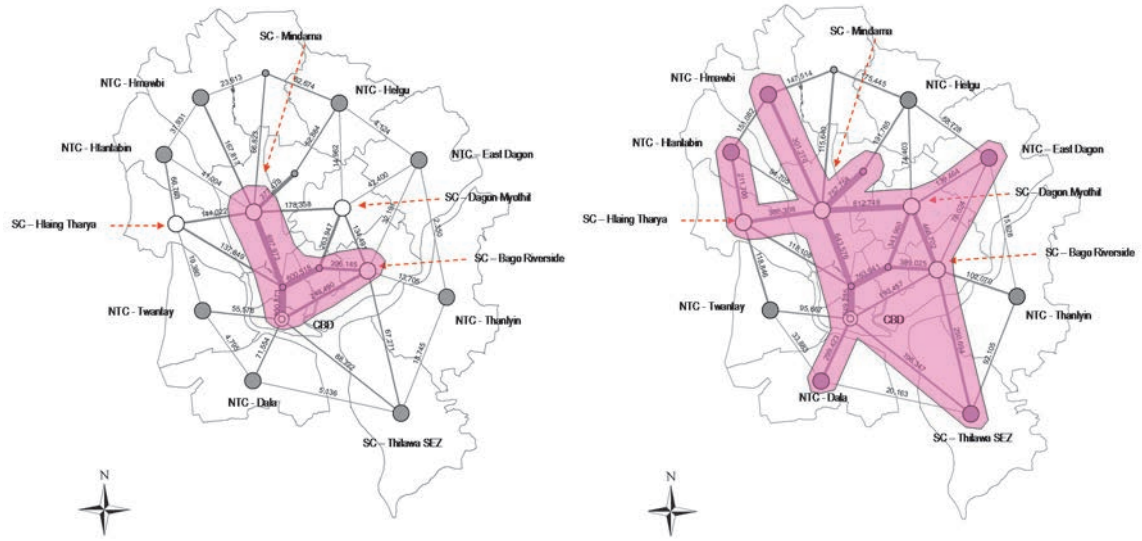
Demand Analysis

Assuming 60% of the total passenger demand of each link is carried by public modes of transport, a likely public mode of transport is indicated. If a 60% of a link volume exceeds 10,000 passenger per peak-hour per direction, a form of mass transit is suggested, while such demand is below 10,000 but above 6,000 passenger per peak-hour per direction, a transit system of medium carrying capacity such as BRT/LRT is suggested.

The link analysis informs the area which needs a higher order transit system. A triangular area formed by three centres, namely CBD, SC Mindama and SC-Bago Riverside needs such higher order transit system already in 2013. The area that needs high-order transit system will be extended to cover a wider area including proposed sub-centres and some town centres as shown in Figure 4.3.2. This shape of service coverage indicates a few number of high-order transit lines of radial direction.

It is highly recommended that the red shaded area shown in Figure 4.3.2, including CBD, the four proposed sub-centres and the three proposed town centres namely Hmawbi, Dala, and Thilawa SEZ are served by a form of mass transit system.

These centres should be directly connected by mass transit systems including the improved MR lines (the Yangon circular lines, part of the Yangon – Mandalay line, and the Thanlyin line) and new mass transit system.

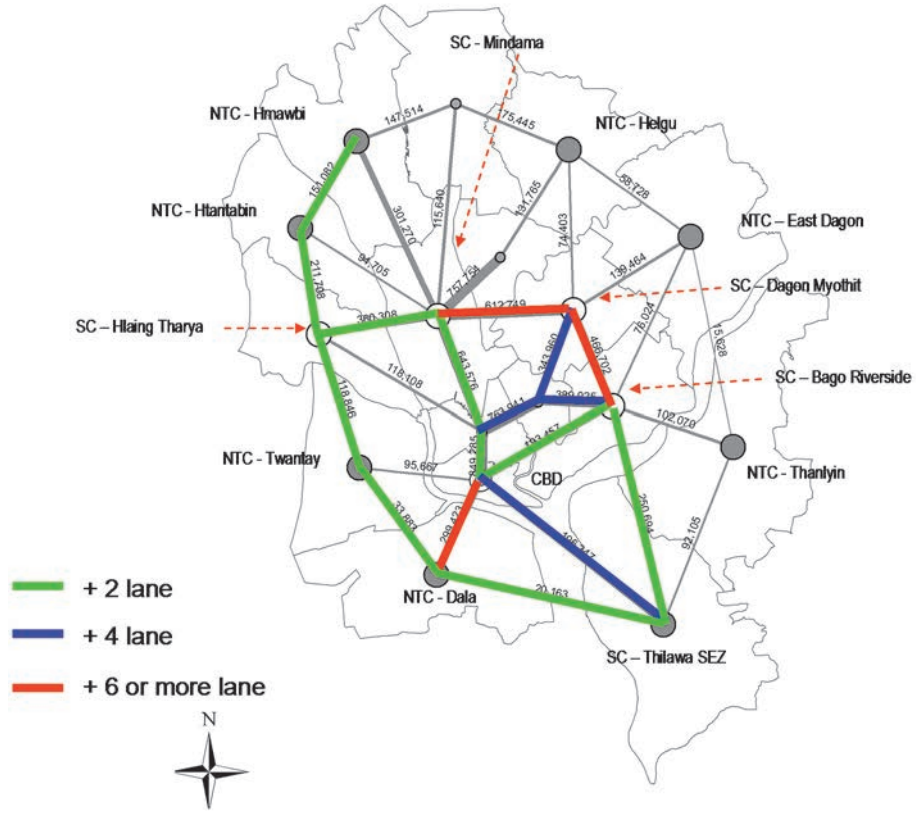


Source: YUTRA Project Team

Figure 4.3.2 Area needs high-order transit service in 2013 and in 2035

Assuming the remaining 40% of the total demand is assumed to be carried by private mode of transport, namely passenger cars, the link between CBD and SC Dala requires 6 lanes or more. The link analysis suggests that additional 10 lanes or more road crossing the creek will be required by 2035. The link between SC Dagon Myothit and SC Mindama requires 6 lanes or more, CBD and SC Dagon Myothit and SC Bago Riverside also require additional 6 lanes in total. (See Figure 4.3.3)

It is recommend to increase the capacity of public modes of transport of this link. Therefore an extension of the UMRT network to Dala area is highly recommended in order to support the planned development in this area.



Source: YUTRA Project Team

Figure 4.3.3 Suggested road capacity increase between the centres

4.4 Public Transport

From the features mentioned above such as high transport capacity, high travel speed, environmental friendly, etc., and high demand in the future, we propose to apply public transport with good combination among railway and middle capacity transit (mainly BRT) positively.

[B1] Policy coordination within the Greater Yangon area

[B2] Authorization of City and Transport Master Plans

[B4] Promotion of integrated urban and transport development, particularly Transit-Oriented Development (TOD)

[C1] Development of a hierarchal mass transit system

[C2] Early introduction of an integrated public transport system (BRT) in the effort to maintain public transport share

[C3] Upgrading the present rail system

[C4] Development and improvement of bus transport system, including reform of management systems and the business model

[C5] Promotion of public transport use and expansion of services

[E1] Integrating urban development and transport (TOD)

1) Urban Railway Development

The following basic principles were established for urban railway development in YUTRA.

- Conformity with Urban Master Plan/ National Transport Master Plan (related to Strategy No. B1, B2, and E1)
  - Public transport network composed of railway and BRT shall fit with layout of urban development plan / land use plan / future urban function plan prepared by Urban Master Plan (SUDP) in 2012.
  - To consider the railway network plan prepared by SUDP as a conceptual plan.
  - To keep conformity with the railway plan of the National Transport Development Plan (MYT-Plan).
- Total Coordination among Public Transport Mode (related to Strategy No. B4, C1, and E1)
  - To fulfill required function by total public transport network including not only railway network but also BRT network in order to save initial cost. Required trips to be shouldered by public transport shall be shared by both railway and BRT networks
- Railway Utilization Promotion (related to Strategy No.C5)
  - To conduct integrated development of railway line with the station plaza / wayside in order to realize synergy effect
  - To have railway/UMRT lines radiating out from CBD as main axes, and connecting East-West line as sub-axis.
- Realistic Development Planning (related to Strategy No.C2 and C3)
  - In order to save initial cost, to endeavor a) existing railway utilization, b) in case of UMRT, installation of at-grade/elevated section as much as possible, and c) active use of BRT with relatively lower cost per km.
  - Regarding existing railway modernization, to give high priority to current population density area.
  - To consider utilization of actual vacant land lots for depot, workshop, transport hub, etc. in order to establish a practical plan.
  - To consider who will be an implementation, operation, management body for UMRT project in order to succeed in the UMRT project.

Even if the railway network is completed, it will not function in case of no related facilities. It is essential to establish feeder service from/to station and station plaza as transfer facility in order to act railway properly, in addition to expanding railway network and modernizing the railway itself. In order to fulfil the ideal railway service, the following countermeasures should be conducted.

a) Improvement and expansion of railway network

b) Improvement of station function as transport hub (station and station plaza): to improve transfer function at railway station, and to enhance integration between railway and the other public transportation like buses, etc. (see “after improved” in the figure below)

Furthermore, in order to realize abovementioned “b)”, redevelopment of the current station yard is essential. In case of implementing yard development, it is necessary to relocate the current depots and workshops in MR yard to any substitute yard. The northwest area of Ywa Tar Gyi station along Yangon-Mandalay line is a strong candidate for substitute land.

Railway freight transport plan should be adjusted to a freight transport plan prepared by MYT-Plan.

It is required that the railway infrastructure layout plan for 2035 should be fulfilled based on step-wise development plan which is to fulfil the short-term, middle-term, and long-term target shapes step-by-step. The step-wise development plan is prepared based on the following principles.

- Short-term projects shall have high maturity status.
- To give first priority to existing line improvement in terms of cost aspect.
- First UMRT installation should be planned in consideration of feasible timing in order to avoid being dream.
- To realize development scenario which has good harmonization of the implementation timing between railway infrastructure project and the related project such as station plaza development, land development along railway with depot/workshop relocation.
- To fulfill the scenario that development benefit from railway yard redevelopment can be allocated to the next railway infrastructure project.
- To apply Step Development effectively which means to conduct electrification, grade separation, etc. on step-by-step basis regarding existing line modernization.

2) BRT and Conventional Bus Services

The decision to build a BRT in Yangon must take into account the opportunities, as well as managing the risks and constraints. The opportunities are:

- A present benefit is a high dependency on bus transport and low car ownership in Yangon. It will easier to maintain this (with decisive steps) than at a later time win back public transport modal share.
- Yangon has well-developed arterial roads sufficient to accommodate BRT (preliminary surveys indicate BRT can be accommodated within existing road widths).

The above opportunities indicate that BRT is a feasible concept terms of society attitudes, travel choice and the physical space requirements. The risks and constraints are:

- Managing power outages (signalling etc.) that affect control systems.
- Managing bus priority at intersections (balancing bus flow with other traffic)
- Preserving integrity of bus lanes (reducing interference)

Three main design objectives need to be upheld for a successful BRT. BRT requires a higher level of management to ensure it operates efficiently.

- Build a quality mass transit system - to attract passenger. This will include:
- Service the main travel demand corridors and provide a fully integrated network

- Commercial management, sustainable business models and maintain commercial speeds

Even after UMRTs and BRTs are developed, the role of conventional bus services are important. It is not only because the patronage for conventional bus services will remain at least the current level, or most likely will gradually increase towards the future, but also the present poor levels of service should be upgraded. Enhancement of the quality of bus and other public transport services is not an end in itself. It is a prerequisite to look for any general improvement of the traffic and transport situation in the whole Yangon Region.

4.5 Road Network Development

The overall road development strategy is naturally to ensure people with good mobility, accessibility, comfort and safety of road transport. Although it is difficult to show quantitative targets regarding the quality of road and road transport, this YUTRA master plan should pursue the following targets:

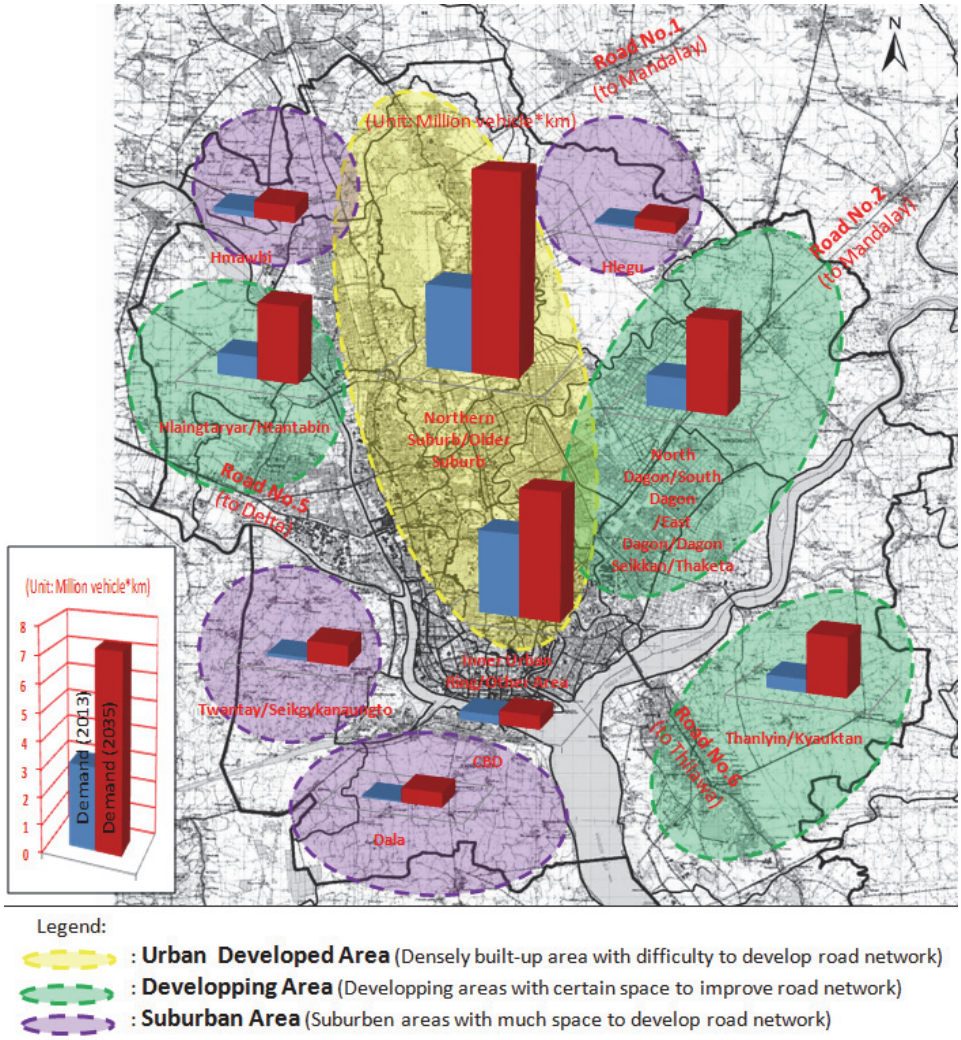
- Average volume/capacity ratio: less than 0.5 in 2035 (about 0.3 at present)
- Average travel speed: more than 20 kph in 2035 (about 30 kph at present)
- Equipped with facilities to improve mobility, accessibility, comfort and safety

Although these targets seem too modest, the situation is still far better than other metropolis in South-east Asia, and it is a well-known fact that road development cannot solve traffic congestion inducing more traffic to roads. In reality, there is no enough space to accommodate new roads in the central area of Yangon.

The city consists of several areas which have different characteristics. The road development strategy is identified for the following each specific area.

- Road Development Strategy for CBD Area
  - 1) Improvement of public transport system
  - 2) Establishment of parking policy and control
  - 3) Improvement of traffic signals and introduction of ITS
  - 4) Detachment of port related traffic from public traffic
  - 5) Introduction of appropriate Traffic Demand Management Systems
  - 6) Improvement of pedestrian facilities
- Road Development Strategy for Urban Developed Area
  - 1) Improvement of public transport system
  - 2) Widening of the existing arterial roads to maximize its road capacity
  - 3) Introduction of the double deck roads to enlarge the road capacity
  - 7) Improvement of traffic signals and introduction of ITS
  - 4) Improvement of pedestrian facilities
  - 5) Relocation of logistic terminals to suburb areas

- Road Development Strategy for Urban Developing Area
  - 1) Construction of new road network including the expressways
  - 2) Widening of the existing arterial roads to maximize its road capacity
  - 3) Improvement of public transport system
  - 4) Effective response to freight transport
  - 5) Improvement of traffic signals and introduction of ITS
  - 6) Improvement of pedestrian facilities
- Road Development Strategy for Suburban Area
  - 1) Development of basic road network
  - 2) Widening of the existing arterial roads to maximize its road capacity
  - 3) Effective response to freight transport



Source: YUTRA Project Team

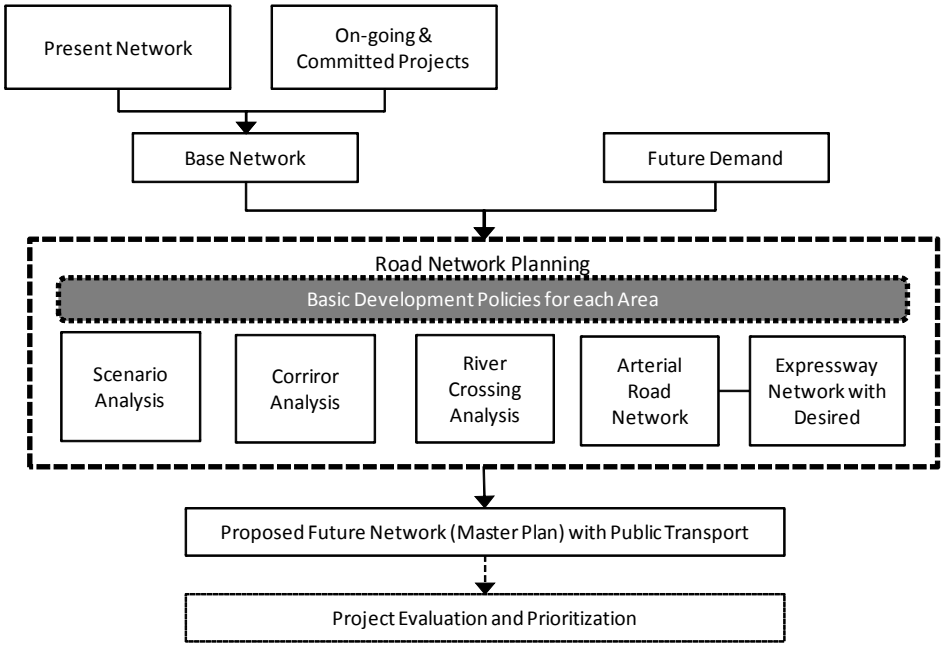
Figure 4.5.1 Demand Increase between 2013 and 2035 showing by "pcu*km" on Current Road Network

Figure 4.5.2 illustrates the flow of the process for the road network planning. The road network planning is conducted taking into account the followings;

- Arterial Road Network Planning
  - Road improvement and the new road construction based on the corridor analysis
  - New bridges based on the river crossing analysis
  - Outer ring road network connecting the potential develop areas
  - Radial road network between the developed area and the ring road network

For the strengthening of the logistic transport network, the following planning concept is identified.

- Expressway Network with Desired Logistic Route
  - Realignment of the current logistic route which is passing on arterial roads inside the developed area
  - Effective utilization of the existing infrastructure such as Dagon Bridge (dual 3-lane) which across Bago River
  - Restructuring of the logistic transport network with the proposed outer ring road by MoC/YCDC and SUDP
  - Implication of the relocation of the existing logistic centres
  - The new arterial road network and the expressway (probably toll road) is proposed in the road network for both logistic vehicles and passenger vehicles.



Source: YUTRA Project Team

Figure 4.5.2 Procedure for Road Network Planning

4.6 Traffic management and Safety

Parking Development Strategies

In order of mitigate traffic congestions due to vehicles parked along the curb, most of the cities control on-street parking particularly on main streets and promote the development of off-street public parking facilities. And also they establish appropriate rules and regulations on mandatory parking facility including garage. Nowadays global climate and environmental viewpoint changed to control parking demand so as to promote modal shift from private mode to public mode of transport system. On the other hand, rapid cutting down number of the parking spaces would affect peoples' daily activities and may induce messy distractions, subsequently the new parking polices would be given up. Therefore the parking policies have to be implemented carefully in coordination with development of off-street parking facilities and public transport improvement as well as coordination with communities. Without improvement of public transport system, discussion of park and ride facilities would be meaningless. Accordingly, YUTRA proposes phased parking policies and strategies for the urban centre in Yangon.

- First Phase (arrangement of usages of existing facilities)
  - Relocation of parking spaces
  - Charge parking fees and control parking duration in the major business/commercial districts
- Second Phase (Development of Off-street Parking Facilities)
  - Development of off-street parking facilities and removal of on-street parking
  - Development of parking facilities for enhancing Park & Ride
  - Strengthening obligated parking facilities
- Third Phase (Reduce Parking Demand)
  - Based on the public transport system development, parking facilities both on-street and off-street should be reduced and converted to urban environment space
  - Relocate facilities/ businesses which depend on automobile such as warehouse, wholesale and transport business, etc., from urban center to suburbs.

In order to implement the policies mentioned above, several related rules and regulations and organizational setup will be required, such as Parking Laws, Garage Law, Parking Fee and Parking Development Fund. Now the new charging system shall be redeveloped and save as a fund for new public parking development.

Traffic Safety Improvement Strategies

Traffic accident has become one of social issues, particularly pedestrian and bus related traffic accidents. Therefore development goal proposed by SUDP, and also by YUTRA, is to reduce accident rate on bus into 1 /10 of the existing extremely high accident rate (749/10,000buses). In order to achieve the goal, YUTRA proposes the following basic strategies.

1) Covering the three elements of Person, Vehicle and Road Traffic Environment, the following eight (8) areas should be focused for implementation:

2) Promotion of comprehensive traffic safety measures for both accident prevention and post-accident measures
3) Establishment of necessary institutions and database for sustainable traffic safety development
4) Focus on peoples' behaviour culture in the traffic society.
5) Sustainable human and financial resource development.
6) Introduction of practical reasonable advanced technology balanced with investments on human resource development.

4.7 Freight Transport and Tourism Development

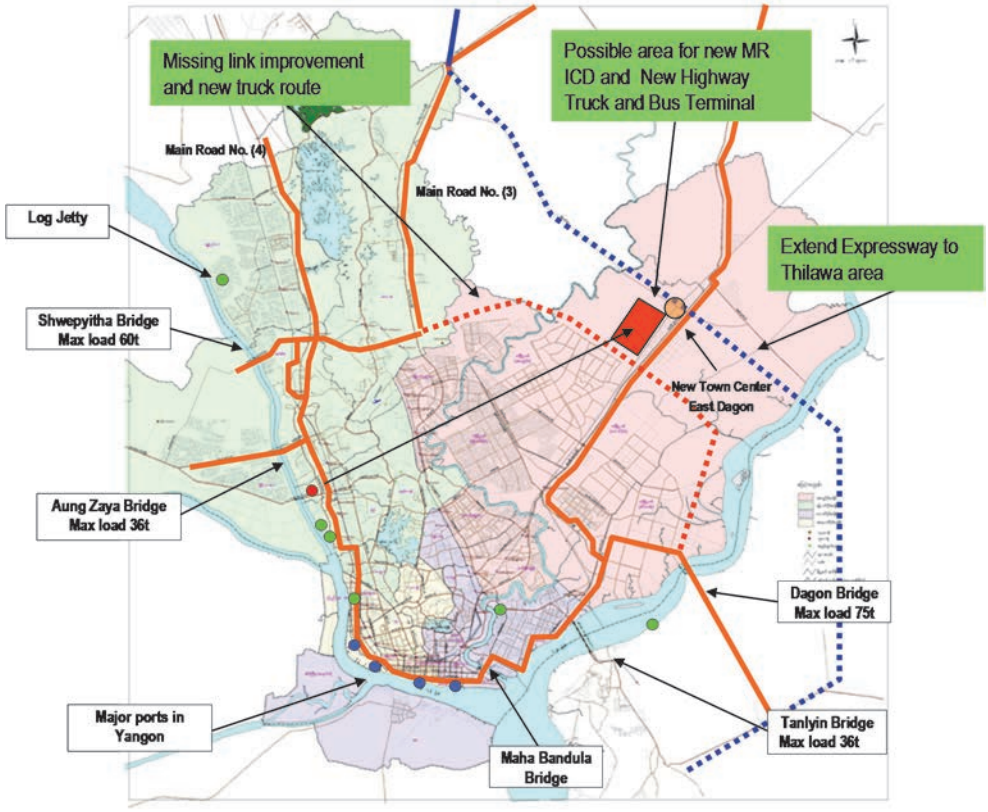
The role existing Yangon Port will remain for the time being in line with the increasing demand of international and general cargo. Whilst, Thilawa area is suitable for industrial activities including SEZ, port and logistic industries. Accordingly the role of international gateway will be shifted from the existing Yangon Main Ports to the Thilawa Port. In order to make the Thilawa Port fully functioning as the country's gateway, corresponding land transport systems should also be improved in parallel. With regard to the future goods movement management, a conceptual plan is prepared.

- New Truck Route designation with missing link development
- Transfer and expansion of truck terminal
- Extension of the Expressway to Thilawa with new MR ICD and Truck Terminal,

The existing truck routes passing through the highly urbanized areas in Yangon needs to be removed and new truck routes should be designated in line with SUDP.

It is not practical to remove the truck route along the Yangon River because accessibility to/ from the existing Yangon ports should be maintained for the time being. While, the truck route running along Thanthumar Road can be removed, and a new truck route can be developed, passing though East Dagon township, connecting Main Road No. 3 in the west, Main Road No. 2 and the Dagon Bridge.

The existing expressway needs to be extended to reach Thilawa SEZ. Trucks are not allowed to use the expressway as of today. It is highly recommended that such high-order road facility should be used effectively for goods movement. In addition, using the vacant land owned by Myanma Railway in East Dagon Township, a new truck terminal and a highway bus terminal can be developed jointly with MR's Inland Container Depot (ICD) and other rail facilities. (See Figure 4.7.1)



Source: YUTRA Project Team

Figure 4.7.1 Extension of the Expressway and New Truck Terminal & MR ICD

4.8 Institutional Reform and Strengthening

Establishment of "Yangon Urban Transport Authority (YUTA)"

As it was identified in Chapter 2 analysing current situation and issues of urban transport management system, in order to meet the increasing challenges of managing urban transport effectively, urban transport must be managed as a single 'function' and not as an array of responsibilities under different departments at present. The purpose of establishing YUTA is to provide such a strategic policymaking umbrella to improve coordination of urban development and transport and to improve planning within urban transport itself.

The functions of the authority should be stated in the new regulation as follows:

(i) formulate a general transportation and action plans to develop and provide integrated transport services;

(ii) strengthen urban public transport services;

(iii) develop and improve infrastructure and facilities that support the urban public transport services;

(iv) implement traffic demand management (TDM);

(v) support transit-oriented development (TOD);

(vi) monitor and evaluate the implementation of the transportation master plan and

programs to develop integrated transport services in the region;

(vii) budget for the implementation of the master plan and programs;

(viii) manage the wealth of the nation; and

(ix) supervise the overall implementation of the tasks under the authorization of the YUTA.

Upon establishment of YUTA, it needs to be institutionalized by law by the union government. For this purpose, it is essential to support the establishment of YUTA by providing a regulatory authority under the Urban Transport Department of Ministry of Railway and Transportation (MORT). YUTA is composed of staff to be hired from the outside according to a special expertise and dispatched staff from the relevant existing institutions. It is assumed that the size of the organization will be more than 50 staff.

Procedure period of 1-2 years is required for the establishment of YUTA. It is proposed in Chapter 6 (Master Plan) for the institutional setup for carrying out the short-term measures to be carried out before the YUTA will be established, particularly for the measures of traffic management and traffic safety.

Development of BRT Management Agency

For a BRT system three distinct institutional levels are proposed, with each level having a defined role and responsibility, with accountability and respective risks assigned at each level. The proposed YUTA (political level) manages the strategic policy direction, while at the mid-level; the proposed system manager (the BRT Agency) manages the business of public transport. At the level below is the bus operations performed under contract.

The BRT Agency will be responsible for planning and managing the network, and is primarily responsible for customer service delivery, with specific responsibilities to:

(i) Generate patronage/build revenue/manage efficiency

(ii) Plan routes, control and monitor service delivery

(iii) Manage BRT infrastructure

(iv) Be responsible for customer service delivery and complaints

(v) Ensure financial performance

(vi) Manage fare policy and collection

(vii) Manage and enforce bus operator contracts

(viii) Manage community relations and the marketing and promotion of the system

BRT Management Agency is composed of the staff dispatched from YUTA and own staff and the size of the organization is assumed to be around 50 staff.

The BRT Management Agency should be a corporate and autonomous entity such as public corporation or state-owned enterprise.

In the implementation phase of the UMRT project, it is also essential to establish a management agency for urban railway called to as the MRTA under the YUTA like the BRTA and it will perform centrally on construction, operation and management of UMRT.

Operator Licensing and Contract

The BRT Agency will contract Bus Operating Companies (BOC) to provide services to the BRT system on a performance-based contract (paid per mile which defines the terms of the contract (duration, level of service and service standard requirements). The BOC can be either private or public entities as the contract structure is equally effective in setting the 'rules of the game' either type of entity.

With a 'smart card' electronic ticketing system, central fare collection and revenue disbursement on a per passenger basis is easily managed.

Possible Technical Assistance for the Development of YUTA and BRT Agency

Considering the current inefficient and complicated institutional system for urban transport development and management and inadequate experience and capacity, it is definitely necessary to receive a technical assistance by international community in order to effectively establish the YUTA and BRT Management Agency and to develop their capacity.

Objectives of this technical assistance project includes mainly as follows:

(i) Assistance with setting up YUTA

(ii) Build the essential function and capability of YUTA, being responsible for urban transport as a whole; and public transport in particular

(iii) Training of personnel, and transferring skills and technology.

Assistance can also be considered for establishing the organisation and functions of the SOE which will serve as the BRT Management Agency.

5 ONGOING AND PROPOSED PROJECTS

On-going Projects

This section provides an outline of all major on-going projects in Yangon Region by various transport related agencies.

- Roads & Bridges (Engineering Department), YCDC is currently upgrading some major roads to the concrete ones under local funding.
- Yangon has constructed flyovers at Hledan, Shwe Gone Tine and Bayint Naung junctions. Hledan finished in April, while Shwe Gone Tine flyover finished in December of this year. Bayint Naung flyover includes two bridges crossing each other and finished in November.
- No. (2) Bayint Naung Bridge spanning Hlaing River which is parallel with the existing Bayint Naung Bridge is under construction by Public Works, Ministry of Construction. The construction was started on 2012 and expected to be finished on mid-2014.
- Recently, Myanmar Government (mainly MORT, instructed by President) keen to implement BRT system in Yangon. A BRT technical support committee has been formed by Yangon Region Government on 25 July, 2013, with 14 members from YCDC, transport-related organizations and bus lines committee. Yangon Region Government has requested the BRT technical support committee to prepare implementation plan for BRT. The committee has a regular meeting almost every week.
- YCDC and traffic police have designated tow-away zones on 37 roads in Yangon. The authority has started taking action against the offending motorists in line with the YCDC vehicle regulations and fines and 64 cars have been towed until 14 November, 2013.
- Yangon circular railway has been equipped with a new train on 1 November 2013. The new train has 6 carriages with room for up to 648 passengers and tickets cost 300 kyats each. It circles round the city four times. Currently JICA study team, collaboration with MR, MORT is conducting “Technical Assistant for Railway Safety and Service Improvement Project” to establish improvement plan of operation for enhancement of safety and service. Since Yangon Circular Railway signal system is quite old and has many problems such as frequent malfunction with no changing signal colour due to fail-safe system worked by shirt-circuited track circuit by water-soaked track in every rainy season. In order to eliminate the problems, appropriate safety facilities such as OCC, electronic interlocking device, etc., will be installed as urgent countermeasure by JICA grant aid. Therefore, JICA study team, cooperation with MR, currently studying in order to decide the scope of grant aid for railway safety facilities.
- JICA study team, collaboration with IWT and MPA, is currently conducting “The Project for Upgrading Ferry Boats in Yangon City” to improve safety by replacing the existing aged boats by 3 new ferries for Yangon-Dala ferry service. Construction of 3 ferry boats in Japan will be completed in October 2014. Ferry boats will be transported to Yangon and handed over to IWT in October 2014. The estimated maximum project cost is JPY 1,168,000,000.
- Moreover, JICA study team, cooperation with MPA, is also conducting “The Urgent

Project for Rehabilitation of Yangon Port and Main Inland Water Transport in the Union of Myanmar" to make recovery plans of the Yangon port facilities, dockyard facilities and navigation system. The project area shall cover Yangon port and four major routes of inland water transport ways, operated by IWT in Delta Area. As a pilot project, re-construction of Dala Jetty is planned by JICA support.

- Japanese private companies concluded an agreement on 10 September 2013 with Ministry of Transport, on the "Project for Improvement of Nationwide Airport Safety and Security" to improve aviation safety at Myanmar's international and major airports (Yangon, Mandalay, Nyaung-U, Heho, Thandwe and Dawei). The project will be implemented with 1.233 billion yen by JICA Grant Aids.

Projects Proposed/Planned by Various Agencies

This section outlines numerous transport related projects, which have been proposed/planned by various transport related agencies.

- Public Works, Ministry of Construction has planned to upgrade road infrastructure on Thanlyin-Thilawa Road, East Dagon-No. (2) Main Road, Thilawa-East Dagon Road, and Yangon-Mandalay New Expresses way, in cooperation with international agencies by Grant Aids or loans.
- Moreover, there are also 6 new bridge construction programs proposed by Public Works, MOC. These are Thaketa Bridge No. (2), Bago River Bridge, Wartayar Bridge, Aye ywar Bridge, Korea-Myanmar Friendship Dala Bridge, Thilawa – Thakhut Yangon River Bridge.
- Yangon Region Government is planning to construct a flyover at the Myaynigone Intersection. The project is estimated to cost around Kyats 17 billion and the money is expected to come from Yangon's regional government budget of next fiscal year as well as from international agencies to cover some expenses.
- Road Transport (RT), MORT has offered tender to local and foreign companies to operate public transport services as a joint venture with the department. The selected local companies; Forever Green Right Services Co., Ltd. and San Yaung Ni Co., Ltd.; in joint venture with RT, has submitted the proposal for their project at Myanmar Investment Commission (MIC), awaiting the approval to start the project. The project includes construction of bus terminals, vehicles maintenance and passengers' transportation.
- YCDC has planned to implement parking areas in Yangon, but it depends on ground conditions and budget availability. Furthermore, according to YCDC, Yangon authorities are planning to build a multi-storey car parking in downtown area in a land plot owned by YCDC. However, it did not disclose the details of the construction plan.
- Yangon-Mandalay railway will be upgraded and modernized. .
- MPA is planning to build 7 new wharves which will be located in Ahlone forestry compound and Thein Phyu shipyard. It is expected to handle about 85% of the import and export cargo coming into Myanmar. Myanmar Economic Corporation (MEC) will build the new wharves in Ahlone forestry compound. In addition, there are Yangon port

development projects, such as Expansion of Botahtaung Foreshore, Upgrading Lanmadaw Foreshore Area, Upgrading Sule Pagoda Wharves Area, and Upgrading Nanthidar Jetty, which are either planned or scheduled to be started in the near future.

- Myanmar is set to build a new international airport, to be called Hanthawaddy International Airport, which is located in Bago Region. It covers an area of 3,912 hectares which will be 9 times larger than existing Yangon International Airport and will be capable of handling at least 12 million passengers per year.
- South Korea Incheon Airport Consortium won the tender for building Hanthawaddy International Airport. The estimated project cost is about USD 1.5 billion. The airport will be developed under BOT agreement. Construction will be started on 2014 and is expected to be completed by the end of 2017, and start operating by the beginning of 2018. The airport will remain under Incheon's ownership until 2067, at which time control of the airport will be transferred to the Myanmar government. Yangon is now Myanmar's financial hub. However, the country hopes to create a second commercial hub around the Hanthawaddy International Airport, and possibly build a high-speed train network connecting the two cities. At the moment, it is just a proposal and the detailed plan has not yet been made whether the Hanthawaddy-Yangon link would comprise rail as well as road, or how the proposed connection would dovetail with existing road and rail connections into Yangon.
- A consortium led by Asia Worldof Myanmar, won tender for upgrading existing Yangon International Airport. The existing Yangon International Airport is capable of handling 2.7 million passengers a year and an extension is planned to bring 6 million passengers by 2017. The estimated cost is USD 150-170 million.

6 MASTER PLAN 2035

This chapter introduces the outline of master plan and proposed projects. Refer to ***Chapter 6*** *in Final Report Volume 1* for detailed information.

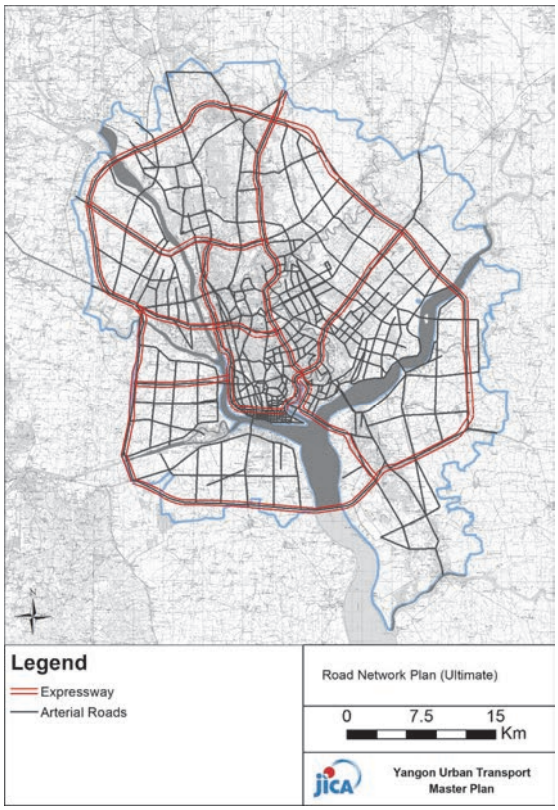
6.1 Transport Network Planning

Road Transport Network Formation

Based on the demand/supply gaps identified earlier, the “Do-maximum” transport network was first prepared. This is the basis for the master planning where unnecessary transport links or routes are removed vis-à-vis the result of traffic assignment. The Do-maximum network is shown in Figure 6.1.1.

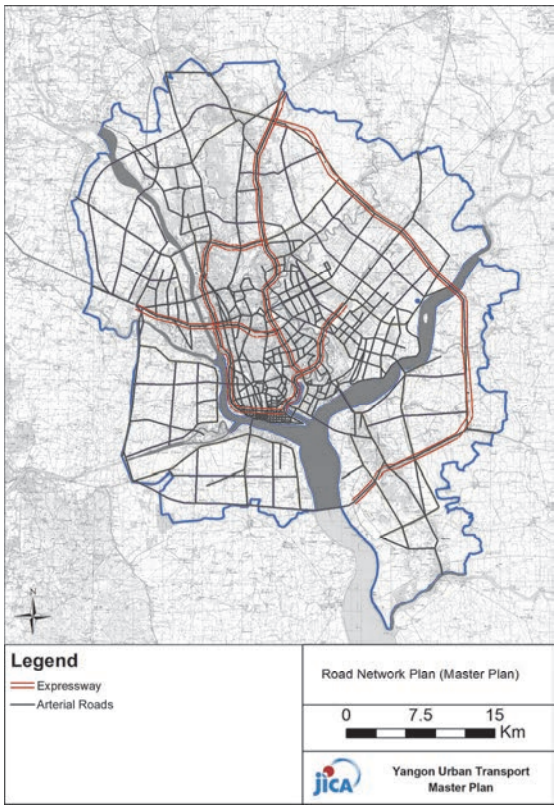
Judging from the result of demand forecast, traffic demand is scarce on some of the road links, and they are considered overinvestment for the master plan by 2035, and were excluded. The Outer Ring Road (ORR) has also shown only little loadings, and should have been excluded naturally. Due, however, to the strategic importance as the national freight corridor, the eastern half of the Outer Ring Road (the section between the entrance/exit to/from the Yangon – Mandalay Expressway and Thilawa SEZ) was re-categorized as a mid-term project. This is consistent with the national transport study (MYT-Plan).

The recommended road network is presented in Figure 6.1.2, and Figure 6.1.3 shows its breakdown to short-, middle- and long-term.



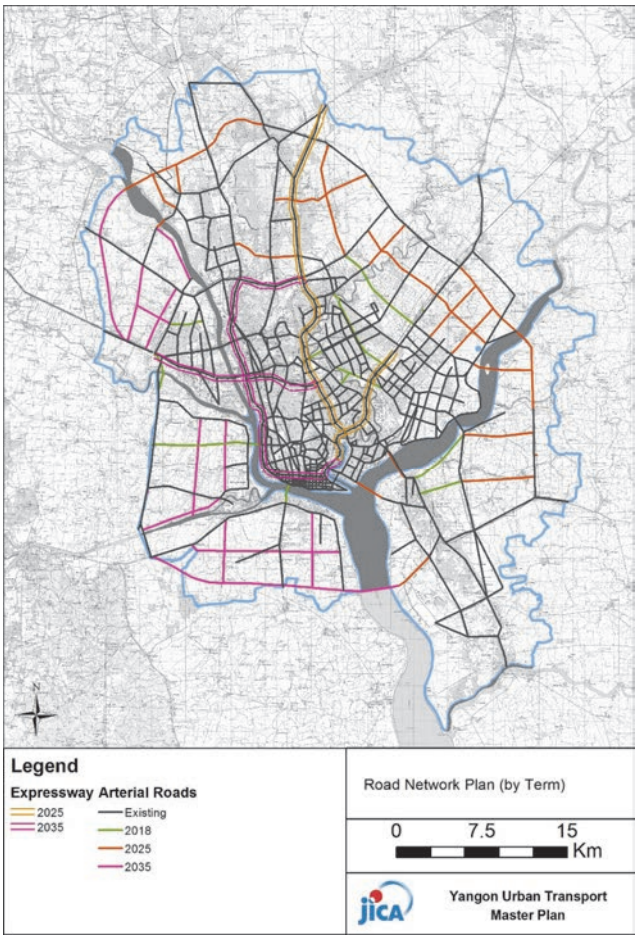
Source: YUTRA Project Team

Figure 6.1.1 Do-maximum Road Network



Source: YUTRA Project Team

Figure 6.1.2 Recommended Road Network for 2035



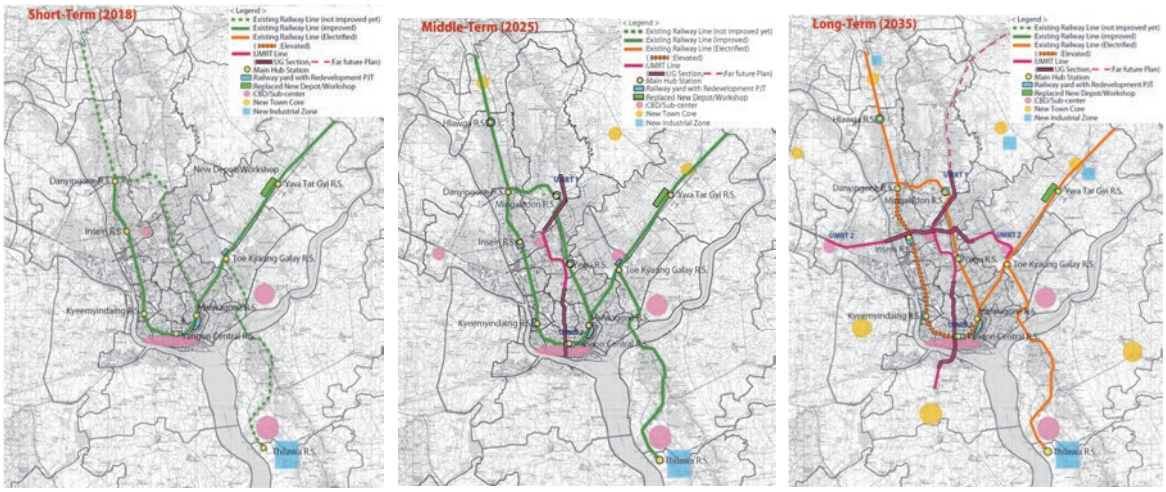
Source: YUTRA Project Team

Figure 6.1.3 Recommended Road Network for Short-, Middle- and Long-term

Railway and BRT Network Formation

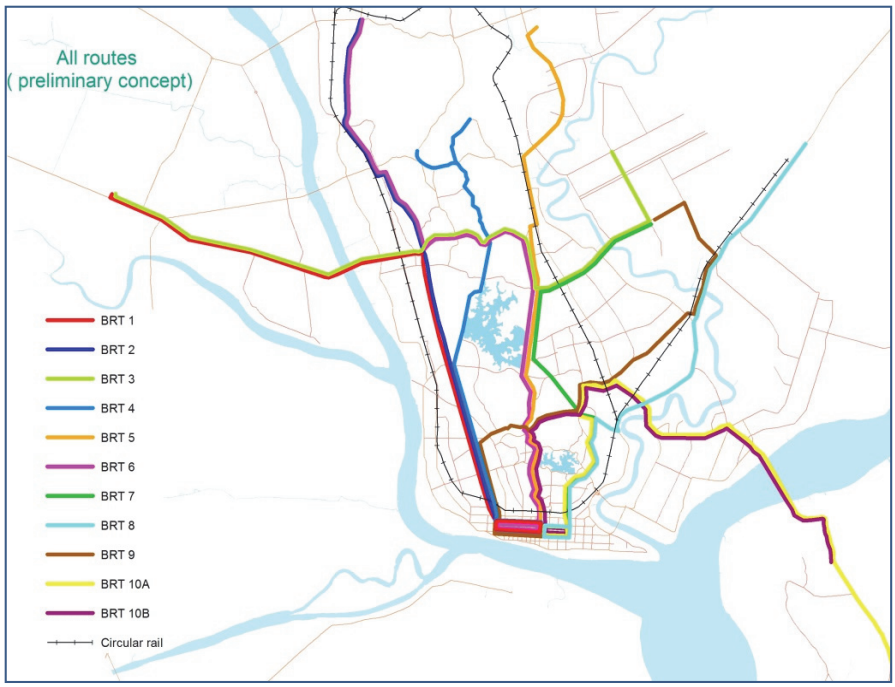
Based on the results of demand forecast, three alternative route networks were formulated at first. Considering the total balance including i) layout balance of North-South axis and East-West axis, ii) connectivity among railway lines (number of transfer stations), the most suitable alternative was selected. The following figure presents the recommended network. After the railway network is established, integration between railway network and other public transport network especially of BRTs and buses is essential.

Based on the traffic demand forecast and road condition, BRT network was planned as shown below. All BRTs are proposed as short-term project to be implemented by 2018.



Source: JICA Project Team

Figure 6.1.4 Recommended Railway Network for Short-, Middle- and Long-term



Source: YUTRA Project Team

Figure 6.1.5 Recommended BRT Routes

Transport Network Assessment

Figure 6.1.6 and Figure 6.1.7 show the result of traffic assignment for 2013 and 2035, respectively.

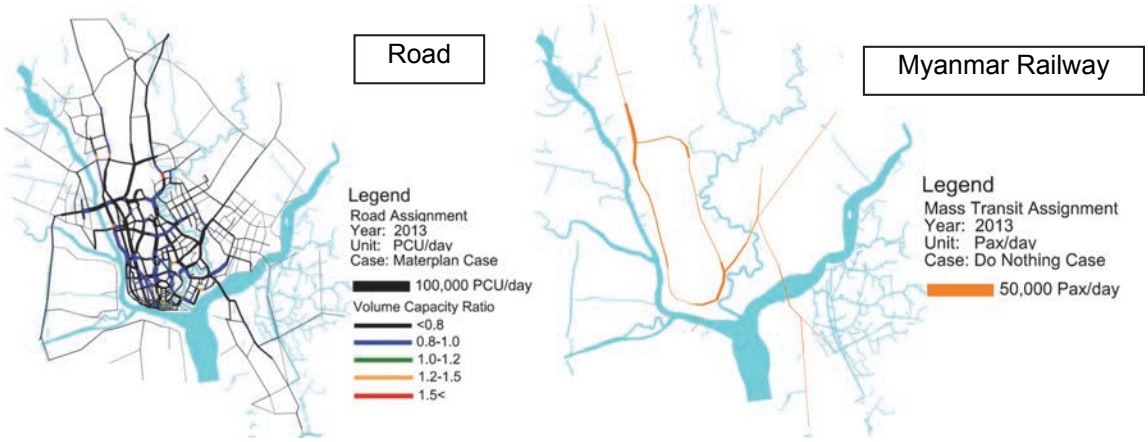
Table 6.1.1 summarises the transport network performance for 2013, 2018, 2025 and 2035. Even after implementing all the proposed projects, road network performance will deteriorate gradually towards 2035. The largest advantage of this master plan is the increasing share of mass transit (Myanmar Railway, UMRT and BRT). The overall share of public transport will decrease significantly, however, will remain relatively high against the

pressure of rapid motorization.

Table 6.1.1 Transport Network Performance

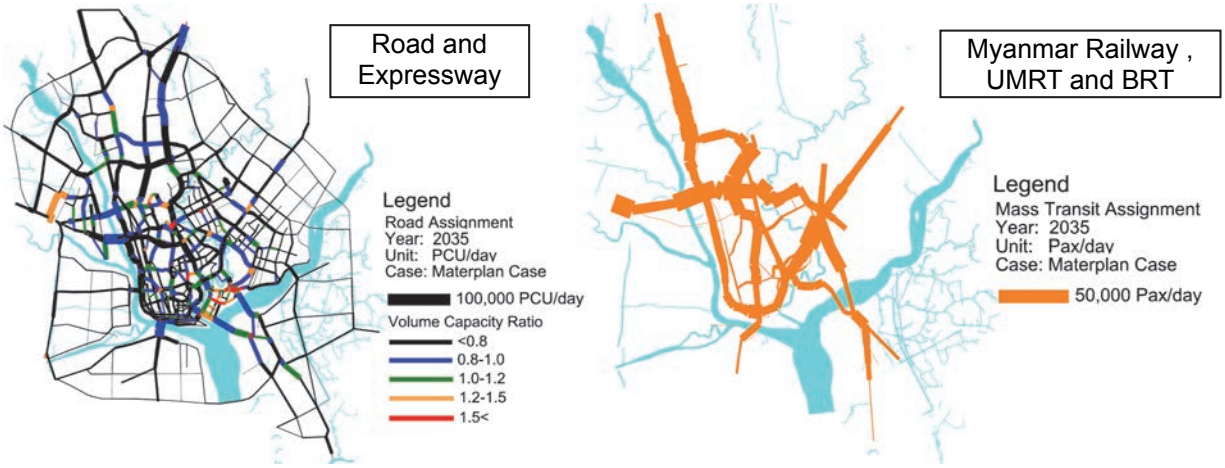
Indicator	2013	2018	2025	2035
Average volume/ capacity ratio (road)	0.27	0.35	0.34	0.42
Average travel speed (kph, road)	30	22	28	24
Public transport share in terms of pax-km (%)	74	65	63	58
Mass transit share in terms of pax-km (%)	1	12	21	22

Source: YUTRA Project Team



Source: YUTRA Project Team

Figure 6.1.6 Assigned Traffic Volume, 2013



Source: YUTRA Project Team

Figure 6.1.7 Assigned Traffic Volume, 2035

6.2 Major Master Plan Projects

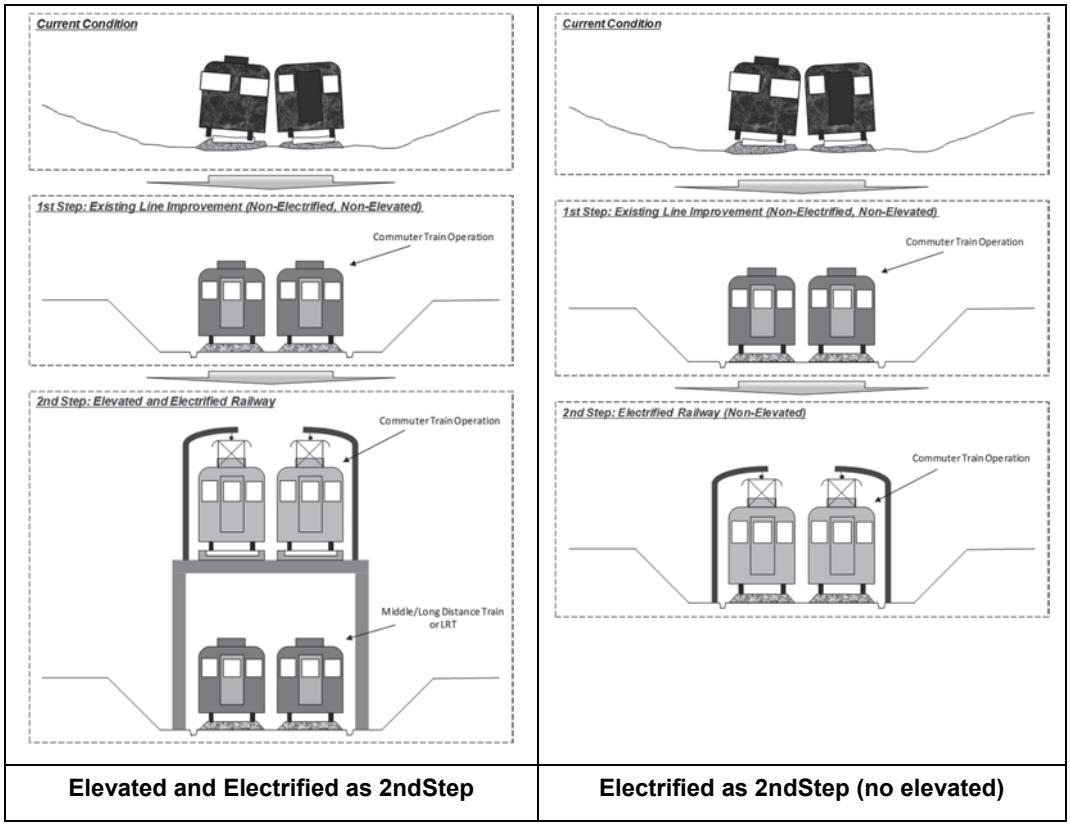
1) Urban Railway Projects

Urban Railway Projects are composed of three types of projects, i) Urban Sections of Existing Myanmar Railway, ii) Urban Railway, and iii) Transit Oriented Development (TOD). In order to enhance the project effect, these projects should be collaborated intimately

Urban Sections of Existing Myanmar Railway

Improvement and modernization of urban sections of the existing MR lines becomes a basis of railway development in Yangon city. Improvement and modernization of urban sections of the existing MR lines has some merits such as i) immediate effectivity due to passing many developed areas with high population density, ii) relatively low initial cost due to existing infrastructure utilization (therefore, the implementation is easy relatively for Myanmar government, which need huge budget for many infrastructure rehabilitation.), and iii) no or little land acquisition and resettlement is required due to locating inside MR yard, etc.

In order to fulfill effective modernization for the existing railway, step-development will be applied as below.



Elevated and Electrified as 2ndStep	Electrified as 2ndStep (no elevated)

Source: YUTRA Project Team (2013)

Figure 6.2.1 Step-Development for Existing Railway Lines

Urban Railway

Judging from the future population increase with increasing the number of trip, it is essential to install Urban Mass Rapid Transit (UMRT) with high speed, high frequency, and high transport capacity, in addition to the existing railway modernization. On the other hand, the installation timing should be set properly due to requiring huge cost for both initial construction and operation and maintenance. The installation timing is decided based on the actual example of relation between UMRT opening year and GRDP in Asian major cities. Two UMRT lines are proposed.

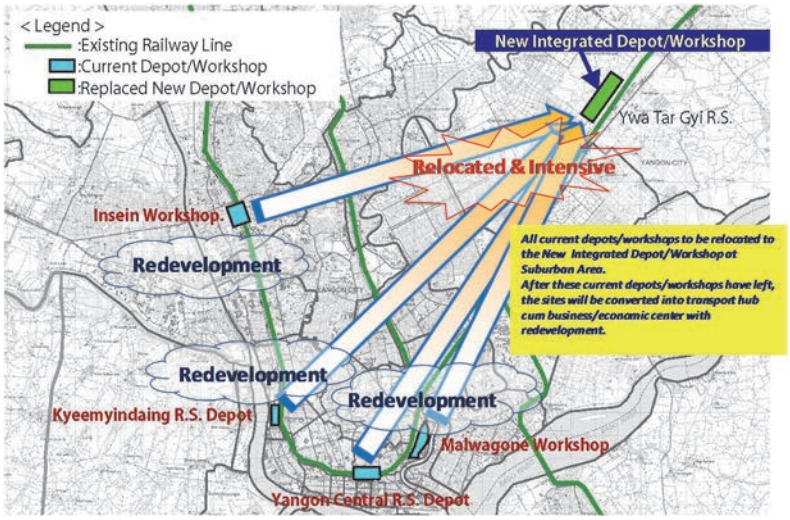
Transit Oriented Development (TOD)

The key to be succeeded in railway project is to enhance ability to attract potential passengers by developing stations as business/commercial center and transport hub by yard redevelopment, land development along railway, transport hub function enhancement, feeder function enhancement, etc. In other word, it is important to conduct TOD projects, which means citizens can access everywhere in the city by public transport (mainly railway) and walking and station becomes attractive in terms of commercial and economical aspect, in harmonized with railway projects spatially and timely.

The Study plans to develop railway yards and high potential vacant lots along the urban sections of the existing lines in harmonized with its improvement / modernization timely. Four yards (Yangon Central station yard, Malwagone depot and workshop yard, Insein workshop yard, and Kyeemyindaing station yard) have high development potential due to large area. Especially, it is expected that Yangon Central station yard located at the center of CBD will be developed early due to current high interest from several private developers. However, in case of private oriented development, there is a possibility to be insufficient public facilities required as basic station function to fulfil TOD such as transfer facility, pedestrian deck, impediment removal design, seamless flow line design, effective station plaza, emergency facility, etc., because private developer is apt to be development to require short-term gain. Therefore, it is important that Myanmar government side makes regulation for development from a leading position and takes appropriate right and responsibility.

In addition, it is important to create virtuous cycle by reflowing the huge development benefits from TOD towards railway upgrades, new construction, renewals, etc. in order to realize further service level improvement

Furthermore, in order to conduct yard redevelopment project, it is required to relocate the current function such stabling and maintaining rolling stocks, etc. to somewhere in advance. The relocation work should be conducted by using development benefit obtained from private developer, because it is recognized as a part of redevelopment project.

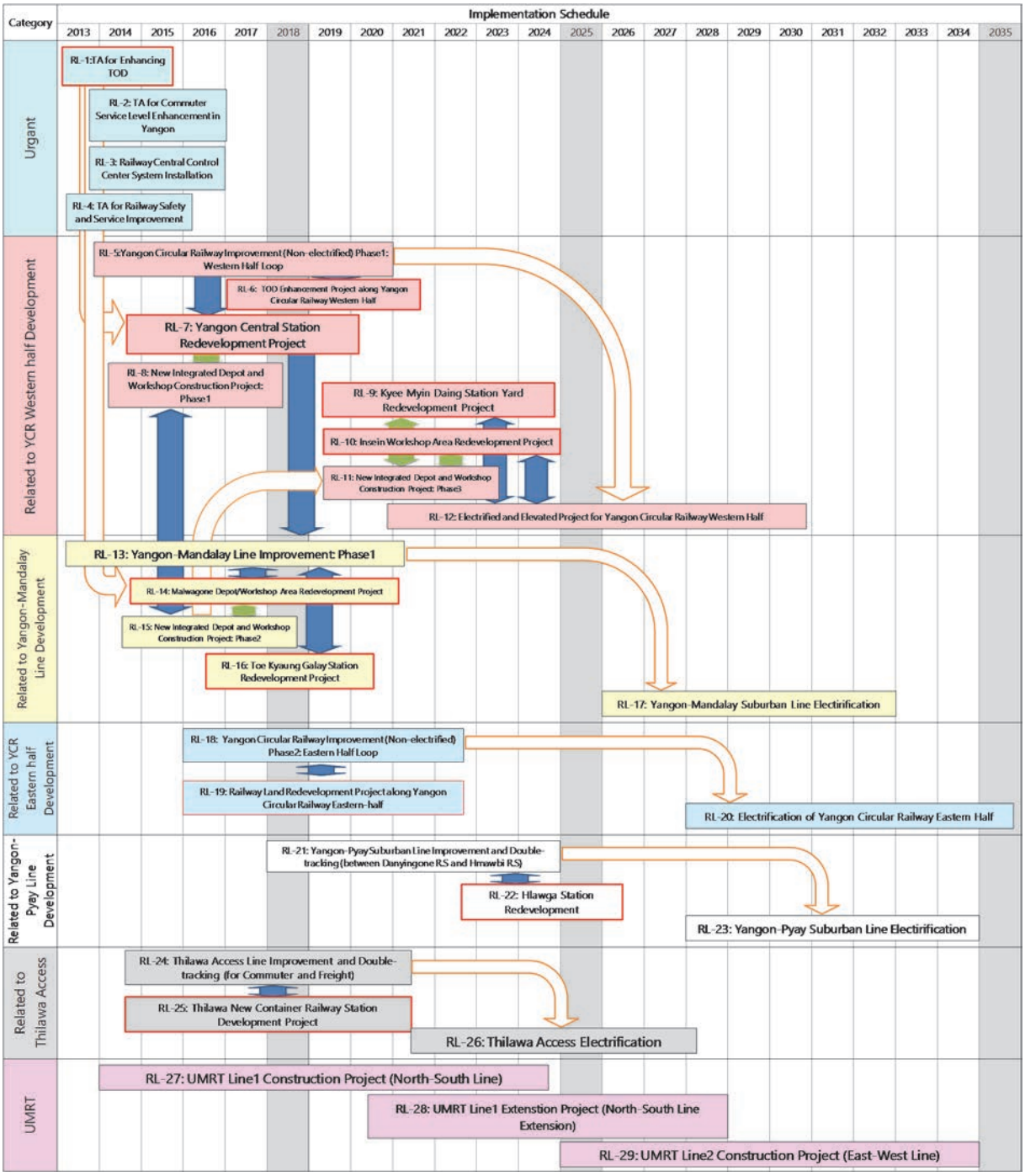


Source: YUTRA Project Team (2013)

Figure 6.2.2 Schematic Figure of Relocation of Existing Depots and Workshops to New Integrated Depot/Workshop

Implementation Schedule

The chronological correlation diagram among proposed railway projects and proposed TOD projects including yard redevelopment projects is shown in the figure below. The study prepares a scenario to enhance reciprocal development effects among all projects.



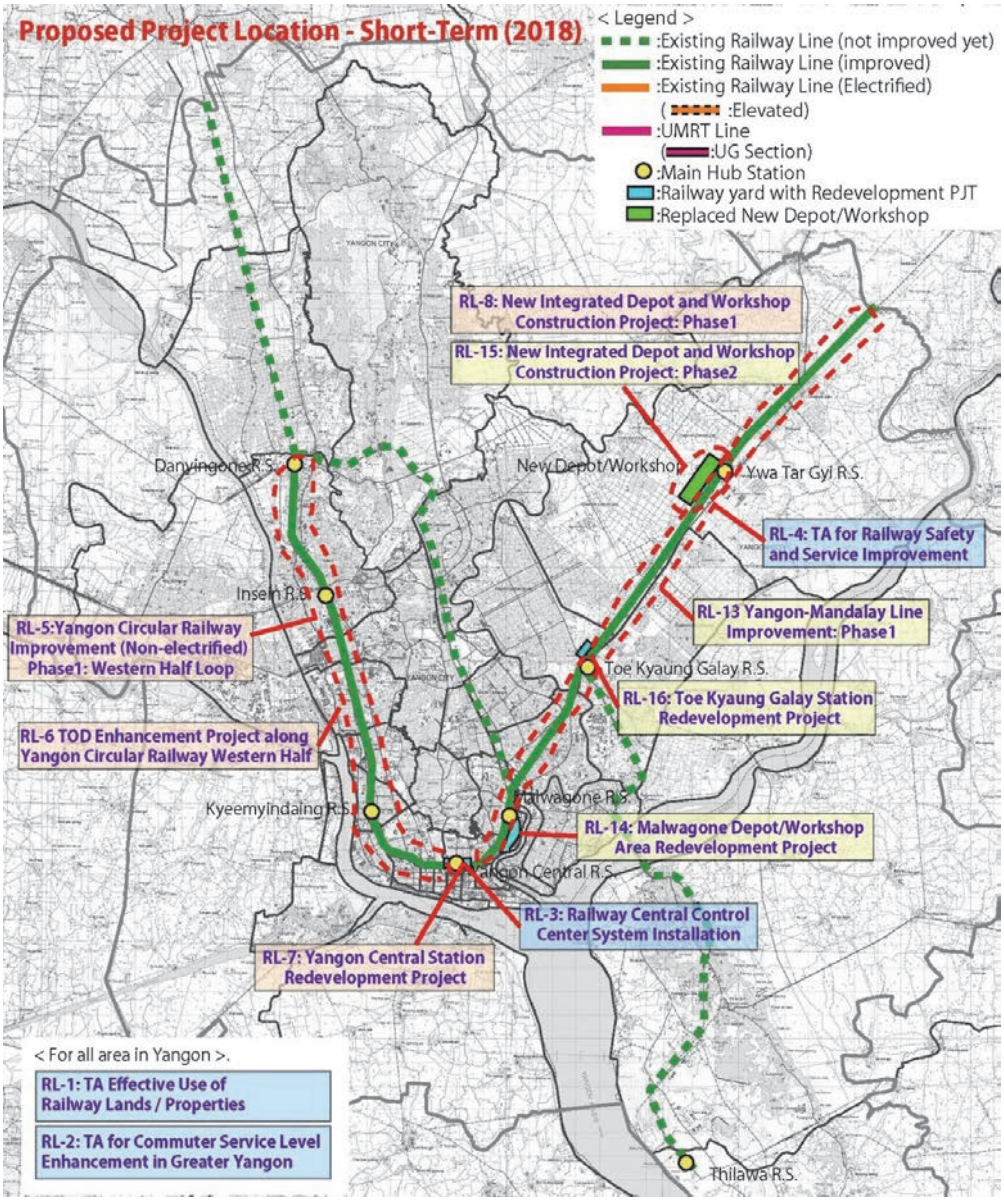
Source: YUTRA Project Team (2013)

Figure 6.2.3 Chronological Correlation Diagram among Railway Projects and TOD/Land Redevelopment Project

The location maps of the proposed projects for short-term, middle-term and long-term are

shown in the following three figures respectively.

For short-term, it is planned to enhance transport capacity of V shape line connecting Danyingone station with Ywa Tar Gyi station via Yangon Central station by improving Yangon Circular Railway Western Half and Yangon-Mandalay Line. In addition, yard redevelopment projects along these lines will be conducted in parallel in order to increase railway user and enhance ability to attract customers. Furthermore, relocation and integration of existing depots and workshops, which is required in connection with yard development, will be implemented simultaneously.



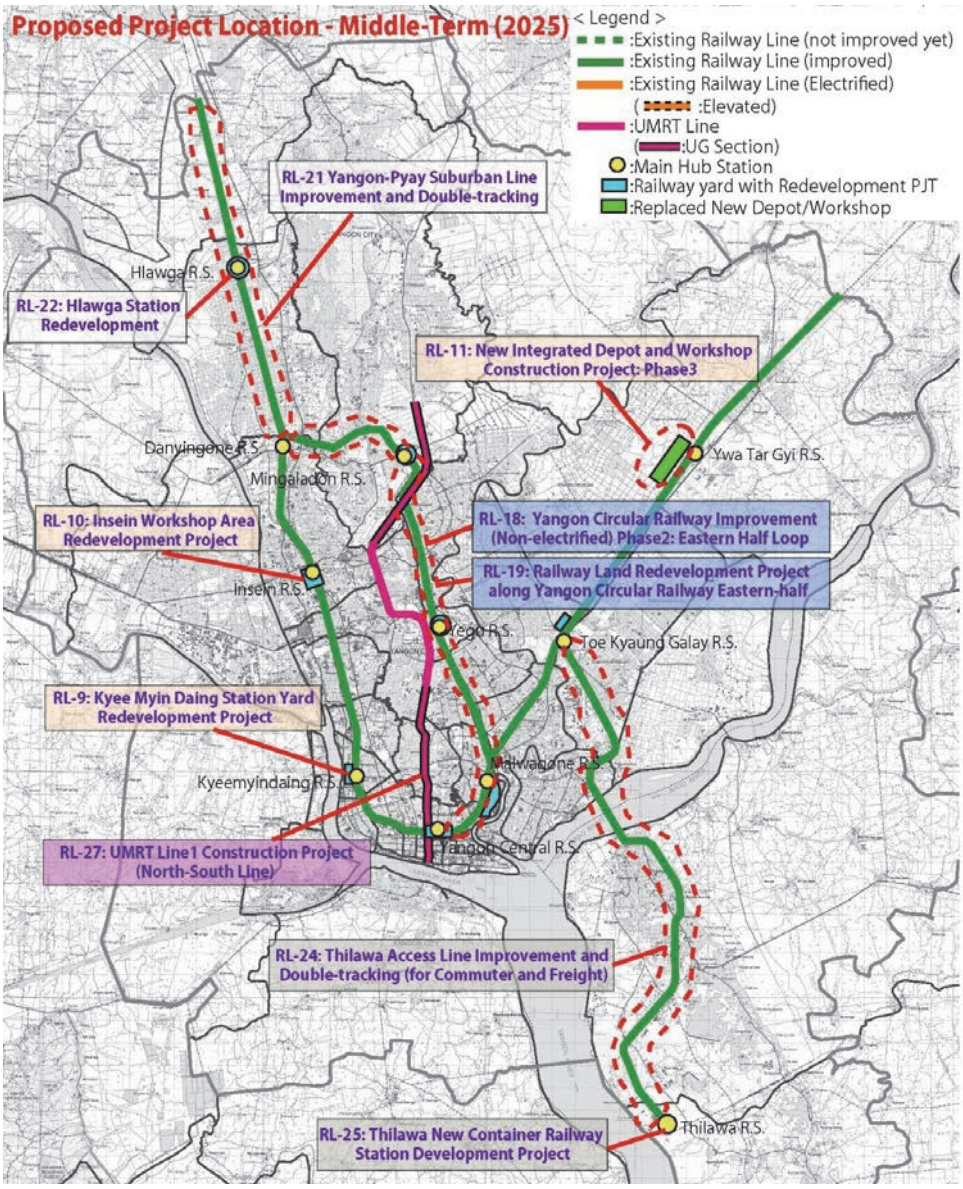
Source: YUTRA Project Team (2013)

Figure 6.2.4 Proposed Project Location Map for Short-term

For middle-term, it is planned to improve the remaining sections of the existing lines (Yangon Circular Railway Eastern Half, Yangon-Pyay line suburban section, Thilawa access line), and to conduct projects for yard redevelopment and land development along these lines in parallel in order to fulfill further increasing railway user and enhancing ability

to attract customers. Expansion of the new integrated depot and workshop will be implemented simultaneously in connection with yard development.

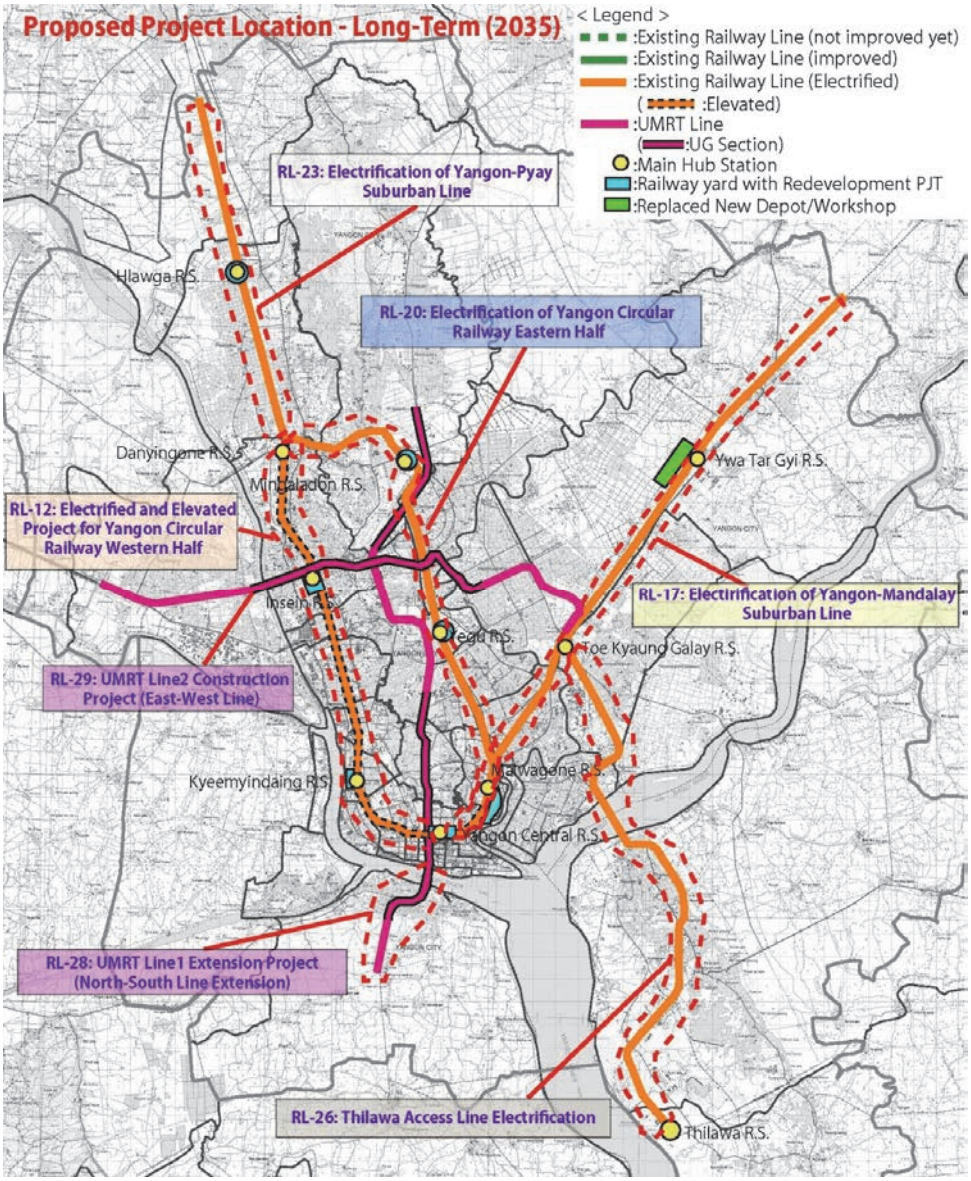
Furthermore, UMRT Line1 which is named as North-South Line connecting CBD with Yangon International Airport via Yangon Central station and Mindama sub-center will be installed as first metro in Yangon. In order to minimize initial cost, it is planed underground section is minimized as much as possible, and elevated section is applied maximally. In addition, it is emphasized that it is essential to establish an implementation and operation body for UMRT exclusively in order to succeed in UMRT projects, judging from examples of other countries. The study is proposing to establish YUTA as organization for managing urban transport in Yangon. Therefore, it is proposed to establish an UMRT implementation and operation body, for example “UMRTA (UMRT Authority)”, under the umbrella of YUTA prior to UMRT project commencement.



Source: YUTRA Project Team (2013)

Figure 6.2.5 Proposed Project Location Map for Middle-term

For Long-term, it is planned to electrify and partially elevate existing lines which were improved as first step in short or middle term, in order to fulfill further transport capacity enhancement and speed-up, and reducing operation cost. Regarding UMRT, extension of UMRT Line 1 and new construction of additional line will be implemented in order to expand railway network.



Source: YUTRA Project Team (2013)

Figure 6.2.6 Proposed Project Location Map for Long-term

List of abovementioned projects with the implementation schedule for all terms is shown in the table below.

Table 6.2.1 Overall Project List (1/3)

No.	Category	Project Name	Status	Implementation Schedule	Remarks
RL-1	Urgent	TA for the Integration of Rail Transport Improvement and Station Area Urban Development in Yangon (Enhancing Transit Oriented Development)	Urgent		- Establish redevelopment rule/standard for railway land in which many private developers will be interested by using PPP scheme, etc. - To prepare plan and necessary documents for Yangon R.S. and Malwagone W.S. relocation/redevelopment, and railway infrastructure development by using the development benefit (inc. preparing demarcation between public and private, standard contract document, standard tender document/TOR)
RL-2	Urgent	TA for Commuter Service Level Enhancement in Greater Yangon	Urgent		(1) Support to establish an effective train operation plan and diagram for commuter, (2) establishing "Commuter Service Improvement Dept." and the capacity building, and (3) Technical Assistance for the existing passenger wagon interior upgrade work for commuter.
RL-3	Urgent	Railway Central Control Center System Installation (The study is ongoing by JICA)	Urgent		The study is ongoing by JICA as potential grant project.
RL-4	Urgent	TA for Railway Safety and Service Improvement (Ongoing by JICA)	Urgent		- Ongoing by JICA TA - Technical transfer for track maintenance skill by using Yangon-Mandalay suburban line. - Technical standard Preparation.
RL-5	Related to YCR Western half Development	Yangon Circular Railway Improvement (Non-electrified) Phase1: Western Half Loop	Short-term		- Improvement as commuter line for app. 21km between Yangon R.S. and Danyingone R.S. - Scope is improvement of civil, track, existing depot/workshop, modernization of signal.&telecom, station, automatic level crossing, DEMU procurement.
RL-6	Related to YCR Western half Development	TOD Enhancement Project along Yangon Circular Railway Western Half	Short-term		- conducted as additional project of Yangon Circular Railway Improvement Phase1: Western Half Loop - provide station plaza with bus stop/terminal at Kyeemyindaing R.S., Insein R.S., and Danyingone R.S.
RL-7	Related to YCR Western half Development	Yangon Central Station Redevelopment Project	Short-term		- assumed as PPP project - At first, the depot function in the yard is relocated, and the station yard is redeveloped as transport hub and business/economic center. - Developer is obliged to install the following infrastructures by the development benefit; RL-8: New Depot and Workshop Project Phase1.
RL-8	Related to YCR Western half Development	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase1	Short-term		- assumed as PPP. - Relocation of current depot forced by "RL-7 Yangon Central Station Redevelopment Project". The project cost should be born by RL-7's development profit. - Proposed site is the northern side of Ywa tar Gyi R.S. which is owned by MR.
RL-9	Related to YCR Western half Development	Kyee Myin Daing Station Yard Redevelopment Project	Middle-term		- assumed as PPP. - At first, the depot function in the yard is relocated, and the station yard is redeveloped as transport hub and business/economic center. - Developer is obliged to install the following infrastructures by the development benefit; RL-11: New Depot and Workshop Project Phase3.
RL-10	Related to YCR Western half Development	Insein Workshop Area Redevelopment Project	Middle-term		- assumed as PPP. - At first, the workshop function in the yard is relocated, and the yard is redeveloped as transport hub and business/economic center. - Developer is obliged to install the following infrastructures by the development benefit; RL-11: New Depot and Workshop Project Phase3.

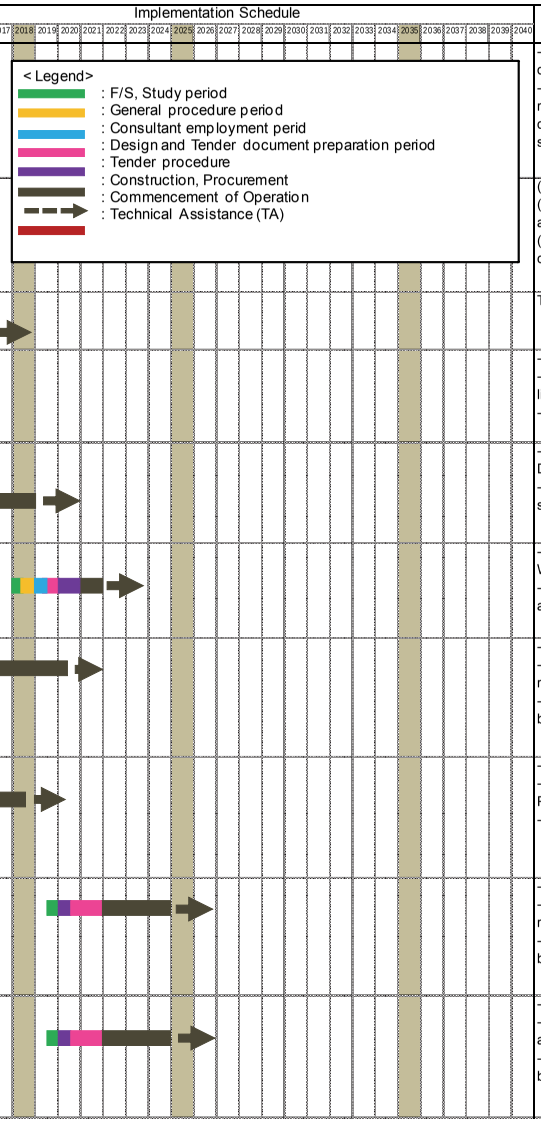


Table 6.2.2 Overall Project List (2/3)

No.	Category	Project Name	Status	Implementation Schedule	Remarks
RL-11	Related to YCR Western half Development	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase3	Middle-term		- assumed as PPP. - Relocation of current depot forced by "RL-9 Kyee Myin Daing Station Yard Redevelopment Project" and "RL-10 Insein Workshop Area Redevelopment Project". The project cost should be born by RL-9 and RL-10's development benefit. - Proposed site is the northern side of Ywa tar Gyi R.S. which is owned by MR.
RL-12	Related to YCR Western half Development	Electrified and Elevated Project for Yangon Circular Railway Western Half	Long-term		- Electrified elevated railway to be constructed above the at-grade YCR. Because of this, purpose of at-grade line tobe changed for middle-long distance train/freight train. - The project should be conducted by maximum using of the development benefit from RL-9 Kyeemyindaing Redevelopment and RL-10 Insein Redevelopment.
RL-13	Related to Yangon-Mandalay Line Development	Yangon-Mandalay Line Improvement: Phase1 (Partial operation)	Short-term		- Infrastructure improvement will be conducted by Japanese Loan. - Infrastructure improvement is as non-electrified and the target section is between Yangon Central Station and Toungoo R.S. However, regarding The section between Yangon Central Station to Malwagone R.S, civil and track are not included. - Additional DEMU procurement is estimated as commuter train.
RL-14	Related to Yangon-Mandalay Line Development	Malwagone Depot/Workshop Area Redevelopment Project (including Track Improvement between Yangon Central Station and Malwagone Station)	Short-term		- assumed as PPP. - At first, the workshop function in the yard is relocated, and the yard is redeveloped as transport hub and business/economic center. - Developer is obliged to improve civil/track between Yangon Central Station and Malwagone R.S. and install the following infrastructures bythe development benefit; RL-15: New Depot and Workshop Project Phase2.
RL-15	Related to Yangon-Mandalay Line Development	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase2	Short-term		- assumed as PPP. - Relocation of current depot forced by "RL-14 Malwagone Workshop Redevelopment Project". The project cost should be born by RL-14's development benefit. - Proposed site is the northern side of Ywa tar Gyi R.S. which is owned by MR.
RL-16	Related to Yangon-Mandalay Line Development	Toe Kyaung Galay Station Development Project	Short-term		- assumed as PPP. - Station area redevelopment and enhancement of transport hub function
RL-17	Related to Yangon-Mandalay Line Development	Yangon-Mandalay Suburban Line Electirification	Long-term		- Electrification between Yangon Central Station and Ledaungan R.S.
RL-18	Related to YCR Eastern half Development	Yangon Circular Railway Improvement (Non-electrified) Phase2: Eastern Half Loop	Middle-term		- The project should be conducted by maximum using of the development benefit from "RL-14 Malwagone Workshop Redevelopment".
RL-19	Related to YCR Eastern half Development	Railway Land Redevelopment Project along Yangon Circular Railway Eastern-half	Middle-term		- assumed as PPP. - to enhance transport hub function and develop station plaza of the main stations (Mingalardon R.S., Yegu R.S., etc.) along YCR Eastern half. - to be conducted as additional project of RL-18: YCR Improvement Phase2: Eastern Half.
RL-20	Related to YCR Eastern half Development	Electrification of Yangon Circular Railway Eastern Half	Long-term		

Table 6.2.3 Overall Project List (3/3)

No.	Category	Project Name	Status	Implementation Schedule	Remarks
RL-21	Related to Yangon-Pyay Line Development	Yangon-Pyay Suburban Line Improvement and Double-tracking (between Danyingone R.S and Hmawbi R.S)	Middle-term		
RL-22	Related to Yangon-Pyay Line Development	Hlawga Station Development	Middle-term		assumed as PPP.
RL-23	Related to Yangon-Pyay Line Development	Yangon-Pyay Suburban Line Electrification	Long-term		
RL-24	Related to Thilawa Access	Thilawa Access Line Improvement and Double-tracking (for Commuter and Freight)	Middle-term		- Double-tracking the existing Thilawa branch line - Regarding across Bago river, Bago bridge which will be constructed newly is to be road-cum-railway bridge. - Container train will pass Bago bridge, not existing bridge, due to the limitation of construction gauge.
RL-25	Related to Thilawa Access	Thilawa New Container Railway Station Development Project	Middle-term		- Additional project of "RL-24: Thilawa access line improvement". - The station is for container and bulk carge handling from/to Thilawa port and SEZ.
RL-26	Related to Thilawa Access	Thilawa Access Line Electrification	Long-term		
RL-27	UMRT	UMRT Line1 Construction Project (North-South Line)	Middle-term		- MRT line linking Sule Pagoda, with Yangon Intl. Airport via Yangon Central Station, Mindama subcenter along mainly Kabar Aye Pagoda Rd. - Length 21.8km (UG:10.5km, EV:11.3km)
RL-28	UMRT	UMRT Line1 Extension Project (North-South Line Extension)	Long-term		- Extension project for RL-27: UMRT line1 to Dala. - 6km extension. (UG: 3.7km, EV: 2.3km)
RL-29	UMRT	UMRT Line2 Construction Project (East-West Line)	Long-term		- MRT line linking with Hlaing Thaya sub-center, Mindama sub-center, and Dagon Myothit sub-center. - Length: 26km (UG: 13km, EV: 13km)

Source: YUTRA Project Team (2013)

Rough Construction and Procurement Cost Estimate (MR, UMRT and TOD)

The rough cost estimate result for construction and procurement work related to railway is shown in the table below. The cost is estimated based on the unit cost per km, per ha, etc. calculated based on the actual project data, related documents, etc. The cost is for initial construction and procurement cost only and does not include the other costs such as engineering service cost, land acquisition and resettlement cost, price escalation, tax, etc.

Table 6.2.4 Rough Construction and Procurement Cost Estimate (MR, UMRT and TOD)

No.	Category	Project Name	Status	Construction Cost (USD	Railway			TOD			Others		
					Short-term	Middle-term	Long-term	Short-term	Middle-term	Long-term	Short-term	Middle-term	Long-term
RL-1	Urgent	TA for the Integration of Rail Transport Improvement and Station Area Urban Development in Yangon (Enhancing Transit Oriented Development)	Urgent	1									
RL-2	Urgent	TA for Commuter Service Level Enhancement in Greater Yangon	Urgent	2									
RL-3	Urgent	Railway Central Control Center System Installation (The study is ongoing by JICA)	Urgent	–									
RL-4	Urgent	TA for Railway Safety and Service Improvement (Ongoing by JICA)	Urgent	–									
RL-5	Related to YCR Western half Development	Yangon Circular Railway Improvement (Non-electrified) Phase1: Western Half Loop	Short-term	485	485								
RL-6	Related to YCR Western half Development	TOD Enhancement Project along Yangon Circular Railway Western Half	Short-term	6				6					
RL-7	Related to YCR Western half Development	Yangon Central Station Redevelopment Project	Short-term	704				704					
RL-8	Related to YCR Western half Development	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase1	Short-term	64							64		
RL-9	Related to YCR Western half Development	Kyee Myin Daing Station Yard Redevelopment Project	Middle-term	220					220				
RL-10	Related to YCR Western half Development	Insein Workshop Area Redevelopment Project	Middle-term	1,144					1,144				
RL-11	Related to YCR Western half Development	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase3	Middle-term	104							104		
RL-12	Related to YCR Western half Development	Electrified and Elevated Project for Yangon Circular Railway Western Half	Long-term	1,260			1,260						
RL-13	Related to Yangon-Mandalay Line Development	Yangon-Mandalay Line Improvement: Phase1 (Partial operation)	Short-term	144	144								
RL-14	Related to Yangon-Mandalay Line Development	Malwagone Depot/Workshop Area Redevelopment Project (including Track Improvement between Yangon Central Station and Malwagone Station)	Short-term	2,684				2,684					
RL-15	Related to Yangon-Mandalay Line Development	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase2	Short-term	244							244		
RL-16	Related to Yangon-Mandalay Line Development	Toe Kyaung Galay Station Development Project	Short-term	220				220					
RL-17	Related to Yangon-Mandalay Line Development	Yangon-Mandalay Suburban Line Electirification	Long-term	425			425						
RL-18	Related to YCR Eastern half Development	Yangon Circular Railway Improvement (Non-electrified) Phase2: Eastern Half Loop	Middle-term	568		568							
RL-19	Related to YCR Eastern half Development	Railway Land Redevelopment Project along Yangon Circular Railway Eastern-half	Middle-term	1,100					1,100				
RL-20	Related to YCR Eastern half Development	Electrification of Yangon Circular Railway Eastern Half	Long-term	398			398						
RL-21	Related to Yangon-Pyay Line Development	Yangon-Pyay Suburban Line Improvement and Double-tracking (between Danyingone R.S and Hmawbi R.S)	Middle-term	500		500							
RL-22	Related to Yangon-Pyay Line Development	Hlawga Station Development	Middle-term	220					220				
RL-23	Related to Yangon-Pyay Line Development	Yangon-Pyay Suburban Line Electirification	Long-term	302			302						
RL-24	Related to Thilawa Access	Thilawa Access Line Improvement and Double-tracking (for Commuter and Freight)	Middle-term	766		766							
RL-25	Related to Thilawa Access	Thilawa New Container Railway Station Development Project	Middle-term	40								40	
RL-26	Related to Thilawa Access	Thilawa Access Line Electrification	Long-term	393			393						
RL-27	UMRT	UMRT Line1 Construction Project (North-South Line)	Middle-term	2,253		2,253							
RL-28	UMRT	UMRT Line1 Extension Project (North-South Line Extension)	Long-term	693			693						
RL-29	UMRT	UMRT Line2 Construction Project (East-West Line)	Long-term	2,730			2,730						
			sum		629	4,087	6,201	3,614	2,684	0	412	40	0
			sub-total				10,917			6,298			452
			total										17,667

Source: YUTRA Project Team (2013)

2) Other Mass Transit Systems including BRT

BRT network for Yangon and Construction Stage

There are 11 BRT routes, however, some of them have overlapping sections and the corridors for construction can be categorized as shown in Figure 6.2.7. The build stages are designed to create an early and effective impact to maximise the opportunity for motorists to use BRT during its early stages and prior to the full network being complete.

Source: YUTRA Project Team

Figure 6.2.7 BRT Corridors for Construction

Implementation Schedule and Cost Estimation

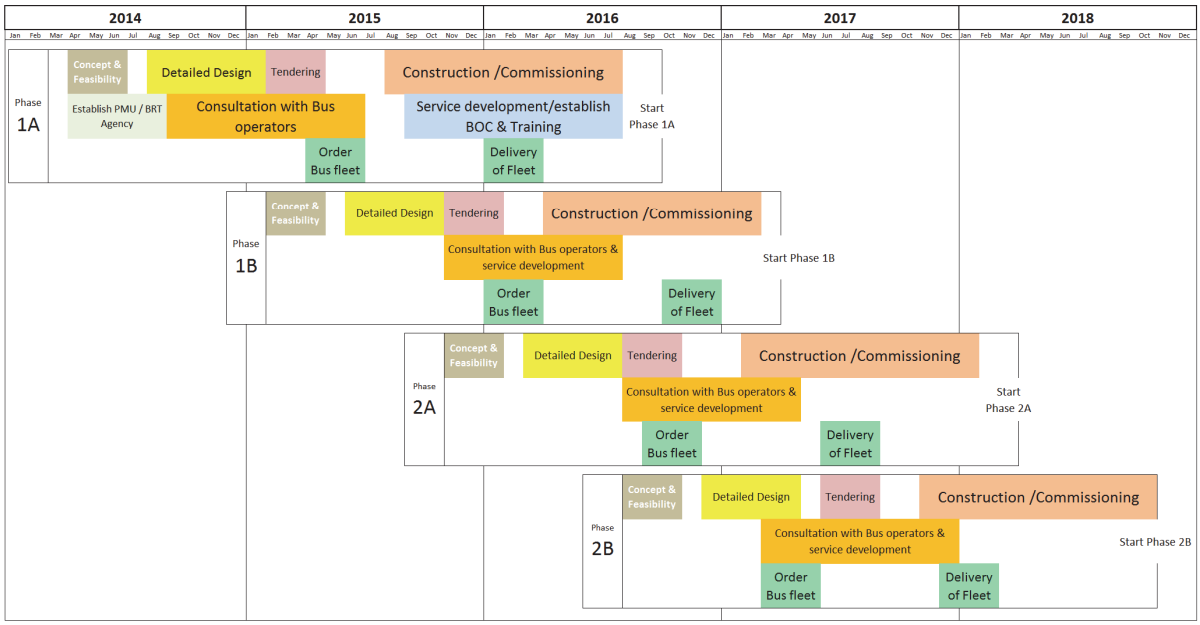
Table 6.2.5 and Figure 6.2.8 show the phases of construction and length of busway construction required for each stage.

Table 6.2.5 BRT Route and Construction Length (per phase)

	Corridor Construction (Km)		BRT Route Length (Km)		Project Cost (USD Mill.)
Phase 1A	Blue Line	22.4	BRT 1 (Red)	24.6	153
	Green Line	27.5	BRT 2 (Blue)	22.5	
			BRT 3 (L/Green)	25.0	
	Subtotal	**49.9**	**Subtotal**	**72.1**	
Phase 1B	Orange Line Section North	8.5	BRT 4 (Light Blue)	18.7	139
	Orange Line Section South	11.4	BRT 5 (Orange)	22.7	
	Red Line	11.2	BRT 6 (Pink)	25.6	
	Subtotal	**31.1**	**Subtotal**	**67.0**	

	Corridor Construction (Km)		BRT Route Length (Km)		Project Cost (USD Mill.)
Phase 2A	Purple Line	20.3	BRT 7 (Dark Green)	19.5	111
	Brown Line	9.7	BRT 8 (Aqua Blue)	20.3	
			BRT 9 (Brown)	21.4	
	Subtotal	**30.0**	**Subtotal**	**61.2**	
Phase 2B	Grey Line	16.9	BRT 10A (Yellow)	23.5	69
			BRT 10B (Purple)	21.1	
	Subtotal	**16.9**	**Subtotal**	**44.6**	
TOTAL		**127.9**	**TOTAL**	**244.9**	**472**

Source: YUTRA Project Team



Source: YUTRA Project Team

Figure 6.2.8 BRT Implementation Schedule by Phase

Conventional Bus

Poorly planned current bus system resulted in bus route overlapping, worsening traffic congestion, and reducing the capacity of public bus transport system. Therefore, restructuring of bus network is required to improve the efficiency of bus operation. This restructuring, however, should be done according to the following principles:

1. A new business model that enables investment on clean and efficient fleet and other modern facilities should be introduced.
2. Rerouting of buses should be conducted as MRTs and BRTs are constructed. Conventional bus should shift step-wise from trunk services to feeder services. In this case, major railway/BRT stations or terminals should provide buses with

enough space for the convenience of transferring passengers.

This is, in one word, a systematic and coordinated approach as the entire public transport system of Yangon. Bus operation is required to change gradually as BRTs and urban railways start operation. This change will be represented by major two movements; 1) modernization of fleet and passenger facilities including bus stops and terminals, and 2) shift from trunk service to feeder service.

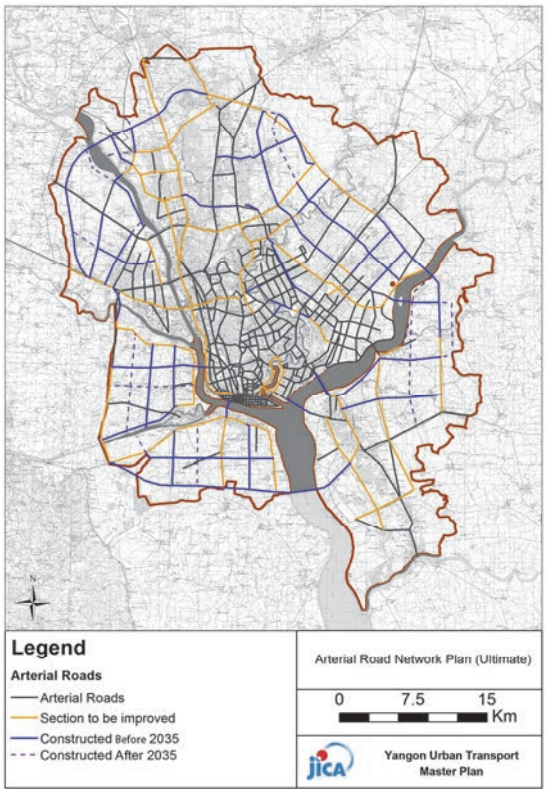
In the light of the above, the following project is proposed. The total cost of this project is about US$ 108 million. Refer to the project profile in the Appendix of this report for details.

- Project Title: Improvement of Existing Public Bus Transport Services in Yangon Region
  - Restructuring of bus network
  - Modernization of bus services
  - Development of bus terminals and interchanges
  - Prioritization of urban bus transport

3) Road Development Projects

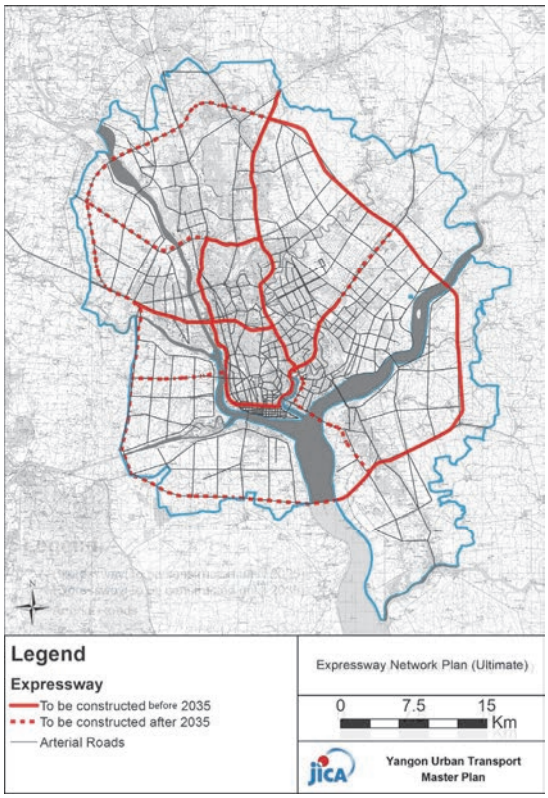
Arterial Road/ Expressway Network Plan

According to the results of traffic demand forecast analysis, arterial road/ expressway network plans in the ultimate stage are shown as Figure 6.2.9 and Figure 6.2.10.



Source: YUTRA Project Team

Figure 6.2.9 Arterial Road Network Plan (Ultimate)



Source: YUTRA Project Team

Figure 6.2.10 Expressway Network Plan (Ultimate)

Typical cross section of Inner Ring Expressway are designed as follows:

- Inner Ring Expressway can be constructed above existing major arterial roads in developed area as elevated viaducts with 4 lanes. Width of traffic lane of existing arterial road shall be narrowed from 3.6 m to 3.0 m, and pier of viaduct is located medium strip.
- North section of Inner Ring Expressway can be constructed as embankment.

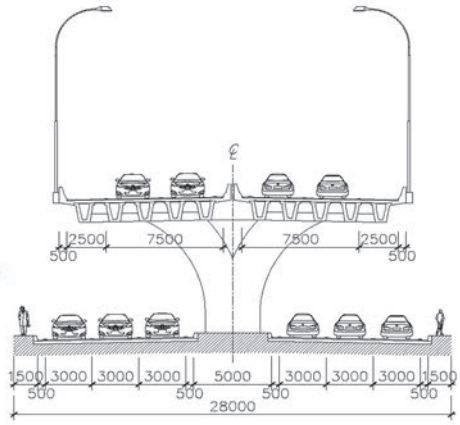


Image of Inner Ring Expressway (Wai Za Yan Tar Road)

Route Alignment of Inner Ring Expressway

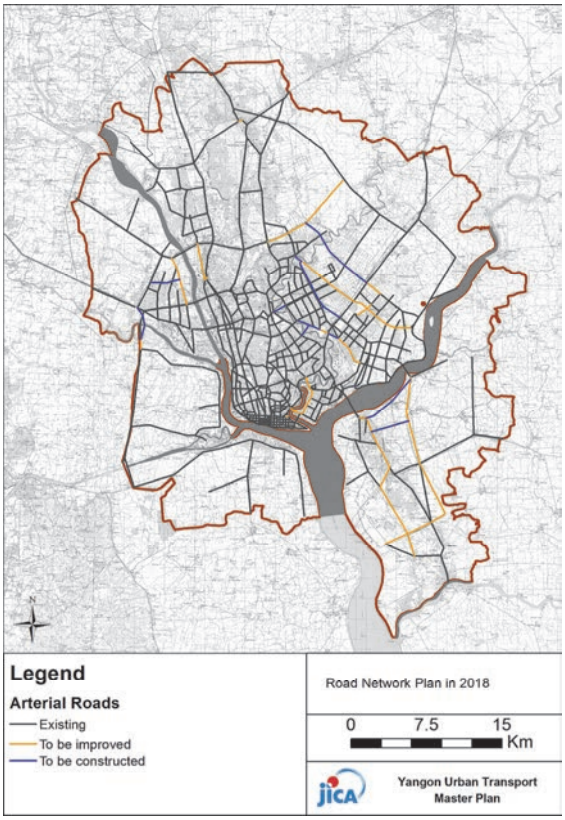
Source: YUTRA Project Team

Figure 6.2.11 Typical Cross Section and Image of Inner Ring Expressway

Road Development Projects for Each Target Year

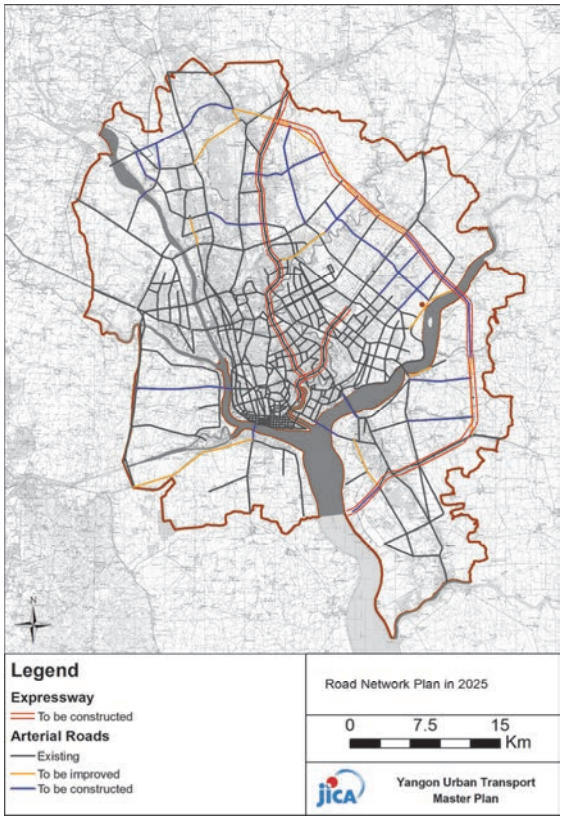
The target year for the short, middle and long term plans are 2018, 2025, and 2035 respectively. Each objective is listed below and highlighted in Figure 6.2.12 to Figure 6.2.14. As reference, road development projects after long term are shown in Figure 6.2.15.

- Short Term Projects (2013-2018)
  - Connectivity with national transport
  - Decentralization to northern and eastern area to accelerate the development of Mindama, Thilawa and Bago Riverside sub-senter.
  - Connectivity to Thilawa SEZ
  - Diversion of truck route



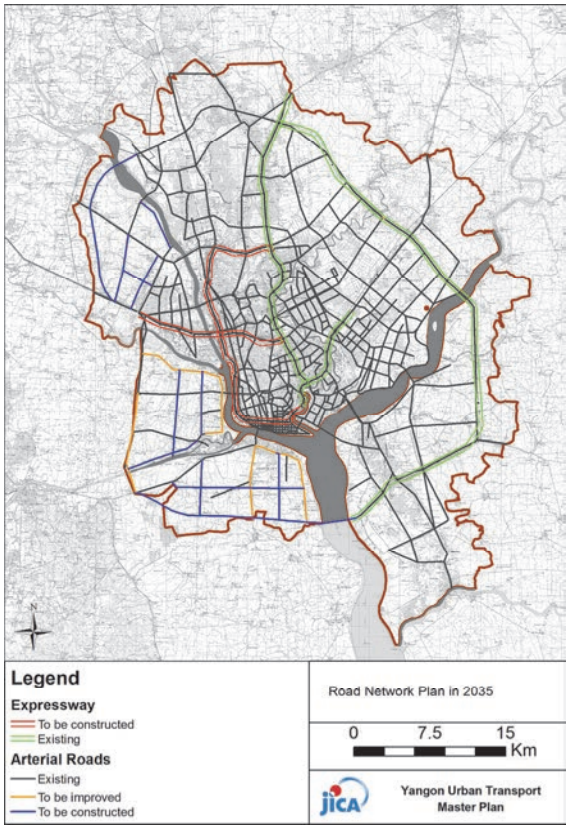
Source: YUTRA Project Team

Figure 6.2.12 Short Term Projects (2018)



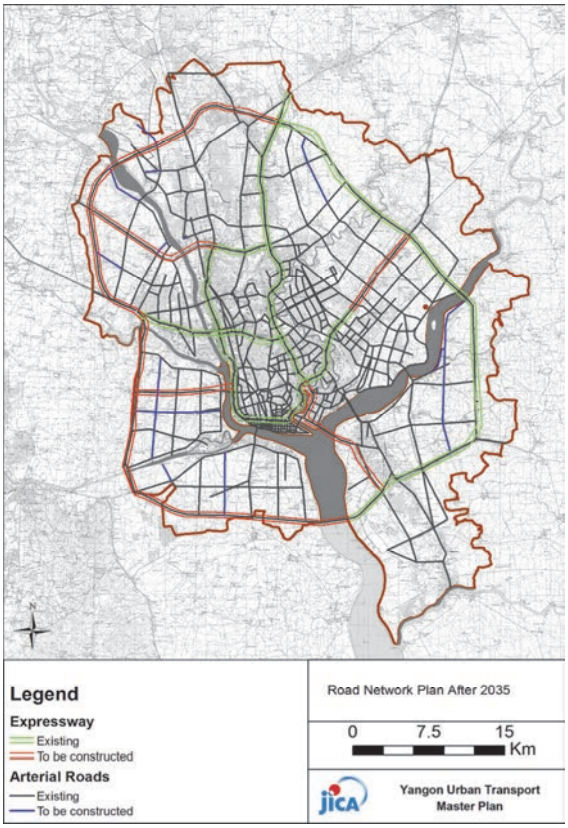
Source: YUTRA Project Team

Figure 6.2.13 Middle Term Projects (2025)



Source: YUTRA Project Team

Figure 6.2.14 Long Term Projects (2035)



Source: YUTRA Project Team

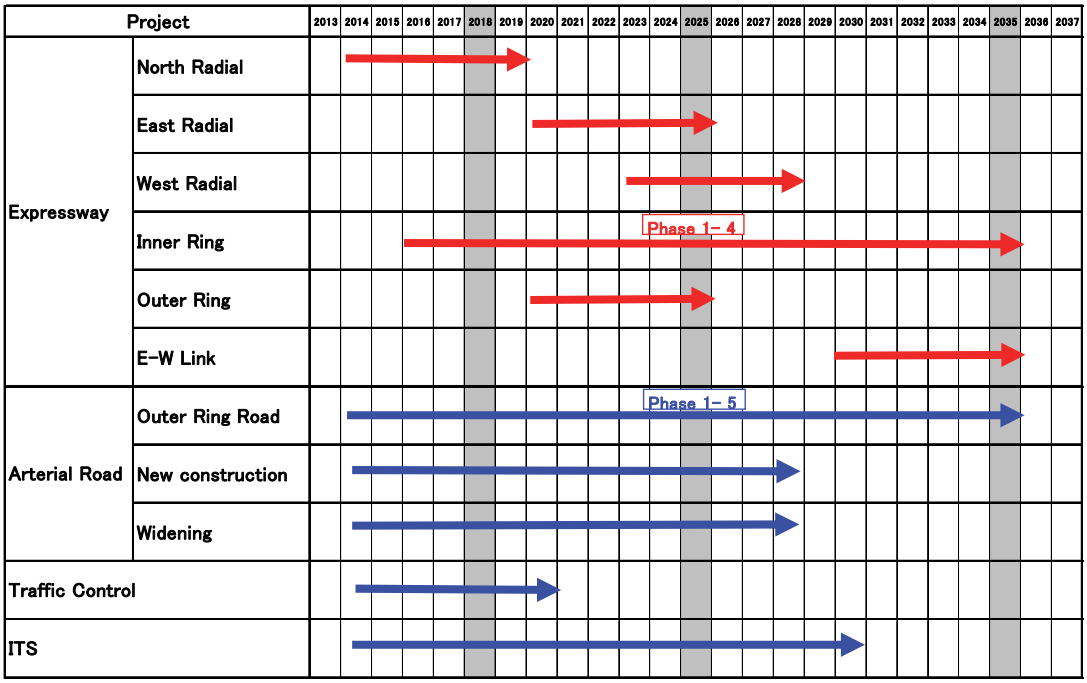
Figure 6.2.15 Road Development Projects (after 2035) <Reference>

- Middle Term Projects (2018-2025)
  - Decentralization to northen and eastern area to accelerate the development of Thilawa, Dagon Myothit and Hlaing Tharaya sub-senter.
  - Extension to road network to Hlegu, Hmawbi and East Dagon New Town Cores.
  - Build north-south Urban Expressway axis.
  - Build Outer Ring Expressway to connect national transport to Thilawa SEZ.
- Long Term Projects (2025-2035)
  - Development of western and southern area.
  - Extension to road network to Thanlyin, Dala, Twanty and Htantabin New Town Core.
  - Closing of Inner Ring Expressway and outer ring arterial road.

Implementation Schedule

Implementation schedule for each road development project in short, middle and long term plans are shown in Table 6.2.6.

Table 6.2.6 Implementation Schedule of Road Development Projects



Source: YUTRA Project Team

Rough Cost Estimates

Rough construction cost estimates for each road development project in short, middle and long term plans are shown in Table 6.2.7.

Table 6.2.7 Rough Cost Estimates of Road Development Projects

(Unit: million USD)

	Short-Term (2018)	Mid-Term (2025)	Long-Term (2035)	Total
Expressway (Inner Ring and Radial)	-	1,098	1,788	2,886
Expressway (Outer Ring)	-	666	-	666
Arterial Road	447	1,002	1,774	3,223
ITS, Traffic Signal, etc.	15	35	35	85
Total	462	2,801	3,597	6,860

Source: YUTRA Project Team

4) Traffic Management Projects

Based on the parking development and traffic safety improvement strategies, six projects are proposed in order to mitigate traffic congestion in CBD and major roads, develop capacity of traffic planning and management, develop parking, and promote traffic safety. Proposed implementation schedule for the traffic management project is shown in Table 6.2.8.

Table 6.2.8 Proposed implementation schedule for the traffic management project

No.	Category	Project Name	Status	Implementation Schedule 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
TMS-1	Traffic Managemnt	Yangon CBD Traffic Congestion Mitigation Project	Urgent	
TMS-2	Traffic Managemnt	Yangon Main Roads Traffic Congestion Mitigation Project	Short	
TMS-3	Traffic Managemnt	Capacity Development on Traffic Planning and Management in Yangon	Urgent	
TMS-4	Traffic Managemnt	Yangon Parking Development Project (Master Plan)	Short-term	
TMS-5	Traffic Managemnt	Yangon Parking Development Project (Construction)	Short/ Middle	
TMS-6	Traffic Safety	Yangon Traffic Safety Five-Year Program	Short-term	

Source: YUTRA Project Team

Yangon CBD Traffic Congestion Mitigation Project

Objective of the project is to mitigate the traffic congestions with comprehensive measures including physical improvement, management enhancement and propaganda activities.

- Modernization of the signal system
- Remove on-street parking from the congested road sections, provide sufficient number of lots to less-congested sections

- Parking Fee charging system (including parking meter)
- Remove street vendors from foot path and develop a Hawker Centre, and improve pedestrian environment
- Provision of bus-bays and taxi-bays
- Implementation of Mobility Management Measures (TDM measures)
- Proposed Implementation Period: from April 2014 to Dec 2015, Implementing Agency: YCDC

Major Roads Traffic Congestion Mitigation Project

This project is aiming to tackle the existing congestion problems on the main roads with areal and comprehensive measures so as to provide a smooth and safe traffic flows.

- installation and upgrading traffic signal control system
- improvement of intersection geometrics, installation of Road signs and pavement marking
- installation of Traffic monitoring system
- provision of pedestrian bridges
- development of bus interchanges and improvement of bus stops, etc.
- Proposed Implementation Period: July 2014 to Dec 2016, Implementing Agency: YCDC

Capacity Development on Traffic Planning and Management

Traffic management policy is one of the significant urban transport policies to enhance the efficiency of road network system and to control traffic demand. However, there is no specialized organization responsible for the traffic management in Yangon. This project is aiming to establish 'Traffic Planning and Management Unit' under Engineering Department of YCDC and to enhance their knowledge and implementation capabilities. Furthermore, comprehensive traffic database which unifies traffic volume, car registration number and so on should be developed in order to grasp and analysis traffic condition changing every moment and apply more appropriate traffic management policy.

- training on traffic engineering and management
- Development of traffic database
- implementation of pilot projects
- development of rules and regulation related to the traffic demand management
- training in Japan and third countries
- seminar and workshop
- Proposed Implementation Period: from August 2014 to July 2017, Implementing Agency: YCDC

Yangon Parking Development Project (Master Plan)

Traffic congestion mitigation projects (TMS-1 and -2) will include countermeasures to

reduce on-street parking problems causing traffic congestions. The Parking Master Plan will make clear numerous issues on the parking, what kind of parking policies will be required to meet comprehensive urban transport policies as well as urban development polices including TOD (Transit Oriented Development).

- Survey on parking situation and estimation of parking demand
- Establishment of laws and regulations as well as technical guidelines
- Public parking development plans (Identification of candidate location, basic design, cost estimation, etc.)
- Examination of public parking operation, enforcement for illegal parking
- Financial and economic evaluation, and funding
- Organizational set up for the parking facilities operation and maintenance
- Proposed Implementation Period: from August 2014 to March 2015, Implementing Agency: YCDC

Yangon Parking Development Project (Construction)

This project aims to construct off-street public parking facilities proposed in the Master Plan above. The proposed Park & Ride parking facilities which will be established at major transit terminals will be planed and constructed in the respective public transit project. Then this project will focus on the public parking located in the CBD area. Due to the limited land availability in the CBD, the location of the parking shall be carefully selected including examination of the availability of underground spaces. In the first stage of the project, feasibility study will be carried out prior to the construction of the public parking facilities.

- to carry out Feasibility Study for the proposed public parking including environmental assessment
- to prepare detail design and tender document
- to supervise the construction
- Proposed Implementation Period: from April 2015 to Dec 2020, Implementing Agency: YCDC

Yangon Traffic Safety Five-Year Program

Currently, there is no proper organizational setup for the comprehensive traffic safety intervention; just traffic police are playing major roles through ad-hoc enforcement activities. This five-year program is aiming (1) to develop institution for the comprehensive traffic safety activities including establishment of Traffic Safety Committee and (2) to implement a series of traffic safety activities.

- preparation of traffic safety projects for five years including 3Es (Engineering, Enforcement and Education)
- Establishment of Traffic Safety Committee
- Development of Traffic Accident Database
- implementation of the traffic safety projects

- Capacity Development for Traffic Police Force, traffic safety committee and other stakeholder involved in traffic safety activities
- Proposed Implementation Period: from April 2014 to Dec 2019, Implementing Agency: YCDC

Recommendation

1. Commitment on “Creation of Human and Environmental Friendly Traffic Society in Yangon” shall be made as a principle among the stakeholders in Yangon, accordingly importance of the public transport system and traffic demand management will be confirmed.
2. To mitigate traffic congestions in CBD and at major intersections outside of CBD will be urgent issues. Among the various causes of the congestions, insufficient traffic signal operation shall be updated in prior to the introduction of the grade-separation structure. In CBD, not only upgrading signal system, but also they have to tackle with parking problems and street vendors. Thus comprehensive traffic management measures will be indispensable in CBD.
3. Based on the experiences in other countries including Japan, during the initial stages of motorization, large number of traffic accident is happened due to the rapid changes of traffic environment. Now, Government of Yangon shall introduce comprehensive traffic safety policies focusing on the current issues; pedestrian safety, strengthening safety driving on commercial vehicles including buses in urban area, and accidents of two-wheel vehicles in suburban areas in Yangon.
4. Currently usage of two wheel vehicles in the urban area is prohibited, so that public passenger bus transport is the most popular transport means among Yangon Citizen in spite of discomfort of the existing public bus transport services. However, it is important to maintain the behavioral habit depending on public transport system in Yangon. Therefore the prohibition of two wheel vehicles should be continued and in addition new traffic demand management including Parking Control Policy should be introduced in order to control rapid motorization in Yangon.
5. For the comprehensive traffic management and traffic safety policy development, innovation of government system and organization as well as human resource development shall be considered to prime importance, particularly establishment of “Traffic Planning and Management Unit” and “Yangon Traffic Safety Committee”. And also in order to ensure the sustainability on the traffic management and safety, it is recommended to formulate a system of continuous 5-Year Plan development strategy and necessary reliable management system and fund resources for the implementation shall be institutionalized.

5) Freight Transport and Tourism Project

New MR ICD and Relocation of Highway Truck Terminal

The candidate area for the MR ICD and other associated facilities is located at about 20 km east along the Main Road No. 2, near the intersection with the Main Road No.7. Referring to the Lat Krabang ICD (80 ha) in Thailand, of which design capacity is around 1.5 million

TEU (see Figure 6.2.16), an indicative size of the ICD at East Dagon can be about 100 ~ 150 ha in the initial stage. At the same time the existing highway truck terminal at Bayint Naung can be relocated to the MR ICD's neighbour, and a new highway bus terminal which serve the residents in the East Dagon Township and surrounding areas can also be developed near the intersection of main road No. 2 and No. 7.

The development of new MR ICD should happen in line with the expansion of the Thilawa port and associated road improvement. The extension of the expressway to Thilawa and the improvement of the MR freight related facilities are the keys for the success of this ICD development. It should be noted that the existing Yangon – Mandalay railway will be improved by 2023, so the development opportunity of MR ICD will be around this time.

Source: YUTRA Project Team

Figure 6.2.16 Lat Krabang ICD, Thailand

New Highway Truck Routes

Yangon regional government designates routes (roads) for container trailers, log trucks and other heavy trucks. Container trucks using the road paralleling Strand Road and Bayint Naung road will remain because they need to serve the existing Yangon ports. While the eastern truck route running north to south from the main road No.(3), passing through the Mingalardon Industrial Park, and further down to south along Thanthumar road can be removed after completion of the upgrading work of main road No. 7.

The missing link section between the main road No. 3 (near Mingalardon Garden City) and the main road No. 2 (at the East Dagon Industrial area) will be widened by 2018. The link from the East Dagon to the Dagon Bridge will also be improved by 2020.

Relocation of the existing truck terminal to the MR ICD site can be made in line with this road improvement schedule.

New Highway Bus Terminal

MR has a site of 7.8 km^2 in East Dagon. It is natural that new highway bus terminal should be built there for the convinience of residents in North Dagon and East Dagon. (Refer Figure 4.7.1)

6.3 Evaluation of Major Master Plan Projects

Economic and Financial Evaluation

Economic evaluation was conducted only for the projects whose economic benefits were calculative among the Major MP projects of Public Transport and Road Development Sector. In addition, the projects which can earn the cash revenue were evaluated its financial

feasibility. As preconditions for the economic evaluation; i. Project evaluation period was set at 30years after year 2014, ii. Project life period was set at 30years for Public Transport projects, while 50years for Road projects, iii. Standard conversion factor to economic price was 0.85, and iv. 10% of social discount rate was applied. For the financial evaluation, current fare setting was applied for calculation.

The EIRR of the overall MP projects was 20.2%, and thereby, the economic feasibility for conducting the overall MP projects was confirmed. The evaluation results for each sector were summarized as follows:

- Public Transport Sector: As a whole, EIRRs for the BRT projects were high. The range of EIRRs for BRT projects were from 15% for BRT-1A to 31% for BRT-2B projects. In addition, railway projects also recorded enough level of EIRRs, which were 13-19% for Yangon Circular Railways projects, 12-13% for UMRT projects, 15% over for the suburban line projects. On the other hand, FIRRs for the most of the target projects were very low or not available to be calculated.
- Road Development Sector: Quite high EIRRs were recorded for many of road development projects, and the overall EIRR of this sector was 27%. Especially, the EIRRs of a new bridge construction project and improvement of arterial road project were higher than 30%. As for the financial evaluation results for the target three projects, two projects recorded 12% of FIRR, whereas FIRR of the rest one was only 1%.

Environmental Evaluation

Regarding selecting criteria in terms of environment following four criteria are desirable to comply with JICA Guidelines for Environmental and Social Considerations, regardless of extent of contribution to overall evaluation.

(i) Social Environment - Occurrence of land acquisition and resettlement

(ii) Natural Environment - Cutting/removal of trees and vegetation

(iii) Environmental Pollution - Emission of air pollutants (NOx and dust)

(iv) Global Warming - Emission of greenhouse gases (CO_2)

Through the environmental evaluation 67 candidate projects are classified into three ranks, A, B and C. Out of them, Rank A projects having the first priority are 23 (34.3 %), Rank B projects having the second priority are 26 (38.8 %) and Rank C projects having the third priority are 18 (26.9%).

Among five project types, railway and traffic management projects have higher scores, while road projects are lower scores. This is mostly due to contribution lower scores by criteria of air pollution and global warming, which are lower values of rating.

These rank data is compiled with other evaluation factor and subject to comprehensive evaluation by using multi-criteria-analysis.

Environmental and Social Considerations in Planning and Implementation of Prioritized Projects

In this Sub-section at first identify roughly anticipated negative impacts due to five type candidate transport projects as a whole and possible mitigation measures against the

impacts are examined. Then suggestions and recommendations for project plans in general and to major environmental items are described in terms of environmental and social aspects.

- Identifying Anticipated Impacts due to Candidate Projects and Examining Possible Mitigation Measures
  - Environmental impacts are identified assuming activities due to five types projects (Roads, BRT, Bus Transport, Railway and Traffic Management) for cases with more serious negative impacts.
  - Baseline survey should be done to make further understanding of existing environment and the effects expected to be caused by the project activities.

Possible mitigation measures to avoid, minimize and/or eliminate negative impacts as well as monitoring measures are proposed.

- Overall Suggestions and Recommendations – In general
  - Comply with both Legislation of Myanmar Government and JICA Guidelines for Environmental and Social Considerations
  - Public participation and information disclosure
  - Comparison of Alternative Project Plans
  - Formulation of Environmental Management Plan including Monitoring
- Overall Suggestions and Recommendations – Social Environment
  - Land acquisition and Resettlement Issues
  - Special Concerns with Cultural and Religious Facilities
  - Avoid a Split of Community
  - The Poor, Indigenous or Ethnic people
  - Working Conditions
  - Infectious Diseases such as HIV/AIDS
  - Measures against disaster/hazards
- Overall Suggestions and Recommendations – Natural Environment and Environmental Pollution
  - Topographical and Geological Conditions
  - Protected Areas
  - Flora, Fauna and Ecosystem
  - Global Warming/climate change
  - Air pollution

7 Implementation Program

7.1 Schedule and Investment Plan

The proposed major master plan projects are categorized into three (3) implementation stages as described in Chapter 6. Based on this implementation schedule, overall investment requirement for each stage are summarized in Table 7.1.1 and compared with the available future fund estimated in Chapter 4 as shown in Table 7.1.2.

Table 7.1.1 Investment Requirement for Major Master Plan Projects

Sector	Category	Estimated Cost (USD Mill.)			Cost to Government (USD Mill.)			
		Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035	% to Capital	Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035
Public Transport	MR Lines Upgrading and Capacity Development	629	1,874	2,778	100	629	1,874	2,778
	UMRT Development	0	2,253	3,423	100	0	2,253	3,423
	TOD/Depot Relocation	4,026	2,684	0	0	0	0	0
	BRT Development	472	0	0	55	212	0	0
	Bus Transport	108	0	0	-	78	0	0
	Sub-Total	**5,235**	**6,811**	**6,201**	**-**	**919**	**4,127**	**6,201**
Road	Arterial Roads and Bridges	253	1,516	1,049	100	253	1,516	1,049
	Expressways	0	1,591	1,700	30	0	477	510
	Traffic Control/ITS, etc.	33	26	26	-	15	26	26
	Sub-Total	**286**	**3,133**	**2,776**	**-**	**268**	**2,019**	**1,585**
Traffic Management	Congestion Management	157	0	0	-	17	0	0
	Traffic Safety	22	0	0	-	20	0	0
	Sub-Total	**179**	**0**	**0**	**-**	**37**	**0**	**0**
Freight Transport	Truck Terminal	0	150	0		0	150	0
	Sub-Total	**0**	**150**	**0**	**-**	**0**	**150**	**0**
TOTAL		**5,700**	**10,094**	**8,977**	**-**	**1,224**	**6,296**	**7,786**

Source: YUTRA Project Team

Table 7.1.2 Investment Requirement vs. Fund Availability

Item	Amount (USD Bill.)			
	Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035	Total for MP Period
(1) Investment Requirement for Master Plan (Cost to Government)	**1.2**	**6.3**	**7.8**	**15.3**
(2) Budget Envelope (Low-High Case)				
a. Transport Sector Total	2.6-2.7	7.7-8.7	16.3-21.3	26.5-32.7
b. 40% of Transport Sector Total (excluding cost for maintenance, secondary road and other local transport facility development, and vehicles, etc.)	**1.05-1.10**	**3.1-3.5**	**6.5-8.5**	**10.6-13.1**

Source: YUTRA Project Team

As shown in the table above, available fund for transport sector is not enough to cover the required cost, particularly in the short-/med-term. Therefore, it is necessary to consider the potential fund sources such as surplus revenues from on-/off-street parking operation and urban expressways, and profit of TOD together with effective use of unused government lands.

7.2 Potential Funding Source for TOD Project

Use of transit oriented development (capture of TOD values) together with effective use of unused lands owned by the Government (by several ministries) in the Yangon area was discussed further as one of the possible measures in financing the urban transport master plan project for Yangon Region. In addition, traffic impact assessment (TIA) was also recommended to consider not only minimizing the traffic impact but also securing the necessary transport facilities and services for the large scale urban development.

7.3 Potential Implementation Mechanism

This section tries to discuss one of the possible measures in financing the urban transport infrastructure development in Yangon. Use of transit oriented development (capture of TOD values) together with effective use of unused lands owned by the Government (by several ministries) in the Yangon area is a focus of this discussion. (See Figure 7.3.1)

Land values in Yangon

Lands of higher values in Yangon are observed in the area between Inya Lake and Kandawgyi Lake, and the lands along the major roads such as Pyay road and Kabr Aye Pagoda road. The land prices in Dala is almost one tenth or less of the prices in the downtown Yangon area even through the distance between the two places is close.

In general major determinates of land values other than the size of land parcel in Yangon include.:

- accessibility to major roads
- distance from CBD
- surrounding environment such as park, green, and accessibility to waterfront, and
- availability of clean water and power

It seems that “accessibility to public transport services” is not working as a determinant of land value at present. That is, the lands near the existing transit nodes are undervalued in the current real estate market.

Value Capture

Implementing the proposed transportation plans by YUTRA requires substantial investments in improving the existing road facilities, new infrastructures such as MRT and BRT, and regeneration of transit nodes such as the Yangon station area.

Such public sector commitments in the form of master plan will stimulate private sector investments especially in those TOD centres. Those economic activities by the private sector will result in increase of land values or land rents, especially in the proposed TOD canters and surrounding areas. In principle, such additionally increased values should belong to the value creator, that is, the public sector. Hence, those surplus should be captured by the tax authority in the course of real estate transaction, and reinvested to

further improvement of the public transport in the city.

As seen in the exiting land values spatially, lands near the transit nodes (rail stations) are not properly valued by the current real estate market. This situation will be changed significantly by the proposed MRT development. It is highly recommended that the tax authority should pay special attention to those areas in the course of development, and collect tax on value surplus generated from the infrastructure development.

Unused Government Lands

There are many large land parcels owned by the public sector including Ministry of Construction (MOC), Ministry of Rail Transportation (MORT), Ministry of Transport (MOT), Ministry of Defence MOD), YCDC, etc in Yangon.

Some potential use of unused land owned by the Government are considered as follows:

(i) Myanma Railway Land in East Dagon Township

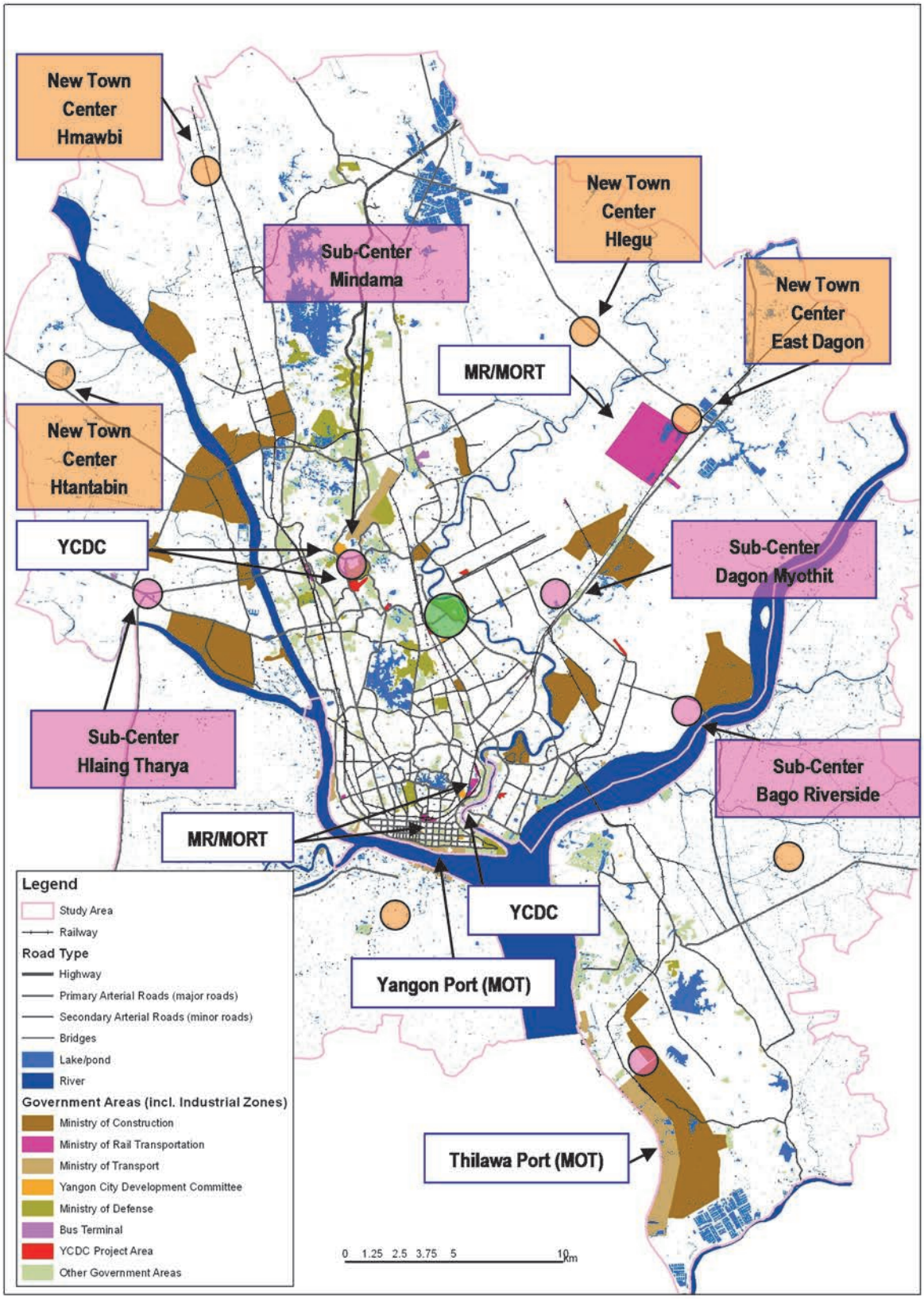
YUTRA recommends development of MR ICD, Depot and Workshop, Truck Terminal and Highway Bus Terminal in this area. The existing YCDC truck terminal at Bayint Naung can be relocated to this area after completion of the proposed extension of the expressway (to Thilawa) and missing link (passing near Ywathargyi). A new highway bus terminal can also be developed which serves residents in the proposed new town centre East Dagon and surrounding areas.

(ii) Myanma Railway Land – Yangon and Insein Station area

The rail section between Insein station and Yangon station of the Yangon Circular rail is the most busy section in terms of passenger and train operation. A higher priority is given to the improvement of this section by YUTRA, accordingly there will be a great opportunity in terms of regeneration of the station areas of this section. Especially two terminus stations of this section, namely Insein and Yangon station are the focus in the short-term.

(iii) Newly created transit nodes

The proposed two YUTRA MRT lines cross at the area near the MR Yegu rail station. There is a large land parcel owned by Ministry of Defence close to this potential TOD centres, namely Okkala in Mayangone Township. SUDP does not indicate this is a potential TOD centre, but eventually this place will have a great opportunity for investors after completion of the proposed MRT.



Source: YUTRA Project Team

Figure 7.3.1. Government lands

7.4 Schedule of Institutional Reforms

The schedule for establishing the proposed YUTA and BRT Management Agency and supporting technical assistance are planned as shown in Table 7.3.1.

Table 7.3.1 Implementation Schedule of Institutional Reform and Strengthening

Activities	Agency	2013	2014	2015	2016	2017	2018
Urban Development Plan for Grater Yangon is formulated	YRG	▲					
Urban Transport Master Plan for Grater Yangon is formulated	YRG		▲				
Yangon Urban Transport Authority (YUTA)							
Institutional Design of YUTA	YRG		▬				
Urban Transport and Passenger Service Act	UG/YRG		▲				
Decision by Union/Region Government	UG/YRG		▲				
Establishment of YUTA	YRG			▲			
Start Operation and Management	YUTA			▬	▬	▬	▬
BRT Agency							
Institutional Design of BRTA	YUTA		▬	▬			
Feasibility Study	YUTA		▬	▬			
Establishment BRTA	YUTA			▲			
Detailed Design, Construction, Procurement	BRTA			▬	▬		
Start Operation and Management	BRTA				▬	▬	▬
Capacity Development Program for YUTA and BRT Management Agency (TA under ODA)							
Preparation	DA/YRG		▬				
Agreement of TA	DA/YUTA		▲				
Procurement of Consultants	DA		▬	▬			
Implementation	DA/YUTA			▬	▬	▬	▬

Source: YUTRA Project Team
UG: Union Government, YRG: Region Government, YUTA: Yangon Urban Transport Authority, BRTA: BRT Agency, DA: Donor Agencies

8 CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion

Challenge to Sustainable Urban Transport Development

The urban transport situation in the Greater Yangon has not yet reached the level that many other large urban areas in Southeast Asia suffer from. People can still move relatively freely but the time will soon come when, if the current trend continues, the current urban transport problem will grow to a level which the society can hardly manage. However, in guaranteeing a sustainable urban transport envisioned by government authorities and the people, the transport sector must not be dealt with independently of other sectors. Rather, urban transport planning must be part of an integrated approach, intertwined with urban planning and economic development. For this reason, it is vital to enhance people's understanding of the importance of the urban transport sector in guiding the future direction of the development of the metropolis. Yangon's competitiveness and livability of in the future depend on actions taken – or not taken – today.

Shared Vision, Common Agenda

With so many governmental bodies, organizations, and individuals involved in the transport planning process, implementation is facilitated when there is unanimity and consistency of actions – especially between union, regional and city governments. This can only occur when all, or most, of them share a common vision about Yangon. A Master Plan articulates that vision in various ways.

A Master Plan involves several trade-offs and choices which are essentially political processes. There will be competition from other sectors for the funds and resources required to implement the plan. Resolving these competing requirements will be a major task, which can only be handled at the political level, guided by technical information. The implementation of schemes and proposals will also require an assessment to be made of the political implications and priorities. The aim of the political processes is to produce a consensus on the plan and its components.

Sector Constraints

The biggest constraint is funding. There is simply no way for Yangon to buy itself out of its existing and emerging problems. Hence, it must turn more and more to the private sector – especially in the provision of transport services, rather than for the government to assume sole responsibilities. Even if the city has unlimited resources, it cannot continuously expand the provision of roads without destroying the fabric of the city nor overcoming ROW obstacles in an expeditious manner. Besides, as apparent from other cities, adding more roads only leads to a vicious cycle of more cars and more congestion.

Getting more commuters on public transport is a must; however, to rapid motorization, this has become a challenging issue. Unlike many developing cities which struggle against the erosion of a high share of public transport, Yangon's public transport is fortunate to have a high modal share presently. This advantage should be maintained or strengthened even further, requiring Government involvement.

A third constraint is weak institutional capability to cope with urban and transport challenges

under an uncertain and changing policy environment. One way to overcome the lack of funds is to improve government's ability to harmonize land use with transport development. This, however, entails expertise and processes that are also scarce in the public sector.

Strategies

YUTRA has proposed the overall goal of urban transport as follows:

"Ensure mobility and accessibility to urban services that are vital for the people and the society, by providing a transport system characterized by safety, amenity, and equity and sustained by an efficient public transport system"

A combination of supply-type and demand-type strategies is required to maintain the present advantage of high modal share of more than 65%. The overall goal has been developed into eight specific objectives and strategies, as follows:

A. Promotion of Social Understanding about Urban Transport Problems and Issues
B. Effective Management of Urban Growth and Development
C. Promotion and Development of Attractive Public Transport
D. Efficient Traffic Control and Management
E. Effective Transport Demand Management (TDM)
F. Comprehensive Development of Transport Space and Environment
G. Enhancement of Traffic Safety
H. Strengthening of Transport Sector Administrative and Management Capacities

Master Plan

The number of projects proposed in YUTRA is summarized in Table 8.1.1.

Table 8.1.1 Proposed Master Plan Projects

Plan Period	Project Type	No. of Projects	Total Cost (US$ million)
Short-term	Public Transport	17	919
	Road	6	268
	Traffic Management	6	37
	Freight Transport, etc.	-	-
	Sub Total	**29**	**1,224**
Mid-term	Public Transport	10	4,127
	Road	11	1,699
	Traffic Management	-	-
	Freight Transport, etc.	2	150
	Sub Total	**23**	**5,677**
Long-term	Public Transport	7	6,201
	Road	10	1,905
	Traffic Management	-	-
	Freight Transport, etc.	-	-
	Sub Total	**17**	**9,423**
Total		**69**	**16,324**

Note: "Total cost" is cost to the Government only. Excludes contribution of the private sector.
Source: YUTRA Project Team

The public available fund can cover only roughly 60-80% of the total cost (to the

Government) shown above, and additional fund source should be developed.

8.2 Recommendations

The recommendation from YUTRA to the Yangon Region Government is naturally to realize the projects proposed in this master plan. Although every project is an integral part of the proposed master plan, the most essential are; A. Parking development and control (short-term), B BRT development (short-term), C. Improvement of existing MR lines (short- to long-term), D. UMRT development (middle- to long- term), and E. Inner Ring Road development (middle- to long- term).

Other related recommendations are:

1) Authorize and get this master plan approved by the concerned agencies of both Union and Region government, and disseminate its contents to all stakeholders.

2) Setup Yangon Urban Transport Authority (YUTA) to make decisions on various transport projects. Allocate implementation responsibilities by project clearly to government agencies. The proposed YUTA will oversee and monitor the implementation of these projects. The establishment of YUTA is crucial for Yangon to have the basis to absorb various types of technical and financial assistance from donor organizations.

3) Raise funding capability of the government by seeking various additional revenue sources and optimising current revenue sources under the institutional arrangements of the government. The most feasible fund source seems to exist in the TOD (Transit Oriented Development). Since the Government has a number of vast unused land lots in strategic places in Yangon, this could be a good seed for launching “urban cum transport” development projects where cross-subsidy can be expected from urban development (business/commercial/residential) to public transport development. Some of other initiatives that could be expanded further in Yangon could include the revenue from the proposed parking development and restriction.

4) Take necessary actions as soon as possible to launch the short-term projects proposed in the master plan. Particularly for those projects that needs feasibility study or prior coordination among relevant organizations, initiatives from the Myanmar government to donor or other related organizations should be exerted immediately.

5) Regarding the proposed BRTs, future patronage will change depending on the development progress of the proposed UMRTs or MR lines. In this case, the affected BRT should adjust its operation. Its disused road space could be reconverted to carriageway for other vehicles, or more preferably, the space could be converted to green promenade for pedestrians and cyclists taking into account the future vision of Yangon.

6) In this master plan, the toll rate for expressway was assumed to be the same as the current level of Yangon-Mandalay expressway, and the fare of Myanmar Railway lines, UMRTs and BRTs was set at the current level as well. Although the rate was assumed to increase in the future in proportion to per capita GDP, it is still very low compared to the international level and the level cannot be raised easily due to the sensitive elasticity of demand against toll/fare rate. This is one of the reasons of the

poor financial performance revealed in Section 6.3 of this report. Considering the promotion of private sector participation and the possible magnitude of public subsidy, however, the toll/fare rate should be carefully looked into in the feasibility study.

7) This master plan assumes that “normal” situation will continue for a long period of time (20 years or more). If abnormal situation occurs, such as long financial panic and war, this master plan cannot be used and will lose its validity. On the contrary, this master plan could be updated periodically if normal situation continues and a series of traffic surveys are conducted again (except for the person-trip survey, in principle). The conclusion and methodology of the master plan could be handed over to the future with periodical updating (basically every 5 years).