REPUBLIC OF THE UNION OF MYANMAR
MINISTRY OF TRANSPORT AND COMMUNICATIONS (MOTC)
YANGON REGION GOVERNMENT (YRG)

COMPREHENSIVE STUDY OF THE URBAN TRANSPORT DEVELOPMENT PROGRAM IN GREATER YANGON (YUTRA UPDATE)

FINAL REPORT
SUMMARY

MARCH 2019

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ALMEC CORPORATION
NIPPON KOEI CO., LTD.
ORIENTAL CONSULTANTS GLOBAL CO, LTD.

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ABBREVIATIONS

YCDC	Yangon City Development Committee
YUTRA	Project for comprehensive urban transport plan of the greater Yangon
SUDP	The Strategic Urban Development Plan for Greater Yangon
UMRT	Urban Mass Rapid Transit
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
GMS	Greater Mekong Subregion
CBD	Central Business District
AGR	Annual Growth Rate
BRT	Bus Rapid Transit
MRT	Mass Rapid Transit
GPS	Global Positioning System
CCTV	Closed-Circuit TeleVision
ICT	Information Communication Technology
MR	Myanma Railway
IWT	IW transport
DWT	Dead Weight Tonnage
MITT	Myanmar International Terminal Thilawa
MPA	Myanmar Port Authority
PCU	Passenger Car Unit
GV	Goods Vehicle
LGV	Light Goods Vehicle
HGV	Heavy Goods Vehicles
OD	Origin - Destination
PPP	Public Private Partnership
ROW	Right of Way
I-RR	Inner Ring Road
O-RR	Outer Ring Road
V/C	Volume / Capacity
TOD	Transit Oriented Development
F/S	Feasibility Study
D/D	Detail Design
YUEX	Yangon Urban Expressway
YBS	Yangon Bus Service
HRD	Human Resource Development
TCC	Traffic Control Centre
SEZ	Special Economic Zone
ICD	Inland Container Depot
TM	Traffic Management
KOICA	KOREA International Corporation Agency

1 INTRODUCTION

1.1 Study Background

1.1 Yangon, the former capital of Myanmar with a population of 5.2 million (as of the 2014 census), is the country's largest commercial hub. In the city, traffic and transport situation has quickly worsened, especially after the new administration took office, due to accelerated economic growth and motorization. The increase in traffic volume mainly accounted for by private cars and buses, has also resulted in air pollution and increasing severity of traffic accidents. By 2035, the population of Yangon is expected to reach 7.7 million, with the population concentrating in the urban area. The urban area is also expected to expand into the surrounding areas, transforming Yangon into a megacity with a population of 10 million in the future. Along with economic and population growth and the resulting increase in traffic demand and incomes, private vehicle ownership rate is expected to grow.

1.2 In 2013–2014, a study entitled "Comprehensive Study on Urban Transport Development Program in Greater Yangon" (YUTRA) was conducted with the technical assistance of the Japan International Cooperation Agency (JICA) to formulate an urban transport development plan for the Yangon metropolitan area focusing on road and urban rail intersections, traffic management and safety, public transportation, and transport sector institutions, among others. The YUTRA study was also conducted in coordination with a parallel JICA-assisted study entitled "Yangon Sustainable Urban Development Planning" (SUDP) which intended to formulate a comprehensive urban development plan for Yangon. Due to a rapidly changing urban transport situation, however, a need arose for a review and an update of YUTRA under the new administration's policy on urban transport development.

1.3 In response, JICA concluded an agreement with the Myanmar government in March 2016 to implement a study which would update and review YUTRA I study findings and recommendations, conduct a pre-feasibility study for the UMRT-2 (east–west line) and YCR Grade Separation, come up with policies and an action plan to ease traffic congestion in Yangon, prevent or minimize traffic accidents, and establish an organization to formulate these policies.

1.4 This study has the following specific objectives:

(i) Review and update YUTRA study which has the target year of 2035;

(ii) Update the roadmap on urban transport in Yangon;

(iii) Implement a pilot project related to bus transport modernization and draw lessons from this pilot project; and

(iv) Formulate a proposal for the Yangon Urban Railway Construction Programme and conduct a pre-feasibility study for selected lines.

1.5 Along with gathering the required data to review YUTRA, efforts have been made to draft a proposal and an action plan for developing the urban transport network and for strengthening the urban transport management system in Yangon.

1.2 Approach

1.6 Updating the transport master plan for Yangon, including the development goals, basic strategies, overall transport network plan, list of projects/actions, and proposed roadmap, took account of the following points:

(i) Compliance with the overall urban and regional framework and structure by updating the Strategic Urban Development Plan (referred to as SUDP-II);

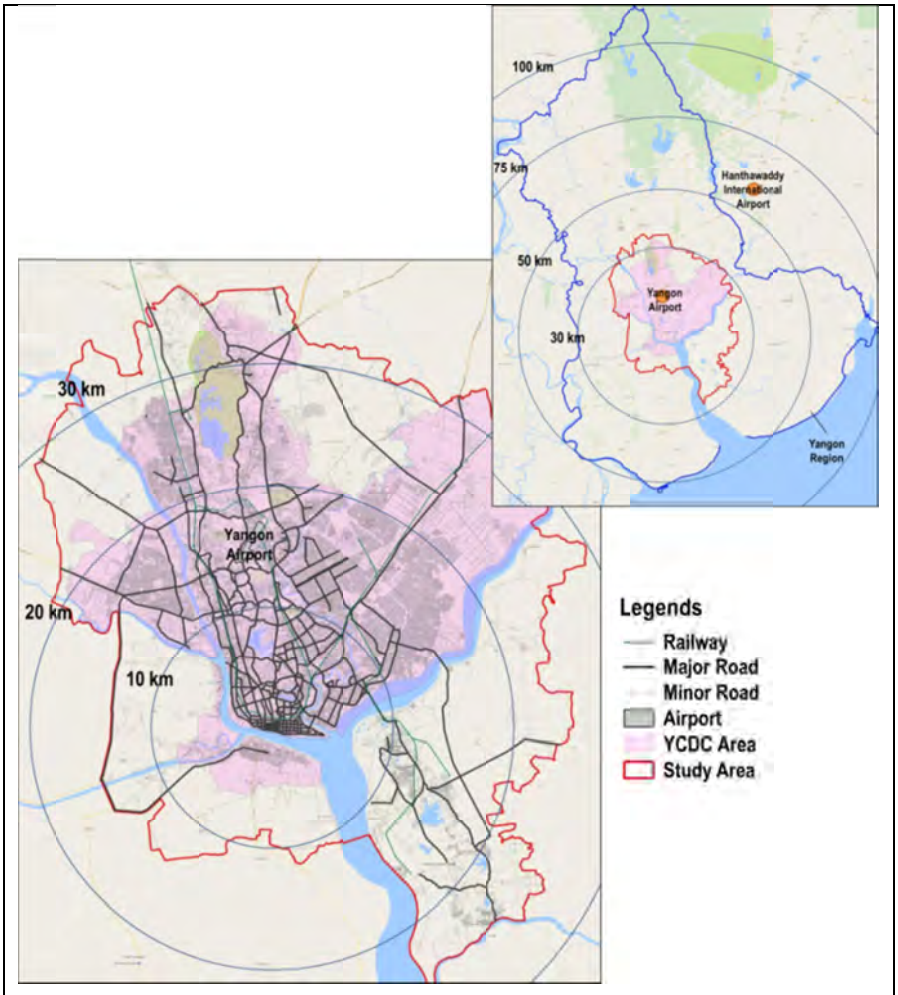
(ii) Incorporation of urban and regional transport policies and development directions of the new administration;

(iii) Review of the YUTRA (2014) plan and projects based on the results of supplemental traffic surveys carried out in this current study and on the updated database;

(iv) Consultation and coordination with Yangon Region Transport Authority (YRTA) to generate a shared understanding of the study and to build their capacity.

1.3 Study Area

1.7 The study area is the same as that of YUTRA, i.e., the metropolitan area of Yangon. It covers Yangon City, which is being administered by the Yangon City Development Committee (YCDC), and the urbanizing areas of Yangon Region, as shown in Figure 1.1.1. The study area is also called Greater Yangon and has an area of 1,500 km^2.



Source: Study Team

Figure 1.3.1 Study Area

2 OVERVIEW OF URBAN/ REGIONAL TRANSPORT SYSTEM

2.1 Strategic Location and Role of Yangon

2.1 Yangon City is the most important hub for socio-economic activities in Myanmar and the gateway to the rest of the world. It is the capital of Yangon Region and had a population of 5.2 million in 2014 compared with Yangon Region's 7.4 million population (14% of the country). In the same year, Yangon accounted for MMK12,359 billion of the GRDP (19% of the country) (see Table 2.1.1).

Table 2.1.1 Yangon in Myanmar, 2014

Item		Myanmar	Yangon Region	Yangon
Population	(000)	51,486	7,361	5,191
	%	100	14	10
Area	km^2	669,794	9,804	971
	%	100	1.5	0.14
Population Density (1,000/km^2)		77	751	5,346
GRDP	MMK billion	65,262	12,359	n.a
	%	100	19	n.a
Per-capita GRDP (MMK000)		1,268	1,679	n.a

Source: Worked out by Study Team, based on Various sources.

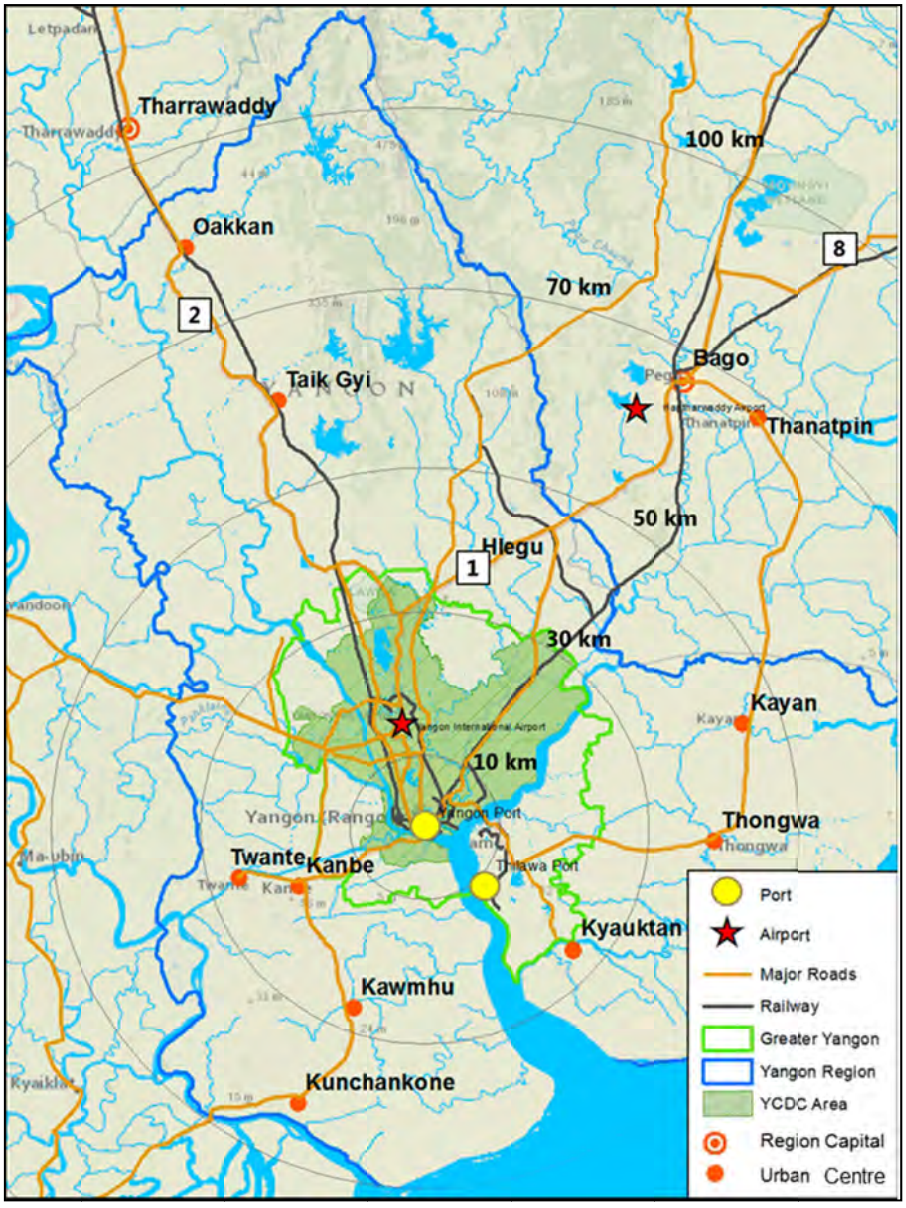
2.2 Yangon is connected to the countries of the Greater Mekong Subregion (GMS) through the Asian Highway network, as shown in Figure 2.1.1. Yangon Region is located on the Western Corridor which connects to the East-West Corridor passing though Thailand, Laos, and Vietnam. The Asian Highway network, however, is underdeveloped at present and Yangon is yet to be integrated with its neighboring countries.

Source: Worked out by Study Team, based on Various sources.

Source: Myanmar National Transport Development Plan (MYT-Plan)

Figure 2.1.1 Yangon Region in Myanmar and the Greater Mekong Subregion

2.3 Yangon City, which is being administered by the Yangon City Development Committee (YCDC) has been growing rapidly. Its urban areas have expanded quickly as the population has increased, forming Greater Yangon[1]. Yangon Region is covered with a network of roads, waterways, rails, and provided with gateway ports and airports (see Figure 2.1.2). However, the current status of the transport infrastructure in the region is not satisfactory, requiring large investments to meet current and future needs. Although the road network around Yangon City accommodates a large share of national traffic, investments in maintenance, improvement, and new construction of roads are limited.



Source: Study Team

Figure 2.1.2 Transport Network in Yangon Region

[1] Greater Yangon is the study area of YUTRA study of 2013 and this study (YUTRA II).

2.2 Urban Transport System in Yangon

1) Overview

2.4 The urban transport system in Yangon City is composed of a network of roads, rails, waterways, ports, and airports (see Figure 2.2.1). Although the main urban areas are covered by major roads, railways, and waterways, they are not connected to each other nor provided with an adequate set of secondary network and feeder services.

2.5 During the last several years, the urban transport situation in Yangon has quickly worsened due to the constantly increasing urban population, increase in car ownership, slow progress in infrastructure development, and lack of traffic management to maximize the use of available transport capacities. The major transport problems identified include: (i) increasing traffic congestion; (ii) worsening traffic safety and undisciplined driving manner; (iii) low quality of public transport (bus, railway, taxi); (iv) worsening traffic pollution (air, noise); (v) illegal parking; (vi) widespread use of used/old vehicles; and (vii) worsening walkability. The problems are so much interrelated and present in many parts of the urban areas, making it difficult for the city to find and implement effective solutions in a short time. The effectiveness of piecemeal measures is also limited.

2.6 Considering the national role of Yangon Region, urban transport issues should not be isolated from international/ regional transport. International traffic will increase and concentrate in gateways points, such as airports and border gates. The impact of international/ regional traffic will become increasingly significant. Further development of roads and bridges, strengthening of existing railways, improvement and modernization of bus services, development of urban water transport is also ongoing.

2) Implications for Land Use and Urban Issues

2.7 Transport demand is derived from various socio-economic activities in urban areas. As transport and land use affect each other, traffic problems and issues should also be looked at in the context of urban development.

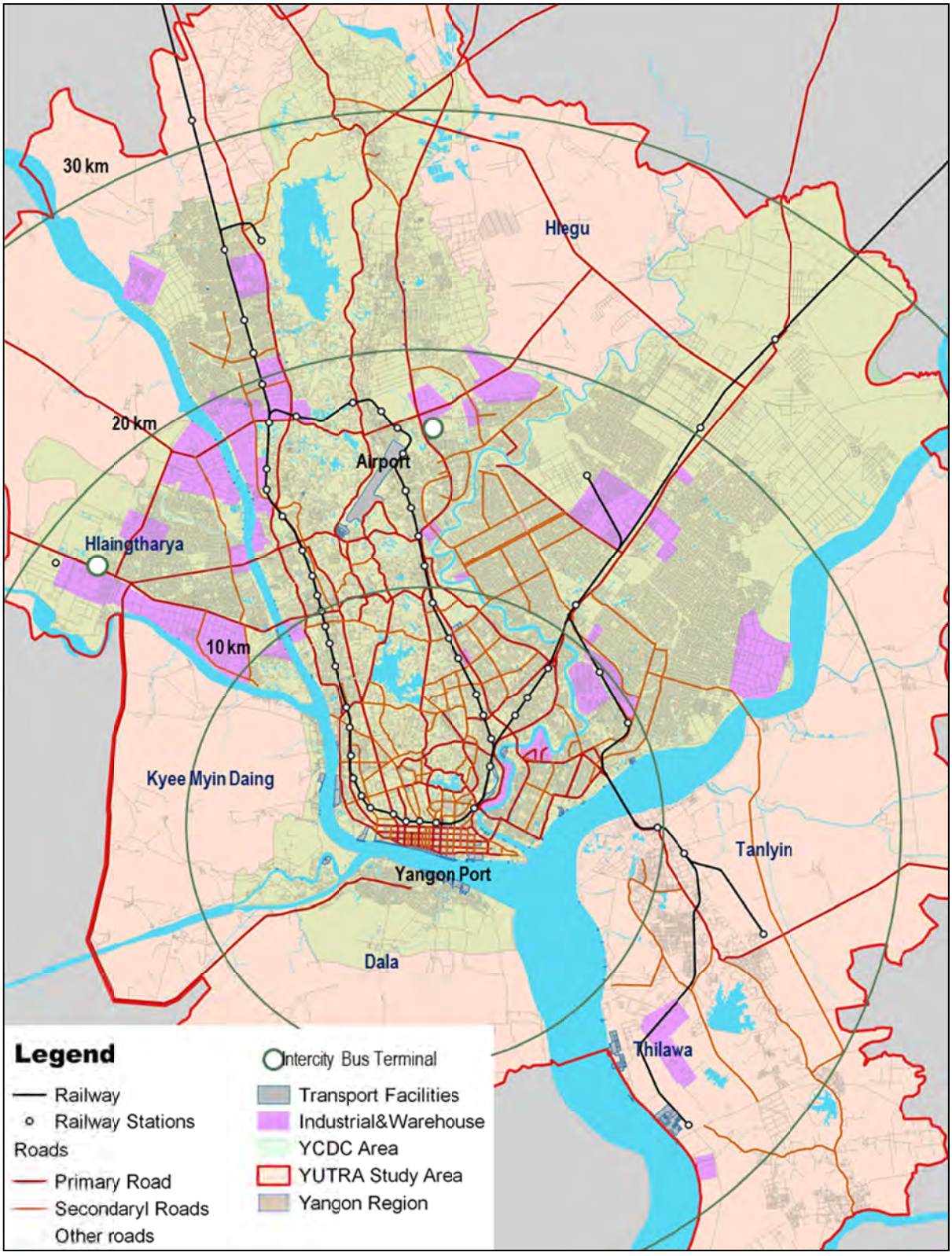
2.8 Urban areas in Yangon, i.e., the central business district (CBD) and the city center, are characterized by very high density and mixed uses. Between these areas and in suburban areas, there is low density. While population increase in central areas is slowing down, it is accelerating in outer areas in a sprawling manner. The major urban needs facing Yangon include the following:

(i) Improvement of living conditions and environment provided with adequate utilities and protected against natural disasters such as flood;

(ii) Expansion of investment opportunities to make the city more competitive and create employment; and

(iii) Presentation of widely distributed heritage sites and rich natural resources (greeneries and water bodies) in urban areas which many cities have been losing in the urbanization process.

2.9 As transport is a key driver in influencing urban land use, it is necessary to look at various transport and traffic issues in relation to urban development and environmental management.



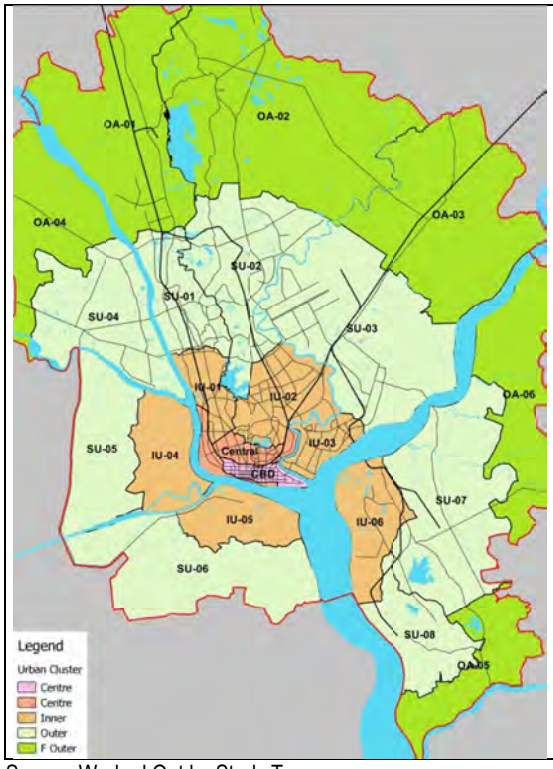
Source: Study Team

Figure 2.2.1 Transport Network in Greater Yangon, 2016

Table 2.2.1 Population Growth in Greater Yangon by Urban Cluster

Cluster			Population		AGR (%/yr)	Population Density (no/ha)
			2,011	2,016		
CBD			252,392	222,256	-2.5	341
Central			318,592	321,115	0.2	234
Inner Cluster	IU-01	Inner North West	344,103	346,743	0.2	200
	IU-02	Inner North	840,726	695,789	-3.7	205
	IU-03	Inner East	340,568	302,554	-2.3	208
	IU-04	Inner South West	89,376	86,786	-0.6	25
	IU-05	Inner South	111,954	112,592	0.1	38
	IU-06	Inner South East	93,526	169,023	12.6	47
	Subtotal		1,820,253	1,713,487	-1.2	103
Outer Cluster	SU-01	Outer North West	442,504	442,393	-0.0	135
	SU-02	Outer North	542,494	587,115	1.6	85
	SU-03	Outer North East	798,760	950,639	3.5	74
	SU-04	Outer West	488,768	803,127	10.4	112
	SU-05	Outer South West	11,297	9,894	-2.6	2
	SU-06	Outer South	17,768	16,976	-0.9	2
	SU-08	Outer South East (Thilawa)	13,974	16,466	3.3	4
	SU-07	Outer East	68,560	123,904	12.6	12
	Subtotal		2,384,125	2,950,514	4.4	50
Far Outer Cluster	OA-01	Far Outer North West	331,698	494,637	8.3	44
	OA-02	Far Outer North	191,473	301,391	9.5	18
	OA-03	Far Outer North East	61,199	73,710	3.8	6
	OA-04	Far Outer West	32,506	44,981	6.7	6
	OA-05	Far Outer South East	45,212	38,804	-3.0	9
	OA-06	Far Outer East	15,160	27,398	12.6	3
	Subtotal		677,248	980,920	7.7	16
Greater Yangon Total			5,452,610	6,188,292	2.6	44

Source: Study Team



CBD

Latha, Lanmadaw, Panbetan, Kyauktada, Botataung, Pazundaung

Central Cluster

Alone, (a part of) Kyeemyindaing, Dagon, Mingalar Taung Nyunt, Seikkan

Inner Cluster

IU-01 Inner North West: San Chaung, Kamayut, Hlaing
IU-02 Inner North: Bahan, Tarmwe, Yankin, Thingankyun, South Okkalapa
IU-03 Inner East: Dawpon, Tharkayta
IU-04 Inner South West: (a part of) Kyeemyindaing, Seikgyikanaungto, (a part of) Twantay
IU-05 Inner South: (a part of) Dala
IU-06 Inner East: Thanlyin

Outer Cluster

SU-01 Outer North West: (a part of) Mayangone, Insein
SU-02 Outer North: (a part of) Mayangone, (a part of) Mingalardon, North Okkalapa
SU-03 Outer North East: North Dagon, South Dagon, (a part of) East Dagon, (a part of) Dagon Seikkan
SU-04 Outer West: Hlaingtaryar
SU-05 Outer South West: (a part of) Twantay
SU-06 Outer South: (a part of) Dala, (a part of) Twantay
SU-07 Outer East: (a part of) Thanlyin
SU-08 Outer South East (Thilawa) : Kyauktan, (a part of) Tanlyin

Far Outer Cluster

OA-01 Far Outer North West: Shwepyitar, (a part of) Hmawbi
OA-02 Far Outer North: (a part of) Mingalardon, Hlegu, (a part of) Hmawbi
OA-03 Far Outer North East: (a part of) East Dagon, (a part of) Dagon Seikkan
OA-04 Far Outer West: Htantabin
OA-05 Far Outer South East: (a part of) Kyauktan
OA-06 Far Outer East: (a part of) Thanlyin

Source: Worked Out by Study Team

Figure 2.2.2 Classification of Urban Cluster

3) Urban Roads and Streets

2.10 Yangon lacks road infrastructure in terms of length, space, density, and quality as characterized in the following:

(i) Small Network Size: The share of the overall road area to the total urban area is only 4.5%, which is much lower than other large cities in the world. On the other hand, roads in the old CBD are well provided both in terms of density and network (i.e., at a high 22%, although most of the space is blocked by parked vehicles and vendors).

(ii) Inadequate Network Connectivity: The urban area is covered with a limited number of major roads which lack east–west connectivity. Secondary roads are also lacking.

(iii) Poor Road Standards: Many roads are narrow, winding, and not properly maintained. Road surfaces are not smooth for cars and are also unsafe for pedestrians.

(iv) Lack of Traffic Management: Congestion takes place in many intersections, roundabouts, and road sections, especially around shopping centers and schools due to unregulated roadside parking and loading/unloading practices. Pedestrians are also not provided with adequate safety facilities and a comfortable walking environment.

4) Traffic Congestion

2.11 Why has traffic congestion become the most critical concern of many cities, including those in developed countries? It is because the economic, social, and environmental costs of traffic congestion are significant. It affects many sectors of society not only transport but also socio-economy, environment, and urban land use. Traffic congestion reduces the mobility of people and accessibility to services, resulting in increased travel costs and discomfort. Traffic congestion also tends to increase air pollution and gasoline consumption. Traffic congestion negatively affects a city's competitiveness, livability, and environmental sustainability, as well as degrades its image. Traffic congestion hits the low-income groups more negatively.

Table 2.2.2 Understanding of Traffic Congestion

Area of Negative Impact	Main Issue/ Cause	Location
• Mobility of people • Smooth flow of goods • Accessibility to services • Safety and comfort • Transport cost (time, vehicle) • Energy cost • Environmental cost (air, noise) • Image of the city	• Road network: bottlenecks and missing links • Parking: facilities/ space, management (fee) • Public transport services: coverage, accessibility, quality, driving manner, boarding/ alighting practice, bus stops (location and facility), etc. • Roadside vendors, schools, commercial activities • Jay walking • Sidewalks/ pedestrian facilities and walkability • People's awareness	• Main corridors • Secondary roads • CBD • Area: clusters, urban block • Point: specific area (e.g. school, shopping center, industrial park, etc.)

Source: Study Team

2.12 Solving traffic congestion in large urban areas requires long-term and constant attention of the government and road users. There is no quick fix, especially in rapidly urbanizing cities such as Yangon. There are three key areas that must be attended to in mitigating the negative impacts of traffic congestion.

(i) Lack of Infrastructure Development: Without adding transport capacities, demand cannot be met. Development infrastructure ranges from proper maintenance; minor improvement; rehabilitation; removal of bottlenecks/missing links; construction of new roads including bridges, elevated expressways, and exclusive transit lines (BRT, MRT), among others. Priorities must be given to basic, low-cost house-keeping measures.

(ii) Inadequate Provision and Use of Road Space: Inefficient use of available road space is one of the most obvious reasons for traffic congestion in Yangon.

(iii) Sharp Increase in Private Vehicles and Lack of Competitive Public Transport Services: Of the total current demand of 11 million trips/day, about 40% and 20% are shouldered by buses and other modes of public transport (truck bus, taxi, rail, waterway), respectively. Bus ridership has gradually decreased, as passengers shifted to private cars and taxis.

(iv) Need for Expansion and improvement of Bus Services: In terms of passenger-km, bus meets 73% of total passenger demand although bus occupies only 21% of road space. Bus is so space-efficient that its services have to be expanded.

5) Bus Transport

2.13 Public transport in Yangon heavily relies on buses, which share about 40% of the total motorized trips and carry about 2 million passengers a day. Considering the importance of bus services and in response to the needs of the people, the Government has committed to reform the system drastically. The reform program was initiated in January 2017 by restructuring bus routes from 333 to 70, which was later increased to 80 in June 2017. More than 100 companies and operators were amalgamated into eight groups. New buses are being introduced to replace old ones. ICT in the form of IC card readers, GPS, and CCTV is being introduced gradually. Improvement of bus stops and terminals are also about to commence. Although the reform program still has many areas that need further improvement, it has been favorably accepted by bus users.

6) Railways

2.14 The current Myanmar Railway lines in the study area are operated poorly and have low transport capacity due to deteriorated infrastructure and a lack of maintenance although there is some demand from people who want to use the railway more. The maximum speed is approximately 25–30 km/h even on 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 at about 5–10 km/h.

2.15 Four trains/hour (15 minutes interval) are operated in the peak hour. About 42% and 36% of railway passengers use the railway to go home and to go to work, respectively. The main means of access to the stations is by walking (72% of all railway users) due to poor feeder services. Continuous urban railway development, including the enhancement of feeder services, is required.

7) Inland Water Transport

2.16 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. Three routes are regularly operated by IW transport (IWT), i.e., Pansodan–Dala (1 km, ferry), Wadan–Dala (2 km, Ro-Ro) and Land Thit–Kha Naung Toh (6 km, ferry).

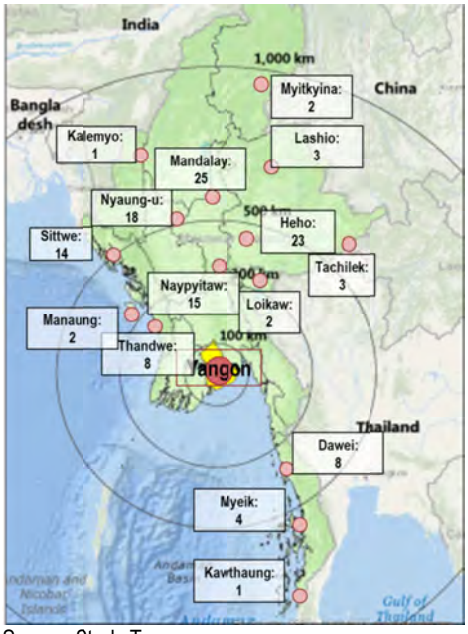
8) Air Transport/Gateway Airports

2.17 The existing Yangon Airport is located in the north of the city, approximately 17 km from the city center. The airport has one runway (3,413 m) and separate terminals for international and domestic flights. The airport has direct flights to 16 international and 15 domestic destinations. The total number of daily flights is 105 for international and 129 for domestic routes. The number of annual incoming and outgoing international and domestic passengers is 3.83 million and 1.99 million, respectively (see Table 2.2.3).

Table 2.2.3 Total Number of Daily Flights

Destination		No. of Trips[1)]
Inter-national	Short-haul International (BKK, DMK, SIN, KUL, PEN, HAN, SGN, CNX)	79
	Mid-haul International (HKG, KMG, CAN, TPE)	20
	Long-haul International (NRT, DOH, DXB, ICN)	6
	Subtotal	**105**
Domestic		129
Total		**234**

1) Operating record as of May 25th, 2018
Source: Study Team



Source: Study Team

Figure 2.2.3 Origin/ Destinations of Domestic Freight to/ from Yangon Airport

2.18 A new international airport planned and Hanthawady in Bago Region, which is 65 km away from the CBD of Yangon City is a candidate of the site. The location of new international airport will change the pattern of access to air transport dramatically when it becomes operational.

9) Gateway Port

2.19 Yangon Port is located along the Yangon River, maintaining 8.5 m of draft during the dry season and 9.0 m during the rainy season, accommodating 15,000 DWT vessels. Port facilities occupy long stretches of waterfront areas, including the CBD, and disconnect the urban areas from the riverbank in many locations.The Yangon Port system is composed of Yangon Main Port and Thilawa Area Port..

2.20 Major cargoes at Yangon Port are handled in container terminals, while general cargo is handled in the general cargo terminal and coastal/inland waterway transport terminals. Myanmar International Terminal Thilawa (MITT) handles container, timber, used cars, etc. There are jetties and pontoons utilized for domestic/inland waterway transport. The wharves owned by the Myanmar Port Authority (MPA) and private companies handle general cargoes and containers.

2.3 Characteristics of Current Urban Transport Demand

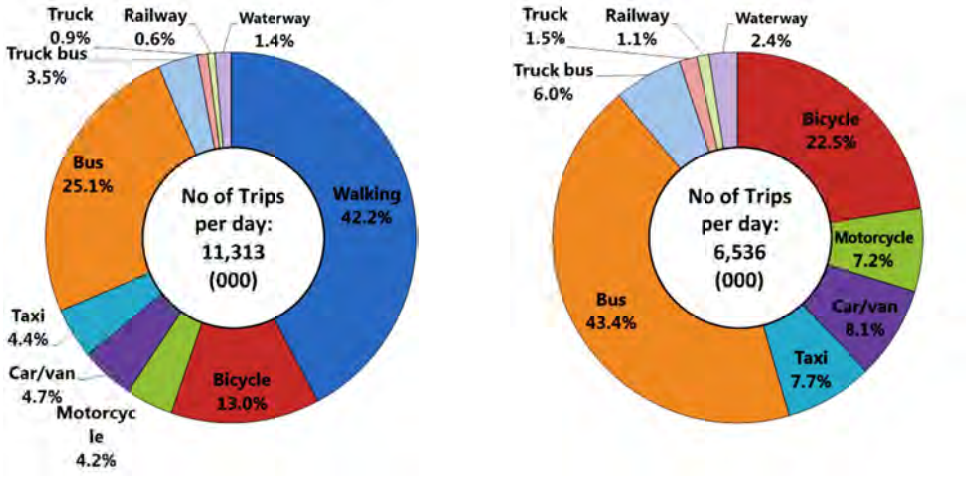
1) Demand Characteristics

2.21 In the YUTRA study conducted in 2013, a comprehensive household interview survey was conducted. Results showed that in the study area, about 11.3 million trips were made on a normal weekday in 2013, as shown in Table 2.3.1. Of those 11.3 million trips, about 4.8 million trips or 42% of the total trips were walk trips. The modal shares are presented in Figure 2.3.1.

Table 2.3.1 Urban Transport Demand by Mode Including Walking in 2013

Mode	Type	No. of Trips (1,000/day)	Mode Share (%)	
			Including Walking	Excluding Walking
Walking		4,778	42.2	-
Road	Bicycle	1,472	13.0	22.5
	Motorcycle	471	4.2	7.2
	Car/Van	530	4.7	8.1
	Taxi	502	4.4	7.7
	Bus	2,838	25.1	43.4
	Truck Bus[1)]	391	3.5	6.0
	Truck	101	0.9	1.5
	Subtotal	6,305	55.7	96.5
Railway		71	0.6	1.1
Inland Waterway		160	1.4	2.4
Total (Excluding Walking)		6,536	57.8	100.0
Total		11,313	100.0	-

1) Truck buses were banned by the government in 2014 and were replaced with minibuses (The Irrawaddy, retrieved on 24 April 2017 from https://www.irrawaddy.com/news/burma/rangoon-ban-passenger-travel-hilux-trucks.html)
Source: YUTRA Household Interview Survey (2013)



Including Walking **Excluding Walking**

Figure 2.3.1 Urban Transport Demand by Mode in 2013

2.22 The modal share of public transport in 2013 was high at about 60% excluding walk trips. Among the public transport modes, buses made up 80% of the share, while railway only accounted for about 1%. The average commuting time was about 59 minutes and 87 minutes by bus and railway, respectively, and the average number of trips per day per person was about 2.0.

2) Update of Urban Transport Demand Data

2.23 In the study, various supplemental traffic and transport surveys were conducted to update the OD tables prepared in YUTRA I and, at the same time, to analyze the current traffic situation and bus operation.

2.24 To capture the changes in traffic demand inside the study area since 2013 and to provide data for the calibration and verification of the traffic demand, a screen line survey was conducted comprising manual classified-traffic counts and vehicle occupancy surveys. A summary of the results of the screen line surveys in YUTRA in 2013 and in this study is as follows:

(i) Changes in Road Traffic crossing Hlaing River: Due to extensive developments of industrial estates and factories on the west side of Hlaing River, traffic across the entire screen line increased by 1.77 times between 2013 and 2016 with an annual average growth rate of 21.0% (numerical growth of 55,928 PCUs). In terms of vehicles, there were 128,470 PCUs in 2016 compared to 72,542 PCUs in 2013. This is shown in the following table.

Table 2.3.2 Traffic Growth across the Hlaing River Screen Line

Vehicle Type	Volume (PCU)		Growth Rate
	2013	2016	2016/2013
Car	11,306	24,358	2.15
Taxi	14,148	35,462	2.51
Small Bus	2,651	4,861	1.83
Large Bus	3,889	4,123	1.06
Light Goods Vehicle (LGV)	27,970	30,415	1.09
Heavy Goods Vehicle (HGV)	12,578	29,251	2.33
Total	72,542	128,470	1.77

Source: Screen Line Survey

(ii) Changes in Road Traffic Demand crossing Bago River: Between 2013 and 2016, PCU traffic crossing Bago River increased by 1.68 times but in terms of numerical growth, traffic only increased by 16,379 PCUs compared to the increase in the number of vehicles crossing Hlaing River. This was because as of 2016, there were still relatively few developments on the eastern side of Bago River.

Table 2.3.3 Traffic Growth across the Bago River Screen Line

Vehicle Type	Volume (PCU)		Growth Rate
	2013	2016	2016/2013
Car	5,118	10,530	2.06
Taxi	5,059	8,471	1.67
Small Bus	1,179	3,890	3.30
Large Bus	2,734	2,814	1.03
Light Goods Vehicle (LGV)	6,919	8,543	1.23
Heavy Goods Vehicle (HGV)	3,061	6,201	2.03
Total	24,070	40,449	1.68

Source: Screen Line Survey

3) Traffic in Major Intersections/ Flyover

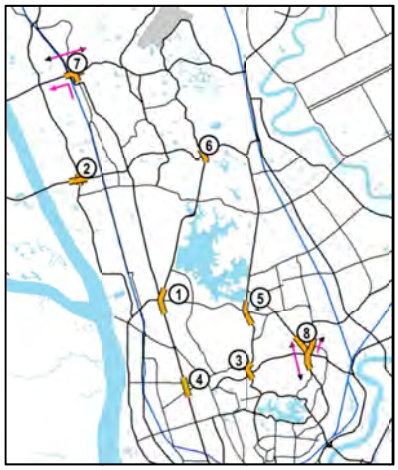
2.25 One of the biggest bottlenecks in Yangon City's road network is the design and operation of the intersections. A number of flyovers were being constructed then even without sufficient analysis of the affected intersections. The construction of a couple of the planned flyovers was eventually suspended because the issue of whether or not they could really contribute to network efficiency had not been resolved. The concern then was that traffic queues might just transfer to the at-grade intersection next/ nearest to the flyovers. The locations of constructed flyovers are shown in Table 2. 3. 4 and Figure 2. 3. 2.

2.26 Based on the results of the survey conducted to assess the effectiveness of Kokkaing Flyover and 8 Mile Flyover, it was concluded that flyovers could increase the overall traffic capacity of intersections and help reduce congestion on the corridor.

Table 2.3.4 Flyovers in Yangon City

Flyover		Opening Date
1	Hledan Flyover	April 2013
2	Bayintnaung Flyover	December 2013
3	Shwe Gon Daing Flyover	March 2014
4	Myaynigone Flyover	March 2015
5	Kokkaing Flyover	February 2016
6	8 Mile Flyover	March 2016
7	Insein Flyover	March 2016
8	Tarmwe Flyover	July 2016

Source: Study Team



Source: Study Team

Figure 2.3.2 Flyovers in Yangon City

4) Changes in Road Traffic in the Airport

2.27 The following table shows the growth in road traffic in the airport. Vehicles crossing the airport cordon line, i.e., vehicles entering or exiting the airport, increased by 1.80 times with an annual average growth rate of 21.7%.

Table 2.3.5 Traffic Growth on the Airport Road Cordon Line

Vehicle Type	Volume (PCU)		Growth Rate
	2013	2016	2016/2013
Car	9,775	19,004	1.94
Taxi	10,791	20,451	1.90
Small Bus	336	571	1.70
Large Bus	147	163	1.11
Light Goods Vehicle (LGV)	5,522	7,898	1.43
Heavy Goods Vehicle (HGV)	1,106	1,749	1.58
Total	27,677	49,836	1.80

Source: Cordon Line Survey

5) Volume of External Road Traffic

2.28 In order to gauge the changes in intercity traffic demand between the study area and outer areas since 2013, a cordon line survey was conducted which involved a 24-hour manual classified count for vehicles and a 24-hour roadside origin-destination (OD) interview survey. OD survey results were used to make 2016 OD trip tables.

2.29 Between 2013 and 2016, the total traffic demand on the cordon line increased by 1.2 times.

Table 2.3.6 Road Traffic Growth on the Cordon Line, 2013–2016

Vehicle Type	Volume (PCU)		Growth Rate
	2013	2016	2016/2013
Car	7,558	19,996	2.65
Taxi	2,683	14,427	5.38
Small Bus	1,240	6,177	4.98
Large Bus	5,757	7,053	1.23
Light Goods Vehicle (LGV)	14,284	26,030	1.82
Heavy Goods Vehicle (HGV)	11,496	19,296	1.68
Total	**43,019**	**92,979**	**2.16**

Source: 2016 Cordon Line Survey

3 APPROACH TO SUSTAINABLE TRANSPORT DEVELOPMENT IN YANGON

3.1 Traffic Demand Forecast

1) Approach

3.1 The traffic demand analysis approach has been kept simple, as the original YUTRA traffic model was already comprehensive. The approach was based on the use of a transport database which was updated based on the following:

(i) Results of the recent (2014) census to update the socio-economic database;

(ii) Updates on urban development information from recent studies including the Strategic Urban Development Plan for Greater Yangon (SUDP) and others;

(iii) Results of supplemental traffic surveys conducted in this study; and

(iv) Information about ongoing and planned transport projects.

3.2 Regarding the demand forecast methodology, five major tasks were carried out, to wit:

(i) Updating of the socio-economic framework for 2016 and forecast years;

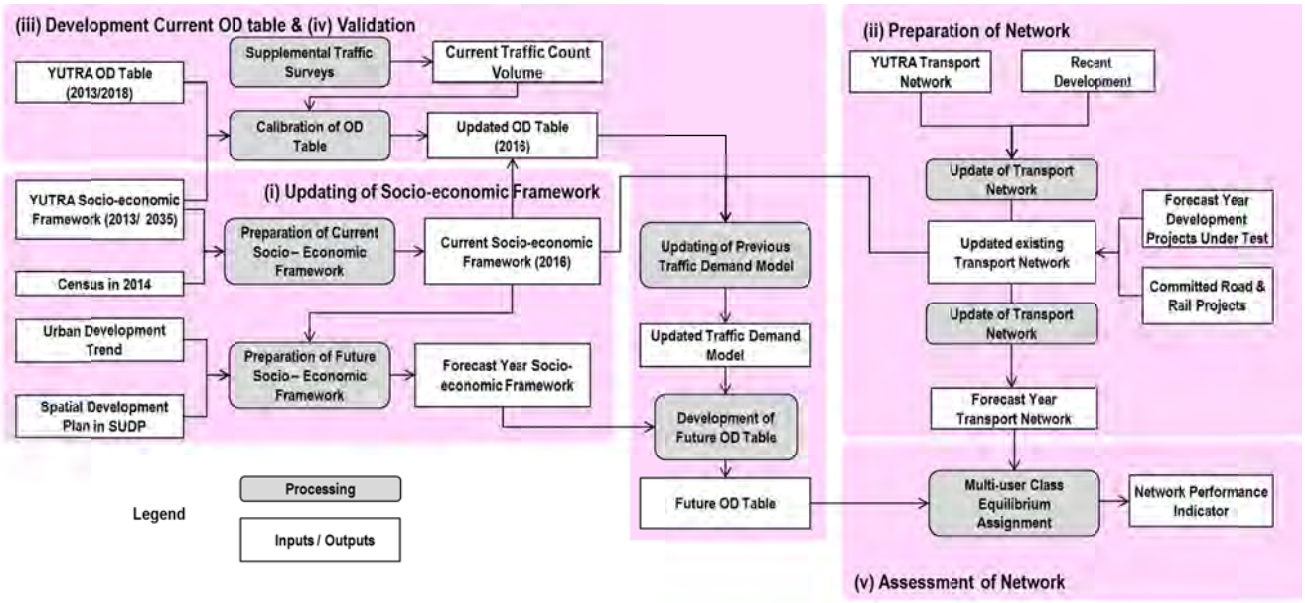
(ii) Preparation and updating of the transport model networks for 2016;

(iii) Development of the initial 2016 OD table by mode using the YUTRA 2013 & 2018 synthesized trip tables;

(iv) Analysis of recent traffic survey data and validation of models for the network and trip tables by mode to calibrate the 2016 situation; and

(v) Forecasting of demand and assessment of network to develop and evaluate

3.3 The overall approach to update and forecast the demand is shown in Figure 3.1.1.



Source: Study Team

Figure 3.1.1 Flowchart for Updating Demand Analysis

2) Traffic Demand Forecast

3.4 The 2016 validated travel demand OD trip matrices were prepared during the traffic model validation. These OD tables reflect the current / recent situation when compared with the 2016 traffic counts. The forecasts for 2035 were estimated using the 2016 OD tables and 2035 trip ends derived using the socio-economic framework. All modes of travel, including walk, trips by bicycle and motorcycle, are forecast independently from other modes, i.e., car, taxi, bus and goods vehicles (GV).

3.5 The growth in travel demand by dominant travel modes from 2016 to 2035 is compared in Table 3.1.1. It is demonstrably clear that car trips would increase at much higher rates than those of taxis, and mostly at the expense of public transport. However, public transport trips are likely to more than double by 2035. This shows that the need for travel would more than double (2.4 times) from 2016 to 2035, and the rate of increase is estimated to be over 4.6% per annum, which is almost double the growth in population.

Table 3.1.1 2016 and 2035 OD Person Trips by Mode

No.	Travel Mode	Validated 2016 OD Person Trips ('000)	2016 Mode Share (%)		Forecast 2035 OD Person Trips ('000)	2035 Mode Share (%)		Person Trip Growth (2035 / 2016)	AAGR in Person Trips (%)
			Total	4+ Wheel		Total	4+ Wheel		
1	Walk	4,624	37.5	-	5,375	24.2	-	1.16	0.8
2	Bicycle	1,091	8.8	-	1,268	5.7	-	1.16	0.8
3	Motorcycle	357	2.9	-	550	2.5	-	1.54	2.3
4	Car	1,118	9.1	17.8	4,186	18.8	27.8	3.75	7.2
5	Taxi	1,019	8.3	16.3	2,280	10.2	15.1	2.24	4.3
6	Public	4,132	33.5	65.9	8,591	38.6	57.1	2.08	3.7
4-6	4+ Wheel Modes	6,269	51	100	15,057	51	100	2.40	4.7
1-6	Total	12,339	100	-	22,250	100	-	1.80	3.2

Sources: Study Team

3.6 The share of walk, bicycle, and motorcycle trips would decline, with walk trips having the biggest decline. In Asia, as societies get richer, the tendency to walk declines. It is considered to be the mode of poor population, who tend to reside near workplaces for lack of resources to travel, even by bus. Car share would almost double, with a small increase in taxi trips.

3.7 Public transport is expected to increase, somewhat at the expense of walk trips. The expected increase in public transport share is also greater than the growth in population. This should be considered a blessing when compared with other Southeast Asian cities like Hanoi or HCMC where motorcycles have swamped the cities and the share of public transport is very limited, despite massive investments in public transport.

3.8 Trips by goods vehicles (GVs) are modelled as a separate category due to their nature, i.e., collection and delivery of goods, and the physical distribution of goods in the city. For a like-with-like comparison and for modelling road traffic, trips by all modes and by different sizes of goods vehicles were converted to PCU, where a 'standard' 4-wheel car is equivalent to 1.0 unit.

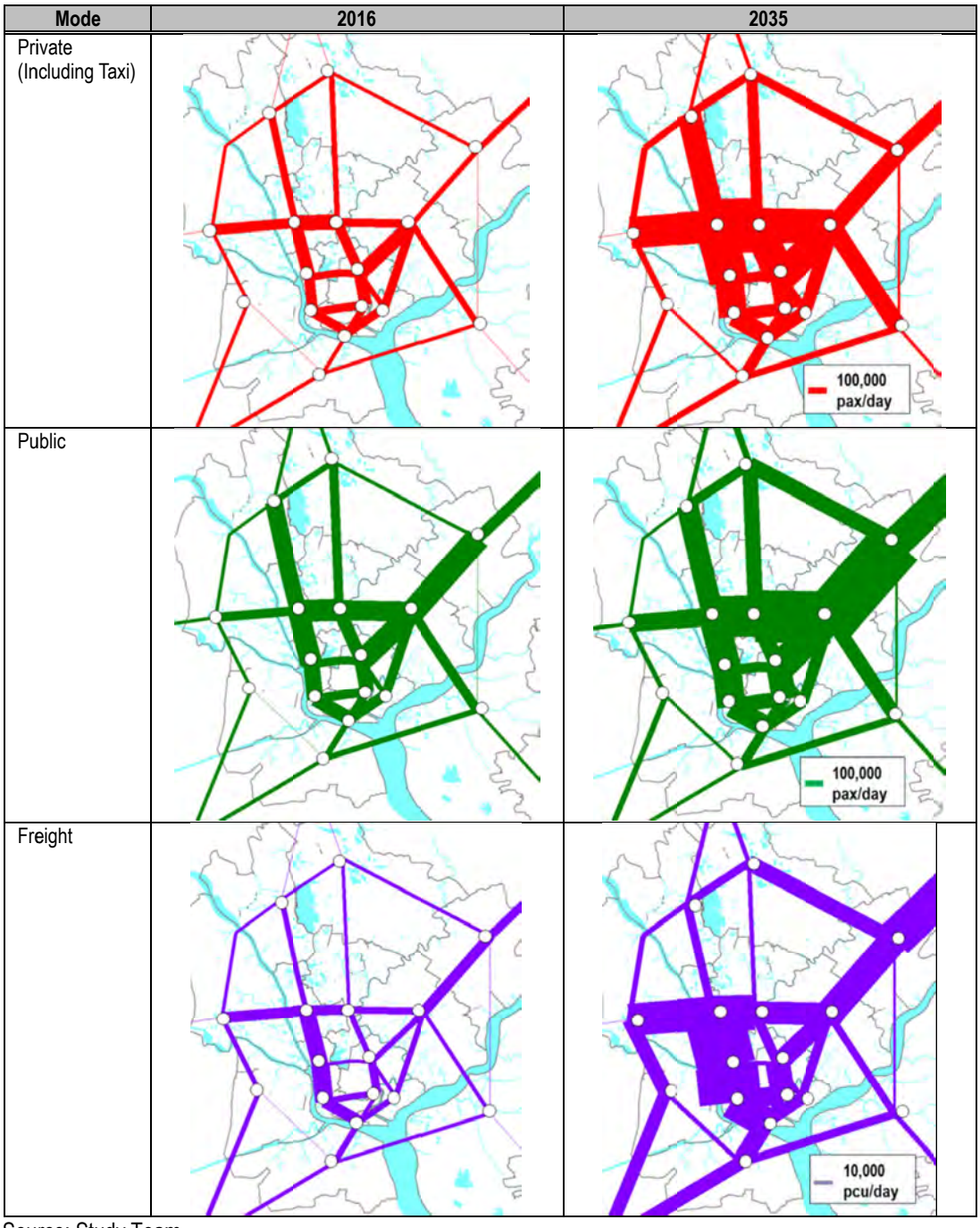
3) Trip Patterns

3.9 Main findings on the trip pattern are explained based on Figure 3.1.2 as follows:

(i) The 2016 distribution of public and private trips is quite different from each other. While private transport trips were rather concentrated in the central urban areas, public transport trips were widely spread over the urban areas. This is also verified from the supplemental survey which shows that the average travel distance of bus passengers

was much longer than that of private car users. Meanwhile, freight traffic was concentrated in major traffic-generating centers mostly within the study area.

(ii) The future will be different from 2016 for all types of traffic demand. The common expectation is that the demand will increase significantly and will spread throughout much of the study area. The increase will also be felt in the outer area, and this has implications for urban transport in Yangon; appropriate planning will thus be needed to address this concern.



Source: Study Team

Figure 3.1.2 Trip Patterns in the Base and Forecast Years

3.2 Approach to Sustainable Transport Development in Yangon

1) Vision

3.10 The transport sector, being an integral part of the overall urban development, aims to achieve the following goal:

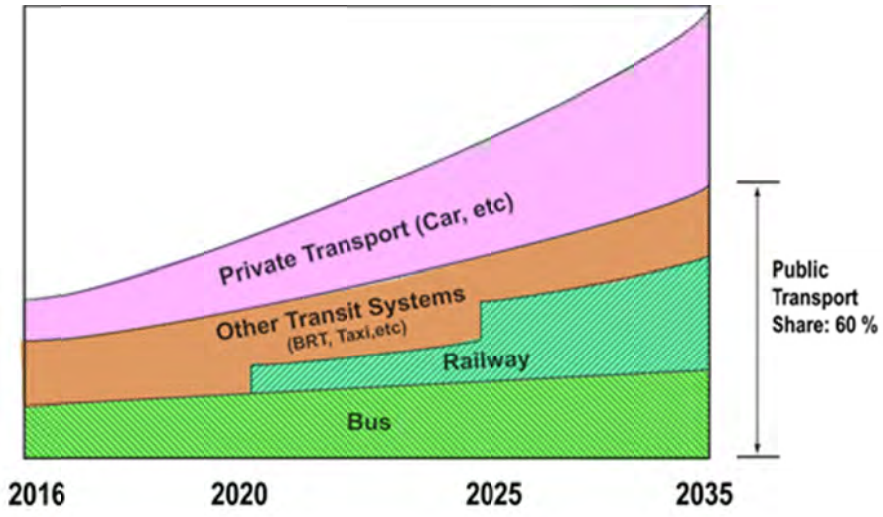
Overall Goal of Yangon Transport

Sustainable transport development for the Yangon Region to enable it to function as a competitive international and national growth hub and provide needed mobility and accessibility for the people.

3.11 In this context, the intention is to rid Yangon Region from traffic congestion, traffic accidents, pollution, poorly accessible areas, and other barriers to ensure the smooth movement of people and goods. The urban transport network will also be comprehensible to both domestic and international visitors and accessible especially to the physically challenged.

2) Target Modal Share

3.12 At present, Yangon Region's urban transport is supported by extensive bus services which, however, have been threatened by rapid motorization. But for the expected size of the future Yangon City, it will be difficult to sustain a public-transport-based city at high levels of service. In order to maintain the current high share of public transport demand, it is necessary to introduce a high-quality, mass transit system such as urban rail, BRT, improved bus system, and other transit services, as conceptually illustrated in Figure 3.2.1.



1.8

Source: Study Team

Figure 3.2.1 Mass Transit Systems Proposed for Yangon City

3.13 Sustainable transport for Yangon City should have the following five characteristics:

(i) **Connected**: Transport must be connected at international, national, regional, and city levels.

(ii) **Competitive**: Transport must be competitive, that is, it has high quality and high performance, must be comfortable and efficient, and offer various amenities.

(iii) **Inclusive**: Transport must be inclusive, that is, people-oriented and accessible to vulnerable groups such as the elderly, people with disabilities, etc.

(iv) **Ecological**: Transport must be ecological, that is, it is energy-efficient, less polluting, and disaster-resilient.

(v) **Coordinated**: Transport must be coordinated well among the vertical and horizontal government institutions and between public and private sectors.

3.14 With the above-mentioned goal and principles, Yangon's transport sector intends to achieve the five "no" conditions, i.e., no traffic congestion, no traffic accidents, no pollution, no poorly accessible areas, and no barriers to smooth movement of people and goods.

3) Basic Strategies

3.15 The basic strategies to achieve the above goal are summarized as follows:

(i) Development of high-quality public transport system comprising competitive urban rail, modern bus, and other public transport modes in integration with efficient land use and urban development. Because the development of urban rails requires lengthy time and large investments, a step-wise rail development, early improvement of bus services, and development of a BRT system must be considered;

(ii) Strengthening of the hierarchical urban road network comprising urban expressways, primary roads, secondary roads, and local roads, which are properly maintained. Priority must be given to road maintenance, minor improvements, and removal of bottlenecks/missing links. The development of elevated urban expressways on self-financing or PPP basis can also be considered;

(iii) Strengthening of traffic management to maximize available transport capacities through such measures as improved traffic control along major roads and intersections/roundabouts, provision of traffic safety facilities, improved enforcement of traffic rules, education of road users including drivers, and improved vehicle inspection, among others;

(iv) Improvement of walking conditions; and

(v) Introduction of alternative methods to address right-of-way (ROW) acquisition and resettlement issues more effectively, such as land readjustment which has been practiced widely in Japan.2

3.16 Key considerations in transport planning and development include the following:

(i) **Comprehensive Approach:** As many projects/actions in large urban areas are interrelated, sectoral approach and piecemeal solutions are not sustainable. Transport

[2] It was reported that about a third of urban areas in Japanese cities were developed based on the land readjustment scheme.

and urban development must be integrated. Transport modes need efficient intermodal connectivity, and infrastructure without proper management by IT and human resource may not function adequately.

(ii) **Continuity among Short-, Medium-, and Long-term Actions:** Short-term solutions must be continued over the midterm and the long term, while long-term solutions must be started during the short-term period. Integrated, coordinated, and phased actions are important for the effective use of limited resources.

(iii) **Emphasis on Urban Transport Issues in National Transport Policy:** As the efficiency of Yangon's urban transport affects the country's economy and image, central government resources must be tapped adequately. This includes projects which strengthen the connectivity between Yangon and other regions, as well as access transport to international gateway ports and airports.

3.17 In addition to the aforementioned considerations, it must be emphasized that integration is key to formulating and implementing transport policy, plan, and projects, as briefly explained below.

(i) **Spatial Integration:** As Myanmar and Yangon are becoming globalized, spatial integration at international, national, regional, urban, township, and even ward/ community levels become more and more important to ensure seamless movement of people and goods. This is especially true for Yangon which must function as the most important socio-economic hub and gateway.

(ii) **Sectoral Integration:** Transport, land use, and environment are highly interactive and must be planned and implemented in an integral manner.

(iii) **Modal Integration:** Various public and private transport modes (such as air, water, rail, road) and services for goods and passengers must be properly integrated as well as efficiently and effectively provided.

(iv) **Hierarchical Integration:** The transport network must be designed in a hierarchical manner, i.e., primary, secondary and tertiary, to enhance network orientation and cost effectiveness.

(v) **Institutional Integration:** As transport development involves various agencies and organizations at national and local levels, including the private sector and communities, coordination among these stakeholders is important and adequate institutions must be provided.

3.3 Future Transport Network For Yangon

1) Transport Network Analysis

3.18 On the basis of the updated demand, the YUTRA network was assessed. Except for some sections where goods vehicles concentrate, and these are at ports and logistics areas, the assessment shows that the network is considered generally adequate. Therefore, the network proposed in the YUTRA is taken as the basis for further analysis in the study.

(a) Baseline Scenario and Do Nothing Scenario

3.19 This scenario aims to analyze the traffic situation in the future by assuming that no investments have been done. The entire transport network will be choked and bottlenecks will spread over the entire urban area. This greatly contrast with the existing situation where traffic congestion is already observed in many sections in the city. Under the Do Nothing Scenario, it is estimated that the total transport cost (sum of vehicle operating cost and time cost of passengers) will reach MMK 170.2 billion a day, which is a 7.0 times increase from 2016. The result indicates that Yangon needs to expand and strengthen its transport system substantially to meet a very large demand.

(b) Do Maximum Scenarios

3.20 There are two Do Maximum scenarios, i.e., the one prepared in YUTRA Study and the other prepared in this study in response to the urban spatial structure updated in the SUDP study and new policy directions. The main differences between the two scenarios are the following:

(i) Expansion of the urban expressway to the outer ring road in the direction of Kyee Myin Daing / Twanty, Dala and the addition of an east–west link in the city center;

(ii) Reduction of 7 BRT routes to 2 due to lack of urban road space; and

3.21 This scenario aims to analyze the adequacy of the future transport network as of 2035. The main findings are as follows:

(i) The updated network shows overall improvement in traffic performance compared to the YUTRA plan, as shown in Table 5.2.1;

(ii) In 2035, overall traffic will improve and become better than the situation in 2016. Average VC ratio will also decrease from 0.56 to 0.45, while average travel speed will increase from 10.6 km/h to 15.1 km/h;

(iii) One of the most significant factors that will contribute to the improvement is the urban railway network which is expected to transport 4.4 million passengers a day in 2035;

(iv) Another important factor is the expressway network which will share about 15% of total road traffic demand. Without elevated expressways in urban areas, congestion on at-grade roads will worsen; and

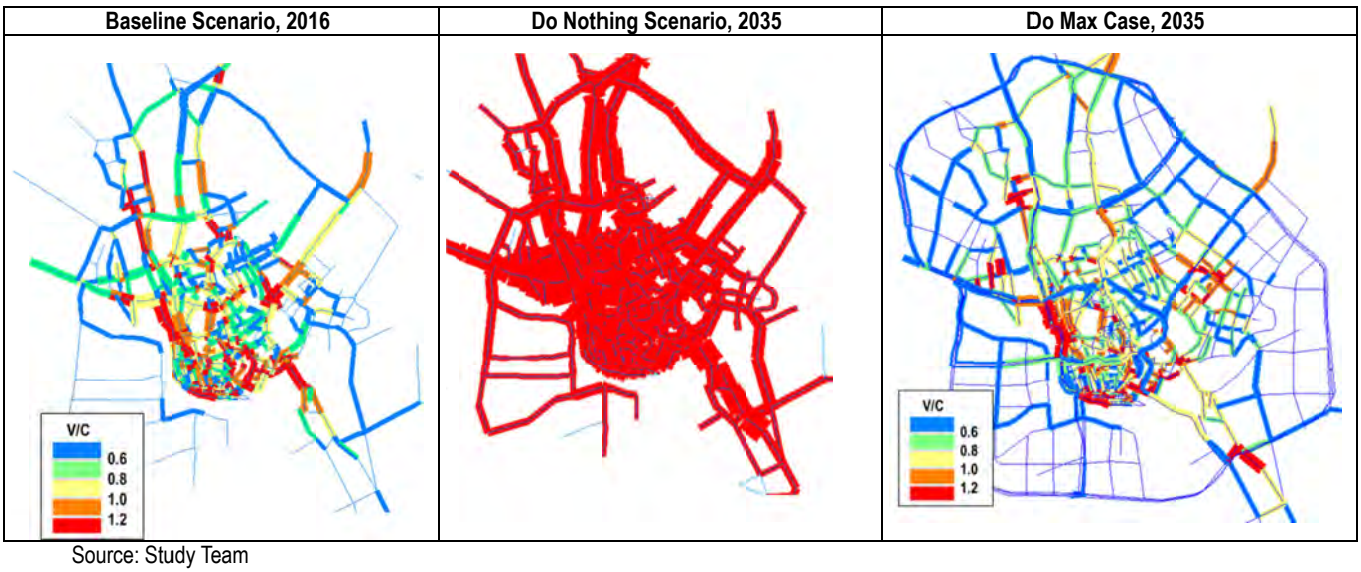
(v) Average transport cost per person trip will decrease from MMK 1,733 in 2016 to MMK 1,539 in 2035, mainly because of reduced traffic congestion and improved connectivity between origins and destinations.

Table 3.3.1 Network Performance under Various Scenarios

Item		2016	2035		
			Do Nothing	Do Maximum (YUTRA)	Do Maximum (This Study)
Travel Demand	Person Trip (000)	6,268		15,058	
	Person-km (000)	71,783	178,622	182,270	185,758
	Person-hours (000)	4,796	26,137	8,897	7,692
Road Traffic Demand	PCUs (000)	1,336		4,022	
	PCU-km (000)	15,068	40,825	33,359	33,203
	PCU-hours (000)	1,329	6,531	2,478	1,861
Network Performance	Ave. V/C Rate	0.6	1.5	0.57	0.44
	Ave. Travel Speed (km/h)	15.0	6.8	20.5	24.1
	Transport Cost (MMK billion)	24.3	170.2	63.4	59.6
	Transport Cost/Pax Trip (Kyat)	3,900	11,302	4,208	3,955
Railway Performance 1)	No. of Pax (000)	214	882	7,846	7,799
	Pax-km (000)	1,014	7,273	64,527	59,981

1) Excluding BRT
Source: Study Team

3.22 The aforementioned analysis indicates that Yangon has a good chance at realizing a much improved urban transport provided the proposed projects are timely implemented.



Source: Study Team

Figure 3.3.1 Traffic Assignment Result for Several Scenario

2) Proposed Transport Network for Yangon

(a) Proposed Network

3.23 In order to meet the expected large traffic demand in Yangon as a result of promoting the desired growth and expansion of urban areas, the future transport network is formulated with the following considerations (see Figure 3.3.2).

(i) **Road Network: I**mprovement and development of hierarchical urban roads consisting of primary and secondary roads both in existing and emerging urban areas including new towns.

(ii) **Expressway Network:** The development of a network of elevated or access-controlled toll expressways in integration with urban roads is a must to resolve traffic congestion on at-grade roads.

(iii) **Public Transport Network:** The development of a high-quality, high-capacity public transport system is the most important challenge for Yangon, not only to improve the traffic situation but also to promote compact and desirable urban areas and land use. With the circular rail forming the backbone, it must be integrated with suburban commuter lines and new urban lines. BRT development under elevated urban expressways is also worth considering.

3.24 The overall urban transport network proposed in the YUTRA Study has been deemed appropriate to meet the future transport demand in Yangon. The main findings of the review which was based on the updated database and planning policy of the new administration include the following:

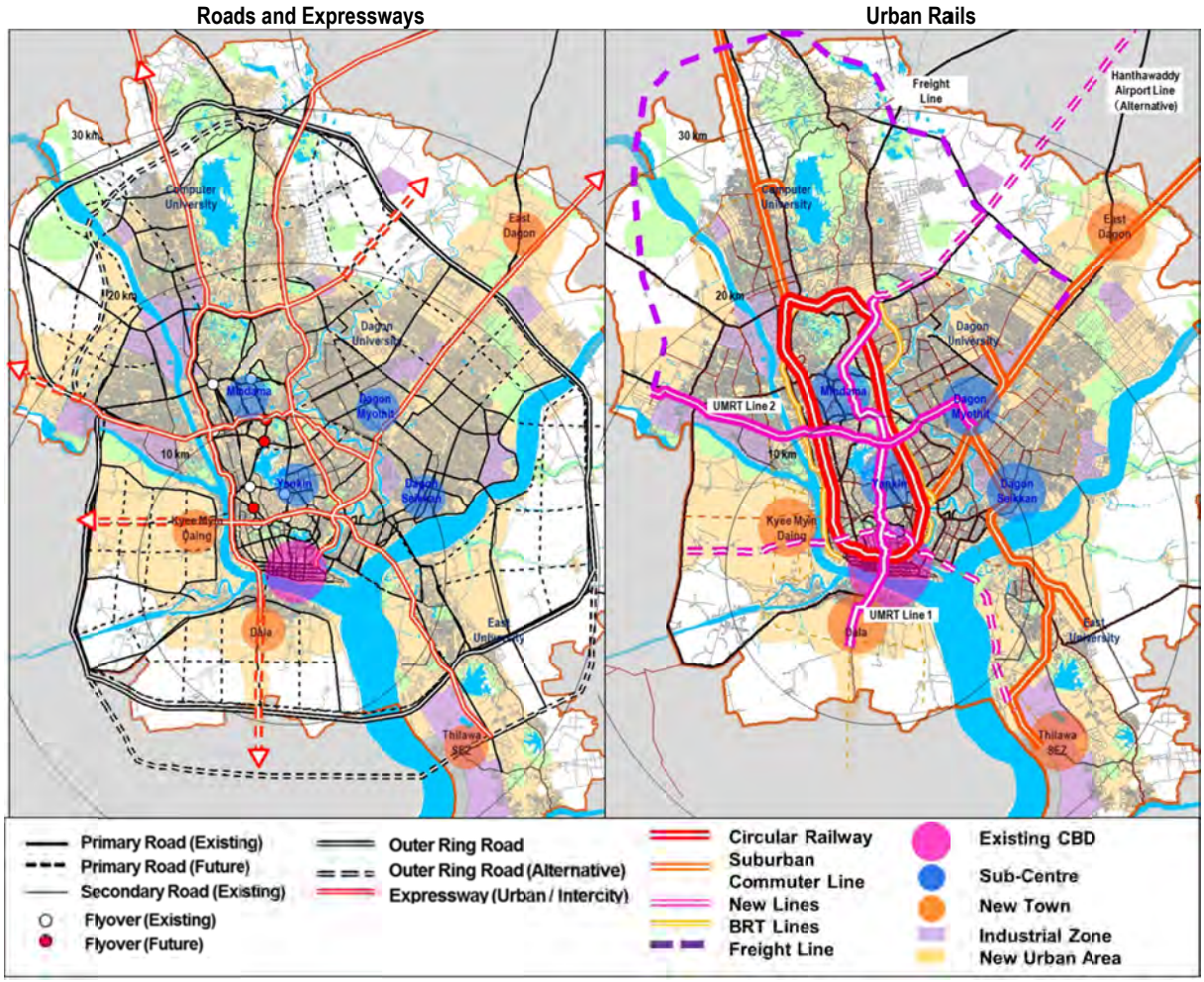
(i) **Development of At-grade Roads:** Further expansion and development of at-grade roads is the most fundamental undertaking of the government. In addition to the upgrading of existing roads, the development of missing links in existing urban areas and new roads in emerging suburban areas must be promoted in integration with land use development.

(ii) **Expansion of Expressways:** The expansion of the urban expressway network is proposed because of substantial increases in the future transport demand compared to YUTRA's estimates, the anticipated difficulties in developing at-grade roads, and in response to the redefined spatial structure in the SUDP. The proposed expressway network will cover the future urban area which will cover areas within and along the outer ring roads. For this, new expressway routes connecting Dala, Kyee Minh Daing, Thilawa, and East Dagon, as well as an additional east-west link in the city center, are proposed. Urban expressways will be elevated or underground in the city center and at-grade in suburban areas.

(iii) **Development of BRT Routes:** The seven BRT routes proposed in YUTRA should be reduced to two to spare road space for vehicular traffic, except inner ring road sections where elevated expressways are to be constructed and is at-grade sections of the roads are wide enough to accommodate two-lane dual carriageways even after BRT development.

(iv) **Development of Urban Rails:** A high-quality mass transit network supplemented with BRT, bus, and other public transport modes is proposed for Yangon. The proposed urban rail network will also promote diversion from private cars through park & ride

schemes, especially in suburban areas. The urban rail network will be composed of the Yangon Circular Rail, suburban commuter rails, and new metro lines. In view of the concentration of high demand in the city center and expected developments in the south, west, and east areas, an additional east–west line has been proposed to connect the city center with Kyee Myint Daing, Dala and Thilawa.



Source: Study Team

Figure 3.3.2 Proposed Urban Transport Network for Yangon

4 STUDY ON MAIN URBAN TRANSPORT SUBSECTOR

4.1 General

4.1 On the basis of the discussions held in Chapter 3, further studies were conducted and preliminary solutions were prepared for the following subsectors:

(i) Urban Road Development

(ii) Expressways

(iii) Bus Transport System

(iv) Traffic Management and Safety

(v) Urban Rail Development

(vi) Development of Yangon Circular Rail

(vii) Inland Waterway Transport Development

(viii) Transit Oriented Development

(ix) Logistic Transport Development.

4.2 For each subsector, strategies and proposed actions were identified and rough cost estimation and implementation plan were worked out as explained in Chapter 5.

4.2 Urban Road Development

1) Context

4.3 Roads are the most fundamental infrastructure in urban area. They provide not only the space simply for the movement of vehicles and pedestrians but also the places for various socio-economic activities along them. Roads provide an important open space as fire belt and evacuation route. Design of roads space also contributes to enhancement of amenity and landscape. Roads can accommodate other urban utilities such as water supply, drainage, electricity, telecommunication facilities. Road spaces can also provide opportunities for various events and recreational activities. Roads are to connect main socio-economic activities centers each other as well as with the living quarters of the people. However, the current urban roads are not necessarily built in such a way that the aforementioned destinations are connected in efficient and effective manner each other.

2) Strategies

4.4 Although traffic volume has increased significantly in the last three years and this high rate is expected to continue for a while, the construction of new major arterial roads or widening of existing major arterial and secondary roads in the city center to increase traffic flow capacity proves to be very difficult because of constraints in land acquisition and resettlement. Because the provision of new road facilities like the elevated inner ring road (IRR) and mass rapid transit (MRT) will likewise require considerable time under such restrictions, the direction of urban road development is proposed as follows:

(i) Maximum utilization of the existing road network and facilities including removal of bottlenecks, expansion of traffic management measures, expanded reliabilities and maintenance;

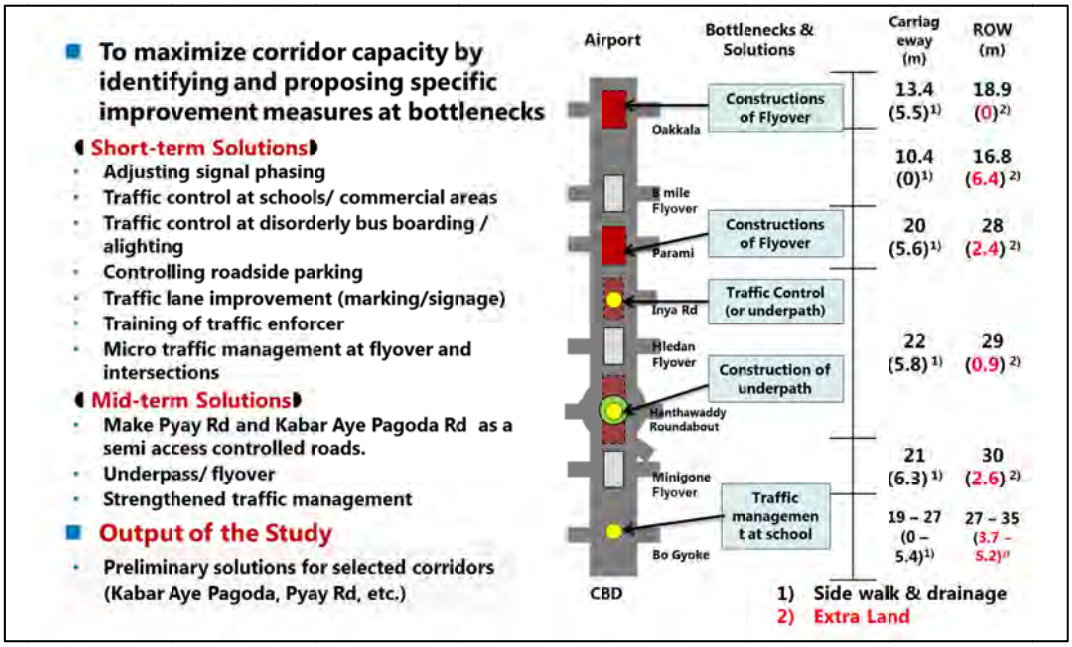
(ii) **Development of missing links** including widening of roads in existing urban areas in integration with improvements of the roadside environment; and

(iii) **Development of new roads in urban areas** even though it is not easy to do so. Yangon must continuously face this challenge in order to establish an adequate transport infrastructure as well as an effective land use. There are alternative approaches in developing new roads in urban areas, to wit:

- When developing roads in urban areas, introduce alternative approaches which will not require acquisition of lands but readjustment of lands, and
- In greenfield projects, plan roads first to secure space and shoulder the cost of subsequent urban development which will follow the planned alignments. In this case, a road plan must be part of the statutory urban plan to force developers to comply.

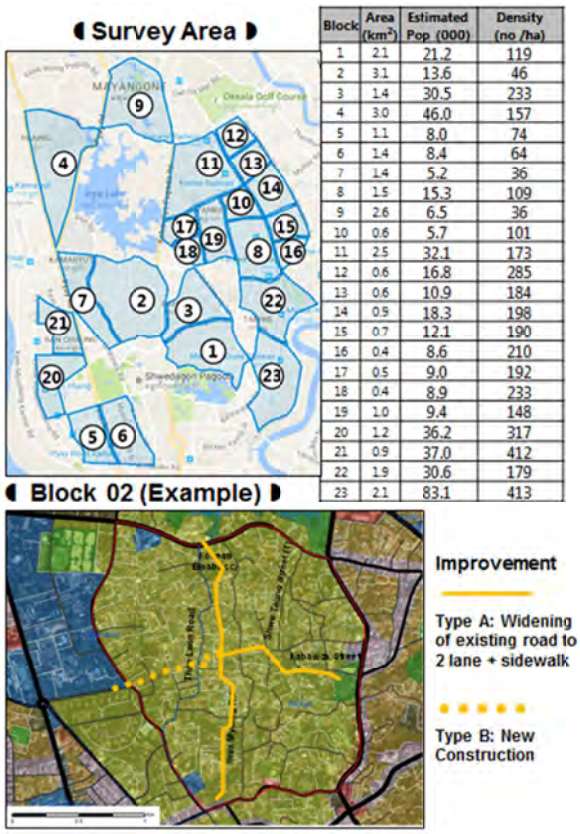
3) Proposed Actions

4.5 Proposed actions of this sector are composed of (i) maintenance/minor improvement, (ii) rehabilitation, (iii) bottlenecks removal, (iv) missing links development, (v) flyover/underpass, (vi) secondary roads packages, (vii) primary road development, (viii) new bridges and (ix) outer ring roads, as explained in Chapter 5.



Source: JICA Study Team

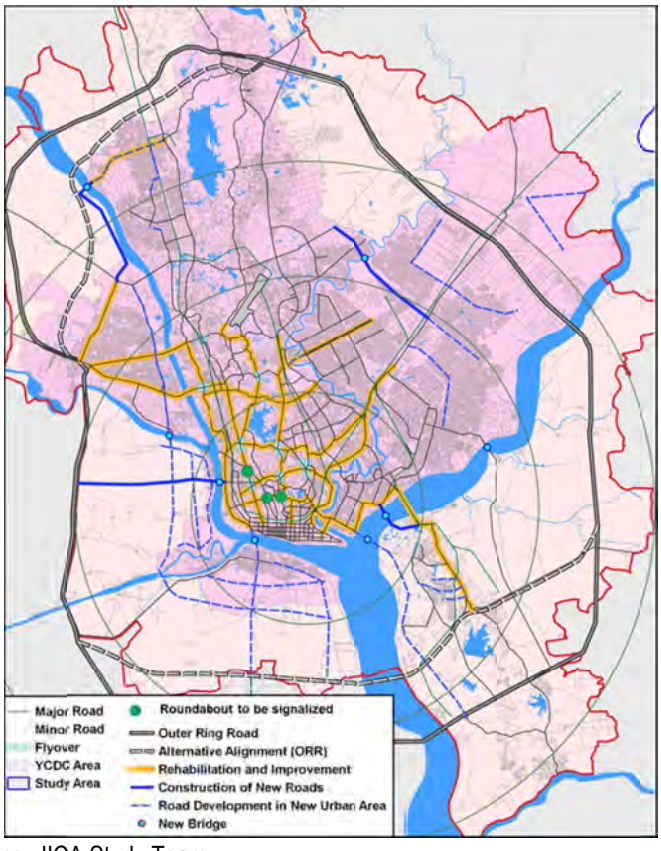
Figure 4.2.1 Bottleneck Analysis (Example: Pyay Rd)



Block	Area (km²)	Estimated Pop (000)	Density (no /ha)
1	2.1	21.2	119
2	3.1	13.6	46
3	1.4	30.5	233
4	3.0	46.0	157
5	1.1	8.0	74
6	1.4	8.4	64
7	1.4	5.2	36
8	1.5	15.3	109
9	2.6	6.5	36
10	0.6	5.7	101
11	2.5	32.1	173
12	0.6	16.8	285
13	0.6	10.9	184
14	0.9	18.3	198
15	0.7	12.1	190
16	0.4	8.6	210
17	0.5	9.0	192
18	0.4	8.9	233
19	1.0	9.4	148
20	1.2	36.2	317
21	0.9	37.0	412
22	1.9	30.6	179
23	2.1	83.1	413

Source: JICA Study Team

Figure 4.2.2 Missing Link Analysis



Source: JICA Study Team

Figure 4.2.3 Road Development Plan in the Greater Yangon

4.3 Expressways

1) Context

4.6 As it is very difficult to expand urban roads in existing urban areas, especially in city centre whilst the use of private car will be more and more accelerated as other cities experience in Asia. Construction of urban rail will encourage the shift from bus and other public transport modes but not much from private cars. Therefore, the construction of urban expressway will directly affect the shift of private vehicles (cars and trucks) from congested at-grade roads to elevated or grade separated expressways. In order to accelerate the implementation of YUTRA projects, "Data Collection Survey on Yangon Urban Expressway (YUEX)" was conducted in 2015 to prepare the basic information for the next step of the study such as Feasibility Study.

4.7 Mega cities like Yangon need both high-quality transit network and urban expressway network. In addition, an inner ring road (IRR) should be ideally located to improve road traffic

(i) To absorb CBD traffic effectively;

(ii) To divert long-distance passengers and goods traffic to/from port; and

(iii) To establish efficient connectivity to Dala and the southern region via the Dala Bridge.

2) Strategies

4.8 In order to meet future traffic demand, development of at-grade roads alone is not enough. It is necessary to consider extensive urban expressway system.

(i) Urban expressway must be developed as a network comprising I-RR and other radial connecting sections including access to Yangon-Mandalay expressway

(ii) In terms of function, I-RR provides the north-south road traffic backbones on the west and east of urban centre. Therefore, the west section of I-RR must be farther extended to Dala area where urban development is expected to accelerate. A branch section to Kyee Myin Daing and Twantay is also necessary. CBD is served by two separate gates of urban expressway on the east and west.

(iii) Yangon is provided with poor east-west connecting roads which constraint dispersal of traffic in the city centre. To solve this, it is proposed to develop two east-west smart tunnels as already constructed and in successful operation in Kuala Lumpur[3].

(iv) Urban expressways have wider opportunities of cost recovery as well experienced in Bangkok, Tokyo and other cities, because car users and logistics operators are willing and affordable to pay for time savings. The project implementation methods should be carefully considered to achieve the financial viability.

3) Proposed Actions

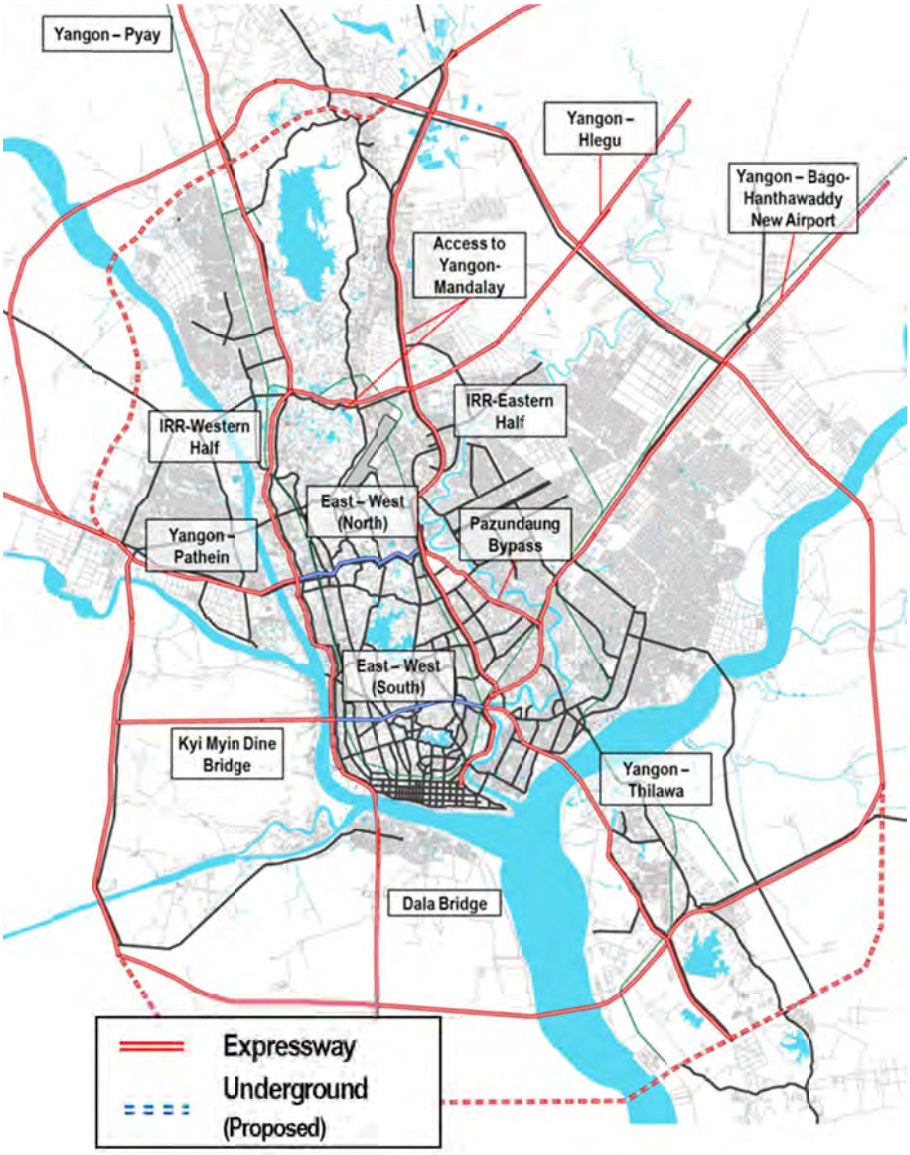
4.9 Proposed actions include following:

(i) Comprehensive F/S on urban expressway system including network, technical standards, operation and management, and PPP opportunities.

(ii) Feasibility Study on the north-south section of I-RR in integration with Dala Bridge.

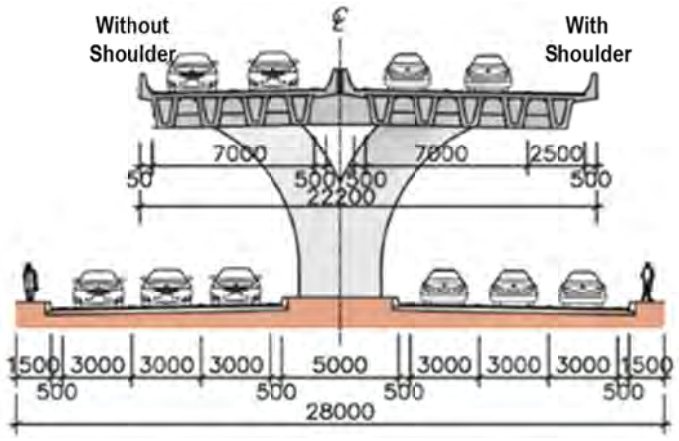
(iii) Pre-Feasibility Study on east-west smart tunnel section.

[2] http://smarttunnel.com.my/



Source: Study Team

Figure 4.3.1 Proposed Urban Expressway Network



Source: Study Team

Figure 4.3.2 Basic Concept of YUEX

4.4 Bus Transport System

1) Context

4.10 Improvement of bus transport is made urgent by the rapid motorization in Yangon. The main challenge is how to eradicate the following bad image of buses on Yangon:

(i) Bus drivers lack discipline: largely due to their penchant for competing against each other, whether belonging to the same company or not. This street competition for passengers can be ascribed to the fragmented structure of the industry.

(ii) The traffic impact of bus operations: They tend to race to the next bus stop to outdo the other buses, and to wait very long on those stops to wait for passengers.

(iii) Another problem cited is the overlapping routes (about 336) that seem to be all going to the same place, or similar direction, without much interconnection.

(iv) Nearly all the vehicles in service are very old.

4.11 On 17 January 2017, the Yangon Region Government launched the new public bus network called the Yangon Bus Service (YBS), and the following major actions were taken4:

(i) Dissolution of the Ma Hta Tha (Central Supervisory Committee for Motor Vehicles) as the bus regulator and operationally replaced by the YRTA;

(ii) Rationalization of more than 300 bus routes in Yangon to about 80 (as of January 2017);

(iii) Replacement of commission-based payments for bus drivers and conductors (which encouraged overcrowding on buses and unsafe driving) with monthly salary payments;

(iv) Establishment of eight companies under the management of the YRTA to replace the existing system where many companies and individuals owned bus vehicles and routes.

(v) Fares changed to MMK100 to flat fares of MMK100 for the three CBD loop routes and MMK200 for all other routes (as of January 2017);

(vi) Retirement of old bus vehicles (those built before 1996); and

(vii) Eventual change in payment of fares from cash to smartcards within months of the launch of the Yangon Bus Service (January 2017) to reduce problems of corruption.

4.12 From lessons on bus reforms in other cities, the key factors for success (converting the preceding “bads” into “goods”) are the following:

(i) Strong political leadership at the local / city level to start and sustain the reform process;

(ii) Strong local institution (a role expected from the soon-to-be created YRTA) that will be responsible for route planning, performance monitoring, support infrastructure);

(iii) Passenger feedback as part of the quality control mechanism;

(iv) Rapid deployment of modern technologies for bus management (GPS-based vehicle tracking, a unified smart card fare collection system, central control center);

(v) Need for calibrated subsidies up front, considering that fares are set too low against the high cost of procuring modern bus assets.

[4] Myint, S. (2017). Yangon’s new bus service is a bold challenge to vested interests. Frontier Myanmar. Retrieved 18 April 2017, from http://frontiermyanmar.net/en/yangons-new-bus-service-is-a-bold-challenge-to-vested-interests

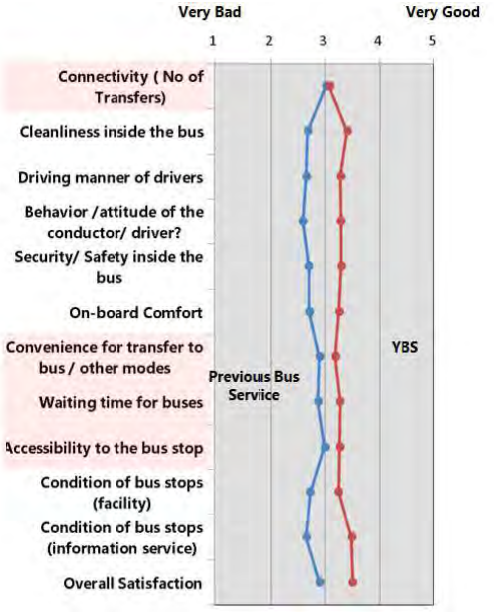
4.13 The Study Team conducted a bus passenger interview survey to gauge bus users' opinion with regard to the new bus service. By April 2017 or three months after the launch of the YBS, 2,400 bus passengers had been interviewed. Results show that the overall satisfaction with the bus service increased after the YBS replaced the previous bus service. However, the users' opinion survey also shows that there are some aspects of the bus service that barely improved, to wit:

(i) Comfort in transferring to buses/other modes (number of transfers);

(ii) Convenience in transferring;

(iii) Waiting time; and

(iv) Accessibility of bus stops.



Source: Study Team
1) Respondents totalled 2,400 bus users.

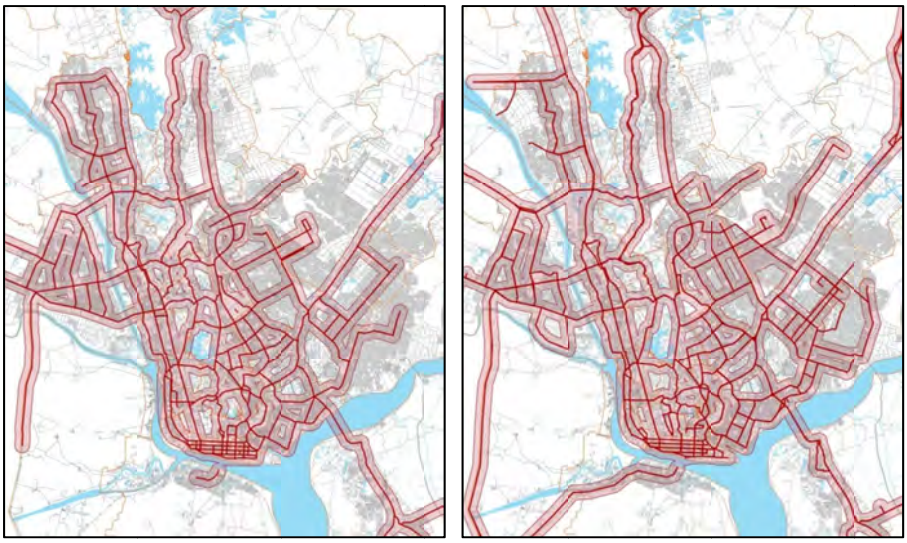
Figure 4.4.1 Bus Users' Opinion about Yangon Bus Service 3 Months After Launch

4.14 More than 300 bus routes were restructured to 81 routes, as shown in Figure 4.4.2. The findings on the coverage of bus service and route connectivity are as follows:

(i) The coverage of the bus network has expanded although the number of transfers has increased in some areas. For instance, in the Northwest/ east clusters, bus network coverage is extensive. On the other hand, the coverage in new urban areas is limited.

(ii) However, as it is not economical to connect all areas with big buses, adequate feeder services need to be provided. Measures to improve connectivity must include facilities, services, and fare integration; and

(iii) In order to supplement city bus services, companies have increasingly provided bus / truck bus services for their workers.



Previous Bus Route Coverage **Current YBS Route Coverage**

Source: Study Team

Figure 4.4.2 Comparison of Bus Route Coverage

2) Strategies

(a) Further Actions to Improve Yangon Bus Service

4.15 The Yangon Bus Service has recently been launched, and there are still many issues and problems which need to be addressed before Yangon can have a safe and reliable public bus system that meets the travel needs of bus users. The Study Team has identified additional actions that can be undertaken by the YRTA to further improve the services of public buses in Yangon. These actions build on current ones which the YRTA has undertaken. The following table summarizes all of the further actions that are required.

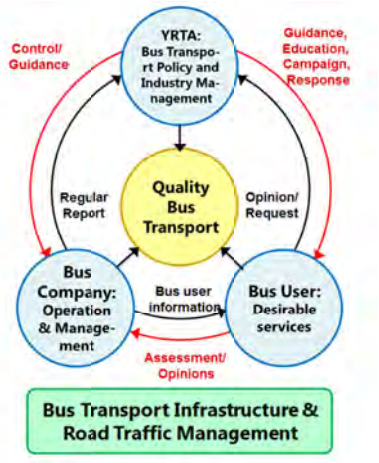
Table 4.4.1 Current and Proposed Actions for the Yangon Bus Service

Area		Current Action by the YRTA	Proposed Action
1	Bus Operators Reorganization	・ Consolidation of the many bus vehicle owners into 8 companies/groups.	・ Only 2 of the 8 companies have a modern organizational structure (Yangon Bus Public Co., Ltd. and Bandoola Transportation Co., Ltd.) in which the company owns all of the bus vehicles. ・ For the other 6 companies (5 association companies) and the Omni Focus Co., Ltd., bus ownership is still split between the actual company and individual owners.
2	Bus Fleet	・ Removal of old buses. ・ Acquisition of new buses (in March 2017).	・ Required fleet size is still large. ・ Need for a system for the sustainable renewal of vehicles. ・ Establishment of a maintenance system.
3	Bus Operation Improvement	・ Consolidation to 80 bus routes. ・ Introduction of loop routes in CBD and restriction of buses run through CBD.	・ Continuous monitoring of the supply and demand gap. ・ Need for further regulated bus operations. ・ Consideration for area/feeder services.
4	Bus Facilities Improvement	・ Ongoing tender for bus stop improvements.	・ Need for technical design guideline for bus stop and access facilities. ・ Improvement of bus depots and turn-around facilities.
5	Bus Corridor Traffic Management	・ Traffic control from the traffic control center for bus corridors/intersections.	・ Micro traffic management at bus stops and specific areas. ・ Consideration for bus priority measures.
6	Business Management Improvement	・ Change in payroll system for driver/conductor to a salary-based system (not fully practiced).	・ Strengthening of operation/management of buses including cost/revenue control. ・ Strengthening of capacities of bus personnel.
7	Bus User Services	・ Bus route information ・ "Yangon Bus Report"	・ Expansion of the dialogue with bus users.
8	YRTA Bus Sector Management	・ Centralization of bus sector management under YRTA.	・ Institutionalization of role-sharing between YRTA and bus companies/operators. ・ Technical support for bus companies/operators ・ Bus fare and subsidy policy ・ Preparation of bus operation rules and regulation and its enforcement

Source: Study Team

(b) Proposals on ICT for Buses

4.16 Every bus line company that is formed (one entity responsible for one transport corridor) should start its business with a new operating model anchored on ICT. This is one aspect of public transport where Yangon can leapfrog other developing country cities. The technology can be deployed rapidly-with little cost-to the city. Commuters would be able to know where and when to take a bus ride, give instant feedback on the quality of the service, to service providers and to the government. Bus operators can track the location of their fleet, adjust their dispatching and deployment according to changing demands during the day. With such a system, government regulators and traffic administrators can monitor performance of the transport system – without need of conducting expensive on-road surveys.



Source: Study Team

Figure 4.4.3 Role-sharing of YRTA, Bus Operator and Bus Users

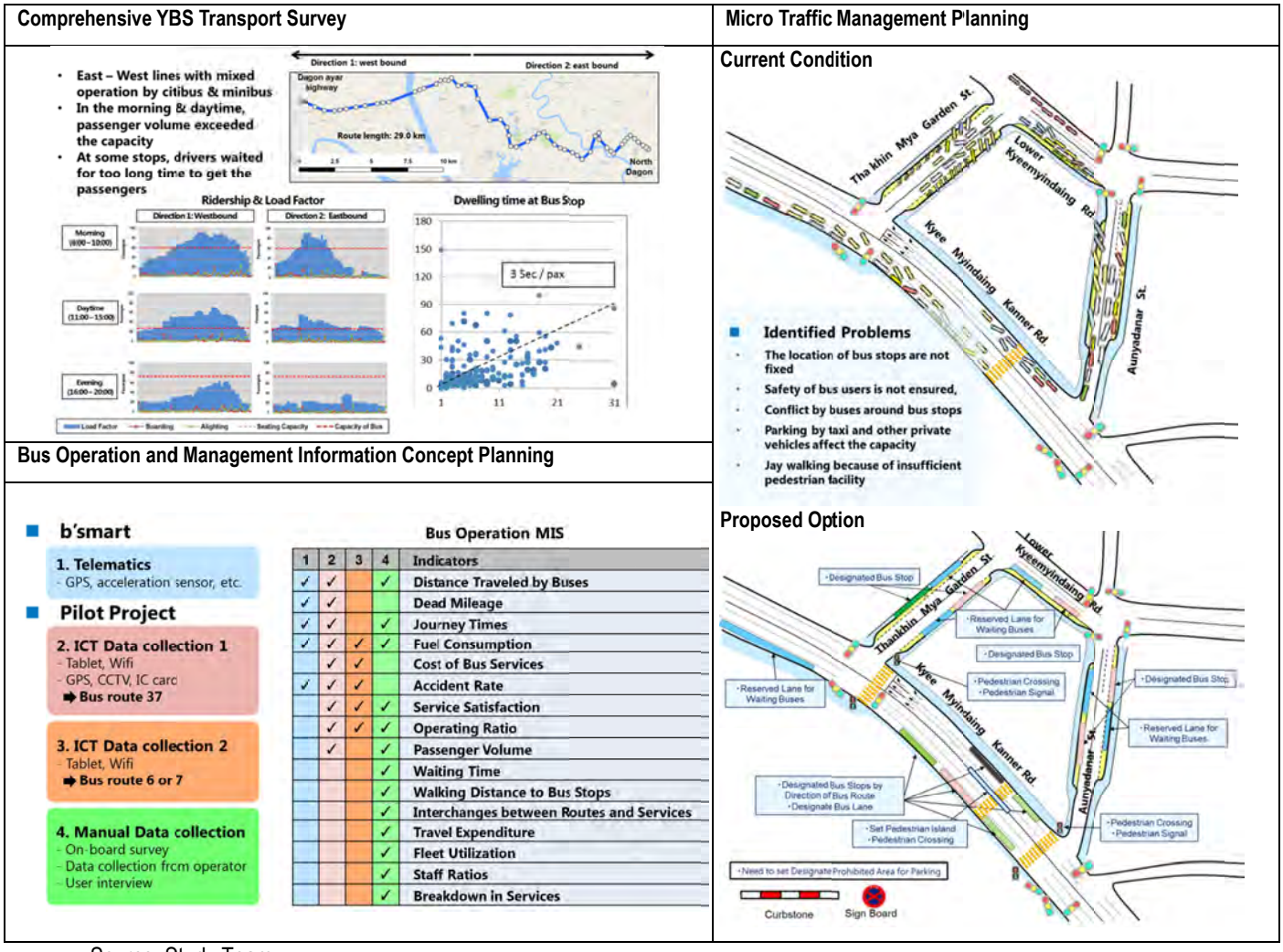
(c) Conduct of Pilot Project

4.17 While the YBS has been undergoing reform and improvement since the beginning of 2017, this study intends to facilitate its further improvement by conducting the following actions on a pilot basis (see Table 4.4.2):

Table 4.4.2 Outline of the Bus Pilot Project

Action	Objective	Scope
Comprehensive YBS Transport Survey	· To preliminary analyze current bus operation characteristics and satisfaction/ needs of bus users · To collect bus operation and passenger ridership data necessary for Bus Management Information System	· All 81 bus routes · On-board survey on operation/ ridership data · Bus passenger interview survey at selected bus stops
Bus Operation and Management Information Concept Planning	· To prepare concept plan for bus operation and management information system though ICT	· Data collection through ICT (IC-card, GPS, Wi-fi) from selected routes
Micro Traffic Management Planning	· To prepare traffic circulation and management plans for smooth bus operation and boarding / alighting	· Preparation of plans for selected bus terminals
Training and Workshops	· To share the outputs of 1,2,3 above with bus operators · Toe learn experiences of foreign bus operators	· To conduct workshops and training for bus operators using guidelines and teaching materials.

Source: Study Team



Source: Study Team

Figure 4.4.4 Proposed Pilot Project on Bus Improvement

4.5 Traffic Management and Safety

1) Context

4.18 Many urban transport problems including traffic congestions and safety are caused by poor or inadequate traffic management as explained in Chapter 2. Causes of the problems are complex and often interrelated that it is difficult to find effective solutions. In large growing urban areas as soon as traffic congestions are improved, they are soon filled by increasing traffic. Increases in transport demand often outpace the provision of infrastructure and transport capacity. Nevertheless, traffic management is always the most basic and important measure to utilize available facilities in the most efficient, safe and equitable manner among road users, especially for public transport users and low income groups.

2) Strategies

4.19 While it is necessary to conduct a comprehensive Traffic Management Study for Yangon because there are so many concerning areas including infrastructure/facilities, human resource development, technologies, specific sites, rules and regulations, education and campaign, main directions for attention include following:

(i) Proper operation and management of Traffic Control Centre which covers all major intersections which is to be completed soon.

(ii) Implementation of Comprehensive Traffic Management program for main corridors.

(iii) Strengthening of traffic enforcement capacity including organization and staffing, preparation of manual/guideline, vehicles and equipment, training, etc.

(iv) Expansion of traffic safety education and public campaign for school children, general public, drivers and road users, and preparation of comprehensive traffic safety program (See Table 4.5.1).

(v) Introduction of traffic demand management such as staggered time, in charge in parking fee on pilot basis (See Figure 4.5.1).

(vi) Preparation of comprehensive traffic management program for CBD. (See Figure 4.5.2)

3) Proposed Actions

4.20 Proposed actions include following:

(i) Road vehicle management,

(ii) Traffic enforcement

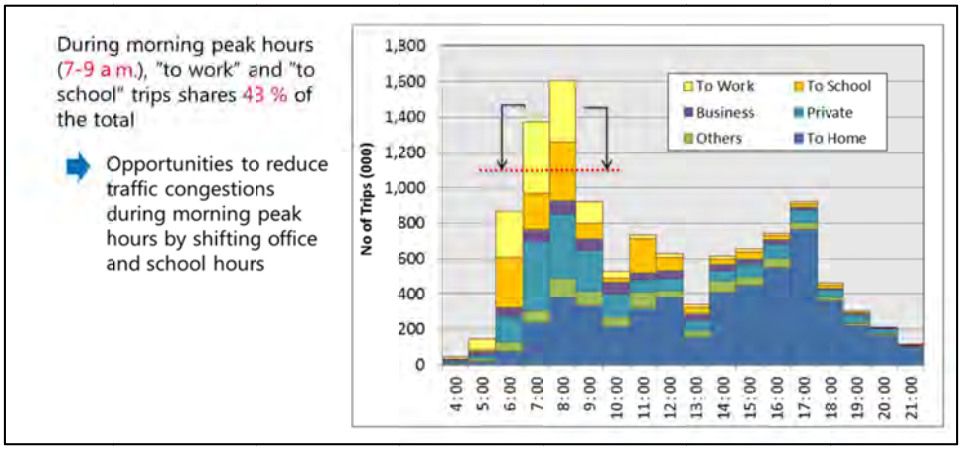
(iii) Traffic engineering

(iv) Traffic safety education

(v) Parking management

(vi) Traffic control

(vii) Traffic demand management.



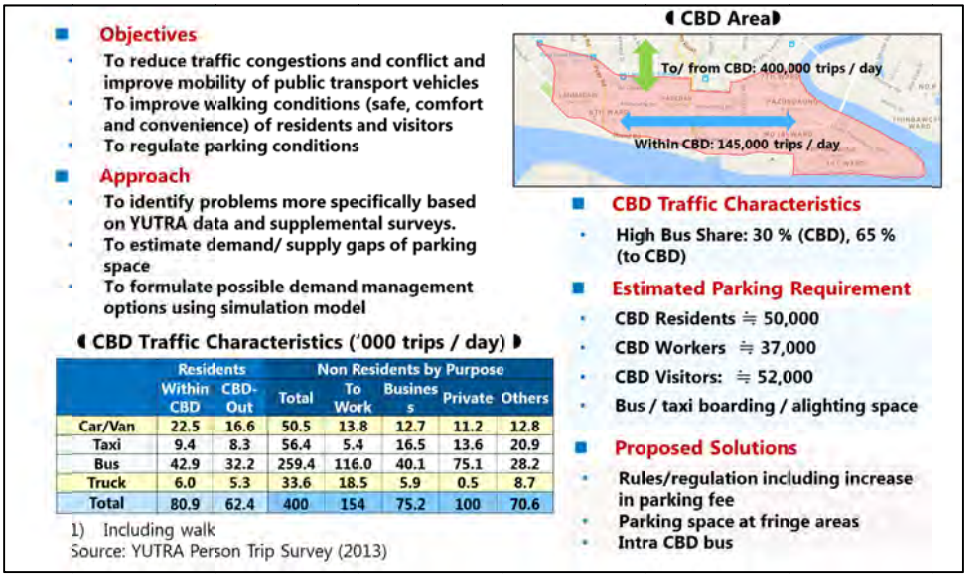
Source: Worked out by JICA Study Team, Based on YUTRA Person Trip Survey

Figure 4.5.1 Possibility of Introducing Staggered Working & Schooling Hours

Table 4.5.1 Proposed Traffic Safety Programs

Objectives	Measures
Accident database development	· Data collection system · Accident analysis · Information sharing/ dissemination
Awareness enhancement of traffic safety	· Safety education for children · Campaign for public · Community education
Facility development for traffic safety	· Road facility (signals, signs, marking) · Traffic engineering (intersections, roundabout) · Walking environment
Policy commitment and enforcement	· National traffic safety policy · Institutional and organizational reform · Enforcement capacity development

Source: JICA Study Team



CBD Traffic Characteristics ('000 trips / day)

	Residents		Non Residents by Purpose				
	Within CBD	CBD-Out	Total	To Work	Business	Private	Others
Car/Van	22.5	16.6	50.5	13.8	12.7	11.2	12.8
Taxi	9.4	8.3	56.4	5.4	16.5	13.6	20.9
Bus	42.9	32.2	259.4	116.0	40.1	75.1	28.2
Truck	6.0	5.3	33.6	18.5	5.9	0.5	8.7
Total	80.9	62.4	400	154	75.2	100	70.6

1) Including walk
Source: YUTRA Person Trip Survey (2013)

Source: JICA Study Team

Figure 4.5.2 Approach to CBD Traffic Improvement

4.6 Urban Rail Development

1) Main Issues

4.21 Yangon who is expected to grow to a mega city with a population of 10 million in coming decades, provision of high capacity and high quality mass transit system is highly necessary. Almost all major cities have been constructing urban rail lines and BRT. Yangon has a good network of potential urban rail services including circular line, though they are under-utilized due to poor facilities and management.

4.22 A key concern is how to make use of the potential assets and establish a competitive public transport backbone for Yangon, because urban rail requires large amount of costs, lengthy construction time and often resettlement in urban areas. High construction cost of urban rail will not only affect other priority projects but also the cost recovery which is not easy to achieve.

2) Basic Directions

4.23 As is tested in YUTRA, future urban development strategy defined in SUDP requires a network of urban rail network comprising, (i) Circular Rail, (ii) Suburban Commuter Services using existing MR lines, and (iii) New Urban Lines including a North-South and an East-West lines. These lines must be coordinated and integrated as an efficient network to provide needed services for the people. It is important to introduce step-wise development strategy to ensure the investment will be done in the most effective manner.

4.24 The highest priority must be given for the development of Circular Rail which has been in daily operation. Although the ridership is limited to about 80,000 passengers a day, the route runs at ideal location in Yangon Urban area.

4.25 In order to develop and manage existing and new rail lines, it is necessary to establish a Urban rail development policy framework, and to avoid the lines are not operated by different entities without necessary coordination.

4.26 Main roles of urban rail is to strengthen accessibility to CBD and sub-center without facing traffic congestions, and promote expansion of urban areas together with good transport accessibility. For this integrated development of urban rail and land-use /urban area is a critical success factor for urban growth management, TOD and cost recovery.

3) Proposed Actions

4.27 Proposed actions include followings. The each project is explained in Chapter 5

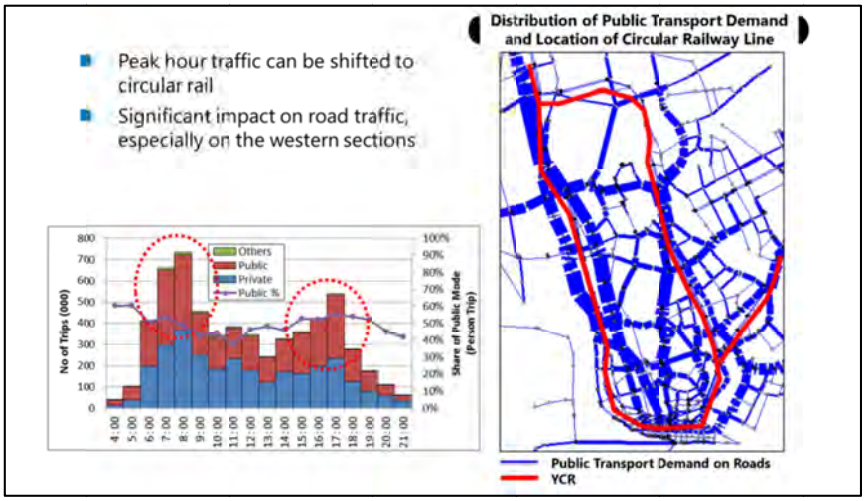
(i) Improvement (Upgrading/ Grade Separation) of Circular Rail to form the main urban transit backbone

(ii) Improvement of Suburban Commuter Lines

(iii) Development of new UMRT Lines to meet the future demand and promote the envisioned urban development

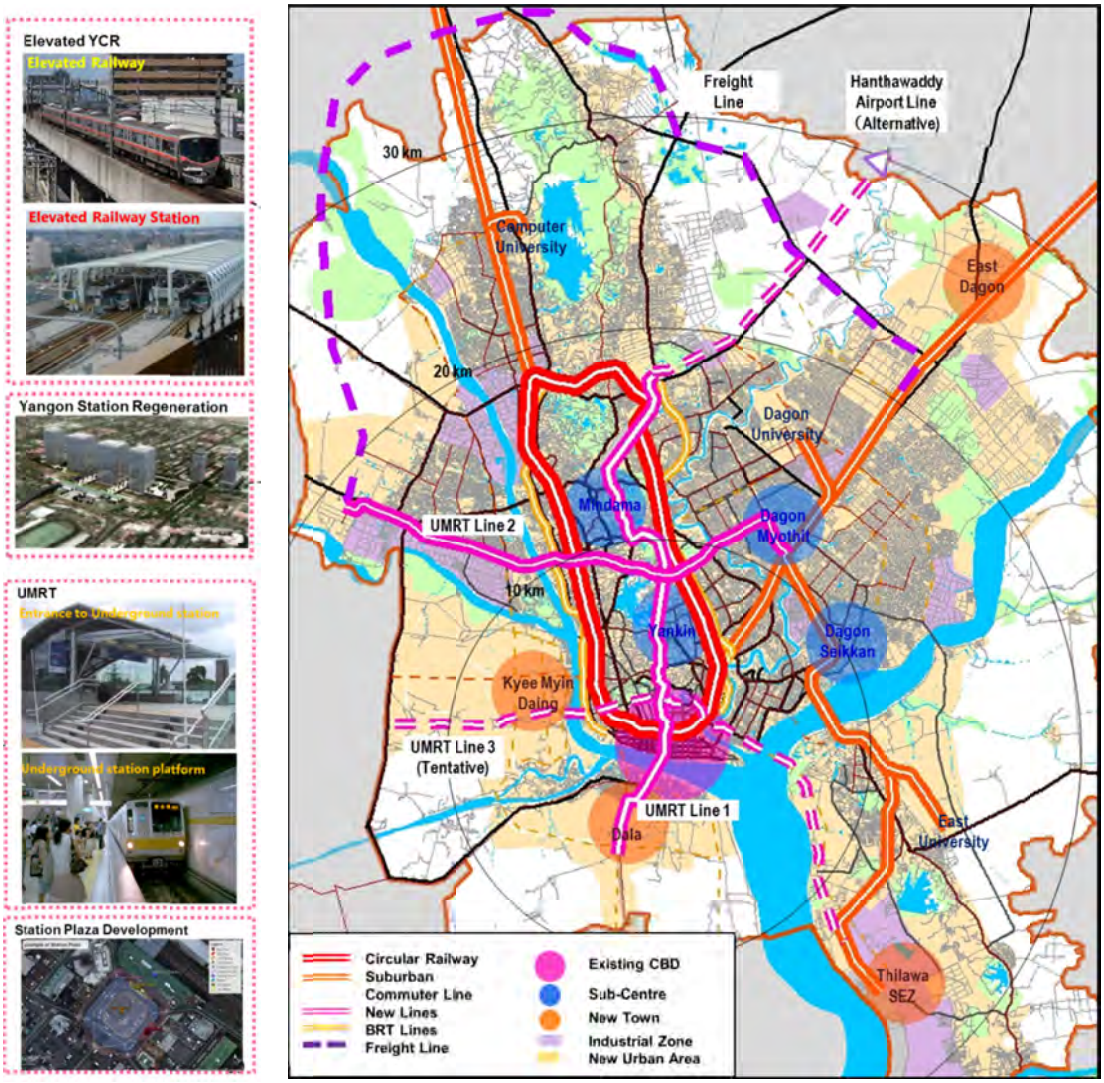
(iv) Other Lines:

- Port Access Line
- Hanthawaddy Airport Access Line
- Suburban Freight Line



Source: JICA Study Team

Figure 4.6.1 Potential Impacts of Urban Rail on Public Transport Market



Source: JICA Study Team
1)Photos are example and Image

Figure 4.6.2 Proposed Railway Network Plan in Greater Yangon

4.7 Development of Yangon Circular Rail

1) Context

4.28 Circular Rail can and must function as the backbone of not only public transport system but also urban development in Yangon urban areas. When the circular rail is developed as the high-speed, high-capacity and high-quality public transport backbone, it will affect the land use and economic development in its influence area, especially at and around the stations. Currently under-utilized and socio-economically depressed areas can be regenerated and new investment opportunities emerge.

2) Strategies

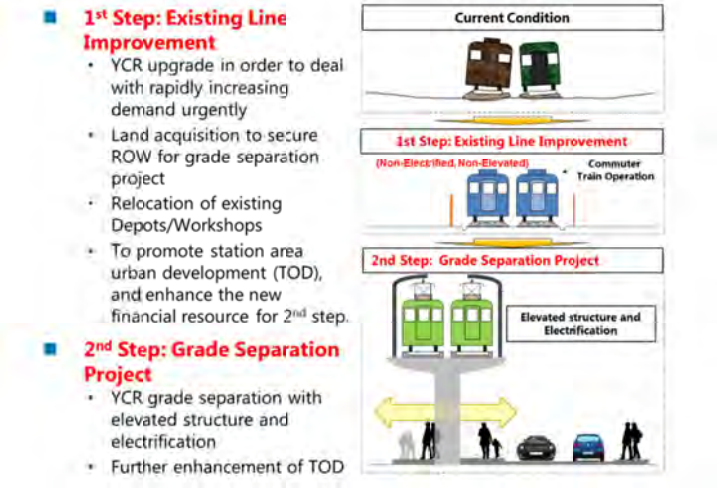
4.29 While Circular Rail has significant opportunities to reform and strengthen both urban public transport and urban landuse/development, it is important how to enjoy the benefits over time period. While the grade separated Circular Rail is the ultimate form of the structure without any level crossing at major roads, it takes long period of time for construction and closure of existing services for long. Since existing Circular Rail is in operation and has a room for upgrading the services within relatively short time. Step-wise development is advisable.

4.30 Based on the information, it is very roughly estimated that 1,400 buildings of which 70% are housing, and 100 ha of lands will be affected. Although the number is large, it is also an intention to regenerate the landuse and environment in the areas along Circular Rail. Once Circular Rail is elevated, the ROW on the other side of road or public space which will be created under the viaduct will become ideal sites for resettlement and new development.

4.31 There are 25 level crossings on Yangon Circular Rail and they cause severe traffic congestion. For Circular Railway which the grade separation is planned in mid and long-term, implementation of short-term solution with improvement of crossing structure and traffic management can be proposed (See Figure 4.7.3).

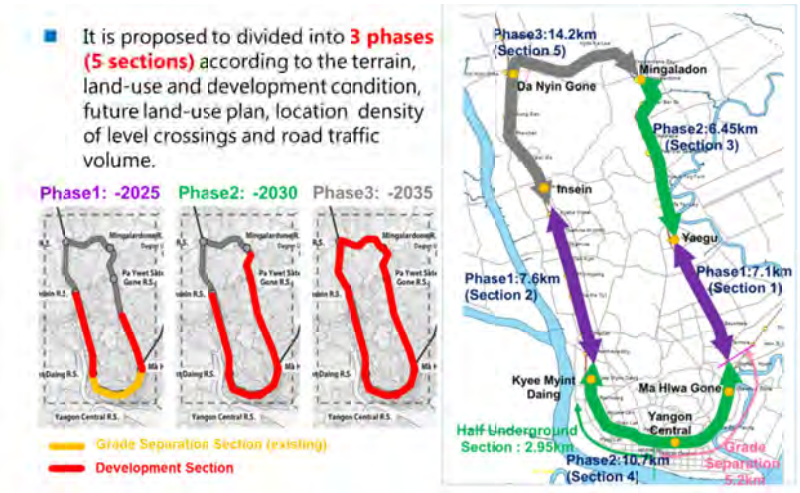
3) Proposed Actions

4.32 Proposed actions include (i) upgrading of existing line and services, (ii) grade separation and electrification after F/S and (iii) improvement/ development of access transport as shown in Chapter 5.



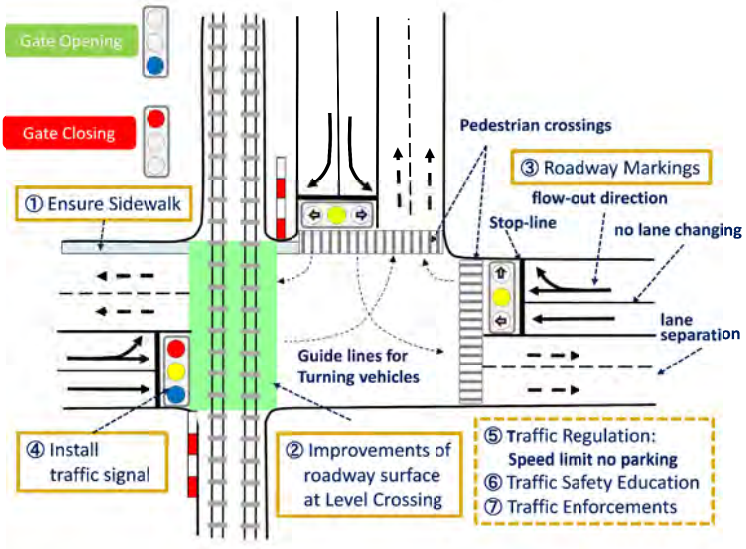
Source: Study Team

Figure 4.7.1 Development Policy 1: Step-wise Development



Source: Study Team

Figure 4.7.2 Development Policy 2: Phasing Development



Source: Study Team

Figure 4.7.3 Proposed Quick Solutions for Level Crossings (Example)

4.8 Inland Waterway Transport Development

1) Context

4.33 Yangon is located in the network and rivers and canals. While the waterways are intensively used for international and intercity freight transport, their use for urban transport is limited to short distance passenger and goods transport. Although there are ample opportunities for farther development of waterways in Yangon, there is also a need to consider various factors which will affect development and smooth operation of water transport;

(i) **Securing of Punctuality:** Strong current of the Yangon River, especially during rainy season, operation speed of vessels will be affected considerably toward upstream due to lack of propulsion power, which makes it difficult to maintain the schedule.

(ii) **Securing of Safety:** There is a risk of vessel stranding during dry season because of insufficient water depth in some areas. (See Figure 4.8.1) There are some areas where vessels are unable to operate during nighttime. Small ships are also affected by bigger wake wave caused by large vessels or speed-ships.

(iii) **Travel time:** Campaign of travel time with alternative modes of road transport such as bus, taxi, railway indicates that it is desirable to introduce high performance vessels to make travel time competitive. (See Table 4.8.1)

(iv) **Bridge Clearance:** As there are many bridges along the rivers and canals, proper clearance must be secured during the high tide.

(v) **Management:** Some aspects on institutional development must be elaborated to ensure development of water transport including management body, human resource development and fare setting.

2) Strategies

4.34 Currently, YRTA is working to develop new inland water transportation. In consideration of future development of Yangon including SEZ, five routes with potential demand have been identified in the study. (See Figure 4.8.2)

3) Proposed Actions

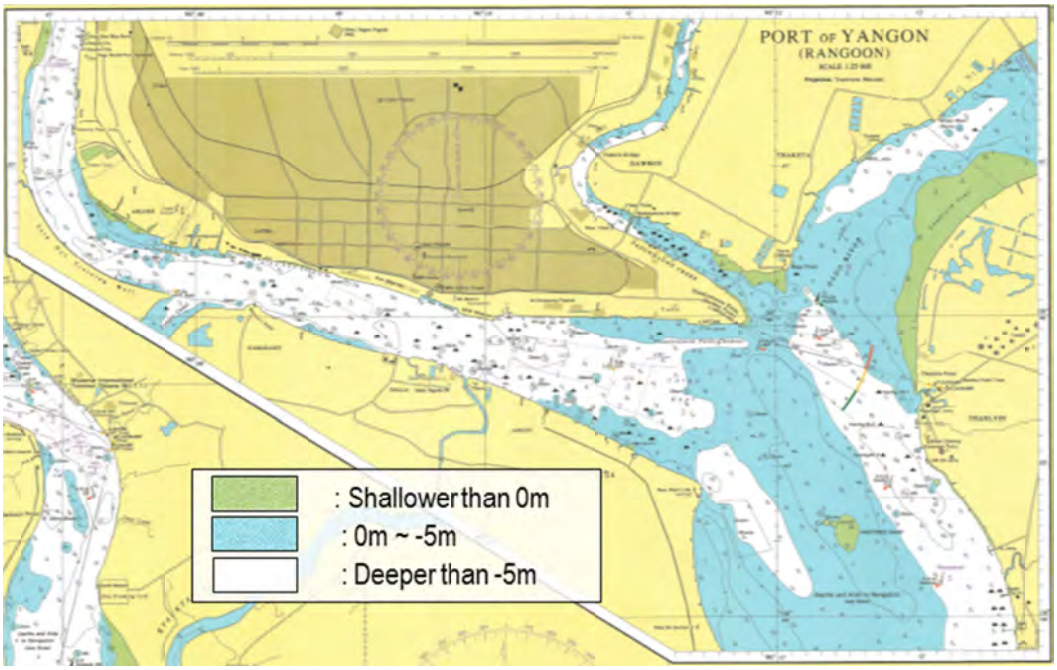
4.35 Proposed actions include (i) upgrading existing facilities and (ii) development of new routes based on feasibility studies as listed in Chapter 5.

Table 4.8.1 Estimated Travel Time by Water Transport and Other Public Transport Modes

	Bus	Taxi	Railway	Water Transport [1)]
i) Pansodan - Hlaingtharya	1.0 - 1.5	1.0 - 1.5	1.0	1.2 - 2.3
ii) Pansodan - Thanlyin	1.5 - 2.0	1 - 1.5	1.5	0.8 - 1.5
iii) Nyaung Tan - Dagon	1.0 - 1.5	1.0	1.0	1.5 - 3.0
iv) Thilawa - Hlaingtharya	1.5 - 2.0	1.5	1.5	2.3 - 4.5
v) Thilawa - Shwe Pyi Thar	2.0 - 2.5	2.0	2.0	2.7 - 5.3

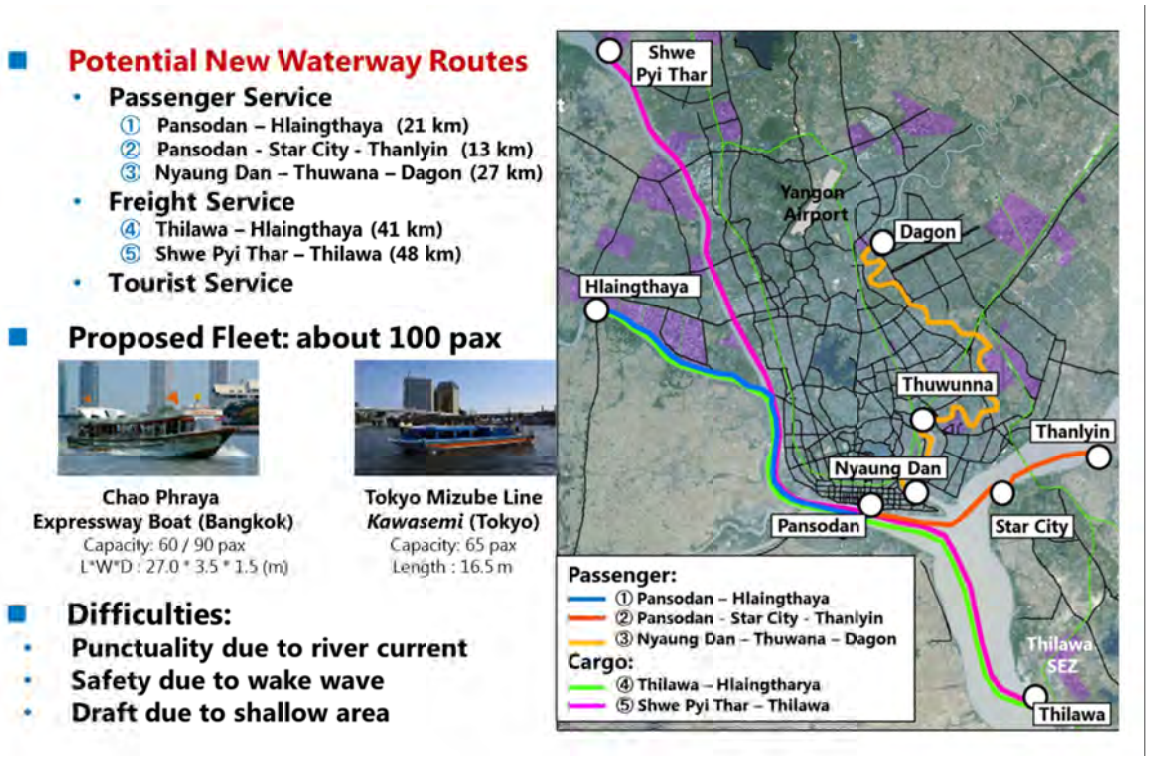
Source: JICA Study Team

1) Regarding the water transportation, time shall be estimated on the following assumption of the speed and added 7 minutes as disembarking and boarding time separately.: Downstream -10 knot, Upstream - 5 knot



Source: JICA Study Team

Figure 4.8.1 Water Depth around Yangon Port



Source: Worked out by JICA Study Team, based on Google Earth

Figure 4.8.2 Proposed New Routes

4.9 Transit Oriented Development (TOD)

1) Context

4.1 Yangon aims to become a mass-transit-based sustainable city wherein the city becomes competitive, livable, and environment-friendly. The development of an extensive urban rail network, comprising both existing and new lines, will provide ample opportunity to integrate public transport and land use development. TOD potential and opportunities for investment both by public and private sector at and around rail stations as well as along rail lines are significant. All types of TOD practices in cities in Japan and other neighboring countries are applicable in Yangon. TOD can be adopted not only for rail but also for in airports, ports, and expressways, as long as the key role of TOD is incorporated.

2) Strategies

4.2 Urban rail-based TOD is expected to bring about the most significant impacts on both transport and urban development in Yangon. Mobility and accessibility will be enhanced, efficient and effective land use will be promoted, and opportunities for value capture to fund public infrastructure will be created. Main components of TOD include following:

(i) Access Roads Development

(ii) Station Plaza

(iii) Pedestrian Access

(iv) Traffic Management/TDM

(v) Feeder Services

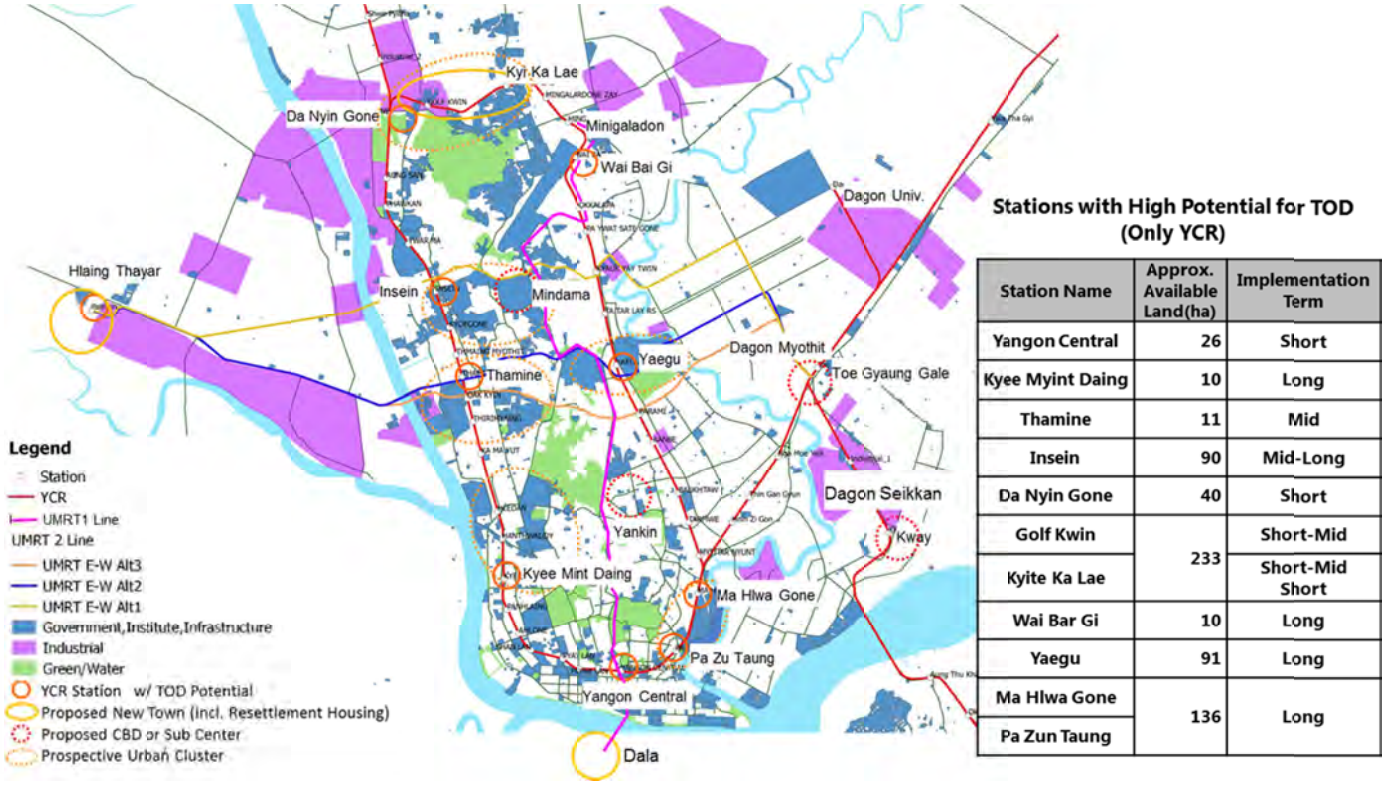
(vi) Integrated Urban Development

(vii) TOD Management

3) Proposed Actions

4.3 Both the formulation of a TOD plan, which includes necessary land use plan, zoning code, and design guidelines, and the institutional arrangement to implement the prepared plan are necessary to implement TOD in Yangon. The establishment of a TOD Committee is the first step, after which opportunities for private investment should be studied with the initiative of the TOD Committee. Based on the results of the study, a pilot TOD can commence within 2 to 3 years. Potential candidates for the pilot TOD are: (i) new town development on north of YCR and (ii) Da Nyin Gone station area development shown in Figure 4.9.1 as short-term projects.

4.4 As Table 4.9.1 shows, TOD project components include both planning and establishment of institutional and legal framework. For the successful implementation of TOD, both aspects need to be conducted simultaneously. Relevant capacity development should also be conducted on the job, i.e., through the planning and establishment of institutional and legal framework.



Stations with High Potential for TOD (Only YCR)

Station Name	Approx. Available Land(ha)	Implementation Term
Yangon Central	26	Short
Kyee Myint Daing	10	Long
Thamine	11	Mid
Insein	90	Mid-Long
Da Nyin Gone	40	Short
Golf Kwin	233	Short-Mid
Kyite Ka Lae		Short-Mid Short
Wai Bar Gi	10	Long
Yaegu	91	Long
Ma Hlwa Gone	136	Long
Pa Zun Taung		

Source: JICA Study Team

Figure 4.9.1 Potential Areas for Integrated Development

Table 4.9.1 Project Components of TOD in Yangon

Major Component	Project Component
TOD along UMRT	・ Integrated urban/suburban development at/around the stations ・ Access improvement especially within walking distances from the stations ・ Development of intermodal facilities at stations (introduction of transfer facilities, integration with regional bus terminals, etc.) ・ New town development ・ Integrated water transport and waterfront development ・ Utilization of underground space at subway stations ・ Utilization of space under viaducts
Implementation Framework	・ Establishment of a TOD Committee ・ Establishment of an operation and management system for TOD ・ Establishment of financial schemes for TOD
Legal Framework	・ Formulation of relevant laws and regulations on BOT, land adjustment, urban redevelopment, air rights transfer, appropriate valuation system, development permit, and control of speculative real estate transactions ・ Clarification of collective land ownership for BOT projects built on government land (amendment of Condominium Law)

Source: JICA Study Team

4.10 Logistic Transport Development

1) Context

4.5 In association with economic growth, freight traffic volume is expected to increase significantly between Yangon and other regions as well as within Yangon Region. The estimated growth between 2013 and 2030 is about 5 times which are contributed by all modes including road, IWT, rail and coastal shipping (See Table 4.10.1).

Table 4.10.1 Growth Rate of Freight Traffic Related to Yangon (2013-2030)

2030	To Yangon	From Yangon	To/ From Out of Yangon	Total Avg.
Truck	4.8	4.6	5.2	5.0
IWT	5.5	5.9	4.8	5.4
Rail	3.0	4.7	4.4	4.2
Coastal	2.8	4.5	-	4.0
Total Avg.	**4.4**	**4.6**	**5.2**	**4.8**

Source: Survey Program for the National Transport Development Plan in the Republic of the Union of Myanmar, Sep. 2014, JICA

4.6 The freight traffic is composed of three main groups including Category 1: consumption goods (raw materials such as vegetable, fruits, fish, chicken, etc.), Category 2: consumption goods (manufactured goods), and Category 3: energy, intermediate and industrial goods such as coal, petroleum, timber, fertilizer, machinery, chemicals, etc.). Traffic growth of Category 2 is the largest which is 7.3 times between 2013 and 2030, followed by Category 1 traffic of 4.9 times and Category 3 of 2.9 times during the same period.

Table 4.10.2 Growth Rate of Freight Traffic by Category in Yangon, 2013-2030

2030/2013		Category 1	Category 2	Category 3	Total
Yangon West	Outflow	9.0	17.5	3.8	5.8
	Inflow	4.5	9.0	3.1	3.8
Yangon East	Outflow	9.6	9.9	4.6	5.8
	Inflow	4.6	3.8	1.5	2.9
Total		**4.9**	**7.3**	**2.9**	**3.8**

Source: Survey Program for the National Transport Development Plan in the Republic of the Union of Myanmar, Sep. 2014, JICA

2) Strategies

4.7 In order to respond to the future change in freight distribution pattern without negative impact on urban traffic, basic directions for logistic transport development are summarized as follows:

(i) **Upgrading of public wholescale market to meet the needs of Category 1 traffic:** This includes allocation of wholesale markets along the ring-road efficiently, upgrading of the facilities and hygienic environment, and attracting food processing-industries nearby the wholesale markets.

(ii) **Upgrading of traditional bazar to meet the needs of Category 2 traffic:** This includes upgrading of the traditional bazars to be modern and distribution system.

(iii) **Shift of port function to Thilawa area to meet the needs of Category 3 traffic:** This is to avoid farther concentration of industrial goods in highly populated CBD.

4.8 Myanmar Railways is considering the construction and operation of a dry port as an important work in freight transport. For the construction of the dry port along the Asia Highway and Trans Asia Railways in Asia and Pacific, Myanmar signed "the intergovernmental Agreement on Dry Port" on on 7 November 2013. Myanmar proposed eight potential locations of dry ports. They are Yangon, Mandalay, Tamu, Muse, Mawlamyine, Bago, Monywa, and Pyay and a dry port for Yangon was planned to be developed in Ywarthargyi in East Dagon Township.

4.9 In November 2018, new dry port in Ywarthargyi started the operation. The nearest seaports are the Asia World Port Terminal, Myanmar Industrial Port, and Botahtaung Port, all of which are located along the Yangon River, and Myanmar International Terminal Thilawa near the mouth of the sea. The Ywarthargyi dry port can easily be linked to the Yangon–Bago–Pyinmana–Meilkhita–Mandalay Road network. Furthermore, it is also situated on the Yangon–Mandalay Railway line (main railway corridor), and the dry port itself has a railway line connected to Yangon–Bago, extending to Hanthawaddy International Airport, which will be the biggest airport in the country. These are some of Yangon's inland waterway ports along the Yangon River which can easily be linked to the dry port as well

Source: Study Team

Figure 4.10.1 Location of the New Dry Port in Ywarthargyi

3) Proposed Actions

4.10 Proposed actions include upgrading of existing facilities and relocation and new development of logistic facilities and function. (See Chapter 5).

5 PROPOSED ACTIONS AND ROADMAP

5.1 Proposed Transport Projects

1) List of Identified Projects

5.1 In order to implement the transport development strategies discussed in previous chapters and realize the desired future transport network, the Study Team and counterpart agencies have identified a total of 101 projects and actions under 10 subsectors and 34 categories (see Table 5.1.1). The subsectors are briefly described below, while project profiles are shown in Technical Report Vol. 6 Project Profiles.

(i) **Roads:** The roads subsector is composed of 24 projects on minor improvement/maintenance, rehabilitation, bottleneck removal, completion of missing road links, and construction of flyovers/underpasses, secondary roads, primary roads, new bridges, and outer ring roads.

(ii) **Expressways:** The expressways subsector is composed of 11 projects on intercity and urban expressways.

(iii) **Public Transport:** The public transport subsector is composed of 8 projects on bus transport modernization and BRT development.

(iv) **Traffic Management and Safety:** The traffic management and safety subsector is composed of 16 projects on road vehicle management, traffic enforcement, traffic engineering, traffic safety education, parking management, traffic control, and traffic demand management.

(v) **Urban and Suburban Railway:** The urban/ suburban rail subsector is composed of 12 projects on circular rail, suburban commuter rail, and new lines.

(vi) **Inland Water Transport:** The inland water transport subsector is composed of 7 projects on upgrading of existing services and the development of new routes.

(vii) **Logistics:** The logistics subsector is composed of 4 projects on the upgrading of existing facilities, relocation, and new development.

(viii) **Information and Communications Technology:** The ICT subsector is composed of 7 projects on the expansion of ICT for the YRTA and the expansion of ICT for public transport operators.

(ix) **Transit-oriented Development:** The TOD subsector is composed of 4 projects on TOD on circular rail and TOD on other lines.

(x) **Institutions:** The institutions subsector is composed of 8 projects on strengthening of the YRTA, capacity building in public transport operation, ROW acquisition and resettlement, and TOD promotion.

Table 5.1.1 Preliminary List and Costs of Proposed Transport Sector Projects

Sector	Category	Code		Project Name	Cost (million USD)	Cost to Government (%)	Term [1), 2)] S (17-20)	M (21-25)	L (26-35)
Roads	Minor Improvement/ Maintenance	R-01		Urban roads and bridges maintenance program	496	100			
	Rehabilitation	R-02		Rehabilitation program for priority roads and bridges (Hlaw Ga Rd, Hlaing River Rd, Main Rd No.5, No.6, etc.)	243	100			
	Bottlenecks Removal	R-03		Program on road improvement of bottlenecks	32	100			
	Road Development in New Urban Area	R-04		Road Development in New Urban Area	2,120	20			
	Bottlenecks Removal	R-05		Program on Remobal of Bottlenecks for Major Corridors	107	100			
	Missing Link Development	R-06	1	Program to construct secondary roads in existing urban areas	79	100			
			2	Program on road widening in urban blocks (5 packages)	356	100			
	Pedestrian Safety Facility	R-07		Pedestrian bridges, pedestrian crossing signals, wide sidewalk, relocation of electric poles, etc.	238	100			
	Primary Roads Development	R-08	1	Construction of new truck route	197	100			
			2	Wataya Br South Approach					
			3	Min Ye Kyaw Swar Rd/Yarzaa Dirit Rd					
			4	Kyi Myin Dine Br & ORR connection					
			5	Dala Br & ORR connection					
			6	Bago River Br -2 and Thanlyin Connection					
	New Bridges	R-09	1	New Thaketa Bridge	1,085	100			
			2	New Bago Bridge					
			3	Dala Bridge					
			4	Wataya Bridge					
			5	Kyi Myin Dine Bridge					
			6	Bago River Bridge 2 for Bago or Monkey Point					
	Outer Ring Road	R-10	1	East Section (Phase 1)	728	90			
			2	East Section (Phase 2)	1,948	90			
			3	South-West Section	590	90			
			4	North-West Section	870	90			
	Subtotal				**9,089**	**80**			
Expressway	Intercity Expressway	R-11	1	Yangon – Bago – Hanthawaddy New Airport	930	30			
			2	Yangon - Pyay	1,160	30			
			3	Yangon - Thilawa	1,310	45			
			4	Yangon – Hlegu	511	30			
			5	Yangon - Pathein	511	30			
	Urban Expressway	R-12	1	North-South Backbone (Western Axis: Insein-CBD-Dala)	1,261	30			
			2	North-South Backbone (Eastern Axis: Mindamar-CBD)	1,333	30			
			3	Access to Yangon-Mandalay Expressway	536	45			
			4	Pazundaung Bypass	422	30			
			5	East-West Smart Tunnel (North)	819	50			
			6	East-West Smart Tunnel (South)	897	50			
	Subtotal				**9,690**	**40**			
Public Transport	Bus Transport Modernization	P-01	1	Bus Industry Reform/Capacity Building	3	100			
			2	Bus Route Restructuring					
			3	Bus Fleet Renewal/Maintenance	240	50			
			4	Bus Terminals/Facilities Improvement	20	80			
			5	Bus Corridor Traffic Management	20	100			
			6	Bus Transport Sector Management (YRTA)	3	100			
	BRT Development	P-02	1	BRT under North - South Backbone Western (Kannur Rd - Bayint Naung Rd)	110	50			
			2	BRT under North - South Backbone Eastern (Waizayandar Rd)	110	50			
	Subtotal				**506**	**54**			
Traffic Management and Safety	Road Vehicle Management	M-01	1	Improvement of Vehicle Registration System	10	80			
			2	Development of Vehicle Inspection System					
	Traffic Enforcement	M-02	1	Establishment of Institutional Framework	5	100			
			2	Capacity Building of Traffic Enforcers					
	Traffic Engineering	M-03	1	Management of Traffic Control Centre	50	100			
			2	Expansion of Traffic Signals for Vehicles and Pedestrians					
			3	Improvement of Pedestrian Facilities/ Walking Environment					
			4	Provision of Signage and Lane Marking					
	Traffic Safety Education	M-04	1	Preparation of Traffic Rules/Regulations	10	100			
			2	Traffic Safety Education for School Children					
			3	Traffic Safety Campaign for the Public and Communities					
	Parking Management	M-05	1	Establishment of Parking Regulations and Enforcement	100	80			
			2	Development of Public Parking Facilities					
	Traffic Demand Management	M-06	1	Introduction of Staggered Working/School Time	50	50			
			2	Expansion of Pricing (higher parking fee, fuel, vehicle tax)					
			3	Area Licensing Scheme Control (CBD)					
	Subtotal				**225**	**80**			
Urban/Suburban Rail	Circular Rail	L-01	1	Upgrading of Existing Line and Services	350	80			
			2	Urgent Service Improvement	3	80			
			3	Elevation and Electrification of Circular Rail	1,100	90			
			4	Improvement/Development of Access Transport	100	100			
	Suburban Commuter Rail	L-02	1	Yangon-Mandalay Line	1,350	80			

			2	Yangon-Pyay Line	780	80			
			3	Thilawa Branch Line	1,730	80			
			4	Outer Circular Rail Line	1,020	90			
			5	Relocation of Depot / Workshop to Suburban Area and Regeneration of MR Land	540	50			
	New Lines	L-03	1	Development of UMRT Line 1 (North-South)	3,630	90			
			2	Development of UMRT Line 2 (East - West)	2,250	90			
			3	Yangon New Airport Access	1,350	100			
	Subtotal				**14,203**	**90**			
Inland Water Transport	Upgrading of Existing Services	W-01	1	Fleet Procurement	10	0			
			2	Facilities Improvement	30	60			
	Development of New Routes	W-02	1	Facilities Development	10	60			
			2	Fleet Procurement (Passenger)	18	0			
			3	Fleet Procurement (Freight)	10	0			
			4	Fleet Procurement (Tourism)	10	0			
	Improvement of Management System	W-03		Strengthening Organization	3	100			
	Subtotal				**91**	**30**			
Logistics	Upgrading of Existing Facilities	F-01	1	Upgrading of Public Wholesale Markets	140	10			
			2	Upgrading of Traditional Markets					
	Relocation and New Development	F-02	1	Relocation of Existing Port Function to Thilawa Port	511	60			
			2	Relocation of ICD and Development of New Truck Terminal along ORR	127	50			
	Subtotal				**778**	**50**			
ICT	Expansion of ICT for YRTA	C-01	1	Collection and Information of Traffic Data through ICT	5	100			
			2	Development of Bus Operation/Management Information system					
			3	Development of Public Transport User Information System					
	Expansion of ICT for Public Transport Operators	C-02	1	Introduction of Compatible ICT System among Public Transport Operators	50	50			
			2a	Provision of ICT Equipment for Public Transport Vehicles					
			2b	Provision of wifi & Digital Signage at Terminals					
			3	Development of Public Transport User Information System					
	Subtotal				**55**	**50**			
TOD	TOD on Circular Rail	T-01	1	Integrated Urban Development at/around the Stations	n.k	0			
			2	Development of Integrated New Town for Resettlement and those who need Affordable Housing					
			3	Effective Use of the Space under the Viaduct					
	TOD on Other Lines	T-02		Integrated Development with New Lines (UMRT)					
	Subtotal				**-**	-			
Institutions	Strengthening of YRTA	I-01	1	Establishment of Legal and Policy Framework	15	100			
			2	Strengthening of Organization and Staffing					
			3	Capacity Building including Study Tour					
	Capacity Building of Public Transport Operation	I-02	1	Development of Training Manuals/Guideline	3	100			
			2	Conduct of Training					
			3	Conduct of Workshops					
	ROW Acquisition and Resettlement and TOD Promotion	I-03	1	Introduction of "Land Readjustment and Urban Renewal System"	1	100			
			2	Development of PPP Guideline on TOD					
	Subtotal				**19**	**100**			

Source: Study Team
1) n.k: Not known

2) Estimated Cost of the Projects

5.2 Based on the preliminarily estimated costs of the projects and on the assumption of a possible participation of the private sector, the cost to the government was calculated. The share of the private sector varies by type of transport project and funding scheme and the share of each project was estimated from examples of similar projects in other countries. It was estimated that roughly 67% of the total cost would be shouldered by the government or about USD23.7 billion out of the total project cost of USD 34.6 billion.

Table 5.1.2 Estimated Project Costs by Subsector

Sector		Total Project (USD mill)	Cost to Government	
			% to Total	USD mill
Roads	Maintenance/Minor Improvement/ Rehabilitation/ Bottlenecks Removal/ Missing Links Development	1,551	100	1,551
	Flyovers/Underpass/Secondary Roads/ Primary Roads/New Bridges/Outer Ring Road	7,538	72	5,428
Expressway	Intercity Expressway	4,422	34	1,523
	Urban Expressway	5,268	38	2,004
Public Transportation	Bus Transport Modernization	286	57	162
	BRT Development	220	50	110
Traffic Management		225	100	225
Rail	Circular Rail	1,553	88	1372
	Suburban Commuter Rail	5,420	79	4,276
	New Urban Lines	7,230	92	6,642
Inland Waterway Transport		91	30	27
Logistics		778	49	384
ICT		55	55	30
TOD		n.k	n.k	n.k
Institutions		19	100	19
Total		**34,656**	**67**	**23,707**

Source: Study Team
1) n.k.=not known

5.3 The cost to the government is further classified into short, medium, and long term.

Table 5.1.3 Estimated Government Share in Project Costs by Subsector

Sector	Cost to Government (USD mill)			Total Project Cost to Government (USD mill)
	Short Term (2017–2020)	Middle Term (2021–2025)	Long Term (2026–2035)	
Roads	1,328	3,879	1,772	6,979
Expressway	0	2,124	1,403	3,527
Public Transportation	149	123	0	272
Traffic Management	178	0	0	178
Rail	382	5,512	6,396	12,290
Inland Waterway Transport	26	2	0	27
Logistics	14	217	153	384
ICT	30	0	0	30
TOD	0	0	0	0
Institutions	10	9	0	19
Total	**2,117**	**11,865**	**9,725**	**23,707**

Source: Study Team

3) Estimated Budget Envelope

5.4 In order to determine the government's capacity to fund the listed transport projects, the budget envelope was estimated for both Yangon Region and Greater Yangon (study area) based on the following assumptions:

(i) GRDP of Yangon Region: estimation result by SUDP Study Team

- 2016: USD17.6 billion
- 2035: USD75.9 billion
- Assumed Growth Rate: 8% / year for 2016–2035

(ii) Share of Greater Yangon to Yangon Region

- 80% in terms of population

(iii) Allocation for the transport sector

- Scenario 1: 6% of GRDP
- Scenario 2: 3% of GRDP

5.5 The estimated budgets for Greater Yangon are USD41 billion for Scenario 1 and USD21 billion for Scenario 2.

Table 5.1.4 Estimated Budget Envelope for Yangon Region and Greater Yangon by Scenario

Item			Yangon Region	Greater Yangon [1] (Study Area)
GRDP		2016	17,607	14,148
		2035 [2]	75,988	60,983
		2017–2035	850,688	683,534
Allocation to Transport Sector (USD million)	Scenario 1: 6% of GRDP	2017–2020 (Short Term)	5,393	4,334
		2021–2025 (Medium Term)	10,387	8,346
		2026–2035 (Long Term)	35,261	28,332
		Total	51,041	41,012
	Scenario 2: 3% of GRDP	2017–2020 (Short Term)	2,697	2,167
		2021–2025 (Medium Term)	5,194	4,173
		2026–2035 (Long Term)	17,630	14,166
		Total	25,521	20,506

Source: Study Team
1) The share of Greater Yangon was assumed to be 80% that of Yangon Region based on population.
2) Assumed average growth rates are 10% in 2016–2025 and 6.2% in 2026–2035 at 2016 prices.

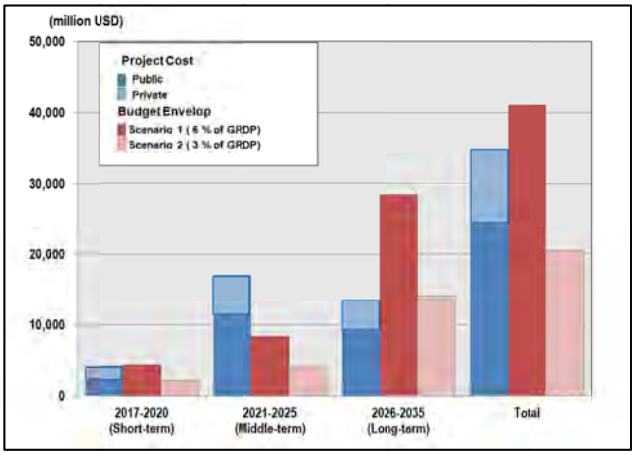
4) Funding Opportunities

5.6 The project costs were compared with the estimated budget envelope, and the results are as follows:

(i) For the period between 2017 and 2035, the estimated budget envelope under Scenario 1 (6% of GRDP) is more or less equal to the project cost. This implies that Greater Yangon can afford to fund the Master Plan;

(ii) On the other hand, in the short to midterm, the budget envelope will be unable to fund the transport projects.

(iii) Therefore, it is critical to mobilize external funding for the short to the medium term.



Source: Study Team

Figure 5.1.1 Project Costs vs. Budget Envelope

5.2 Strategic Action Program

1) Overall

5.7 While the proposed master plan up to 2035 would help improve the transport situation in the future Yangon, implementing the plan would be critical. If improvements will not be done in a timely manner to address the increasing demand every year, long-term solutions would not be accepted by society. Therefore, in light of the master plan's envisioned scenario for 2035, the proposed projects are further packaged as short-term strategic programs that the government has to lead.

5.8 Recommendations for effective implementation include the following:

(i) **Packaging of Proposed Individual Projects into Programs to avoid Haphazard Development:** In this study, nine (9) strategic programs are recommended as follows:

- Removal of bottlenecks on major corridors and the CBD;
- Bus modernization;
- Traffic management and safety improvement;
- Construction of missing links;
- Development of the urban rail network;
- Development of the urban expressway network;
- Development of inland waterway transport;
- Transit-oriented development; and
- Strengthening of the YRTA.

(ii) **Implementation of Short-term Actions to Promote Long-term Projects:** Large infrastructure projects, especially urban rails, require equally large investments and lengthy implementation periods. It is thus recommended that an alternative to the conventional implementation sequence of "FS-DD-ROW acquisition-Construction" be introduced and integrated urban planning, as well as development of institutions and processes, as conceptually explained in Table 5.2.1.

(iii) **Closer Integration with Urban Development Strategies:** As the impact of transport on socio-economic activities, land use, environment and public funding is so large, the transport plan needs to be integrated into urban development strategies, such as the provision of affordable housing, relocation of poor families from high hazard risk areas, and development of new towns and subcenters. High-density commercial complex development must undergo a detailed assessment of the traffic impact they will create to avoid or minimize such negative impact on local circulation. Households and commercial facilities must also have adequate parking spaces.

(iv) **Development of Transport as an Integrated Network and System:** Urban transport in Yangon is composed of various modes to which high-standard new modes, such as urban rail, elevated expressways and modern bus, will be added. These modes must function as an integrated and coordinated system to ensure seamless and safe movement of people at affordable costs. For this, it is necessary to strengthen the function and capacity of the YRTA as the sole administrative body in charge of planning and management of the urban transport system in Yangon.

Table 5.2.1 Alternative Steps for Urban Rail Development

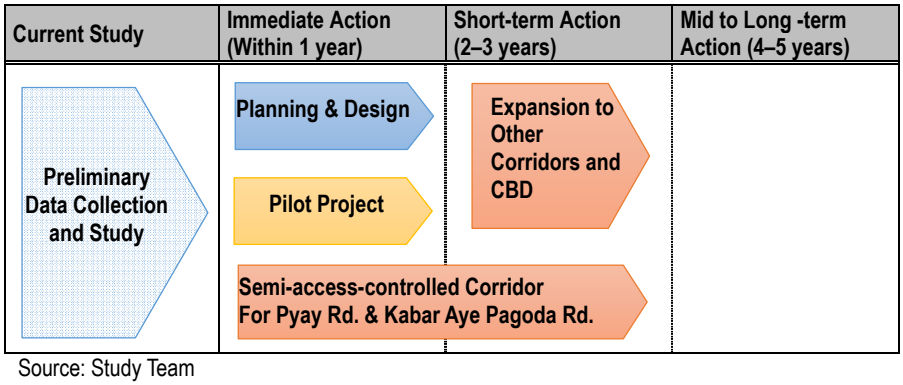
Step	Action	Purpose
1	Conduct of FS on the Entire Network or Priority Route	To verify feasibility of the project To determine ROW necessary for rail structure, stations, intermodal facilities To identify potential areas for TOD
2	Integration with Urban Plan	To designate rail routes and ROW in statutory urban plan To formulate detailed land use/ urban plan for the influence area of urban rails for enforcement/ control/ guidance of land use/ urban development
3	Land Acquisition / Resettlement	To commence acquisition of rail ROW To introduce land adjustment for wider area of improvement including railway ROW and TOD-potential area To incorporate resettlement as a concept of TOD
4	Initial Development	To introduce quality bus service or BRT along planned rail routes while land acquisition is carried out To encourage commercial development in/ around the stations without encroaching on necessary space for intermodal facilities
5	Conduct of D/D for the Routes with Acquired ROW	DD must include TOD plan to involve potential private investments for value capture.
6	Construction	When the rail is opened, initial TOD is also completed or on-going.

Source: Study Team

2) Programmatic Approach to Strategic Projects

(a) Removal of Bottlenecks on Eight Major Corridors and in CBD

5.9 This program intends to provide smooth and safe traffic on major traffic corridors and in the CBD. The projects included in this program are maintenance/minor improvement/rehabilitation of roads and removal of specific bottlenecks, and related traffic management and improvement measures.

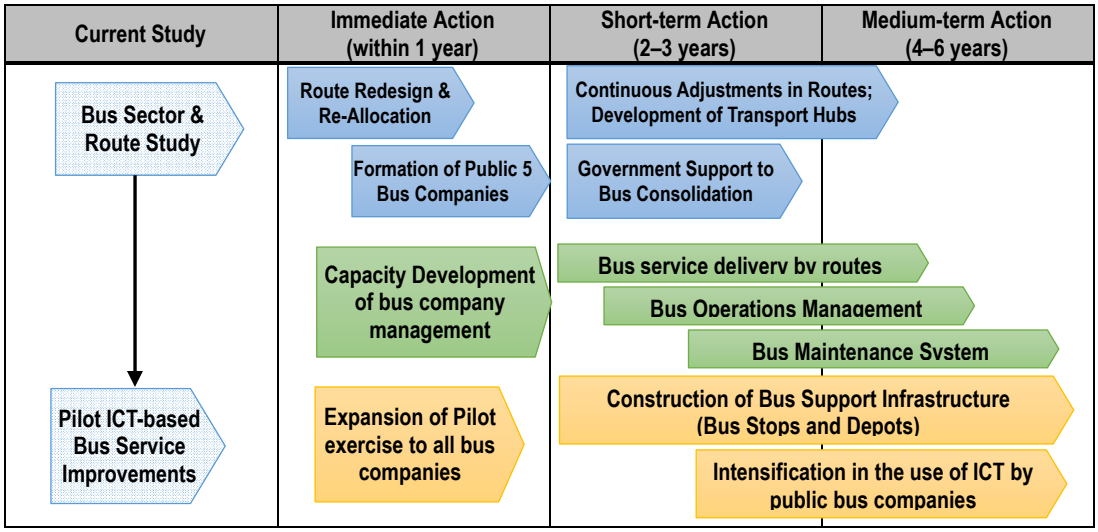


Source: Study Team

Figure 5.2.1 Roadmap for Bottleneck Removal

(b) Bus Modernization

5.10 This program comprises the following projects: (i) bus route redesign, (ii) bus industry re-structuring, (iii) bus fleet renewal and expansion, (iv) bus support infrastructure, (v) bus corridor traffic management, and (vi) bus sector management and regulation by YRTA. The estimated cost of this program is USD350 million, of which about USD52 million is the government's share in the equity of five public bus companies, spread over 5 years.

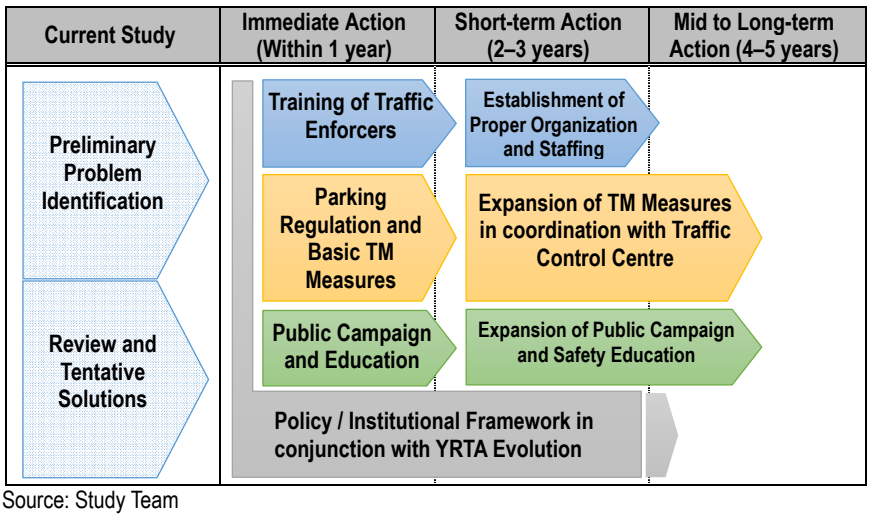


Source: Study Team

Figure 5.2.2 Roadmap for Bus Modernization

(c) Traffic Management and Safety Improvement

5.11 This program includes such components as (i) road vehicle management, (ii) traffic enforcement, (iii) traffic engineering, (iv) traffic safety education, (v) parking management, (vi) traffic control, and (vii) traffic demand management. The estimated cost of the program is approximately USD245 million (cost to Government is USD198 million).



Source: Study Team

Figure 5.2.3 Roadmap for Traffic Management and Safety Improvement

(d) Construction of Missing Links

5.12 This program intends to strengthen overall road network and accessibility in large urban blocks by widening or constructing secondary roads through new approaches widely practiced in Japan. This program comprises (i) road widening and new construction in large-scale urban blocks (5 packages), and (ii) ROW acquisition and resettlement through the introduction of land readjustment. The estimated cost is approximately USD500 million (cost to Government is USD250 million).

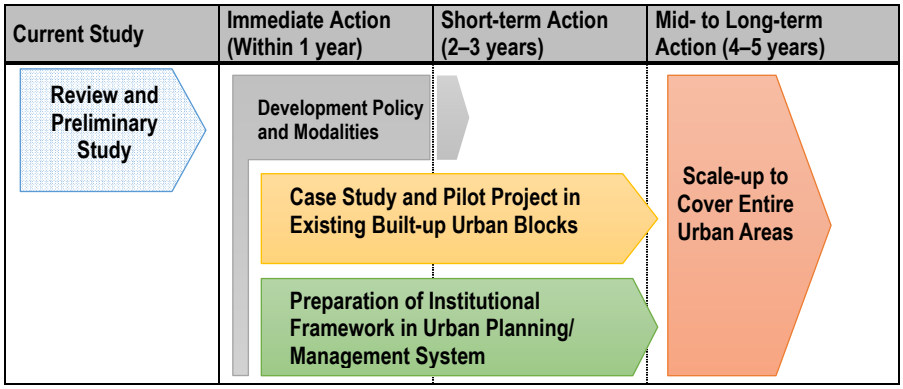
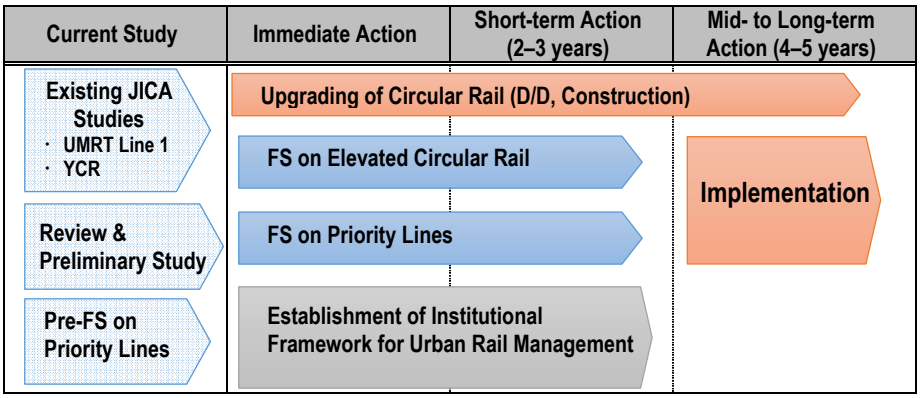


Figure 5.2.4 Roadmap for the Construction of Missing Links

(e) Development of the Urban Rail Network

5.13 This program intends to provide the people with congestion-free, high-quality public transport services in integration with feeder services and TOD. The roadmap of the program is shown below.

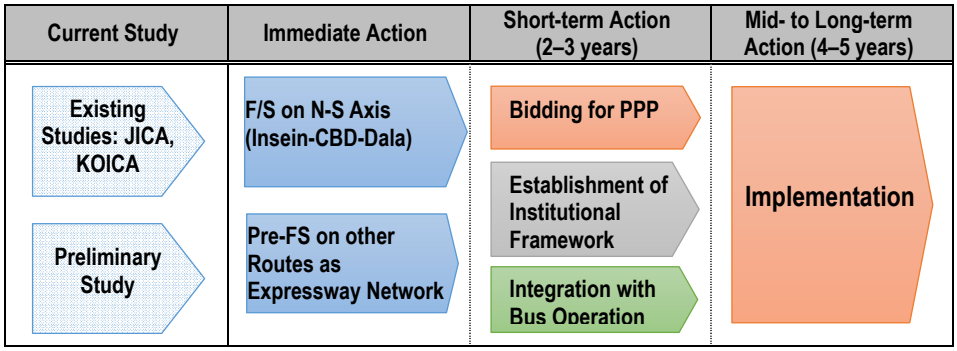


Source: Study Team

Figure 5.2.5 Roadmap for Urban Rail Network Development

(f) Development of the Urban Expressway Network

5.14 This program intends to provide high-level, high-capacity channels for private and public transport including (i) urban expressways including north–south backbone (western axis: Insein–CBD–Dala), north–south backbone (eastern axis: Mindama–CBD), access to Yangon–Mandalay Expressway, and Pazundaung bypass, east–west smart tunnel (north and south sections), and (ii) BRT development including Kanar Road–Bayint Naung Road (under an urban expressway), and Waizayandar Road (under an urban expressway).

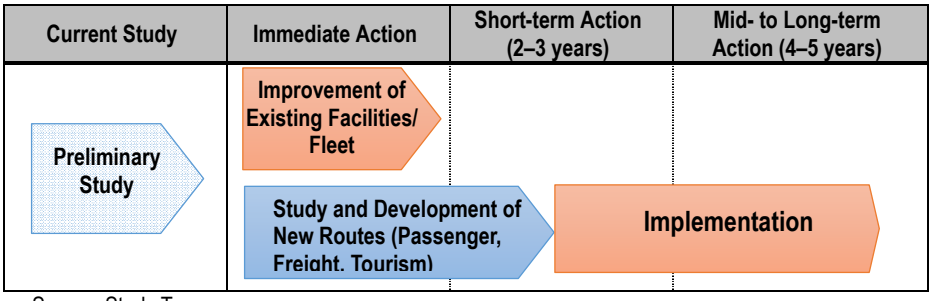


Source: Study Team

Figure 5.2.6 Roadmap for Urban Expressway Development

(g) Development of Inland Waterway Transport

5.15 This program intends to meet urban transport needs along waterfront areas and comprises (i) upgrading of existing services including fleet procurement and facilities improvement and (ii) development of new routes including fleet procurement and facilities improvement.

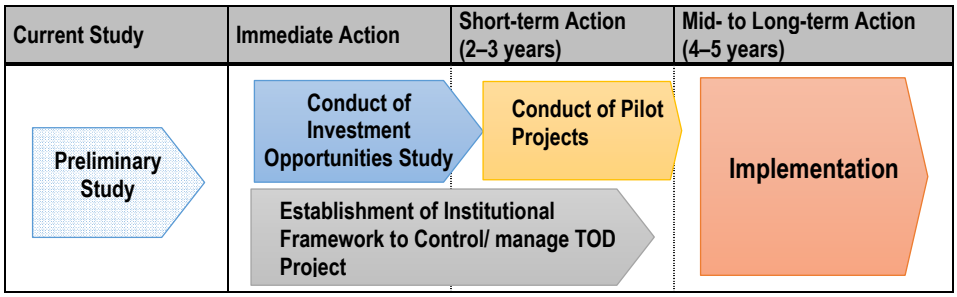


Source: Study Team

Figure 5.2.7 Roadmap for Inland Waterway Transport Development

(h) Transit-oriented Development

5.16 This program intends to promote transit-based compact urban area, local economic development and value capture, including (i) TOD for the Yangon Circular Rail including integrated urban development in/around the stations, improvement of access to/from the stations, especially in areas within walking distance to stations, development of integrated new towns for resettlement and those who need affordable housing, effective use of space under viaducts and integrated development of publicly owned lands, and (ii) TOD on other lines including integrated development with suburban centers and development of underground space at metro stations.

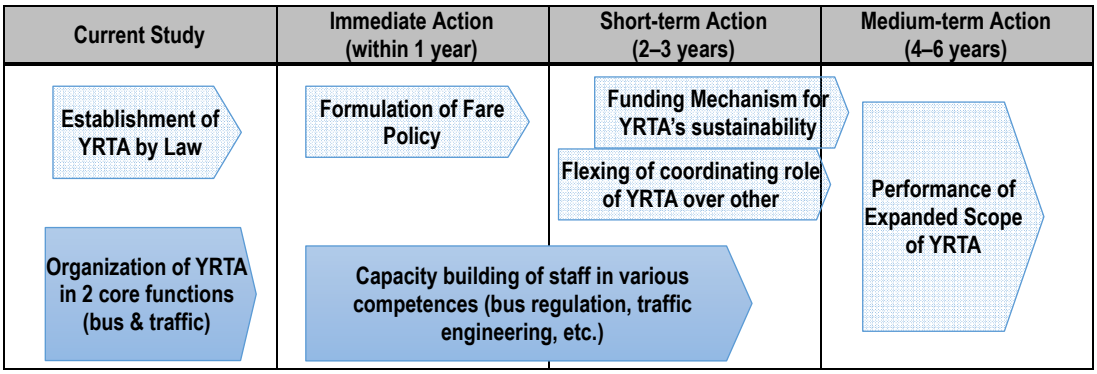


Source: Study Team

Figure 5.2.8 Roadmap for Transit Oriented Development

(i) Strengthening of the YRTA

5.17 This program seeks to transform the newly organized YRTA into an effective instrument for planning, managing, and regulating the region's multimodal transport system. This package includes (i) mobilization of YRTA and formulation of legal and policy framework; (ii) staffing and capacity building via study tours, attendance in specialized training courses, and hands-on exercises; and (iii) expansion of functions to include construction of bus support infrastructure, and coordination of other transport modes (railways, IWT); and TOD planning and promotion. The estimated cost of the program is approximately USD19 million, most of which will be expenses on personnel compensation and external training.



Source: Study Team

Figure 5.2.9 Roadmap for YRTA Strengthening