# 3 TRANSPORT DEMAND CONTEXT

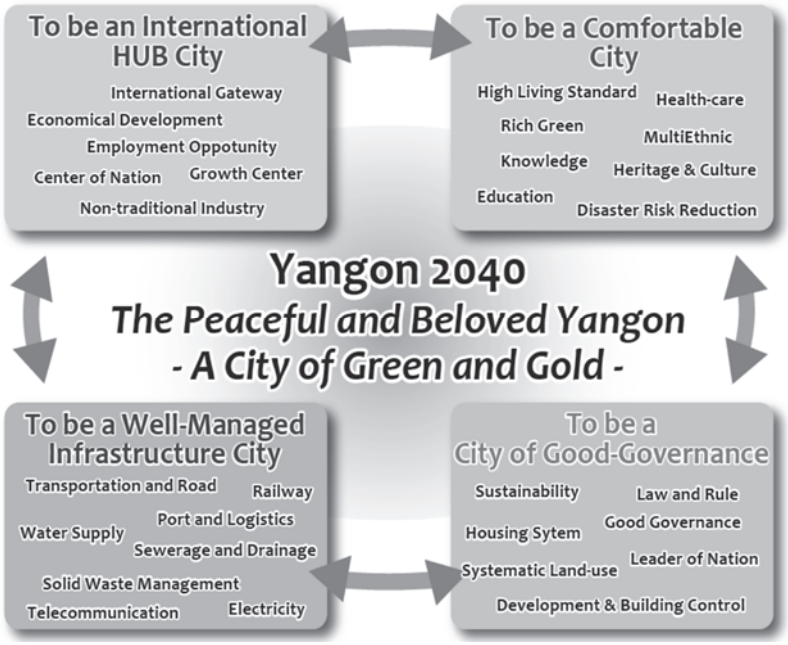
## 3.1 Urban Development Scenario

### 3.1.1 Development Vision of Greater Yangon

A master plan of urban development with the target year at 2040 was adopted by YCDC in January 2013. It was "The Project for the Strategic Urban Development Plan of the Greater Yangon" (SUDP) supported by JICA. This master plan defines the development vision of Greater Yangon as follows:

**Development Vision**

The development vision of the Greater Yangon is summarized into four main points: 1) international hub city; 2) comfortable city; 3) well-managed infrastructure city; and 4) city of good-governance.

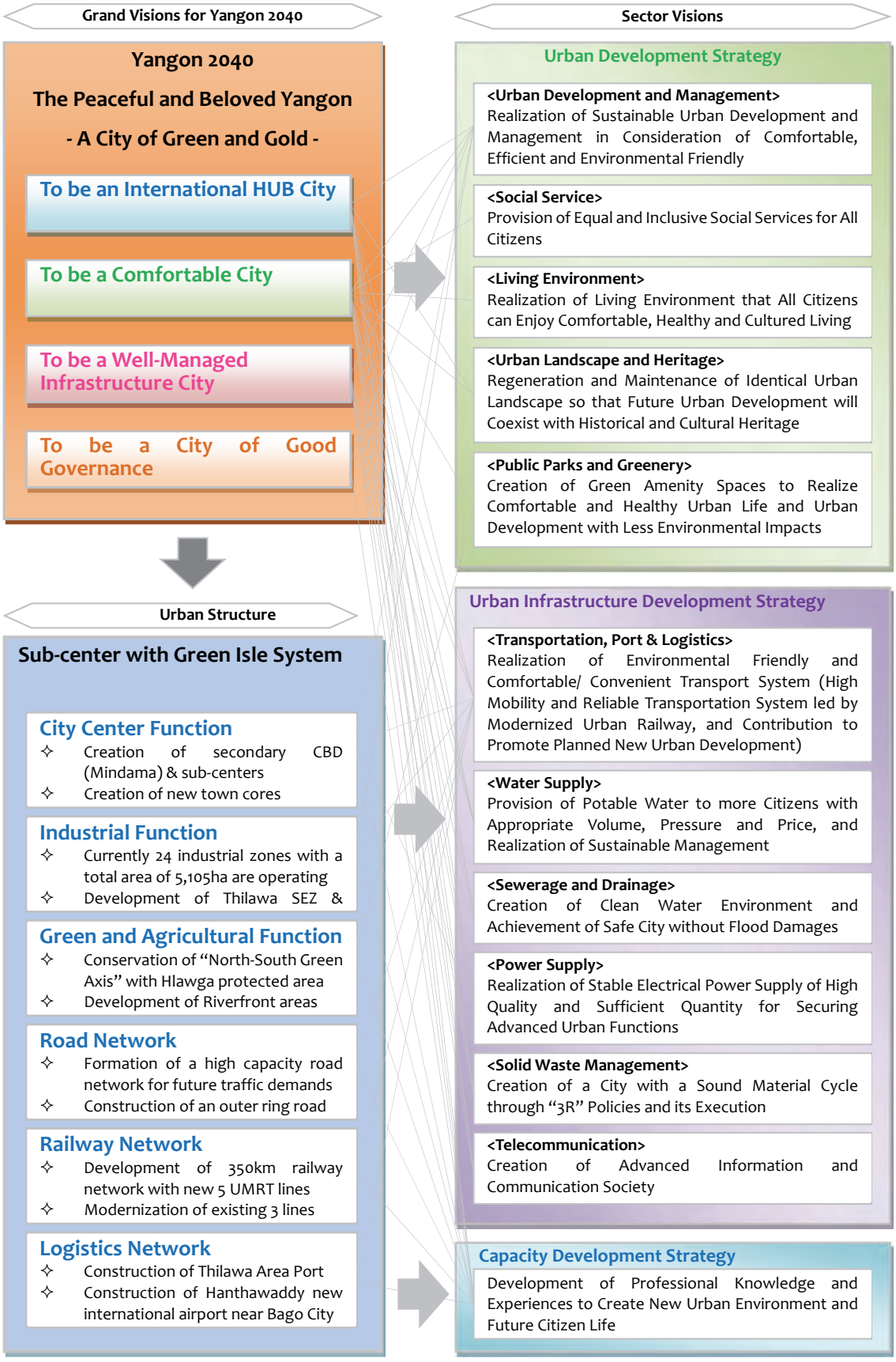



Source: SUDP, JICA, 2013

**Figure 3.1.1.1 The Development Vision of Greater Yangon for 2040**

In this master plan (SUDP), various sector plans and candidate projects were considered. The sectors relating to urban infrastructure are; Transportation, Port & Logistics, Water Supply, Sewerage and Drainage, Power Supply, Solid Waste Management and Telecommunications.

The present project (YUTRA) is regarded as the sector plan of "Transportation, Port & Logistics". The relationship of the development vision and the sector visions is summarized in Figure 3.1.1.2.




Source: SUDP, JICA, 2013

**Figure 3.1.1.2 Relationship of Development Vision and Sector Visions**

### 3.1.2 Urban Structure of Greater Yangon

In the light of past trends, urbanization of Greater Yangon is likely to expand outward, especially northward and eastward along the main roads No.4, No.1, No.3, and No.2, rather than southward and westward. The new international airport in Hantawaddy, which is planned to start operation in 2020, might accelerate this future trend.

The CBD, which is the center of Yangon, is likely to accommodate more urban functions in the future, especially of commercial and business uses on the basis of currently ongoing development projects and plans including high-rise buildings. This trend in the CBD will continue for a while, however, it will shift outward such as to proposed sub-centers to avoid over-concentration in the CBD in the future.

On the other hand, development of Thilawa SEZ and Thilawa Port might be of utmost importance in accelerating the economic growth of not only Greater Yangon but also Myanmar. It means that the southeast area, including Thanlyin and Kyawktan Townships, shall be developed much faster in the future.

Although urbanization is likely to expand northward and eastward, it should be noted that Dala and Twantay areas have large potentials for urban development in the future, particularly for people with limited means for livelihood.

Desirable urban structure of Greater Yangon in the future should be determined in order to solve existing urban problems and to enhance urban functions. For instance, Greater Yangon shall require strong economic functions such as commercial, business, industry and logistics. The improvement of living environment should also be pursued at the same time, under rapid population growth in the future. The urban structure was examined taking into account the following factors:

(i) Urbanization pattern (decentralization or concentration from/to the city center)

(ii) Distribution of main urban functions (CBD, industrial area, residential area, etc.)

(iii) Green conservation (public park, protected area, productive agricultural area, etc.)

(iv) Transportation network (radial/circumferential trunk roads, railway, etc.)

Based on the discussions with relevant organizations such as YCDC, MOC and others, SUDP selected the urban structure “Sub-center with Green Isle System (Decentralized Urban Pattern)”.

This urban structure aims at decentralization of the functions of urban center. A few sub-centers will be created at areas within 10-15 km radius from the CBD. Additionally, this urban structure aims to control urban expansion by means of creating an outer green belt in order to avoid continuous and extensive urban expansion with low density, and to supply urban infrastructure efficiently and effectively. Therefore, enhancement of urban management capacity and introduction of a proper legal system will be necessary. An outer ring road will be provided and future urbanization along the outer ring road will be promoted. SUDP calls it as “outer ring growth belt”. Green areas, including high productive agricultural areas, will be conserved as much as possible to sustain a more comfortable living environment for the citizen.

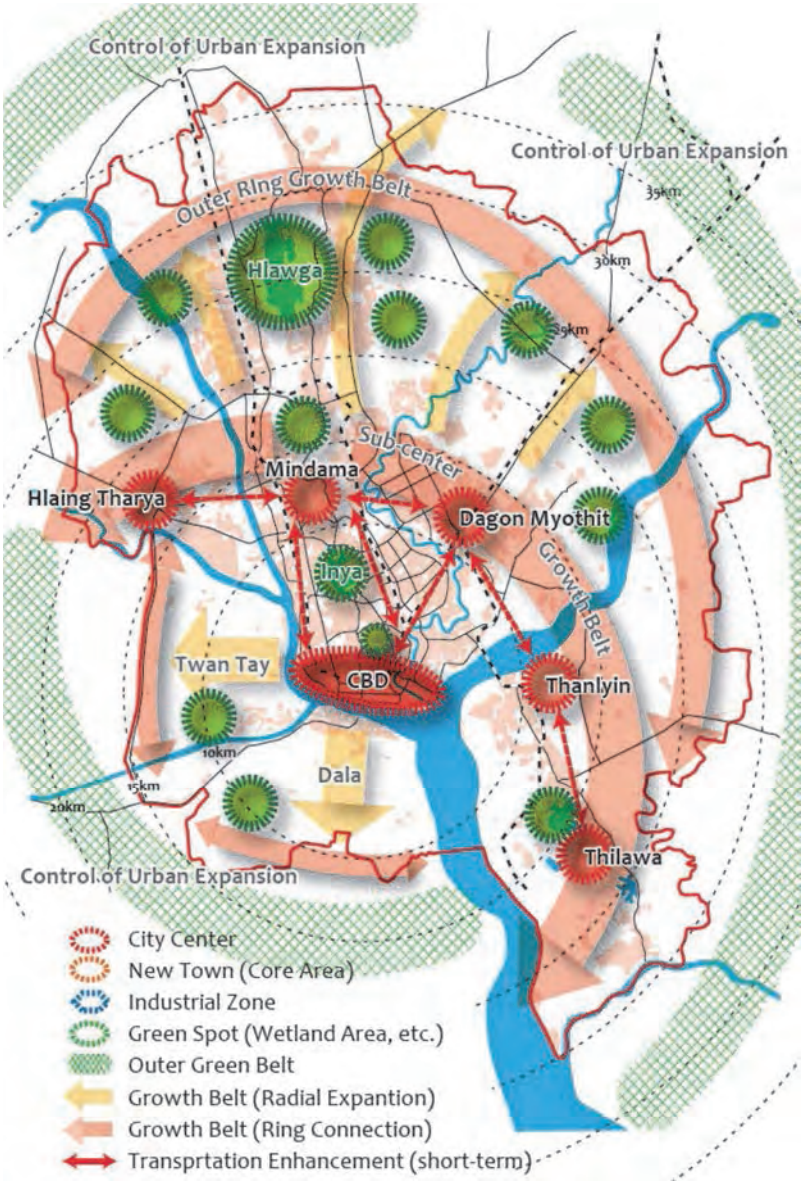
Based on the discussions with relevant organizations, the following points were taken into account in proposing the new urban structure:

(i) Although the sub-center system aims to avoid over-concentration in the CBD, the

existing CBD will still absorb more urban functions especially of commercial/business with high-rise buildings, because the construction of sub-centers will take a long time.

(ii) To accommodate future labor population expected to increase by 3.3 million, it will be necessary to create not only sub-centers but also new residential areas. Development of Mindama will be the first priority among the proposed sub-centers.

(iii) In the sub-center system, development of Dala and Twantay areas was not emphasized due to the physical constraints of these areas. Considering the large potential of these areas for development, however, Dala and Twantay areas will play an important role in the long run.




Source: SUDP, JICA, 2013

**Figure 3.1.2.1 Proposed Urban Structure of Greater Yangon, "Sub-center with Green Isle System"**

### 3.1.3 Future Land Use

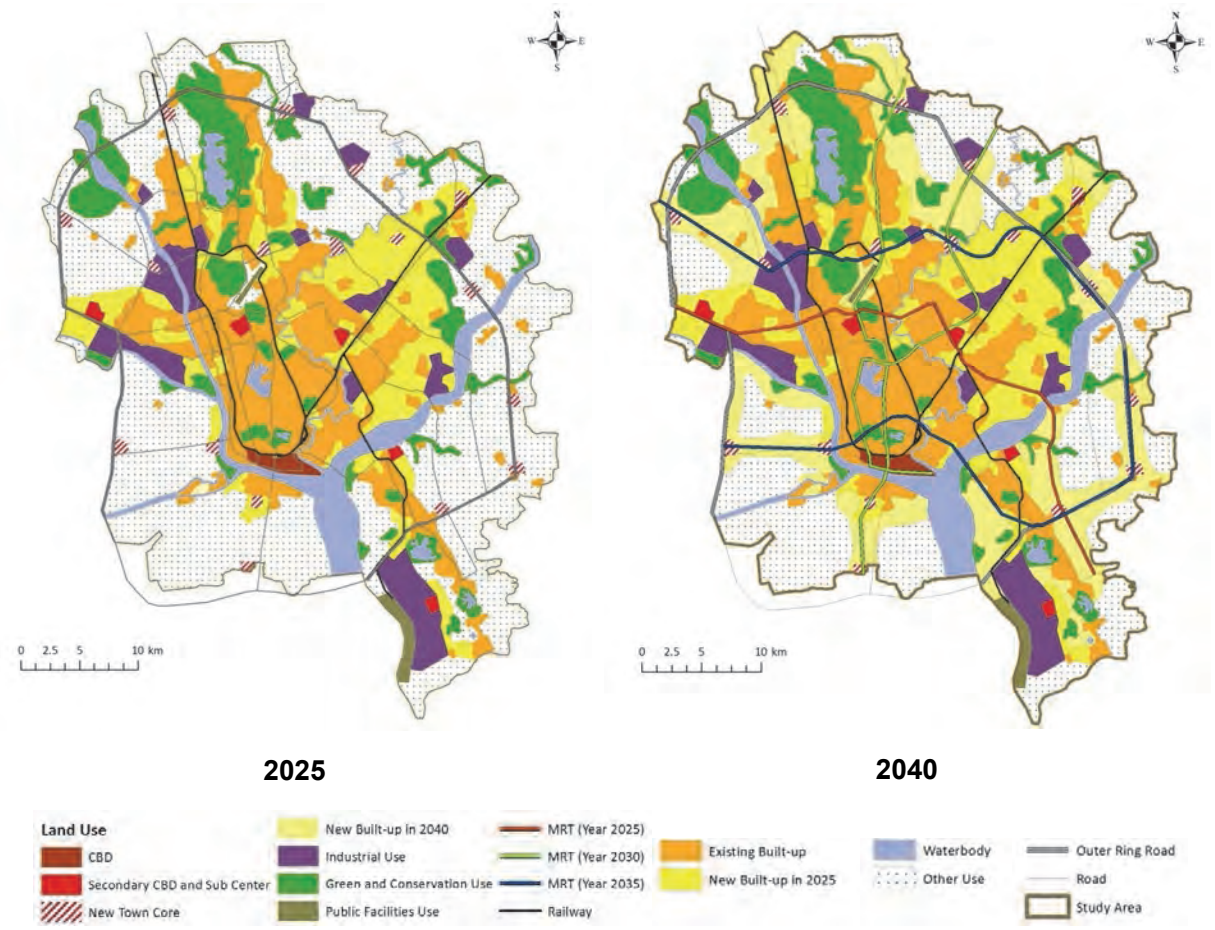
Future land use of mid-term (2025) and long-term (2040) was planned or assumed on the basis of land suitability analyses. Figure 3.1.3.1 showing the future land use takes into account the land suitability and the existing land use, and presumes that a series of development projects ongoing and proposed in the study area including the Thilawa Special Economic Zone development project will have been implemented. The urban functions including secondary CBD/ sub-centers, residential new towns, agriculture and green area are allocated, considering future transport network including road and railway.

The categories of the future land use are defined as presented in Table 3.1.3.1.

**Table 3.1.3.1 Definition of Land Use Category**

| Land Use Category | Definition |
|---|---|
| CBD | Existing CBD area |
| Secondary CBD and Sub-centers | 1 secondary CBD and 4 sub-centers |
| New Town Core | 17 new town cores |
| Existing Built-up | Built-up area in 2012 including residential, commercial, small scale industrial and public facilities areas |
| Existing Built-up in 2025 | Built-up area in 2025 including residential, commercial, small scale industrial and public facilities areas |
| Existing Built-up in 2040 | Built-up area in 2040 including residential, commercial, small scale industrial and public facilities areas |
| Industrial use | Large size industrial area |
| Green and Conservation use | Large size green area (larger than 10 ha) with types of forest, swamp, glass land, and open space, and Hlawga wildlife area |
| Public Facility use | Yangon International Airport and planned river port |
| Water body | River, lake and ponds |
| Others | Agricultural area and others |

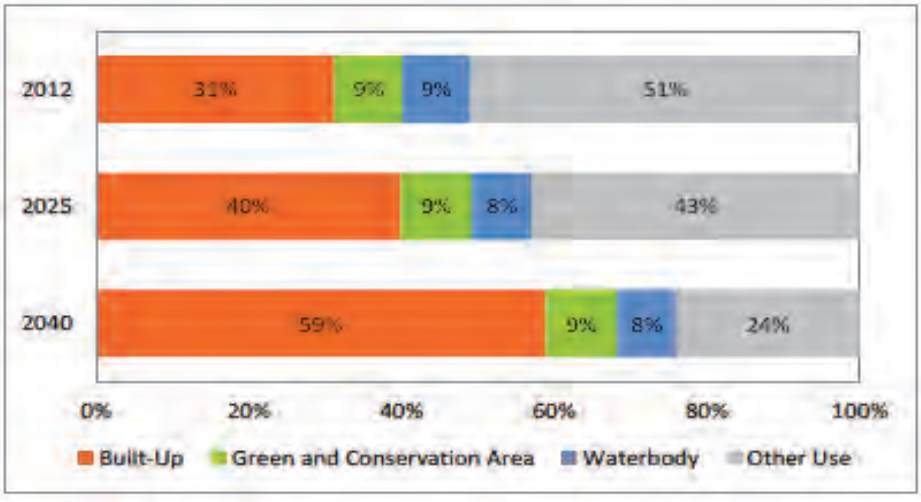
Source: SUDP, JICA, 2013




Source: SUDP, JICA, 2013

**Figure 3.1.3.1 Future Land Use Maps**

The land use in the study area is expected to change as shown in Figure 3.1.3.2 Built–up areas include residential, commercial, industrial and public facilities. Built-up area in 2040 would double, while the green area will keep its current size.




Source: SUDP, JICA, 2013

**Figure 3.1.3.2 Land Use in 2012, 2025 and 2040**

## 3.2 Socio-Economic Framework

### 3.2.1 Population

#### 1) Past Trends in Population Growth

Table 3.2.1.1 shows the 1998 and 2011 population by township and by planning area for the YUTRA Study Area. The night-time and day-time population in 2011 have been estimated by the SUDP study team after consulting with government agencies. In the CBD, the population growth has been stagnant while population in New Suburbs is growing rapidly.

**Table 3.2.1.1 Past Population Trends of Yangon City and YUTRA Study Area**

| Township | | | Area ($km^2$) | Night-time Population | | | Day-time Population in 2011 |
|---|---|---|---|---|---|---|---|
| | | | | 1998 | 2011 | Annual Growth Rate | |
| 1 | Latha | | 0.6 | 32,535 | 34,125 | 0.37% | 46,704 |
| 2 | Lanmadaw | | 1.3 | 40,597 | 43,137 | 0.47% | 54,891 |
| 3 | Pabedan | | 0.6 | 47,461 | 37,551 | -1.79% | 54,626 |
| 4 | Kyauktada | | 0.7 | 44,076 | 34,797 | -1.80% | 71,251 |
| 5 | Botahtaung | | 2.6 | 52,653 | 49,134 | -0.53% | 73,387 |
| 6 | Pazundaung | | 1.1 | 38,363 | 53,648 | 2.61% | 59,025 |
| 7 | Ahlone | | 3.4 | 43,569 | 65,510 | 3.19% | 70,314 |
| 8 | Kyee Myin Daing | | 4.5 | 87,491 | 115,841 | 2.18% | 115,775 |
| 9 | Sanchaung | | 2.4 | 78,788 | 105,208 | 2.25% | 106,435 |
| 10 | Dagon | | 4.9 | 39,967 | 24,492 | -3.70% | 44,885 |
| 11 | Bahan | | 8.5 | 95,114 | 100,695 | 0.44% | 114,087 |
| 12 | Tarmwe | | 5.0 | 128,455 | 191,114 | 3.10% | 194,720 |
| 13 | Mingalar Taung Nyunt | | 4.9 | 109,796 | 155,767 | 2.73% | 152,116 |
| 14 | Seikkan | | 1.2 | 1,379 | 2,241 | 3.81% | 5,781 |
| 15 | Dawbon | | 3.1 | 79,582 | 87,284 | 0.71% | 84,034 |
| 16 | Kamaryut | | 6.5 | 82,943 | 87,881 | 0.45% | 110,080 |
| 17 | Hlaing | | 9.8 | 167,881 | 151,014 | -0.81% | 144,401 |
| 18 | Yankin | | 4.8 | 107,195 | 125,909 | 1.25% | 122,012 |
| 19 | Thingangyun | | 13.1 | 240,417 | 231,621 | -0.29% | 223,800 |
| 20 | Mayangone | | 25.8 | 183,024 | 205,403 | 0.89% | 220,149 |
| 21 | Insein | | 31.4 | 240,704 | 311,200 | 2.00% | 290,133 |
| 22 | Mingalardon | | 128.0 | 170,950 | 288,858 | 4.12% | 270,198 |
| 23 | North Okkalapa | | 27.8 | 189,068 | 333,484 | 4.46% | 311,101 |
| 24 | South Okkalapa | | 8.2 | 220,214 | 191,388 | -1.07% | 175,609 |
| 25 | Thaketa | | 13.5 | 279,799 | 253,284 | -0.76% | 237,637 |
| 26 | Some parts of Dala | Total | 229.8 | 77,236 | 181,087 | 6.77% | 170,490 |
| | | In Study Area | 98.4* | N/A | 122,845 | - | 115,656 |
| 27 | Seikgyikhanaungto | | 12.1 | 25,586 | 38,425 | 3.18% | 35,112 |
| 28 | Shwe Pyi Thar | | 52.7 | 172,377 | 295,993 | 4.25% | 295,914 |
| 29 | Hlaing Tharyar | | 77.6 | 199,190 | 488,768 | 7.15% | 479,317 |
| 30 | North Dagon | | 24.2 | 101,673 | 221,200 | 6.16% | 220,284 |
| 31 | South Dagon | | 37.5 | 140,387 | 370,403 | 7.75% | 342,055 |
| 32 | East Dagon | | 170.9 | 55,192 | 145,505 | 7.74% | 135,356 |
| 33 | Dagon Seikkan | | 42.0 | 18,279 | 120,161 | 15.59% | 103,548 |
| 34 | Some parts of Kyauktan | | 76.1* | N/A | 54,473 | - | 52,371 |
| 35 | Some parts of Thanlyin | | 254.9* | N/A | 181,959 | - | 171,221 |
| 36 | Some parts of Hlegu | | 101.0* | N/A | 16,439 | - | 17,741 |
| 37 | Some parts of Hmawbi | | 84.2* | N/A | 59,482 | - | 56,233 |
| 38 | Some parts of Htantabin | | 81.8* | N/A | 32,506 | - | 49,870 |
| 39 | Some parts of Twantay | | 107.9* | N/A | 23,866 | - | 22,496 |
| **1-6** | **CBD** | | **6.9** | **255,685** | **252,392** | **-0.10%** | **359,883** |
| **7-15** | **Inner Urban Ring** | | **37.8** | **664,141** | **848,152** | **1.90%** | **888,147** |
| **16-19** | **Outer Ring** | | **34.2** | **598,436** | **596,425** | **-0.03%** | **600,293** |
| **20-22** | **Northern Suburbs** | | **185.2** | **594,678** | **805,461** | **2.36%** | **780,479** |
| **23-25** | **Older Suburbs** | | **49.4** | **689,081** | **778,156** | **0.94%** | **724,348** |
| **26-27** | **South of CBD*** | | **110.5** | **102,822** | **219,512** | **6.01%** | **150,768** |
| **28-33** | **New Suburbs** | | **404.9** | **687,098** | **1,642,030** | **6.93%** | **1,576,474** |
| **34-39** | **Periphery Area** | | **705.8** | **N/A** | **430,114** | **-** | **437,017** |
| **1-33** | **Yangon City Total** | | **828.9** | **3,591,941** | **5,142,128** | **2.80%** | **5,135,226** |
| **1-39** | **Study Area Total** | | **1,534.8** | **-** | **5,572,242** | **-** | **5,450,324** |

Note: Population in Dala and Periphery Area was adjusted according to the area ratio (inside/outside Study Area).
Refer to Section 2.1 for the definition of the urban planning zone.

Source: SUDP, JICA, 2013

### 2) Population Projection

#### Night-time Population

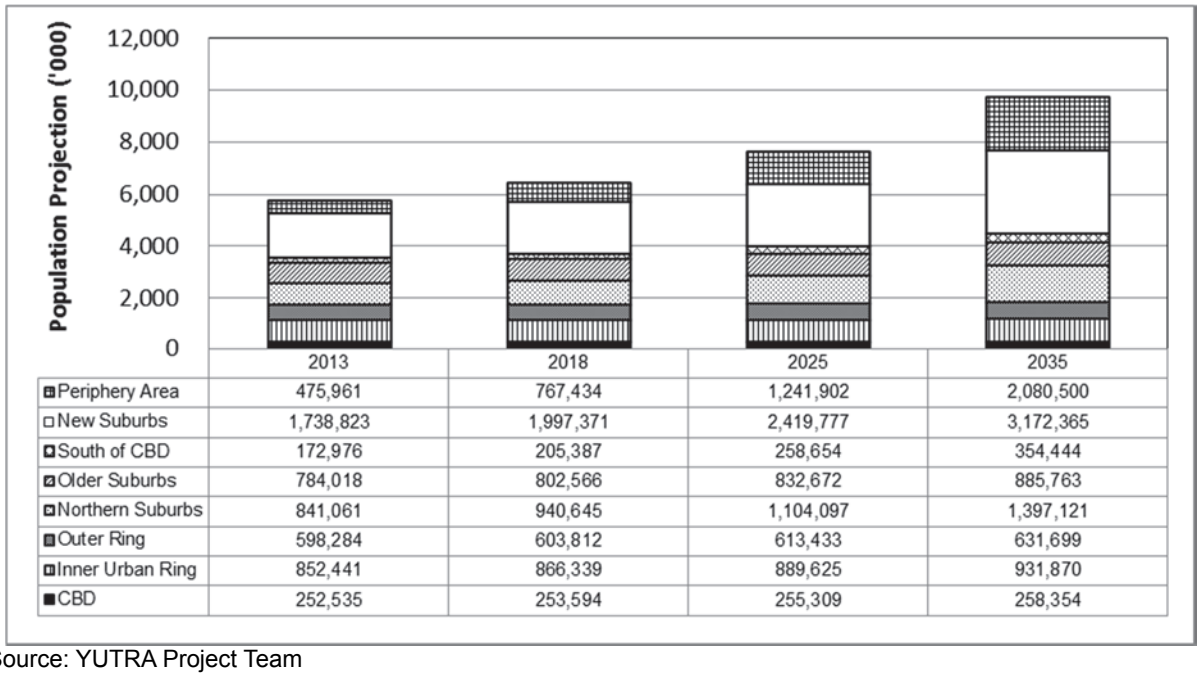
YUTRA has projected night-time population based on the estimate by SUDP. SUDP Study Team prepared three different scenarios in comparison with other Asian cities. The future population growth rate of each scenario is shown in Table 3.2.1.2. In SUDP, and hence YUTRA, the "Middle Scenario" was selected for the Greater Yangon.

The population projection by each township was done by allocating the increment of population growth calculated in proportion to the developable land area by township. The projected population for the base year (2013) and target years (2018, 2025, 2035) by urban planning zone is shown in Figure 3.2.1.1. Table 3.2.1.3 presents the projected population by town ship.

**Table 3.2.1.2 Future Population Growth Rate**

| Population Growth Scenario | Assumption of Annual Growth Rate | Remarks |
|---|---|---|
| Low Scenario | 2.4% | Less than the past trend of YCDC |
| Middle Scenario | 2.6% | Past Trend of YCDC (Bangkok level) |
| High Scenario | 3.3% | Jakarta level |

Source: SUDP, JICA, 2013




| | 2013 | 2018 | 2025 | 2035 |
|---|---|---|---|---|
| Periphery Area | 475,961 | 767,434 | 1,241,902 | 2,080,500 |
| New Suburbs | 1,738,823 | 1,997,371 | 2,419,777 | 3,172,365 |
| South of CBD | 172,976 | 205,387 | 258,654 | 354,444 |
| Older Suburbs | 784,018 | 802,566 | 832,672 | 885,763 |
| Northern Suburbs | 841,061 | 940,645 | 1,104,097 | 1,397,121 |
| Outer Ring | 598,284 | 603,812 | 613,433 | 631,699 |
| Inner Urban Ring | 852,441 | 866,339 | 889,625 | 931,870 |
| CBD | 252,535 | 253,594 | 255,309 | 258,354 |

Source: YUTRA Project Team

**Figure 3.2.1.1 Night-time Population Projection by Urban Planning Zone**

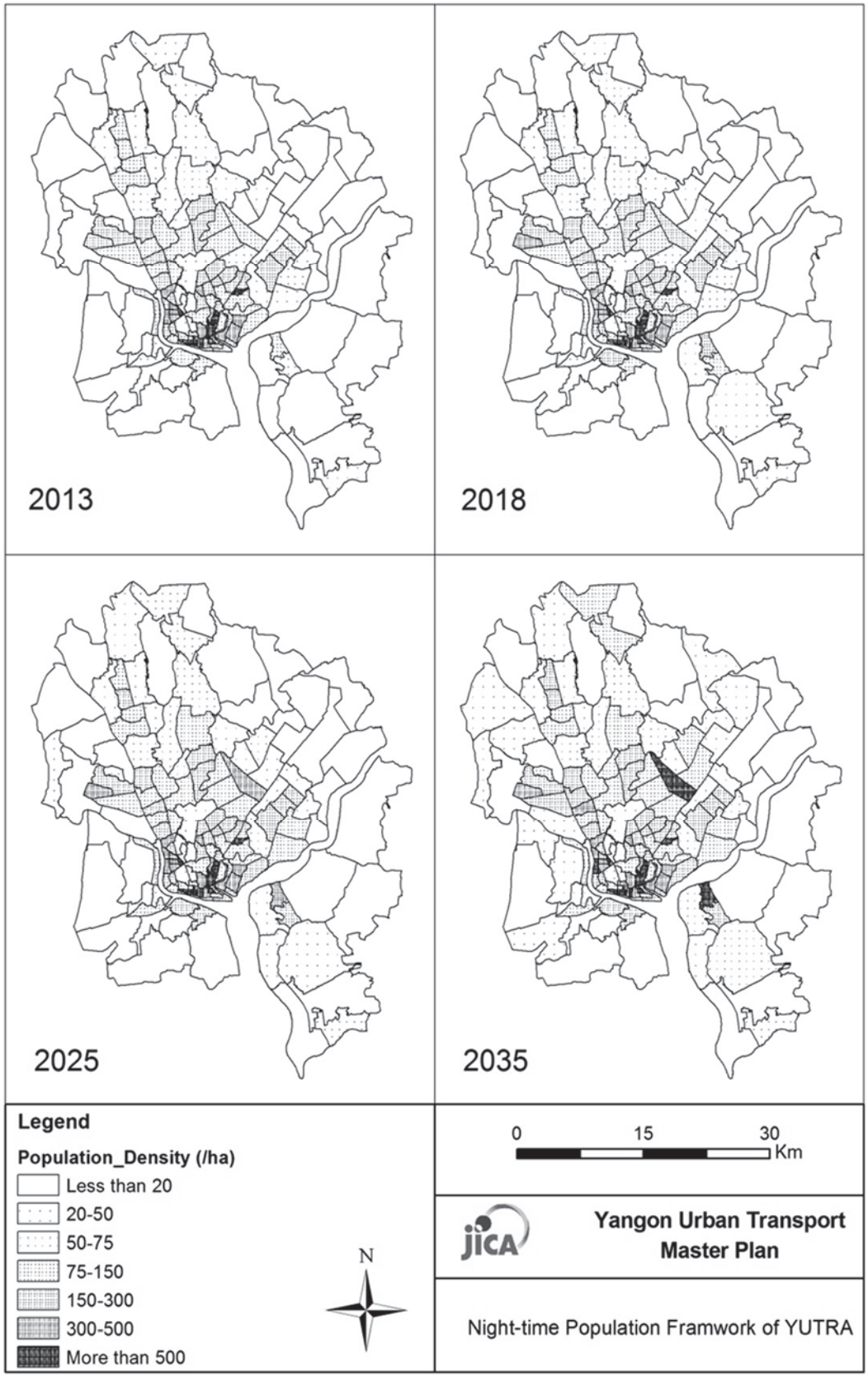
**Table 3.2.1.3 Night-time Population Projection by Township**

| Township | | Night-time Population in 2011 | Night-time Population Projections for Target Years | | | | Annual Growth Rate (2013-2035) | Ratio of Population in 2035 to 2013 |
|---|---|---|---|---|---|---|---|---|
| | | | 2013 | 2018 | 2025 | 2035 | | |
| 1 | Latha | 34,125 | 34,125 | 34,220 | 34,374 | 34,647 | 0.1% | 1.02 |
| 2 | Lanmadaw | 43,137 | 43,137 | 43,256 | 43,448 | 43,789 | 0.1% | 1.02 |
| 3 | Pabedan | 37,551 | 37,551 | 37,650 | 37,809 | 38,092 | 0.1% | 1.01 |
| 4 | Kyauktada | 34,797 | 34,797 | 34,886 | 35,030 | 35,285 | 0.1% | 1.01 |
| 5 | Botahtaung | 49,134 | 49,134 | 49,277 | 49,508 | 49,918 | 0.1% | 1.02 |
| 6 | Pazundaung | 53,648 | 53,791 | 54,304 | 55,139 | 56,624 | 0.2% | 1.06 |
| 7 | Ahlone | 65,510 | 65,653 | 66,210 | 67,157 | 68,881 | 0.2% | 1.05 |
| 8 | Kyee Myin Daing | 115,841 | 117,414 | 122,028 | 129,676 | 143,500 | 0.9% | 1.24 |
| 9 | Sanchaung | 105,208 | 105,351 | 106,008 | 107,138 | 109,204 | 0.2% | 1.04 |
| 10 | Dagon | 24,492 | 25,636 | 28,845 | 34,141 | 43,700 | 2.4% | 1.78 |
| 11 | Bahan | 100,695 | 101,124 | 102,568 | 104,988 | 109,374 | 0.3% | 1.09 |
| 12 | Tarmwe | 191,114 | 191,400 | 192,648 | 194,806 | 198,766 | 0.2% | 1.04 |
| 13 | Mingalar Taung Nyunt | 155,767 | 156,196 | 157,749 | 160,387 | 165,198 | 0.2% | 1.06 |
| 14 | Seikkan | 2,241 | 2,241 | 2,246 | 2,255 | 2,271 | 0.1% | 1.01 |
| 15 | Dawbon | 87,284 | 87,427 | 88,036 | 89,077 | 90,976 | 0.2% | 1.04 |
| 16 | Kamaryut | 87,881 | 88,596 | 90,623 | 94,031 | 100,279 | 0.6% | 1.14 |
| 17 | Hlaing | 151,014 | 151,586 | 153,261 | 156,145 | 161,563 | 0.3% | 1.07 |
| 18 | Yankin | 125,909 | 125,909 | 126,001 | 126,271 | 126,991 | 0.0% | 1.01 |
| 19 | Thingangyun | 231,621 | 232,193 | 233,927 | 236,985 | 242,865 | 0.2% | 1.05 |
| 20 | Mayangone | 205,403 | 208,405 | 217,187 | 231,703 | 258,035 | 1.0% | 1.26 |
| 21 | Insein | 311,200 | 314,345 | 323,744 | 339,333 | 367,775 | 0.7% | 1.18 |
| 22 | Mingalardon | 288,858 | 318,310 | 399,714 | 533,060 | 771,310 | 4.2% | 2.67 |
| 23 | North Okkalapa | 333,484 | 337,773 | 350,746 | 371,692 | 408,483 | 0.8% | 1.22 |
| 24 | South Okkalapa | 191,388 | 191,674 | 193,168 | 195,463 | 199,270 | 0.2% | 1.04 |
| 25 | Thaketa | 253,284 | 254,571 | 258,653 | 265,517 | 278,010 | 0.4% | 1.10 |
| 26 | Some parts of Dala | 122,845 | 132,835 | 160,450 | 205,813 | 287,364 | 3.6% | 2.34 |
| 27 | Seikgyikhanaungto | 38,425 | 40,141 | 44,937 | 52,841 | 67,080 | 2.3% | 1.75 |
| 28 | Shwe Pyi Thar | 295,993 | 306,430 | 333,899 | 378,805 | 459,081 | 1.8% | 1.55 |
| 29 | Hlaing Tharyar | 488,768 | 500,635 | 531,167 | 581,093 | 670,591 | 1.3% | 1.37 |
| 30 | North Dagon | 221,200 | 224,345 | 232,176 | 244,985 | 268,041 | 0.8% | 1.21 |
| 31 | South Dagon | 370,403 | 378,981 | 400,980 | 436,743 | 499,702 | 1.3% | 1.35 |
| 32 | East Dagon | 145,505 | 194,974 | 329,798 | 550,134 | 942,377 | 8.1% | 6.48 |
| 33 | Dagon Seikkan | 120,161 | 133,457 | 169,352 | 228,018 | 332,573 | 4.3% | 2.77 |
| 34 | Some parts of Kyauktan | 54,473 | 60,096 | 75,072 | 98,961 | 138,748 | 4.0% | 2.55 |
| 35 | Some parts of Thanlyin | 181,959 | 232,571 | 370,214 | 594,453 | 991,847 | 7.3% | 5.45 |
| 36 | Some parts of Hlegu | 16,439 | 23,889 | 44,237 | 77,456 | 136,493 | 9.2% | 8.30 |
| 37 | Some parts of Hmawbi | 59,482 | 75,329 | 118,351 | 188,382 | 312,352 | 7.2% | 5.25 |
| 38 | Some parts of Htantabin | 32,506 | 46,252 | 83,660 | 144,625 | 252,715 | 8.9% | 7.77 |
| 39 | Some parts of Twantay | 23,866 | 37,823 | 75,899 | 138,025 | 248,345 | 10.3% | 10.41 |
| 1-6 | CBD | 252,392 | 252,535 | 253,594 | 255,309 | 258,354 | 0.1% | 1.02 |
| 7-15 | Inner Urban Ring | 848,152 | 852,441 | 866,339 | 889,625 | 931,870 | 0.4% | 1.10 |
| 16-19 | Outer Ring | 596,425 | 598,284 | 603,812 | 613,433 | 631,699 | 0.2% | 1.06 |
| 20-22 | Northern Suburbs | 805,461 | 841,061 | 940,645 | 1,104,097 | 1,397,121 | 2.3% | 1.73 |
| 23-25 | Older Suburbs | 778,156 | 784,018 | 802,566 | 832,672 | 885,763 | 0.5% | 1.14 |
| 26-27 | South of CBD | 161,270 | 172,976 | 205,387 | 258,654 | 354,444 | 3.3% | 2.20 |
| 28-33 | New Suburbs | 1,642,030 | 1,738,823 | 1,997,371 | 2,419,777 | 3,172,365 | 2.8% | 1.93 |
| 34-39 | Periphery Area | 368,725 | 475,961 | 767,434 | 1,241,902 | 2,080,500 | 7.5% | 5.64 |
| 1-33 | Yangon City Total | 5,083,886 | 5,240,137 | 5,669,714 | 6,373,567 | 7,631,617 | 1.7% | 1.50 |
| 1-39 | Study Area Total | 5,452,611 | 5,716,098 | 6,437,148 | 7,615,469 | 9,712,117 | 2.4% | 1.78 |

Note: Populations in Dala and Periphery Area are modified according with the ratio of Study Area.
Source: SUDP, JICA, 2013

The projected night-time population density by traffic zone is shown in Figure 3.2.1.2.

The high density area will extend mainly to the north of the Study Area. Because population growth depends on developable land area, the growth at Dagon Myothit and Bago Riverside (identified as sub-centers in SUDP) is remarkably high.




Source: YUTRA Project Team

**Figure 3.2.1.2 Projected Population Density by Traffic Zone (Night-time)**

### Day-time Population

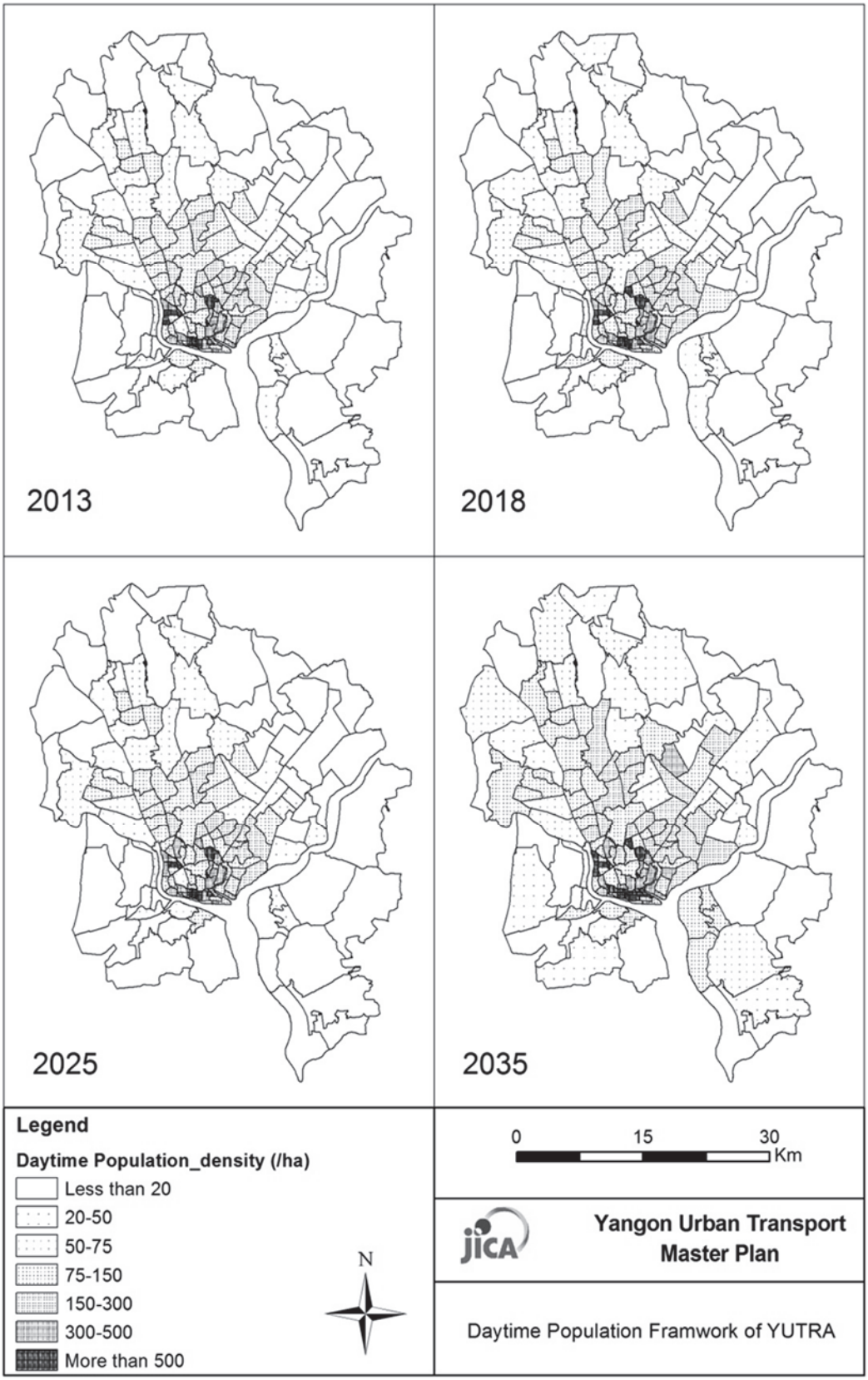
Day-time population projection is also based on the result of SUDP Study Team estimated using future land use distribution. However, it was modified by YUTRA to a minor extent taking into account the number of external trips crossing the boundary of the Greater Yangon as revealed by the YUTRA Cordon Survey. Projected future day-time population is shown in Table 3.2.1.4 by township.

The projected day-time population density by traffic zone is presented in Figure 3.2.1.3. The high density areas are found mainly in the southern area of central Yangon including the existing CBD.

**Table 3.2.1.4 Day-time Population Projection by Township**

| Township | | Day-time Population in 2011 | Day-time Population Projections for Target Years | | | | Annual Growth Rate (2011-2035) | Ratio of Population in 2035 to 2011 |
|---|---|---|---|---|---|---|---|---|
| | | | 2013 | 2018 | 2025 | 2035 | | |
| 1 | Latha | 46,704 | 48,113 | 50,295 | 52,866 | 57,167 | 0.8% | 1.22 |
| 2 | Lanmadaw | 54,891 | 52,240 | 53,758 | 60,140 | 70,395 | 1.0% | 1.28 |
| 3 | Pabedan | 54,626 | 57,307 | 61,279 | 64,606 | 69,474 | 1.0% | 1.27 |
| 4 | Kyauktada | 71,251 | 75,126 | 79,617 | 82,037 | 85,497 | 0.8% | 1.20 |
| 5 | Botahtaung | 73,387 | 71,056 | 73,000 | 80,968 | 94,572 | 1.1% | 1.29 |
| 6 | Pazundaung | 59,025 | 58,141 | 59,800 | 63,629 | 70,088 | 0.7% | 1.19 |
| 7 | Ahlone | 70,314 | 68,037 | 69,899 | 76,480 | 87,522 | 0.9% | 1.24 |
| 8 | Kyee Myin Daing | 115,775 | 124,863 | 132,770 | 136,456 | 141,878 | 0.9% | 1.23 |
| 9 | Sanchaung | 106,435 | 112,933 | 115,728 | 112,664 | 108,903 | 0.1% | 1.02 |
| 10 | Dagon | 44,885 | 45,176 | 49,302 | 57,594 | 73,004 | 2.0% | 1.63 |
| 11 | Bahan | 114,087 | 110,193 | 113,565 | 124,341 | 143,678 | 1.0% | 1.26 |
| 12 | Tarmwe | 194,720 | 211,040 | 222,589 | 224,641 | 231,021 | 0.7% | 1.19 |
| 13 | Mingalar Taung Nyunt | 152,116 | 148,221 | 149,911 | 157,847 | 172,958 | 0.5% | 1.14 |
| 14 | Seikkan | 5,781 | 5,639 | 6,603 | 8,775 | 13,273 | 3.5% | 2.30 |
| 15 | Dawbon | 84,034 | 86,573 | 89,699 | 92,872 | 98,804 | 0.7% | 1.18 |
| 16 | Kamaryut | 110,080 | 107,842 | 109,290 | 119,964 | 137,587 | 0.9% | 1.25 |
| 17 | Hlaing | 144,401 | 140,861 | 142,427 | 151,847 | 168,799 | 0.7% | 1.17 |
| 18 | Yankin | 122,012 | 120,152 | 120,710 | 125,365 | 134,959 | 0.4% | 1.11 |
| 19 | Thingangyun | 223,800 | 232,904 | 237,016 | 237,687 | 245,449 | 0.4% | 1.10 |
| 20 | Mayangone | 220,149 | 208,818 | 216,673 | 247,419 | 305,434 | 1.4% | 1.39 |
| 21 | Insein | 290,133 | 281,427 | 287,688 | 320,747 | 372,834 | 1.1% | 1.29 |
| 22 | Mingalardon | 270,198 | 281,783 | 349,561 | 486,927 | 764,886 | 4.4% | 2.83 |
| 23 | North Okkalapa | 311,101 | 329,563 | 345,586 | 361,297 | 391,344 | 1.0% | 1.26 |
| 24 | South Okkalapa | 175,609 | 185,688 | 189,483 | 185,042 | 180,438 | 0.1% | 1.03 |
| 25 | Thaketa | 237,637 | 247,262 | 254,183 | 257,680 | 266,392 | 0.5% | 1.12 |
| 26 | Some parts of Dala | 115,656 | 126,920 | 156,550 | 197,297 | 268,618 | 3.6% | 2.32 |
| 27 | Seikgyikhanaungto | 35,112 | 38,682 | 43,814 | 49,242 | 57,137 | 2.0% | 1.63 |
| 28 | Shwe Pyi Thar | 295,914 | 313,236 | 345,624 | 394,816 | 472,437 | 2.0% | 1.60 |
| 29 | Hlaing Tharyar | 479,317 | 518,010 | 552,049 | 592,912 | 712,196 | 1.7% | 1.49 |
| 30 | North Dagon | 220,284 | 233,018 | 233,170 | 250,321 | 302,313 | 1.3% | 1.37 |
| 31 | South Dagon | 342,055 | 361,465 | 389,083 | 427,087 | 488,880 | 1.5% | 1.43 |
| 32 | East Dagon | 135,356 | 167,239 | 297,396 | 498,635 | 794,787 | 7.7% | 5.87 |
| 33 | Dagon Seikkan | 103,548 | 121,783 | 140,491 | 194,456 | 301,204 | 4.5% | 2.91 |
| 34 | Some parts of Kyauktan | 52,371 | 55,999 | 69,282 | 97,033 | 142,731 | 4.3% | 2.73 |
| 35 | Some parts of Thanlyin | 171,221 | 206,575 | 321,749 | 535,849 | 919,978 | 7.3% | 5.37 |
| 36 | Some parts of Hlegu | 17,741 | 22,562 | 45,537 | 75,583 | 133,622 | 8.8% | 7.53 |
| 37 | Some parts of Hmawbi | 56,233 | 69,328 | 115,907 | 180,793 | 284,163 | 7.0% | 5.05 |
| 38 | Some parts of Htantabin | 49,870 | 62,519 | 105,302 | 159,928 | 246,809 | 6.9% | 4.95 |
| 39 | Some parts of Twantay | 22,496 | 32,803 | 75,825 | 127,929 | 211,644 | 9.8% | 9.41 |
| 1-6 | CBD | 359,884 | 361,983 | 377,749 | 404,246 | 447,193 | 0.9% | 1.24 |
| 7-15 | Inner Urban Ring | 888,147 | 912,676 | 950,067 | 991,671 | 1,071,042 | 0.8% | 1.21 |
| 16-19 | Outer Ring | 600,293 | 601,759 | 609,444 | 634,862 | 686,793 | 0.6% | 1.14 |
| 20-22 | Northern Suburbs | 780,480 | 772,028 | 853,922 | 1,055,093 | 1,443,154 | 2.6% | 1.85 |
| 23-25 | Older Suburbs | 724,347 | 762,512 | 789,252 | 804,019 | 838,174 | 0.6% | 1.16 |
| 26-27 | South of CBD | 150,768 | 165,603 | 200,364 | 246,539 | 325,755 | 3.3% | 2.16 |
| 28-33 | New Suburbs | 1,576,474 | 1,714,751 | 1,957,813 | 2,358,227 | 3,071,817 | 2.8% | 1.95 |
| 34-39 | Periphery Area | 369,932 | 449,786 | 733,601 | 1,177,116 | 1,938,948 | 7.1% | 5.24 |
| 1-33 | Yangon City Total | 5,080,393 | 5,291,312 | 5,738,610 | 6,494,657 | 7,883,929 | 1.8% | 1.55 |
| 1-39 | Study Area Total | 5,450,325 | 5,741,098 | 6,472,212 | 7,671,774 | 9,822,877 | 2.5% | 1.80 |

Source: YUTRA Project Team




Source: YUTRA Project Team

**Figure 3.2.1.3 Projected Population Density by Traffic Zone (Day-time)**

### 3.2.2 Employment

#### 1) Sectoral Composition of Workers

Number of workers by sector at present was obtained also based on the estimated result by SUDP Study Team. With regard to the primary sector, however, YUTRA changed the assumption of employment growth from “constant share” to “constant number”. The difference was adjusted in the number of workers of the tertiary sector. This is shown in Table 3.2.2.1. The ratio of the number of workers to the total population is 50.5 % for the entire study area.

**Table 3.2.2.1 Number of Workers by Sector for YUTRA Study Area, 2013 (Night-time, ‘000)**

| Workers | | | Total Population |
|---|---|---|---|
| Primary Sector | Secondary Sector | Tertiary Sector | |
| 58<br>(2.29%) | 219<br>(8.62%) | 2,263<br>(89.10%) | 5,716<br>(100.0%) |
| 2,540<br>(44.4%) | | | |

Note: Adjusted based on SUDP’s estimate.
Source: YUTRA Project Team based on SUDP, JICA, 2013

#### 2) Employment Projection

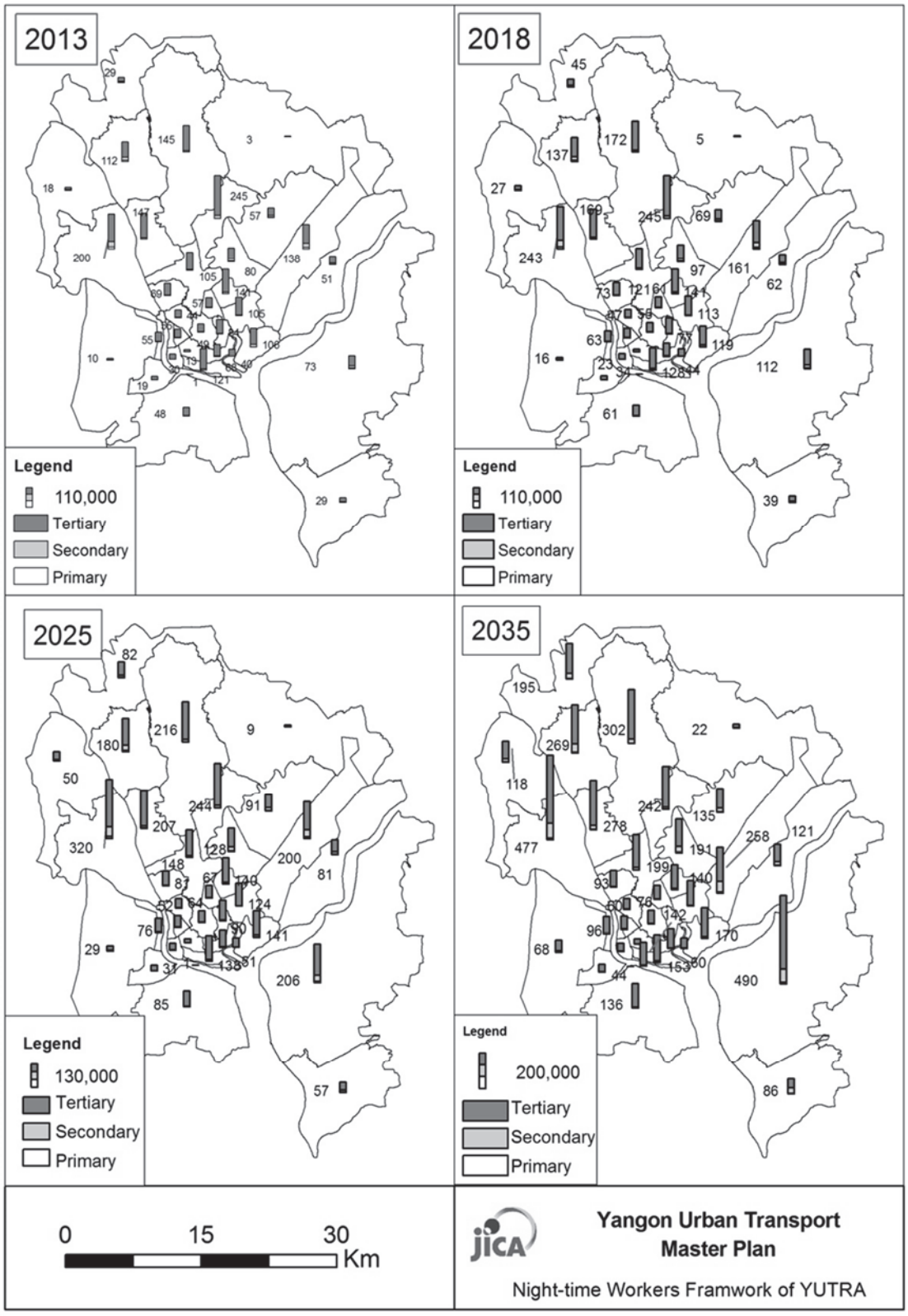
**Night-time employment**

Number of workers by sector at night-time was estimated by SUDP for 2011 by urban planning zone (township group). This was broken down by YUTRA into each township, after adjusting the numbers from 2011 to 2013 basis, using the sectoral composition of the urban planning zone the township belongs to. Table 3.2.2.2 and Figure 3.2.2.1 present the estimated number of workers by sector and by township.

**Table 3.2.2.2 Projected Number of Workers by Sector (Night-time, '000)**

| No. | Township Name | Primary Industry | | | | Secondary Industry | | | | Tertiary Industry | | | | Total Workers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2013 | 2018 | 2025 | 2035 | 2013 | 2018 | 2025 | 2035 | 2013 | 2018 | 2025 | 2035 | 2013 | 2018 | 2025 | 2035 |
| 1 | Latha | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 16 | 17 | 18 | 21 | 17 | 18 | 20 | 22 |
| 2 | Lanmadaw | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 2 | 20 | 21 | 23 | 26 | 22 | 23 | 25 | 27 |
| 3 | Panbetan | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 17 | 18 | 19 | 21 | 18 | 19 | 20 | 23 |
| 4 | Kyauktada | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 15 | 16 | 17 | 19 | 16 | 17 | 18 | 20 |
| 5 | Botataung | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 2 | 24 | 26 | 28 | 31 | 26 | 27 | 30 | 33 |
| 6 | Pazundaung | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 2 | 20 | 22 | 23 | 26 | 22 | 23 | 25 | 28 |
| 7 | Alone | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 29 | 32 | 37 | 44 | 30 | 34 | 39 | 46 |
| 8 | Kyeemyin daing | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 3 | 52 | 60 | 73 | 93 | 55 | 63 | 76 | 96 |
| 9 | San Chaung | 0 | 0 | 0 | 0 | 2 | 2 | 3 | 3 | 46 | 51 | 60 | 71 | 48 | 54 | 63 | 73 |
| 10 | Dagon | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 12 | 15 | 20 | 29 | 13 | 16 | 21 | 30 |
| 11 | Bahan | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 3 | 47 | 52 | 61 | 73 | 49 | 55 | 64 | 76 |
| 12 | Tarmwe | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 5 | 80 | 90 | 106 | 127 | 84 | 94 | 111 | 131 |
| 13 | Mingalar Taung Nyunt | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 4 | 65 | 73 | 87 | 104 | 68 | 77 | 90 | 108 |
| 14 | Seikkan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 15 | Dawpon | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 2 | 38 | 42 | 49 | 58 | 40 | 44 | 51 | 60 |
| 16 | Kamayut | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 43 | 46 | 51 | 59 | 44 | 47 | 52 | 60 |
| 17 | Hlaing | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 67 | 72 | 79 | 92 | 69 | 73 | 81 | 93 |
| 18 | Yankin | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 55 | 60 | 66 | 76 | 57 | 61 | 67 | 77 |
| 19 | Thingankyun | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 102 | 110 | 122 | 140 | 105 | 113 | 124 | 142 |
| 20 | Mayangone | 0 | 0 | 0 | 0 | 5 | 7 | 10 | 16 | 99 | 114 | 138 | 182 | 105 | 121 | 148 | 199 |
| 21 | Insein | 0 | 0 | 0 | 0 | 7 | 10 | 14 | 23 | 139 | 159 | 193 | 255 | 147 | 169 | 207 | 278 |
| 22 | Mingalardon | 0 | 0 | 0 | 0 | 7 | 9 | 14 | 23 | 138 | 162 | 202 | 278 | 145 | 172 | 216 | 302 |
| 23 | North Okkalapa | 0 | 0 | 0 | 0 | 17 | 16 | 15 | 14 | 228 | 228 | 228 | 228 | 245 | 245 | 244 | 242 |
| 24 | South Okkalapa | 0 | 0 | 0 | 0 | 10 | 9 | 9 | 8 | 131 | 131 | 131 | 132 | 141 | 141 | 140 | 140 |
| 25 | Tharkayta | 0 | 0 | 0 | 0 | 14 | 13 | 12 | 11 | 92 | 106 | 129 | 159 | 106 | 119 | 141 | 170 |
| 26 | Dala | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 4 | 46 | 59 | 82 | 133 | 48 | 61 | 85 | 136 |
| 27 | Seikgyikanaungto | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 18 | 22 | 30 | 43 | 19 | 23 | 31 | 44 |
| 28 | Shwepyitar | 7 | 7 | 6 | 6 | 18 | 22 | 30 | 46 | 88 | 108 | 144 | 217 | 112 | 137 | 180 | 269 |
| 29 | Hlaingtaryar | 12 | 12 | 11 | 10 | 32 | 39 | 53 | 82 | 156 | 191 | 255 | 385 | 200 | 243 | 320 | 477 |
| 30 | North Dagon | 5 | 5 | 5 | 4 | 13 | 16 | 21 | 33 | 62 | 77 | 102 | 154 | 80 | 97 | 128 | 191 |
| 31 | South Dagon | 9 | 9 | 8 | 7 | 23 | 28 | 38 | 59 | 106 | 124 | 153 | 192 | 138 | 161 | 200 | 258 |
| 32 | East Dagon | 3 | 3 | 3 | 3 | 9 | 11 | 15 | 23 | 44 | 54 | 72 | 109 | 57 | 69 | 91 | 135 |
| 33 | Dagon Seikkan | 3 | 3 | 3 | 3 | 8 | 10 | 14 | 21 | 39 | 49 | 65 | 98 | 51 | 62 | 81 | 121 |
| 34 | Kyauktan | 2 | 2 | 3 | 4 | 5 | 7 | 13 | 31 | 23 | 30 | 41 | 51 | 29 | 39 | 57 | 86 |
| 35 | Thanlyin | 4 | 5 | 7 | 10 | 11 | 17 | 31 | 72 | 57 | 90 | 167 | 408 | 73 | 112 | 206 | 490 |
| 36 | Hlegu | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 3 | 4 | 8 | 19 | 3 | 5 | 9 | 22 |
| 37 | Hmawbi | 2 | 2 | 3 | 4 | 5 | 7 | 12 | 29 | 23 | 36 | 67 | 162 | 29 | 45 | 82 | 195 |
| 38 | Htantabin | 1 | 1 | 2 | 2 | 3 | 4 | 8 | 17 | 14 | 22 | 40 | 98 | 18 | 27 | 50 | 118 |
| 39 | Twantay | 1 | 1 | 1 | 1 | 2 | 2 | 4 | 10 | 8 | 12 | 23 | 57 | 10 | 16 | 29 | 68 |
| **1-6** | **CBD** | **0** | **0** | **0** | **0** | **8** | **9** | **9** | **9** | **112** | **119** | **129** | **144** | **121** | **128** | **138** | **153** |
| **7-15** | **Inner Urban Ring** | **1** | **1** | **1** | **0** | **18** | **19** | **20** | **22** | **369** | **417** | **495** | **600** | **387** | **436** | **516** | **622** |
| **16-19** | **Outer Ring** | **6** | **5** | **3** | **2** | **2** | **2** | **2** | **3** | **268** | **288** | **318** | **367** | **275** | **294** | **324** | **372** |
| **20-22** | **Northern Suburbs** | **1** | **1** | **1** | **1** | **20** | **26** | **37** | **62** | **376** | **435** | **534** | **716** | **397** | **462** | **572** | **779** |
| **23-25** | **Older Suburbs** | **1** | **0** | **0** | **0** | **41** | **39** | **37** | **33** | **451** | **465** | **488** | **519** | **492** | **505** | **525** | **552** |
| **26-27** | **South of CBD** | **0** | **0** | **0** | **0** | **2** | **3** | **3** | **5** | **65** | **81** | **112** | **175** | **67** | **84** | **116** | **181** |
| **28-33** | **New Suburbs** | **40** | **39** | **37** | **33** | **102** | **127** | **172** | **265** | **496** | **602** | **791** | **1,154** | **637** | **768** | **1,000** | **1,451** |
| **34-39** | **Periphery Area** | **10** | **12** | **16** | **22** | **26** | **39** | **71** | **163** | **127** | **193** | **346** | **795** | **163** | **244** | **432** | **979** |
| **1-33** | **Yangon City Total** | **48** | **46** | **42** | **37** | **193** | **223** | **279** | **399** | **2,136** | **2,408** | **2,868** | **3,675** | **2,377** | **2,677** | **3,190** | **4,110** |
| **1-39** | **Study Area Total** | **58** | **58** | **58** | **58** | **219** | **263** | **350** | **562** | **2,263** | **2,601** | **3,214** | **4,470** | **2,540** | **2,921** | **3,622** | **5,089** |

Source: YUTRA Project Team




Note: 6 Townships in the CBD are expressed as one area

Source: YUTRA Project Team

**Figure 3.2.2.1 Projected Number of Workers by Township and Sector (Night-time)**

**Day-time Employment (Employment at Workplace)**

In the SUDP, the strategy for future land use was established. Then workers' density was set for each land use category, and the numbers of workers at workplace were estimated. The definition of land use category and density of workers assumed by SUDP are shown in Table 3.2.2.3.

**Table 3.2.2.3 Land Use Category and Workers' Density**

| Sector | Area for Primary Sector | Area for Secondary Sector | Area for Tertiary Sector | | |
|---|---|---|---|---|---|
| Land use Area | Agricultural Area | Industrial Area | Ex-high Dense Residential Area (Only in CBD) | Other Areas for Tertiary Industry | 2nd CBD & Sub-center |
| Worker density (persons / ha) | 2.8 | 69.9 | 320 | | Particular value by centers |

Source: SUDP, JICA, 2013

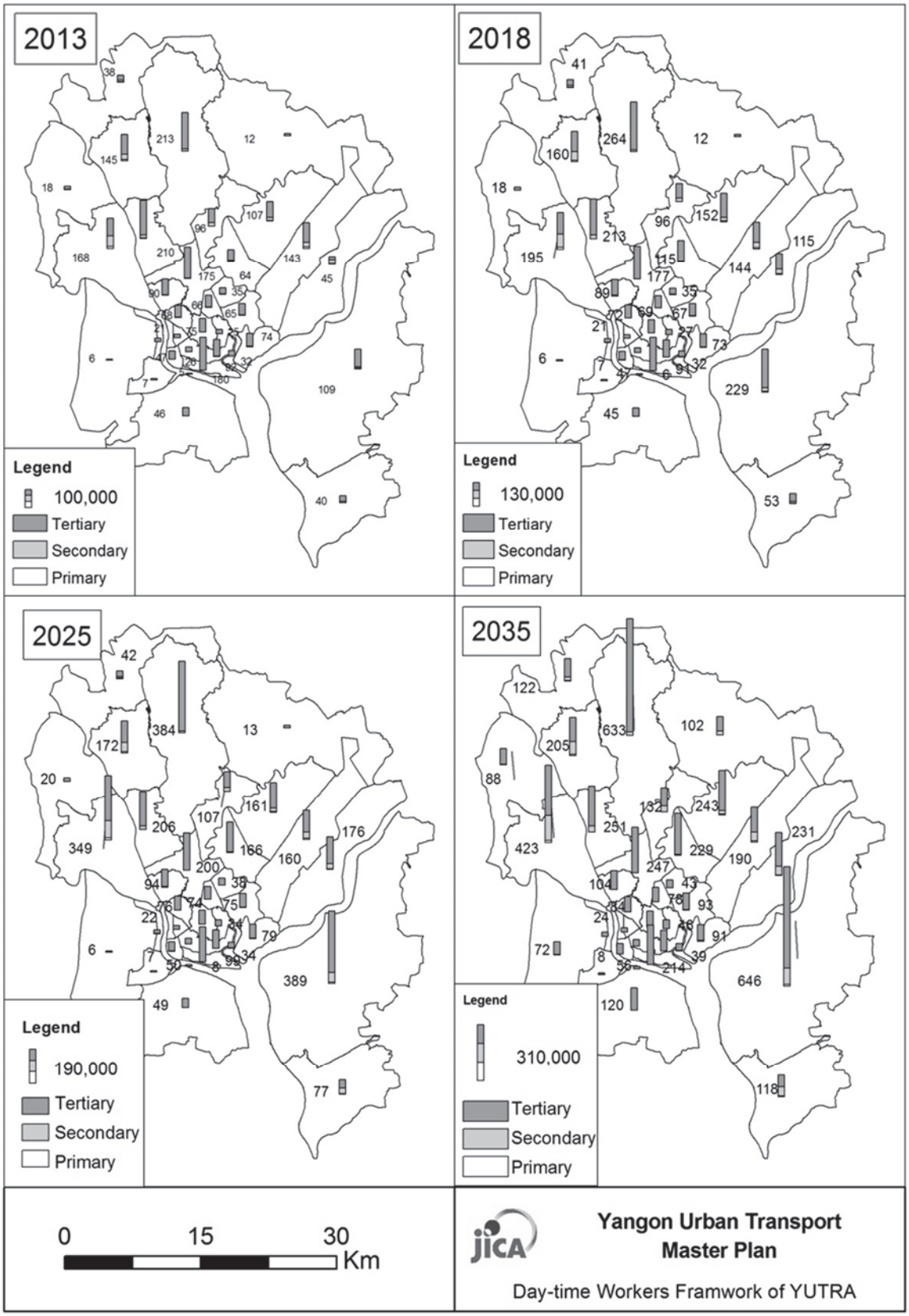
Projected number of workers at workplace by township is shown in Table 3.2.2.4 and Figure 3.2.2.2. It was assumed to increase basically in proportion to population. With regard to the primary sector, YUTRA changed the assumption of employment growth from "constant share" to "constant number" as well.

In some areas such as Shwepyitar, Hlaingtaryar and Kyauktan, growth of the number of workers is remarkable in the secondary sector due to the assumption of SUDP that industrial zones will be developed in these areas (refer to Figure 3.2.2.3).

**Table 3.2.2.4 Projected Number of Workers (Day-time, '000)**

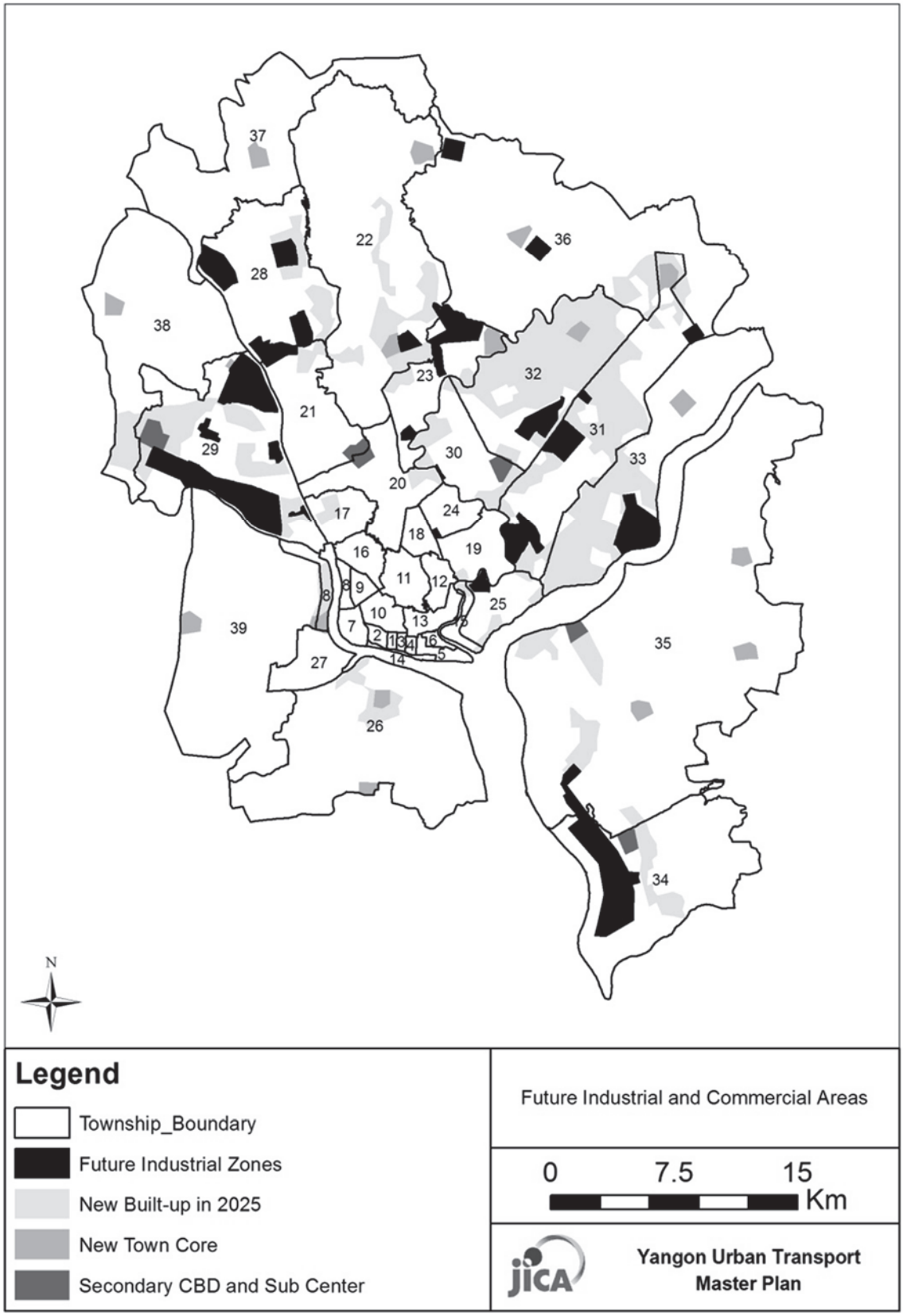
| No. | Township Name | Primary Industry | | | | Secondary Industry | | | | Tertiary Industry | | | | Total Workers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2013 | 2018 | 2025 | 2035 | 2013 | 2018 | 2025 | 2035 | 2013 | 2018 | 2025 | 2035 | 2013 | 2018 | 2025 | 2035 |
| 1 | Latha | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 17 | 19 | 21 | 18 | 17 | 19 | 21 |
| 2 | Lanmadaw | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 41 | 41 | 44 | 49 | 41 | 41 | 44 | 49 |
| 3 | Panbetan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 18 | 19 | 21 | 18 | 18 | 19 | 21 |
| 4 | Kyauktada | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 20 | 21 | 24 | 20 | 20 | 21 | 24 |
| 5 | Botataung | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49 | 48 | 51 | 58 | 49 | 48 | 51 | 58 |
| 6 | Pazundaung | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34 | 34 | 36 | 41 | 34 | 34 | 36 | 41 |
| 7 | Alone | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47 | 46 | 50 | 56 | 47 | 47 | 50 | 56 |
| 8 | Kyeemyin daing | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 20 | 20 | 21 | 23 | 21 | 21 | 22 | 24 |
| 9 | San Chaung | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 19 | 20 | 23 | 19 | 19 | 20 | 23 |
| 10 | Dagon | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 24 | 29 | 36 | 26 | 24 | 29 | 36 |
| 11 | Bahan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 75 | 69 | 74 | 84 | 75 | 69 | 74 | 84 |
| 12 | Tarmwe | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 27 | 33 | 46 | 25 | 27 | 34 | 46 |
| 13 | Mingalar Taung Nyunt | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 92 | 91 | 99 | 113 | 92 | 91 | 99 | 113 |
| 14 | Seikkan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 6 | 8 | 13 | 5 | 6 | 8 | 13 |
| 15 | Dawpon | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 3 | 31 | 30 | 32 | 37 | 32 | 32 | 34 | 39 |
| 16 | Kamayut | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 66 | 69 | 75 | 84 | 68 | 72 | 76 | 84 |
| 17 | Hlaing | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 0 | 86 | 85 | 92 | 104 | 90 | 89 | 94 | 104 |
| 18 | Yankin | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 65 | 64 | 69 | 77 | 66 | 65 | 70 | 78 |
| 19 | Thingankyun | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 62 | 64 | 73 | 92 | 65 | 67 | 75 | 93 |
| 20 | Mayangone | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 174 | 176 | 200 | 246 | 175 | 177 | 200 | 247 |
| 21 | Insein | 0 | 0 | 0 | 0 | 18 | 20 | 20 | 34 | 192 | 193 | 185 | 217 | 210 | 213 | 206 | 251 |
| 22 | Mingalardon | 0 | 0 | 0 | 0 | 11 | 11 | 10 | 19 | 201 | 253 | 373 | 614 | 213 | 264 | 384 | 633 |
| 23 | North Okkalapa | 0 | 0 | 0 | 0 | 19 | 19 | 22 | 33 | 77 | 78 | 85 | 99 | 96 | 96 | 107 | 132 |
| 24 | South Okkalapa | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 33 | 33 | 37 | 42 | 35 | 35 | 38 | 43 |
| 25 | Tharkayta | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 6 | 70 | 69 | 75 | 85 | 74 | 73 | 79 | 91 |
| 26 | Dala | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45 | 45 | 49 | 120 | 46 | 45 | 49 | 120 |
| 27 | Seikgyikanaungto | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 7 | 7 | 8 | 7 | 7 | 7 | 8 |
| 28 | Shwepyitar | 7 | 7 | 6 | 6 | 29 | 46 | 50 | 69 | 109 | 108 | 116 | 130 | 145 | 160 | 172 | 205 |
| 29 | Hlaingtaryar | 12 | 12 | 11 | 10 | 59 | 70 | 91 | 136 | 96 | 112 | 247 | 277 | 168 | 195 | 349 | 423 |
| 30 | North Dagon | 5 | 5 | 5 | 4 | 2 | 1 | 1 | 0 | 58 | 109 | 160 | 224 | 64 | 115 | 166 | 229 |
| 31 | South Dagon | 9 | 9 | 8 | 7 | 25 | 26 | 34 | 48 | 109 | 109 | 118 | 134 | 143 | 144 | 160 | 190 |
| 32 | East Dagon | 3 | 3 | 3 | 3 | 17 | 19 | 19 | 19 | 86 | 130 | 139 | 221 | 107 | 152 | 161 | 243 |
| 33 | Dagon Seikkan | 3 | 3 | 3 | 3 | 25 | 27 | 29 | 47 | 16 | 84 | 144 | 182 | 45 | 115 | 176 | 231 |
| 34 | Kyauktan | 2 | 2 | 3 | 4 | 5 | 9 | 29 | 51 | 33 | 42 | 45 | 63 | 40 | 53 | 77 | 118 |
| 35 | Thanlyin | 4 | 5 | 7 | 10 | 8 | 17 | 53 | 88 | 97 | 206 | 329 | 549 | 109 | 229 | 389 | 646 |
| 36 | Hlegu | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 12 | 12 | 13 | 79 | 12 | 12 | 13 | 102 |
| 37 | Hmawbi | 2 | 2 | 3 | 4 | 10 | 10 | 8 | 19 | 26 | 29 | 31 | 100 | 38 | 41 | 42 | 122 |
| 38 | Htantabin | 1 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 17 | 17 | 18 | 85 | 18 | 18 | 20 | 88 |
| 39 | Twantay | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 70 | 6 | 6 | 6 | 72 |
| **1-6** | **CBD** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **180** | **178** | **190** | **214** | **180** | **178** | **190** | **214** |
| **7-15** | **Inner Urban Ring** | **1** | **1** | **1** | **0** | **3** | **3** | **3** | **3** | **340** | **333** | **368** | **431** | **344** | **337** | **371** | **434** |
| **16-19** | **Outer Ring** | **6** | **5** | **3** | **2** | **5** | **5** | **4** | **0** | **279** | **283** | **308** | **357** | **290** | **292** | **316** | **359** |
| **20-22** | **Northern Suburbs** | **1** | **1** | **1** | **1** | **29** | **30** | **30** | **53** | **567** | **622** | **759** | **1,077** | **598** | **654** | **790** | **1,131** |
| **23-25** | **Older Suburbs** | **1** | **0** | **0** | **0** | **24** | **24** | **27** | **39** | **181** | **180** | **196** | **226** | **205** | **205** | **224** | **265** |
| **26-27** | **South of CBD** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **52** | **52** | **56** | **128** | **52** | **52** | **56** | **129** |
| **28-33** | **New Suburbs** | **40** | **39** | **37** | **33** | **158** | **190** | **224** | **320** | **475** | **652** | **923** | **1,169** | **672** | **881** | **1,183** | **1,522** |
| **34-39** | **Periphery Area** | **10** | **12** | **16** | **22** | **24** | **36** | **90** | **180** | **189** | **311** | **442** | **946** | **223** | **359** | **548** | **1,147** |
| **1-33** | **Yangon City Total** | **48** | **46** | **42** | **37** | **220** | **252** | **288** | **415** | **2,074** | **2,299** | **2,800** | **3,602** | **2,341** | **2,598** | **3,130** | **4,053** |
| **1-39** | **Study Area Total** | **58** | **58** | **58** | **58** | **244** | **289** | **378** | **595** | **2,263** | **2,610** | **3,242** | **4,547** | **2,565** | **2,956** | **3,678** | **5,200** |

Source: YUTRA Project Team




Note: 6 Townships in CBD are summarized as one area
Source: YUTRA Project Team

**Figure 3.2.2.2 Projected Number of Workers by Township and Sector (Day-time)**




Source: SUDP, JICA, 2013

**Figure 3.2.2.3 Future Industrial Zones, Planned by SUDP**

### 3.2.3 Number of Students

#### 1) Ratio of Students vs. Population

Ratio of students vs. population for each township is shown in Table 3.2.3.1. This was obtained by the YUTRA Person Trip Survey. In the group of 5 – 19 ages, students share more than 80 %. The share of students in the total population is 19.9% at present.

**Table 3.2.3.1 Ratio of Students vs. Population in YUTRA Study Area, 2013**

| No. | Township Name | Ratio of Students vs. Population | |
|---|---|---|---|
| | | Vs. 5-19 Age Group | Vs. Total Population |
| 1 | Latha | 80.6% | 17.0% |
| 2 | Lanmadaw | 44.8% | 7.8% |
| 3 | Panbetan | 51.7% | 6.7% |
| 4 | Kyauktada | 88.7% | 15.6% |
| 5 | Botataung | 82.3% | 15.8% |
| 6 | Pazundaung | 86.2% | 19.2% |
| 7 | Alone | 86.9% | 17.3% |
| 8 | Kyeemyin daing | 75.6% | 18.9% |
| 9 | San Chaung | 87.4% | 16.7% |
| 10 | Dagon | 86.7% | 20.4% |
| 11 | Bahan | 90.0% | 16.1% |
| 12 | Tarmwe | 89.4% | 15.9% |
| 13 | Mingalar Taung Nyunt | 82.7% | 17.3% |
| 14 | Seikkan | 93.1% | 36.4% |
| 15 | Dawpon | 77.2% | 18.5% |
| 16 | Kamayut | 86.3% | 15.2% |
| 17 | Hlaing | 86.5% | 17.9% |
| 18 | Yankin | 85.7% | 17.0% |
| 19 | Thingankyun | 82.8% | 19.6% |
| 20 | Mayangone | 85.8% | 21.7% |
| 21 | Insein | 89.0% | 22.5% |
| 22 | Mingalardon | 80.2% | 18.3% |
| 23 | North Okkalapa | 85.0% | 20.3% |
| 24 | South Okkalapa | 88.7% | 17.8% |
| 25 | Tharkayta | 87.7% | 18.5% |
| 26 | Dala | 73.8% | 23.9% |
| 27 | Seikgyikanaungto | 86.0% | 26.5% |
| 28 | Shwepyitar | 83.2% | 24.2% |
| 29 | Hlaingtaryar | 80.8% | 21.7% |
| 30 | North Dagon | 86.3% | 20.1% |
| 31 | South Dagon | 84.7% | 21.9% |
| 32 | East Dagon | 93.2% | 22.6% |
| 33 | Dagon Seikkan | 75.2% | 20.5% |
| 34 | Kyauktan | 71.5% | 20.7% |
| 35 | Thanlyin | 77.7% | 20.8% |
| 36 | Hlegu | 72.2% | 16.3% |
| 37 | Hmawbi | 83.9% | 16.6% |
| 38 | Htantabin | 71.0% | 21.9% |
| 39 | Twantay | 73.6% | 25.8% |
| **1-6** | **CBD** | **74.6%** | **13.9%** |
| **7-15** | **Inner Urban Ring** | **83.7%** | **17.3%** |
| **16-19** | **Outer Ring** | **84.8%** | **17.9%** |
| **20-22** | **Northern Suburbs** | **85.0%** | **20.7%** |
| **23-25** | **Older Suburbs** | **86.6%** | **19.1%** |
| **26-27** | **South of CBD** | **76.5%** | **24.5%** |
| **28-33** | **New Suburbs** | **83.4%** | **22.0%** |
| **34-39** | **Periphery Area** | **76.1%** | **20.4%** |
| **1-33** | **Yangon City Total** | **83.7%** | **19.8%** |
| **1-39** | **Study Area Total** | **82.9%** | **19.9%** |

Source: YUTRA Person Trip Survey, 2013

### 2) Projection of Number of Students

#### Number of Students at Residence (night-time)

The number of students was estimated using the projected night-time population and the ratio of students vs. population. In YUTRA, the ratio of students vs. population was assumed to gradually decline in the future (up to 10% of students' share in 2035) according to the decrease of birth rate.

Table 3.2.3.2 summarizes the estimated number of students at residence (night-time) by township. Projected number of students shows a declining tendency in many townships. However, because of the high growth in the newly urbanized areas particularly in the "Periphery Area", the total number of students will increase.

**Table 3.2.3.2 Projected Number of Students at Residence (Night-time, '000)**

| Township | | Projected Number of Students for Target Years | | | | Annual Growth Rate (2013-2035) | Ratio of Population in 2035 to 2011 |
|---|---|---|---|---|---|---|---|
| | | 2013 | 2018 | 2025 | 2035 | | |
| 1 | Latha | 5,873 | 5,873 | 5,873 | 5,873 | 0.0% | 1.00 |
| 2 | Lanmadaw | 3,417 | 3,417 | 3,417 | 3,417 | 0.0% | 1.00 |
| 3 | Pabedan | 2,471 | 2,471 | 2,471 | 2,471 | 0.0% | 1.00 |
| 4 | Kyauktada | 5,446 | 5,446 | 5,446 | 5,446 | 0.0% | 1.00 |
| 5 | Botahtaung | 7,704 | 7,704 | 7,704 | 7,704 | 0.0% | 1.00 |
| 6 | Pazundaung | 10,287 | 10,362 | 10,484 | 10,702 | 0.2% | 1.04 |
| 7 | Ahlone | 11,425 | 11,494 | 11,605 | 11,803 | 0.1% | 1.03 |
| 8 | Kyee Myin Daing | 21,961 | 22,766 | 24,082 | 26,423 | 0.8% | 1.20 |
| 9 | Sanchaung | 17,519 | 17,584 | 17,690 | 17,879 | 0.1% | 1.02 |
| 10 | Dagon | 5,190 | 5,824 | 6,860 | 8,703 | 2.4% | 1.68 |
| 11 | Bahan | 16,192 | 16,380 | 16,687 | 17,233 | 0.3% | 1.06 |
| 12 | Tarmwe | 30,449 | 30,573 | 30,776 | 31,138 | 0.1% | 1.02 |
| 13 | Mingalar Taung Nyunt | 26,934 | 27,137 | 27,468 | 28,056 | 0.2% | 1.04 |
| 14 | Seikkan | 781 | 781 | 781 | 781 | 0.0% | 1.00 |
| 15 | Dawbon | 16,071 | 16,143 | 16,260 | 16,470 | 0.1% | 1.02 |
| 16 | Kamaryut | 13,464 | 13,761 | 14,247 | 15,111 | 0.5% | 1.12 |
| 17 | Hlaing | 27,098 | 27,378 | 27,835 | 28,649 | 0.3% | 1.06 |
| 18 | Yankin | 21,332 | 21,332 | 21,332 | 21,332 | 0.0% | 1.00 |
| 19 | Thingangyun | 46,736 | 47,051 | 47,566 | 48,482 | 0.2% | 1.04 |
| 20 | Mayangone | 44,729 | 46,492 | 49,374 | 54,501 | 0.9% | 1.22 |
| 21 | Insein | 69,487 | 71,390 | 74,499 | 80,032 | 0.6% | 1.15 |
| 22 | Mingalardon | 60,680 | 76,045 | 101,153 | 145,830 | 4.1% | 2.40 |
| 23 | North Okkalapa | 65,104 | 67,366 | 71,064 | 77,642 | 0.8% | 1.19 |
| 24 | South Okkalapa | 36,210 | 36,358 | 36,599 | 37,029 | 0.1% | 1.02 |
| 25 | Thaketa | 60,538 | 61,375 | 62,743 | 65,178 | 0.3% | 1.08 |
| 26 | Some parts of Dala | 33,329 | 40,188 | 51,397 | 71,342 | 3.5% | 2.14 |
| 27 | Seikgyikhanaungto | 8,595 | 9,601 | 11,244 | 14,167 | 2.3% | 1.65 |
| 28 | Shwe Pyi Thar | 73,369 | 80,208 | 91,383 | 111,268 | 1.9% | 1.52 |
| 29 | Hlaing Tharyar | 111,219 | 118,434 | 130,223 | 151,201 | 1.4% | 1.36 |
| 30 | North Dagon | 52,350 | 54,359 | 57,641 | 63,481 | 0.9% | 1.21 |
| 31 | South Dagon | 113,183 | 120,193 | 131,650 | 152,037 | 1.4% | 1.34 |
| 32 | East Dagon | 26,229 | 44,441 | 74,202 | 127,157 | 7.4% | 4.85 |
| 33 | Dagon Seikkan | 26,152 | 33,282 | 44,934 | 65,667 | 4.3% | 2.51 |
| 34 | Some parts of Kyauktan | 13,532 | 16,997 | 22,659 | 32,735 | 4.1% | 2.42 |
| 35 | Some parts of Thanlyin | 36,947 | 58,949 | 94,906 | 158,886 | 6.9% | 4.30 |
| 36 | Some parts of Hlegu | 5,475 | 10,147 | 17,783 | 31,369 | 8.3% | 5.73 |
| 37 | Some parts of Hmawbi | 14,525 | 22,887 | 36,551 | 60,866 | 6.7% | 4.19 |
| 38 | Some parts of Htantabin | 11,720 | 21,253 | 36,830 | 64,547 | 8.1% | 5.51 |
| 39 | Some parts of Twantay | 9,861 | 19,820 | 36,093 | 65,050 | 9.0% | 6.60 |
| **1-6** | **CBD** | **35,198** | **35,273** | **35,396** | **35,613** | **0.1%** | **1.01** |
| **7-15** | **Inner Urban Ring** | **146,522** | **148,681** | **152,208** | **158,485** | **0.4%** | **1.08** |
| **16-19** | **Outer Ring** | **108,631** | **109,523** | **110,980** | **113,574** | **0.2%** | **1.05** |
| **20-22** | **Northern Suburbs** | **174,896** | **193,926** | **225,026** | **280,363** | **2.2%** | **1.60** |
| **23-25** | **Older Suburbs** | **161,852** | **165,099** | **170,406** | **179,849** | **0.5%** | **1.11** |
| **26-27** | **South of CBD** | **41,924** | **49,789** | **62,641** | **85,509** | **3.3%** | **2.04** |
| **28-33** | **New Suburbs** | **402,502** | **450,917** | **530,034** | **670,811** | **2.3%** | **1.67** |
| **34-39** | **Periphery Area** | **92,060** | **150,053** | **244,823** | **413,453** | **7.1%** | **4.49** |
| **1-33** | **Yangon City Total** | **1,071,525** | **1,153,207** | **1,286,691** | **1,524,205** | **1.6%** | **1.42** |
| **1-39** | **Study Area Total** | **1,163,585** | **1,303,260** | **1,531,514** | **1,937,658** | **2.3%** | **1.67** |

Source: YUTRA Project Team

**Number of Students at School Place (day-time)**

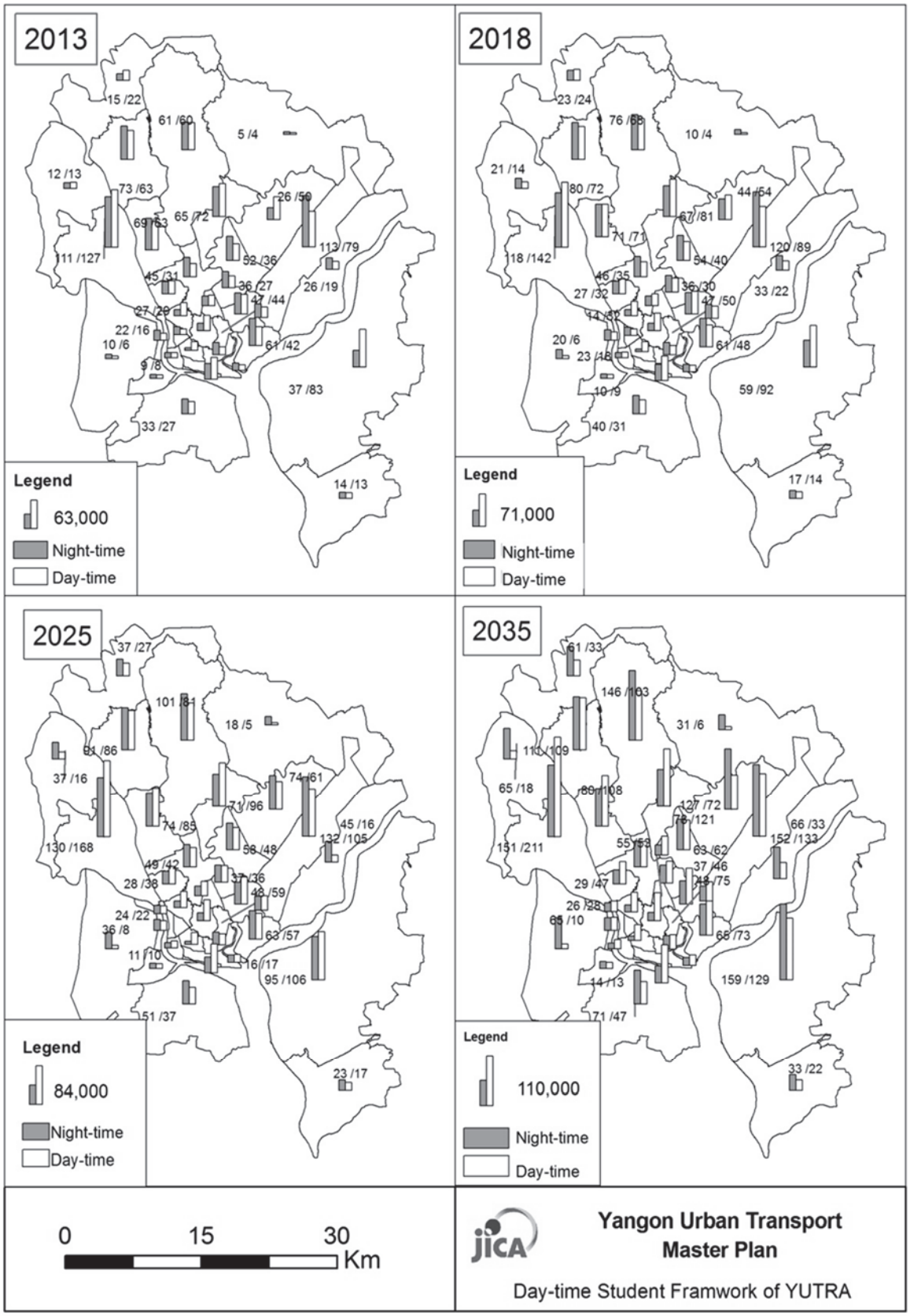
The projected number of students for day-time is also based on the estimate of SUDP Study Team. For zonal breakdown, land area for school s and the number of university students (obtained from Ministry of Education) were taken into account.

Table 3.2.3.3 shows the distribution of students (day-time) by township. As compared with night-time, all townships have positive growth rate. The projected number of students by township, for night-time and day-time is shown in Figure 3.2.3.1.

**Table 3.2.3.3 The Projected Number of Students (Day-time, '000)**

| Township | | Projected Number of Students for Target Years | | | | Annual Growth Rate (2011-2035) | Ratio of Population in 2035 to 2011 |
|---|---|---|---|---|---|---|---|
| | | 2013 | 2018 | 2025 | 2035 | | |
| 1 | Latha | 7,857 | 8,879 | 10,620 | 13,516 | 2.5% | 1.72 |
| 2 | Lanmadaw | 10,246 | 10,861 | 11,954 | 13,684 | 1.3% | 1.34 |
| 3 | Pabedan | 3,074 | 3,479 | 4,169 | 5,316 | 2.5% | 1.73 |
| 4 | Kyauktada | 2,816 | 3,187 | 3,819 | 4,870 | 2.5% | 1.73 |
| 5 | Botahtaung | 18,926 | 21,319 | 25,402 | 32,183 | 2.4% | 1.70 |
| 6 | Pazundaung | 5,803 | 6,567 | 7,869 | 10,036 | 2.5% | 1.73 |
| 7 | Ahlone | 10,898 | 12,334 | 14,779 | 18,849 | 2.5% | 1.73 |
| 8 | Kyee Myin Daing | 15,909 | 18,005 | 21,574 | 27,515 | 2.5% | 1.73 |
| 9 | Sanchaung | 12,500 | 14,146 | 16,951 | 21,618 | 2.5% | 1.73 |
| 10 | Dagon | 19,189 | 21,717 | 26,023 | 33,188 | 2.5% | 1.73 |
| 11 | Bahan | 33,724 | 38,167 | 45,734 | 58,327 | 2.5% | 1.73 |
| 12 | Tarmwe | 23,302 | 26,372 | 31,601 | 40,302 | 2.5% | 1.73 |
| 13 | Mingalar Taung Nyunt | 17,663 | 19,990 | 23,953 | 30,549 | 2.5% | 1.73 |
| 14 | Seikkan | 0 | 0 | 0 | 0 | - | - |
| 15 | Dawbon | 12,639 | 14,304 | 17,140 | 21,860 | 2.5% | 1.73 |
| 16 | Kamaryut | 29,431 | 31,561 | 35,298 | 41,306 | 1.6% | 1.40 |
| 17 | Hlaing | 28,766 | 32,018 | 37,591 | 46,799 | 2.2% | 1.63 |
| 18 | Yankin | 23,070 | 26,110 | 31,286 | 39,901 | 2.5% | 1.73 |
| 19 | Thingangyun | 43,865 | 49,523 | 59,168 | 75,203 | 2.5% | 1.71 |
| 20 | Mayangone | 30,922 | 34,954 | 41,824 | 53,251 | 2.5% | 1.72 |
| 21 | Insein | 62,889 | 70,994 | 84,809 | 107,777 | 2.5% | 1.71 |
| 22 | Mingalardon | 59,718 | 67,586 | 80,986 | 103,285 | 2.5% | 1.73 |
| 23 | North Okkalapa | 72,055 | 80,935 | 96,096 | 121,253 | 2.4% | 1.68 |
| 24 | South Okkalapa | 26,640 | 30,150 | 36,128 | 46,075 | 2.5% | 1.73 |
| 25 | Thaketa | 42,044 | 47,583 | 57,018 | 72,717 | 2.5% | 1.73 |
| 26 | Some parts of Dala | 27,124 | 30,697 | 36,784 | 46,912 | 2.5% | 1.73 |
| 27 | Seikgyikhanaungto | 7,551 | 8,545 | 10,240 | 13,059 | 2.5% | 1.73 |
| 28 | Shwe Pyi Thar | 63,378 | 71,636 | 85,707 | 109,112 | 2.5% | 1.72 |
| 29 | Hlaing Tharyar | 126,671 | 141,812 | 167,697 | 210,586 | 2.3% | 1.66 |
| 30 | North Dagon | 35,749 | 40,459 | 48,481 | 61,830 | 2.5% | 1.73 |
| 31 | South Dagon | 78,825 | 88,588 | 105,253 | 132,911 | 2.4% | 1.69 |
| 32 | East Dagon | 49,933 | 53,952 | 60,955 | 72,303 | 1.7% | 1.45 |
| 33 | Dagon Seikkan | 19,327 | 21,873 | 15,721 | 33,426 | 2.5% | 1.73 |
| 34 | Some parts of Kyauktan | 12,767 | 14,450 | 17,314 | 22,082 | 2.5% | 1.73 |
| 35 | Some parts of Thanlyin | 83,442 | 91,689 | 105,907 | 129,238 | 2.0% | 1.55 |
| 36 | Some parts of Hlegu | 3,595 | 4,069 | 4,876 | 6,218 | 2.5% | 1.73 |
| 37 | Some parts of Hmawbi | 22,285 | 24,183 | 27,479 | 32,840 | 1.8% | 1.47 |
| 38 | Some parts of Htantabin | 13,249 | 14,070 | 15,524 | 17,833 | 1.4% | 1.35 |
| 39 | Some parts of Twantay | 5,740 | 6,496 | 7,784 | 9,928 | 2.5% | 1.73 |
| **1-6** | **CBD** | **48,722** | **54,292** | **63,833** | **79,607** | **2.3%** | **1.63** |
| **7-15** | **Inner Urban Ring** | **145,824** | **165,035** | **197,757** | **252,208** | **2.5%** | **1.73** |
| **16-19** | **Outer Ring** | **125,132** | **139,212** | **163,342** | **203,208** | **2.2%** | **1.62** |
| **20-22** | **Northern Suburbs** | **153,529** | **173,534** | **207,619** | **264,313** | **2.5%** | **1.72** |
| **23-25** | **Older Suburbs** | **140,740** | **158,668** | **189,242** | **240,046** | **2.5%** | **1.71** |
| **26-27** | **South of CBD** | **34,674** | **39,243** | **47,023** | **59,971** | **2.5%** | **1.73** |
| **28-33** | **New Suburbs** | **373,884** | **418,320** | **483,814** | **620,168** | **2.3%** | **1.66** |
| **34-39** | **Periphery Area** | **141,079** | **154,956** | **178,885** | **218,138** | **2.0%** | **1.55** |
| **1-33** | **Yangon City Total** | **1,022,505** | **1,148,304** | **1,352,629** | **1,719,520** | **2.4%** | **1.68** |
| **1-39** | **Study Area Total** | **1,163,585** | **1,303,260** | **1,531,514** | **1,937,658** | **2.3%** | **1.67** |

Source: YUTRA Project Team, JICA (2013)




Note: 6 Townships in CBD are summarized as one area
Source: YUTRA Project Team, JICA (2013)

**Figure 3.2.3.1 Projected Number of Students by Township (Night-time / Day-time)**

### 3.2.4 Household Income and Car Ownership

#### 1) Forecast Methodology

Table 3.2.4.1 presents the current household income and car ownership by township in the study area. Higher-income townships have high car ownership. The highest car ownership is found in Lanmadaw and Kyauktada at about 39%. The average percentage of car-owning household is about 12% in the study area at present.

**Table 3.2.4.1 Household Car Ownership Ratio and Average Income, 2013**

| Township | | Total No. of Households | % Car-owning Households | Average Household Income (Kyat 000 /month) |
|---|---|---|---|---|
| 1 | Latha | 8,037 | 30.0 | 293 |
| 2 | Lanmadaw | 9,180 | 39.0 | 313 |
| 3 | Panbetan | 8,169 | 19.7 | 269 |
| 4 | Kyauktada | 8,054 | 39.0 | 339 |
| 5 | Botataung | 10,235 | 13.6 | 252 |
| 6 | Pazundaung | 11,369 | 27.1 | 294 |
| 7 | Alone | 13,966 | 28.0 | 289 |
| 8 | Kyeemyin daing | 24,595 | 10.1 | 251 |
| 9 | San Chaung | 23,793 | 25.3 | 346 |
| 10 | Dagon | 5,315 | 32.3 | 319 |
| 11 | Bahan | 23,173 | 24.2 | 324 |
| 12 | Tarmwe | 40,195 | 23.6 | 296 |
| 13 | Mingalar Taung Nyunt | 32,018 | 25.6 | 291 |
| 14 | Seikkan | 271 | 0.0 | 214 |
| 15 | Dawpon | 20,879 | 8.2 | 234 |
| 16 | Kamayut | 19,588 | 21.7 | 312 |
| 17 | Hlaing | 34,360 | 16.1 | 284 |
| 18 | Yankin | 27,752 | 14.8 | 298 |
| 19 | Thingankyun | 50,647 | 19.0 | 254 |
| 20 | Mayangone | 45,507 | 8.3 | 248 |
| 21 | Insein | 69,888 | 11.1 | 239 |
| 22 | Mingalardon | 69,737 | 8.2 | 219 |
| 23 | North Okkalapa | 72,229 | 9.0 | 230 |
| 24 | South Okkalapa | 42,369 | 15.2 | 248 |
| 25 | Tharkayta | 55,694 | 10.3 | 233 |
| 26 | Dala | 25,747 | 3.2 | 175 |
| 27 | Seikgyikanaungto | 8,696 | 5.2 | 137 |
| 28 | Shwepyitar | 69,777 | 1.7 | 191 |
| 29 | Hlaingtaryar | 106,098 | 4.4 | 207 |
| 30 | North Dagon | 48,439 | 13.4 | 256 |
| 31 | South Dagon | 82,660 | 8.8 | 224 |
| 32 | East Dagon | 37,285 | 4.2 | 216 |
| 33 | Dagon Seikkan | 30,715 | 4.4 | 234 |
| 34 | Kyauktan | 10,927 | 17.0 | 176 |
| 35 | Thanlyin | 49,333 | 4.5 | 205 |
| 36 | Hlegu | 5,863 | 4.9 | 161 |
| 37 | Hmawbi | 17,619 | 3.3 | 207 |
| 38 | Htantabin | 9,326 | 2.0 | 202 |
| 39 | Twantay | 6,440 | 1.8 | 227 |
| **1-6** | **CBD** | 55,044 | 27.6 | 292 |
| **7-15** | **Inner Urban Ring** | 184,205 | 21.3 | 292 |
| **16-19** | **Outer Ring** | 132,347 | 17.8 | 280 |
| **20-22** | **Northern Suburbs** | 185,132 | 9.3 | 234 |
| **23-25** | **Older Suburbs** | 170,292 | 11.0 | 235 |
| **26-27** | **South of CBD** | 34,443 | 3.7 | 165 |
| **28-33** | **New Suburbs** | 374,974 | 6.0 | 217 |
| **34-39** | **Periphery Area** | 99,508 | 5.2 | 201 |
| **1-33** | **Yangon City Total** | 1,136,437 | 12.1 | 244 |
| **1-39** | **Study Area Total** | 1,235,945 | 11.6 | 241 |

Source: YUTRA Person-trip Survey, 2013

The forecast methodology is two-step; (1) forecast of total household income by zone, and (2) forecast of household car ownership ratio by zone.

**Forecast of Total Household Income by Zone**

Car ownership has a strong correlation with household income. Therefore the first step to forecast car ownership is to estimate future household income. Based on the result of YUTRA Person-trip Survey, the following regression equation was developed:

HI = 0.07013 * (No. of tertiary employment) + 0.2325 * (No. of primary and secondary employment) + 346.8

Where, HI: total household income by zone

($R^2$=0.85, T-statistics: 18.3 for primary employment, 8.6 for primary and secondary employment and 4.8 for Constant)

It is well known that income increases or decreases in proportion to GDP. For the future target yeas, 2018, 2025 and 2035, the total household income of the entire study area was first estimated as the control total. This was calculated using the future population as explained earlier and the growth rate of per Capita GRDP as estimated by the MYT-Plan for the Yangon Region (7.1, 6.2 and 6.2 % per annum for 2013-2018, 2019-2025 and 2026-2035).

Then these control totals were broken down into each zone having the value calculated by the equation above as its weight.

**Forecast of Car Ownership Ratio by Zone**

Next step is to analyze the interrelationship between household car ownership and household income. As analyzed by regression analysis, household car ownership ratio and household income by zone have shown a very good correlation as anticipated. However, this analysis tends to lead very high forecast because all the zones have the same weight in this analysis regardless of the size of zones. Hence, the following equation was selected to forecast the future car ownership:

NCOH = 0.0978 * ln (NH) + 0.1343 * ln (HI)

Where, NCOH: No. of car owning households by zone

NH: Total no. of households by zone

HI: Total household Income by zone

($R^2$=0.60, T-statistics: 5.71 for NH and 6.51 for HI)

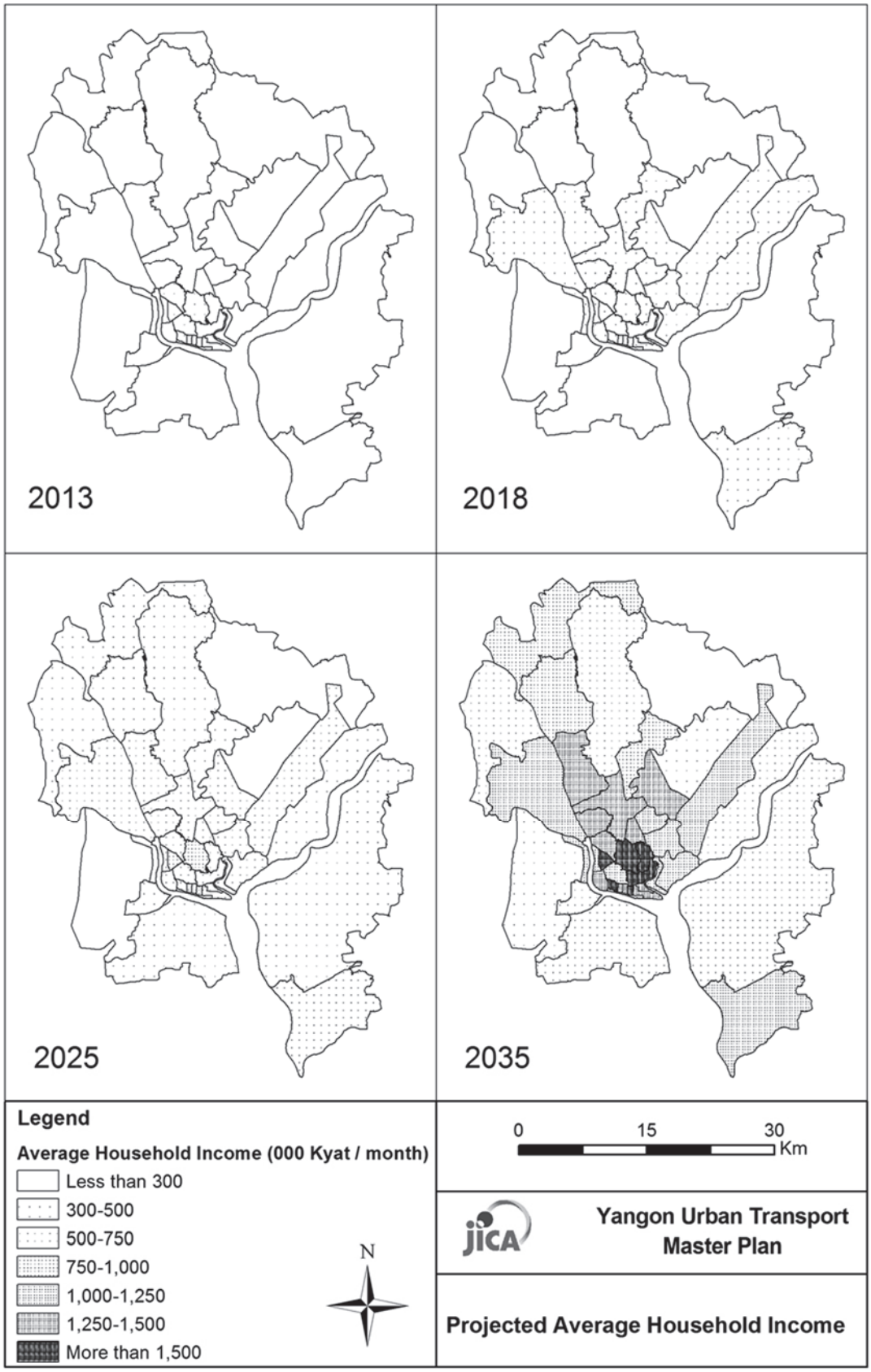
### 2) Projection of Household Income and Car Ownership

The projected result is presented in Table 3.2.4.2, Figure 3.2.4.1 and Figure 3.2.4.2. Household car ownership ratio will increase to 32.3% in 2035 from 11.6% in 2013.

**Table 3.2.4.2 Projected Household Car Ownership Ratio and Average Income**

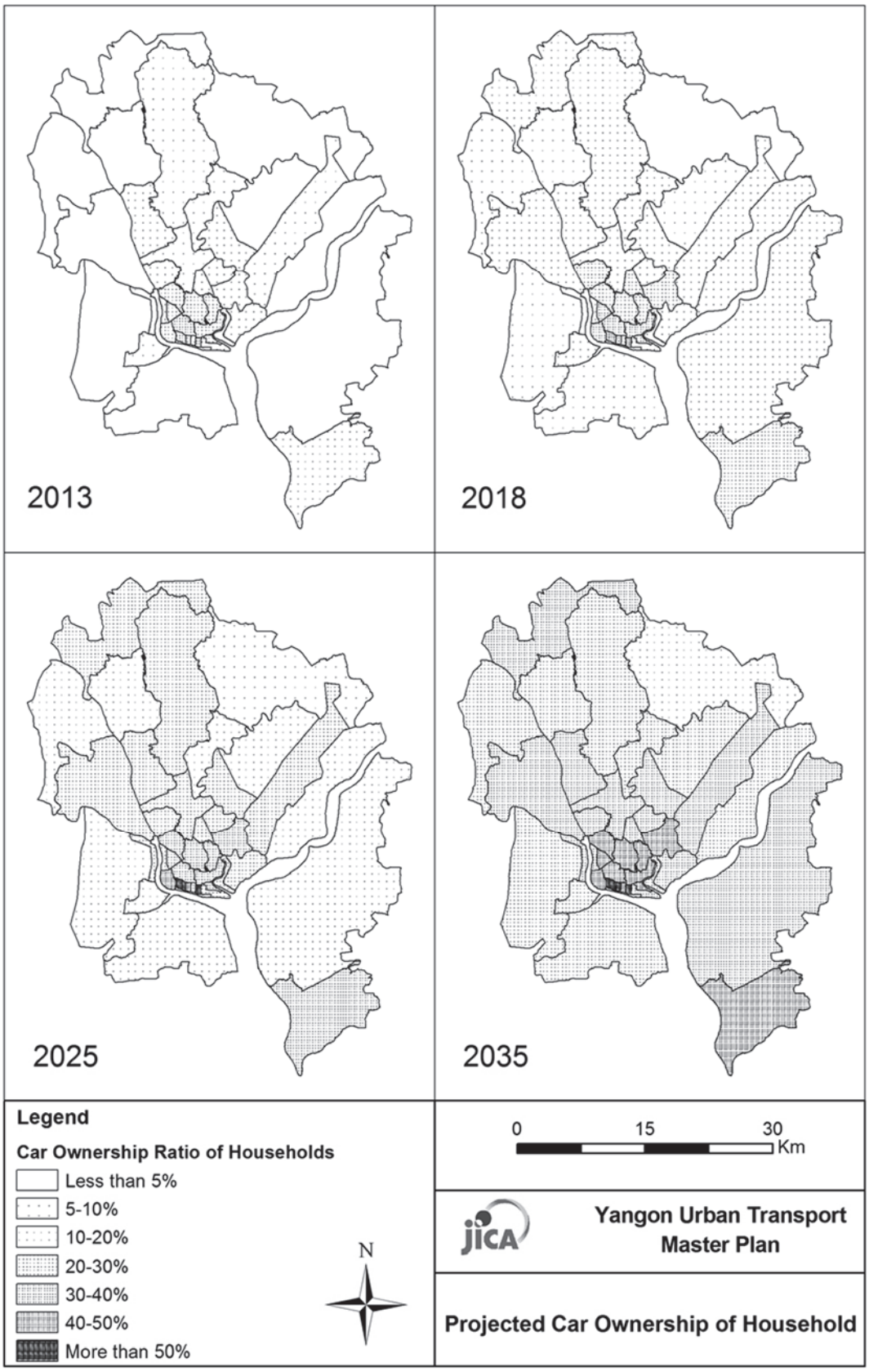
| TOWNSHIP | | 2018 | | | 2025 | | | 2035 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total No of Households | % Car owning Households | Average Household income ('000 kyat / month) | Total No of Households | % Car owning Households | Average Household income ('000 kyat / month) | Total No of Households | % Car owning Households | Average Household income ('000 kyat / month) |
| 1 | LATHA | 8,059 | 35.1 | 429 | 8,096 | 41.7 | 700 | 8,160 | 51.2 | 1,426 |
| 2 | LANMADAW | 9,205 | 44.0 | 458 | 9,246 | 50.5 | 748 | 9,318 | 59.9 | 1,525 |
| 3 | PANBETAN | 8,191 | 24.8 | 394 | 8,225 | 31.4 | 646 | 8,286 | 41.0 | 1,320 |
| 4 | KYAUKTADA | 8,075 | 43.9 | 494 | 8,108 | 50.4 | 801 | 8,167 | 59.7 | 1,625 |
| 5 | BOTATAUNG | 10,265 | 18.9 | 372 | 10,313 | 25.6 | 613 | 10,397 | 35.3 | 1,261 |
| 6 | PAZUNDAUNG | 11,477 | 32.0 | 426 | 11,654 | 38.3 | 686 | 11,969 | 47.3 | 1,368 |
| 7 | ALONE | 14,085 | 33.3 | 435 | 14,286 | 40.1 | 726 | 14,653 | 49.5 | 1,484 |
| 8 | KYEEMYIN DAING | 25,562 | 15.9 | 376 | 27,164 | 23.1 | 619 | 30,059 | 32.9 | 1,214 |
| 9 | SAN CHAUNG | 23,941 | 30.6 | 514 | 24,197 | 37.4 | 851 | 24,663 | 46.9 | 1,732 |
| 10 | DAGON | 5,980 | 35.3 | 452 | 7,078 | 38.8 | 689 | 9,060 | 44.1 | 1,219 |
| 11 | BAHAN | 23,504 | 29.4 | 481 | 24,058 | 36.0 | 791 | 25,063 | 45.3 | 1,585 |
| 12 | TARMWE | 40,457 | 29.1 | 446 | 40,910 | 36.1 | 749 | 41,741 | 45.7 | 1,537 |
| 13 | MINGALAR TAUNG NYUNT | 32,336 | 31.1 | 439 | 32,877 | 38.0 | 735 | 33,863 | 47.5 | 1,501 |
| 14 | SEIKKAN | 272 | 3.3 | 333 | 273 | 10.6 | 575 | 274 | 20.8 | 1,217 |
| 15 | DAWPON | 21,024 | 13.8 | 353 | 21,273 | 20.9 | 594 | 21,727 | 30.7 | 1,221 |
| 16 | KAMAYUT | 20,036 | 26.5 | 448 | 20,790 | 32.7 | 711 | 22,171 | 41.5 | 1,379 |
| 17 | HLAING | 34,740 | 21.2 | 413 | 35,393 | 27.7 | 667 | 36,622 | 37.2 | 1,331 |
| 18 | YANKIN | 27,772 | 20.0 | 437 | 27,832 | 26.7 | 717 | 27,991 | 36.4 | 1,470 |
| 19 | THINGANKYUN | 51,025 | 24.1 | 371 | 51,692 | 30.7 | 606 | 52,975 | 40.2 | 1,227 |
| 20 | MAYANGONE | 47,425 | 14.6 | 380 | 50,594 | 22.4 | 643 | 56,344 | 33.1 | 1,316 |
| 21 | INSEIN | 71,977 | 17.2 | 370 | 75,444 | 24.8 | 632 | 81,767 | 35.4 | 1,322 |
| 22 | MINGALARDON | 87,571 | 13.8 | 283 | 116,785 | 20.5 | 390 | 168,983 | 29.4 | 626 |
| 23 | NORTH OKKALAPA | 75,003 | 13.7 | 316 | 79,482 | 19.8 | 474 | 87,350 | 28.8 | 862 |
| 24 | SOUTH OKKALAPA | 42,699 | 19.9 | 350 | 43,207 | 26.0 | 551 | 44,048 | 35.1 | 1,078 |
| 25 | THARKAYTA | 56,587 | 15.8 | 347 | 58,089 | 22.8 | 576 | 60,822 | 32.6 | 1,160 |
| 26 | DALA | 31,100 | 9.6 | 250 | 39,892 | 17.3 | 381 | 55,699 | 27.5 | 682 |
| 27 | SEIKGYIKANAUNGTO | 9,735 | 11.5 | 222 | 11,447 | 19.1 | 380 | 14,532 | 28.7 | 741 |
| 28 | SHWEPYITAR | 76,032 | 8.7 | 294 | 86,257 | 17.2 | 492 | 104,538 | 28.5 | 977 |
| 29 | HLAINGTARYAR | 112,569 | 11.6 | 331 | 123,149 | 20.3 | 580 | 142,117 | 32.1 | 1,222 |
| 30 | NORTH DAGON | 50,130 | 19.7 | 401 | 52,895 | 27.5 | 696 | 57,874 | 38.3 | 1,485 |
| 31 | SOUTH DAGON | 87,458 | 15.0 | 342 | 95,258 | 22.7 | 571 | 108,989 | 33.0 | 1,131 |
| 32 | EAST DAGON | 63,068 | 9.3 | 209 | 105,203 | 14.7 | 232 | 180,212 | 22.2 | 319 |
| 33 | DAGON SEIKKAN | 38,976 | 10.5 | 302 | 52,478 | 17.6 | 415 | 76,540 | 27.0 | 671 |
| 34 | KYAUKTAN | 13,650 | 24.0 | 323 | 17,994 | 31.4 | 593 | 25,227 | 41.1 | 1,243 |
| 35 | THANLYIN | 78,530 | 11.6 | 254 | 126,095 | 19.9 | 366 | 210,391 | 31.4 | 694 |
| 36 | HLEGU | 10,857 | 4.7 | 147 | 19,010 | 8.1 | 169 | 33,500 | 15.9 | 265 |
| 37 | HMAWBI | 27,682 | 11.3 | 267 | 44,062 | 20.2 | 397 | 73,058 | 32.2 | 772 |
| 38 | HTANTABIN | 16,869 | 9.1 | 238 | 29,161 | 17.2 | 338 | 50,957 | 28.7 | 642 |
| 39 | TWANTAY | 12,923 | 6.4 | 221 | 23,501 | 12.8 | 278 | 42,284 | 23.1 | 486 |
| **1-6** | **CBD** | **55,272** | **32.7** | **427** | **55,642** | **39.2** | **696** | **56,297** | **48.6** | **1,413** |
| **7-15** | **Inner Urban Ring** | **187,161** | **26.6** | **437** | **192,116** | **33.4** | **725** | **201,103** | **42.7** | **1,460** |
| **16-19** | **Outer Ring** | **133,573** | **22.9** | **407** | **135,707** | **29.4** | **661** | **139,759** | **38.9** | **1,327** |
| **20-22** | **Northern Suburbs** | **206,973** | **15.2** | **336** | **242,823** | **22.2** | **518** | **307,094** | **31.7** | **938** |
| **23-25** | **Older Suburbs** | **174,289** | **15.9** | **334** | **180,777** | **22.3** | **525** | **192,220** | **31.5** | **1,006** |
| **26-27** | **South of CBD** | **40,835** | **10.1** | **243** | **51,339** | **17.7** | **381** | **70,231** | **27.7** | **694** |
| **28-33** | **New Suburbs** | **428,232** | **12.3** | **314** | **515,241** | **19.5** | **488** | **670,270** | **29.0** | **886** |
| **34-39** | **Periphery Area** | **160,510** | **11.4** | **250** | **259,823** | **18.9** | **361** | **435,417** | **29.8** | **680** |
| **1-33** | **Yangon City Total** | **1,226,336** | **17.5** | **352** | **1,373,646** | **24.0** | **553** | **1,636,974** | **32.9** | **1,028** |
| **1-39** | **Study Area Total** | **1,386,846** | **16.8** | **340** | **1,633,469** | **23.2** | **522** | **2,072,391** | **32.3** | **955** |

Source: YUTRA Project Team




Source: YUTRA Project Team

**Figure 3.2.4.1 Projected Household Income by Township**




Source: YUTRA Project Team

**Figure 3.2.4.2 Projected Household Car Ownership Ratio by Township**

### 3.2.5 Summary of Socio-economic Framework for Greater Yangon

Table 3.2.5.1 presents the summary of the socio-economic framework for the Greater Yangon.

**Table 3.2.5.1 Summary Socio-economic Framework for Greater Yangon**

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

Source: YUTRA Project Team

## 3.3 Future Transport Demand

### 3.3.1 Demand Forecast Methodology

Base year travel demand analysis and the development of travel demand forecast models have been described in detail in Volume II, Chapter 2. This Chapter focuses on the application of the travel demand model for the YUTRA study area. The inputs to the travel demand forecast are the future year socio-economic framework and the data for the forecast years, which has been described above in this chapter, sections 3.1 and 3.2. This section presents the travel demand forecast for the YUTRA study area for the Master plan development horizon years of 2016 (short term), 2025 (medium term) and the long term for scenario of 2035.

### 3.3.2 Travel Demand Forecast

Travel demand estimates were made for a single urban development scenario as stipulated by the JICA SUDP study and defined in previous sections of this Chapter. The estimate of travel demand for the three years is summarised for the main development areas in Table 3.3.2.1 below. It compares the growth in demand for each of the forecast years.

**Table 3.3.2.1 Growth in Total Travel by All Modes, Person Trips ('000)**

| Description | 2013 | 2018 | 2025 | 2035 |
|---|---|---|---|---|
| Walk | 4,778 | 5,238 | 6,072 | 7,403 |
| Bicycle | 1,472 | 1,661 | 1,981 | 2,704 |
| **Mechanised** | 4,935 | 5,862 | 7,185 | 9,477 |
| **% mechanised** | 44.1 | 45.9 | 47.2 | 48.4 |
| **Total Trips** | **11,185** | **12,761** | **15,238** | **19,584** |
| **Population** | 5,716 | 6,437 | 7,616 | 9,712 |
| **Trip Rate** | 1.96 | 1.98 | 2.00 | 2.02 |
| **Growth Indicator** | | **Growth Rate % p.a.** | | |
| | | **2013-18** | **2018-25** | **2025-35** |
| Walk | | 1.86 | 2.13 | 2.00 |
| Bicycle | | 2.45 | 2.55 | 3.16 |
| **Mechanised** | | 3.50 | 2.95 | 2.81 |
| **Total Trips** | | 2.67 | 2.57 | 2.54 |
| **Population** | | 2.40 | 2.43 | 2.46 |
| ***Trip Rate*** | | ***0.26*** | ***0.13*** | ***0.08*** |

Source: YUTRA Project Team

The table reflects a rapid growth in travel demand with almost constant population growth rate of just over 2.4% per annum. The demand forecast growth in trip rate is reflective of rapid growth in mechanised trips. The high growth in mechanised trips is caused by increase in vehicle owning household from some 12% of the population to over 34% of all

households by 2035. The pace of growth is rather rapid in earlier years than later Tdue to higher growth in car ownership in earlier years.

The mechanised person trips are forecast to almost double from 4.9 million trips in 2013 to 9.5 million trips by 2035. The share of walk trips and by bicycle would also grow steadily, albeit at slower pace as the vehicle ownership grows. The tendency of household to use the vehicle for all trips, by all members of the household, once a vehicle is available This is a common phenomenon in the developing countries, where purchase of a vehicle is major step towards 'status' in the society, and then its maximum use is inevitable as there is limited or restraint (parking availability/ charges, no road user charges). This tends to increase the vehicle use resulting in much higher growth in vehicle available trips than the trips by non-car available households. This aspect is further illustrated in Table 3.3.2.2 which summarises the forecast trip-ends by vehicle availability for each of the five trip purpose. The overall share of the trips by vehicle available persons increases considerably, from about 18% of the total trips in 2013 to 45% by 2035.

**Table 3.3.2.2 Forecast Person Trips by Purpose and Vehicle Availability**

| YUTRA Study Area Mechanised Trips by Purpose | | | | | | % Growth | | | % Growth p.a. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Purpose | by Vehicle Availability | 2013 | 2018 | 2025 | 2035 | 2013-2018 | 2018-2025 | 2025-2035 | 2013-2018 | 2018-2025 | 2025-2035 |
| to Home | VA-Destination | 385,300 | 735,400 | 1,137,700 | 1,833,800 | 90.9 | 54.7 | 61.2 | 13.80 | 6.43 | 4.89 |
| | NVA-Destinations | 1,791,600 | 1,835,600 | 2,009,900 | 2,332,000 | 2.5 | 9.5 | 16.0 | 0.49 | 1.30 | 1.50 |
| | Total | 2,176,900 | 2,571,000 | 3,147,600 | 4,165,800 | 18.1 | 22.4 | 32.3 | 3.38 | 2.93 | 2.84 |
| | % Vehicle Available | 17.7 | 28.6 | 36.1 | 44.0 | | | | | | |
| Home to Work | VA-Generations | 109,300 | 209,400 | 343,600 | 615,000 | 91.6 | 64.1 | 79.0 | 13.89 | 7.33 | 5.99 |
| | NVA - Generation | 813,600 | 850,600 | 969,000 | 1,227,200 | 4.5 | 13.9 | 26.6 | 0.89 | 1.88 | 2.39 |
| | Attraction | 922,900 | 1,060,000 | 1,312,600 | 1,842,200 | 14.9 | 23.8 | 40.3 | 2.81 | 3.10 | 3.45 |
| | % Vehicle Available | 11.8 | 19.8 | 26.2 | 33.4 | | | | | | |
| Home to School | VA-Generations | 97,300 | 202,800 | 313,300 | 493,400 | 108.4 | 54.5 | 57.5 | 15.82 | 6.41 | 4.65 |
| | NVA - Generation | 333,500 | 336,100 | 365,100 | 423,200 | 0.8 | 8.6 | 15.9 | 0.16 | 1.19 | 1.49 |
| | Attraction | 430,800 | 538,900 | 678,400 | 916,600 | 25.1 | 25.9 | 35.1 | 4.58 | 3.34 | 3.06 |
| | % Vehicle Available | 22.6 | 37.6 | 46.2 | 53.8 | | | | | | |
| Home to Other | VA-Generations | 169,500 | 306,000 | 433,600 | 583,400 | 80.5 | 41.7 | 34.5 | 12.54 | 5.11 | 3.01 |
| | NVA - Generation | 635,900 | 641,000 | 668,300 | 675,200 | 0.8 | 4.3 | 1.0 | 0.16 | 0.60 | 0.10 |
| | Attraction | 805,400 | 947,000 | 1,101,900 | 1,258,600 | 17.6 | 16.4 | 14.2 | 3.29 | 2.19 | 1.34 |
| | % Vehicle Available | 21.1 | 32.3 | 39.4 | 46.4 | | | | | | |
| NHB | VA-Generations | 148,400 | 283,200 | 438,200 | 706,200 | 90.8 | 54.7 | 61.2 | 13.80 | 6.43 | 4.89 |
| | NVA - Generation | 451,100 | 462,200 | 506,000 | 587,100 | 2.5 | 9.5 | 16.0 | 0.49 | 1.30 | 1.50 |
| | Attraction | 599,500 | 745,400 | 944,200 | 1,293,300 | 24.3 | 26.7 | 37.0 | 4.45 | 3.44 | 3.20 |
| | % Vehicle Available | 24.8 | 38.0 | 46.4 | 54.6 | | | | | | |
| Total | VA-Generations | 909,800 | 1,736,800 | 2,666,400 | 4,231,800 | 90.9 | 53.5 | 58.7 | 13.80 | 6.32 | 4.73 |
| | NVA - Generation | 4,025,700 | 4,125,500 | 4,518,300 | 5,244,700 | 2.5 | 9.5 | 16.1 | 0.49 | 1.31 | 1.50 |
| | Attraction | 4,935,500 | 5,862,300 | 7,184,700 | 9,476,500 | 18.8 | 22.6 | 31.9 | 3.50 | 2.95 | 2.81 |
| | % Vehicle Available | 18.4 | 29.6 | 37.1 | 44.7 | | | | | | |

Source: YUTRA Project Team

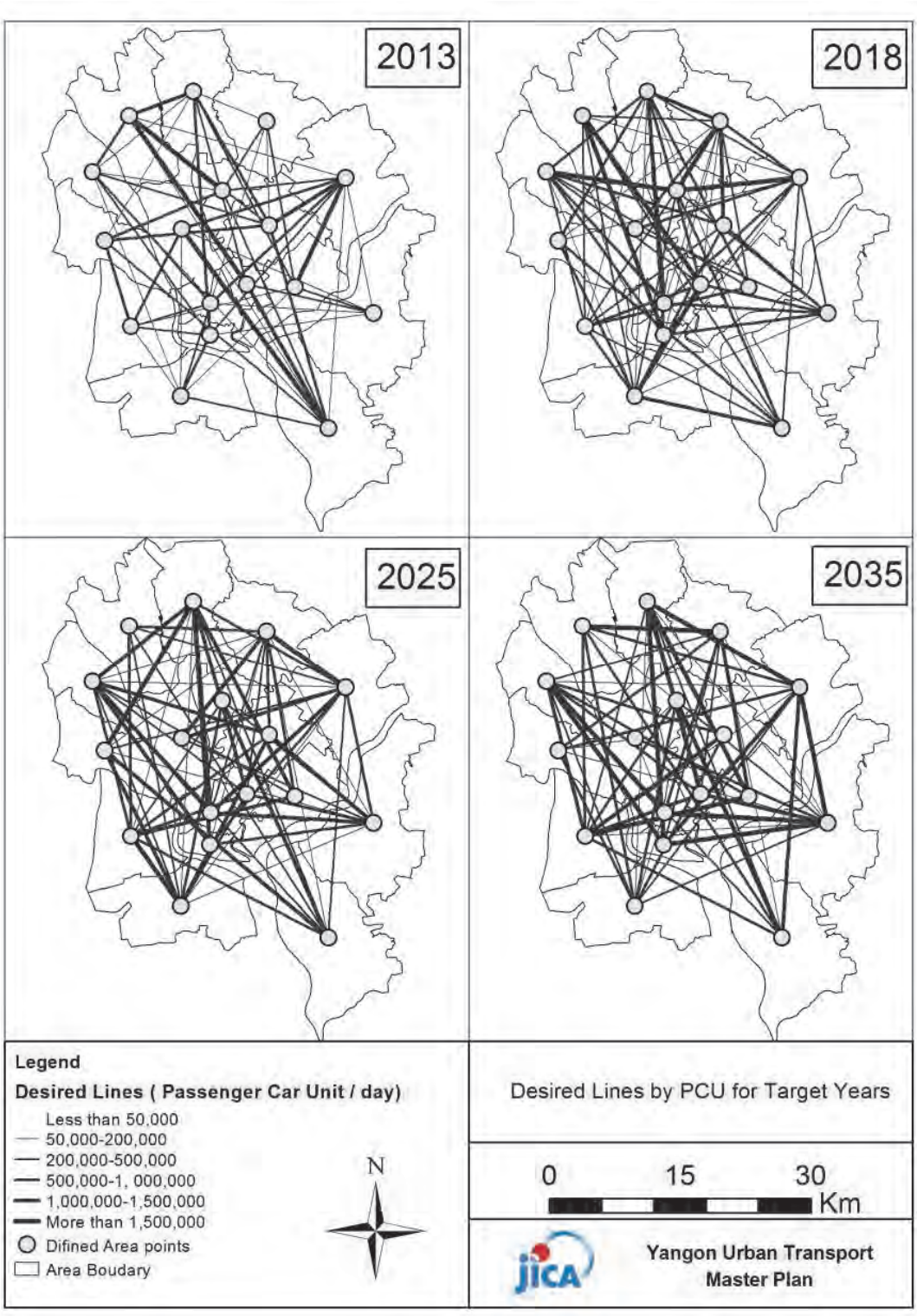
The next stage in the demand forecast process is to distribute the estimated trip ends between origin and destinations. This process is performed by using future year travel costs and the calibrated trip distribution models. The future year travel costs are estimated form the anticipated future network accessibility and increase in cost of travel. The future cost of travel was forecast to increase in line with growth in GRDP/capita. Table 3.3.2.3 summarises the growth in GRDP, and GRDP/ capita as used in the travel demand forecast models.

**Table 3.3.2.3 Growth in YUTRA Area GRDP and GRDP per Capita**

| Description | 2013-2018 | 2013-2025 | 2013-2025 |
|---|---|---|---|
| GRDP/Capita Growth Rate % p.a. | 7.11 | 6.23 | 6.16 |
| GRDP/Capita Growth Factor from 2013 | 1.3985 | 2.1340 | 3.8809 |

Source: YUTRA Project Team

The resulting trip distribution patterns are illustrated by the desire-line diagrams for base and forecast years in Figure 3.3.2.1. It is evident that the demand for travel from the new town-centers spread around the central core of the Yangon City would grow considerably.




Source: YUTRA Project Team

**Figure 3.3.2.1 Current and Forecast Trip Distribution Patters in YUTRA Areas**

In the next stage of the process the travel demand estimated by trip purpose and by vehicle available groups is combined to determine the choice of travel mode. The mode choice model has been described in Chapter 2, Volume II. In summary, the vehicle available trips are allocated among those who would use the car or choose the public transport. Such

choices would have to be made as not all persons of a household could not have vehicle available and hence the use of public transport is the only choice left. Similarly the non-vehicle available trips are allocated to a) to those who could travel by car by sharing with other, take a taxi or use other public transport. In the forecast process it is assumed that the Government of Myanmar/ Yangon would continue to enforce the use of motorcycles in the Yangon city area and ownership would also be restricted in the suburban areas.

Travel demand to and from areas outside the YUTRA area (External Trips) was estimated exogenously, and added to the above described estimated demand. The forecast external travel demand was then compared with the MYT strategic demand study conducted by JICA and controlled to the MYT travel demand to/ from Yangon and those pass through YUTRA area by private and public mode also for the goods vehicles. Table 3.3.2.4 summarises the total travel demand in the study area by mode of travel and by commercial vehicles.

**Table 3.3.2.4 Total Travel Demand in YUTRA Study Area**

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

Source: YUTRA Project Team

The table illustrates that there will be doubling of growth in personal travel 2035. There are some counter-intuitive, but there is explanation. In the base year both the bicycle and motorcycle trips were observed sparsely at screen lines, as these trips are mostly in local areas, and do not appear on major roads and river crossings, to be confirmed or adjusted to any cross-check counts. Hence there validity, as reported in the HIS, may have been exaggerated to some extent. In the forecast year the forecast of these trips is based on a conservative approach, and all forecast bicycle trips longer than 4km (say more than 30 minutes of cycling) were deemed to be over zealous, and were transferred to the public mode as no one would make such log journeys by public transport – if the public transport is both accessible and affordable. Hence the initial decline (2013 to 2018) in these trips and growth in later years is considered plausible.

Over the forecast period the trips reflect the impact of expected economic growth and prevailing infrastructure conditions, resulting in both the growth in vehicle ownership and its un-restrained use. The forecast mode share of around 65% in 2035 is still very healthy, for a city of about 10 million inhabitants. Given that the most Asian cities are spending

considerable resources to achieve a fraction of such percentage share of public transport. This demand forecast assumes a considerable growth in the provision of additional transport infrastructure both public (in terms of BRT and rail based mass transit and improved suburban rail system with much enhanced road capacity free of encroachments.

The commercial vehicles also play a vital role in the economy of the city, both in supplying goods to the industrial areas and the physical distribution of goods for everyday life. The growth in the light goods vehicle were expected to grow in line with the growth in local economy and population i.e. at the same rate as GRDP/ capita; whereas growth in heavy goods vehicles – those with two or more axles was forecast to grow in line with the region's economy, albeit for a much lower current volume of traffic of over 110,000 pcu trips per day. The overall growth in trips requiring the use of transport infrastructure (excluding short distance intra-zonal trips) as shown in the above table are anticipated to double by 2035, with almost similar is forecast growth in population.

### 3.3.3 Impact of Forecast Travel Demand on Transport Infra structure

A road and rail based traffic assignment model was calibrated for 2013 conditions. The model was then used to assign forecast traffic on the current (without any enhancement). This process identifies the level requirement of transport infrastructure in each and for all modes of traffic. For this purpose the person and goods vehicle trips are converted to a single common unit called Passenger Car equivalent Unit (PCU). Table 3.3.3.1 lists the vehicle occupancy equivalent PCU factors used to convert the total trips tabled above.

**Table 3.3.3.1 Vehicle Occupancy and PCU Factors**

| Vehicle Type | Occupancy | PCU Factor |
|---|---|---|
| Bicycle | 1.14 | 0.20 |
| Motorcycle | 1.76 | 0.25 |
| Car including Vans | 2.55 | 1.00 |
| Taxi (Excluding driver) | 2.46 | 1.00 |
| Standard Bus | 40.0 | 1.75 |
| Pickup Truck | - | 1.50 |
| 2-Axle Truck | - | 1.75 |
| 3+Axle truck | - | 2.00 |
| Truck Trailer | - | 2.50 |
| Other Commercial Vehicles | - | 1.75 |

Source: YUTRA Project Team

The resulting demand to be assigned in each year is summarised in Table 3.3.3.2. The public transport is converted to equivalent standard bus PCU for comparison purposes, and in fact the bus volumes would be lower than the specified volumes as many public transport passengers would take all the available modes of public transport i.e. rail, BRT and mass transit – if available.

**Table 3.3.3.2 Total Travel Demand in PCU in YUTRA Study Area**

| Summary of Trip Totals by Mode (Inter-zonal) PCU | | | | | % Growth | | | % Growth p.a. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Total Trips** | **2013** | **2018** | **2025** | **2035** | **2013-2018** | **2018-2025** | **2025-2035** | **2013-2018** | **2018-2025** | **2025-2035** |
| Bicycle | 105,000 | 74,200 | 88,500 | 120,900 | -29.3 | 19.3 | 36.6 | -6.7 | 2.5 | 3.2 |
| Motorcycle | 43,300 | 29,600 | 35,000 | 45,500 | -31.6 | 18.2 | 30.0 | -7.3 | 2.4 | 2.7 |
| Car & Van | 246,400 | 471,100 | 694,600 | 1,069,800 | 91.2 | 47.4 | 54.0 | 13.8 | 5.7 | 4.4 |
| Taxi | 241,900 | 307,400 | 369,600 | 476,900 | 27.1 | 20.2 | 29.0 | 4.9 | 2.7 | 2.6 |
| Equivalent Standard Bus | 134,100 | 171,300 | 199,500 | 248,200 | 27.7 | 16.5 | 24.4 | 5.0 | 2.2 | 2.2 |
| Goods Vehicle PCU | 110,900 | 151,200 | 205,200 | 301,600 | 36.3 | 35.7 | 47.0 | 6.4 | 4.5 | 3.9 |
| **Total PCU** | **881,600** | **1,204,800** | **1,592,400** | **2,262,900** | **36.7** | **32.2** | **42.1** | **6.4** | **4.1** | **3.6** |
| *% by Public Equivalent Buses* | *15.2* | *14.2* | *12.5* | *11.0* | | | | | | |

Source: YUTRA Project Team

The impact of traffic assignment is measured in terms of volume (assigned traffic) capacity (road capacity of each section of road in the network) ration – commonly called as 'V/C Ratio'. The traffic assignment process and base year calibration results has been detailed in Chapter 2 volume II. This section outlines the impact of future traffic demand on the current network. Figure 3.3.3.1 below shows the current traffic volumes on the current road network in 2013 with the V/C ratios are illustrated by colour.

The figure shows that most of the network is congestion free (i.e. Green links with V/C Ratio <0.75) and there are only limited number of road sections which are above capacity. This network also reflects the impact of current rampant on-street parking, which is the main reason of congestion in the CBD area. Outside the CBD area some key links are at near capacity (blue links with V/C Ratio between 0.,75~1.0). Some bottle necks are also illustrated by the brown colour links.

Figure 3.3.3.2 shows the current traffic volumes on the current road network in 2018 with the V/C ratios are illustrated by colour. The figure clearly illustrates that if the current transport infrastructure is not improved congestion would worsen. The most severe impact would be the rapidly growing urban areas to the west and south of Yangon river, where V/C ratio exceeds 2.0 on the only arterial road in the area. Congestion on the bridges form the west and from Bago area would be operating almost at capacity most of the day. This illustrates the immediate need for addition Yangon and Bago river crossings.


Source: YUTRA Project Team

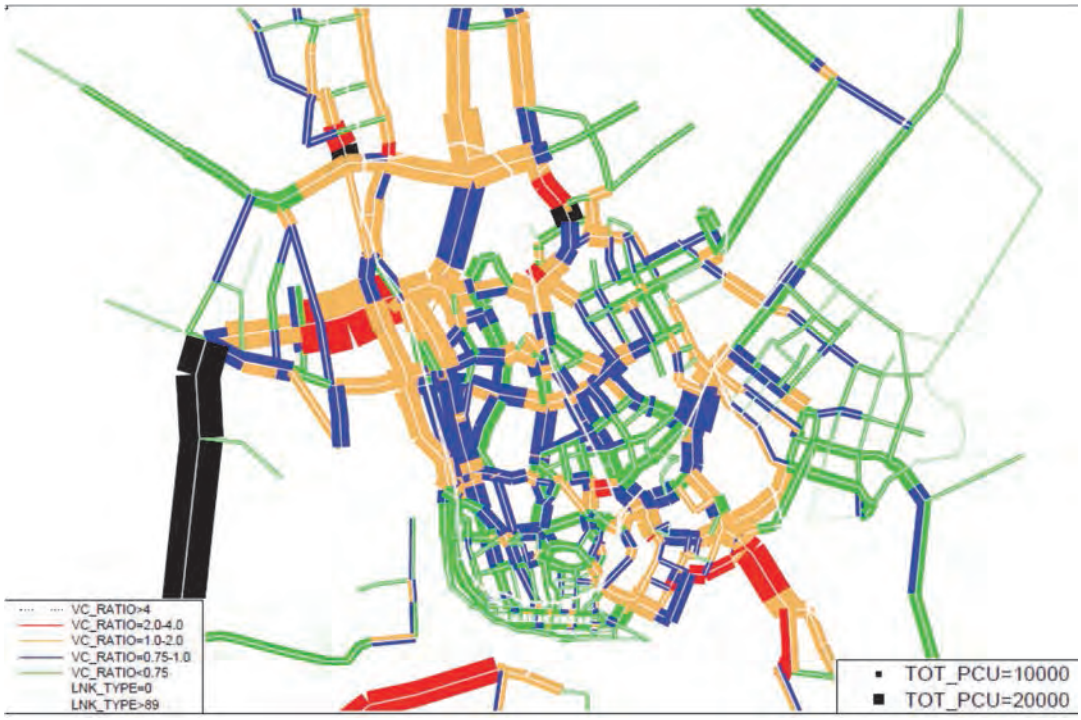
**Figure 3.3.3.1 2013 Assigned Traffic Volume on Current Transport Network**


Source: YUTRA Project Team

**Figure 3.3.3.2 2018 Assigned Traffic Volume on Current Transport Network**

Figure 3.3.3.3 below shows the current traffic volumes on the current road network in 2025 with the V/C ratios are illustrated by colour.

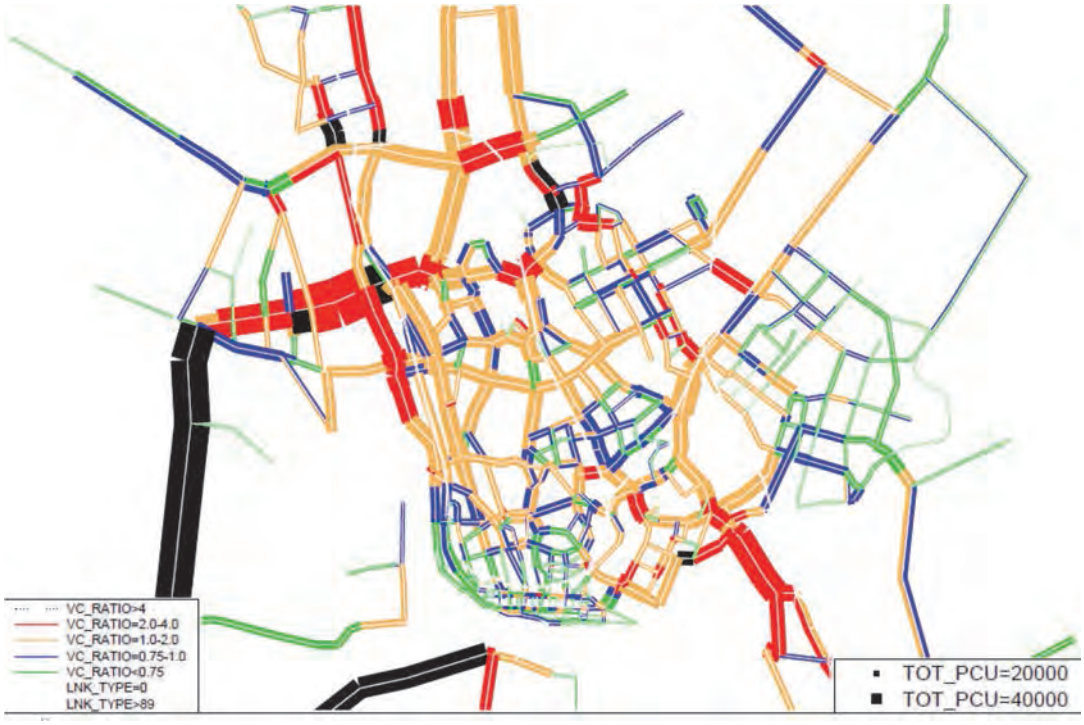
The figure demonstrates that considerable road network capacity would be required to accommodate almost 80% increase in road traffic volume (see Table 3.3.3.2 above). The need for a comprehensive arterial and secondary road network would be required in the townships to the west of the Yangon River, As indicated by the black colour that the only current north-south road reached V/C ratio of over 4. Additional river crossing would be required as shown in the 2018 V/C ratio figures. By 2025 the whole of the Yangon area road network would require almost doubling of the road network capacity, or some traffic restraint and use charges system would need to be in place. The demand for public transport would also require more efficient systems other than the regular bus services to alleviate congestion. The stress on the outer area highway network is also evident from the V/C ratio between 1~2 (brown) and over 2.0 indicated by Red colour. By 2025, the internal external traffic would also require arterial or expressway network ot be in place to meet the demand efficiently.




Source: YUTRA Project Team

**Figure 3.3.3.3 2025 Assigned Traffic Volume on Current Transport Network**

The impact on the road network by 2035 under the stress of increase in total PCU to 2.3million would be unthinkable if the city is to grow and the transport infrastructure remains at the current 2013 level. The need for addition capacity is illustrated below in Figure 3.3.3.4, which shows the projected 2035 traffic volume and illustrates the likely V/C Ratios on the network. It can be seen that on most of the network V/C ratio exceeds 1.0, and the brown, red and black colours show the intensity of the poor level of service. In fact the red and black colours imply the need for more doubling the current road capacity and an efficient mass transit system by 2035. A corridor based supply a demand analysis is presented in the next section.




Source: YUTRA Project Team

**Figure 3.3.3.4 2035 Assigned Traffic Volume on Current Transport Network**

## 3.4 Assessment of Future Demand-Supply Gaps

### 3.4.1 Setting Mini Screen Lines

In order to analyze the gaps between transport demand and infrastructure supply, 17 mini screen lines were set as illustrated in Figure 3.4.1.1. This analysis intends to determine future demand/supply gaps by location and direction. Based on this analysis, future transport network plans are prepared.


Source: YUTRA Project Team

**Figure 3.4.1.1 Mini Screen Lines for Demand/Supply Gap Analysis**

### 3.4.2 Demand/Supply Gaps

Using the traffic assignment technique on 2013 transport network and 2013&2035 OD matrices, demand/supply gaps were analyzed as presented in Table 3.4.2.1 and Figure 3.4.2.1.

At present, there is no screen line showing a transport demand greater than capacity. Note that this does not mean there is no traffic congestion. Traffic congestion is a phenomenon caused not only by insufficient capacity but by other local conditions such as on-road parking, encroachment and poor traffic control/management.

In the future, however, demand will surpass present transport capacity at many screen lines. Particularly at the Yangon River crossing between Yangon CBD and Dala, traffic demand will increase rapidly, and countermeasures are needed to ease this situation. Other critical screen lines include Hlain River, Bago River and Pazundaung Creek.

The YUTRA transport master plan shall be formulated to cover the demand/supply gaps thus identified.

**Table 3.4.2.1 Demand/Supply Gaps by Mini Screen Line, 2013 and 2035**

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

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


Source: YUTRA Project Team

**Figure 3.4.2.1 Demand/Supply Gaps by Mini Screen Line, 2013 and 2035**

# 4 TRANSPORT DEVELOPMENT STRATEGY

## 4.1 Overall Transport Policy

### 4.1.1 Current Urban Development Policy

City growth – in terms of population, urbanization, scale of economic activities, and household income levels – has been rapid in Yangon. It is unlikely to slow down due to the unique position of the city as the economic engine of the entire Myanmar. The population in the study area will nearly double to 9.7 million. A large part of this growth will be accounted by in-migration, as rural population gets attracted into the city by expanded job opportunities and prospects of better lives. Household income is expected to grow by about 4 times of the current levels. As a consequence, some of the dramatic changes that will ensue are:

**Expanding urbanization**: Although the central areas will retain their density, suburbanization will occur through a mushrooming of medium- to low-density residential areas as households with higher incomes seek larger living spaces, better environment, and car ownership. The adjoining areas will become closely intertwined with the city's social and economic activities.

**Progressing motorization**: As economy grows, household car ownership ratio will increase inevitably. The current rate of 11.6% is forecast to grow to 32.3% by 2035. Coupled with the population growth and longer trip length, stress to road users will be strong due to congestion, uncomfortable commuting, long travel times and parking space scarcity.

**Worsening living conditions for low-income groups in the central areas**: Urban redevelopment will be accelerated in the central areas for business and commercial activities, therefore exerting pressures on property values and on low-income households to relocate.

As other cities in developed and developing countries have experienced, such a scale of urban growth will entail painful adjustments on the residents of the city. Undisciplined and unregulated use of private cars should not be permitted to continue in a large city such as Yangon.

Yangon and its adjoining areas would continue to be the main link of Myanmar to the global economy. The country's global competitiveness will therefore rely on the efficiency of transport system in the Greater Yangon.

#### 1) Objectives

The city's future should be liveable as well as competitive and its transport sector should support and facilitate this objective. The overall goal of urban transport is to:

*"Ensure mobility and accessibility to needed urban services for its people and society, through safety, amenity and equity – towards the development of a public-transport-based city with more than 60% share of the total urban transport demand."*

Accordingly, eight specific objectives in the master plan are identified:

- Promotion of social understanding about urban transport problems and issues
- Effective management of urban growth and development

- Promotion and development of attractive public transport
- Efficient traffic control and management
- Effective management of transport demand
- Comprehensive development of transport space and environment
- Enhancement of traffic safety and reduced environmental impacts
- Strengthening of urban transport administrative and management capacities

**2) Sector Constraints**

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

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

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

**3) On-going Initiatives**

Even before the completion of the overall master plan, three flyovers have been recently completed, and several feasibility studies are on-going for bridge construction, improvement of existing railways, and airports. These projects have strategic and long-term implications – not only for the master plan, but also with impacts on the city's future.

Another on-going initiative is the construction of Thilawa Special Economic Zone that assumes gradual relocation of major ports along the Yangon River. Apparently, this was already decided by the Government and supported by Japan's ODA. The timing and speed of execution would alter the competitive standing of many industries in the study area – both in a negative or positive manner. It may have the salutary benefit of reducing truck traffic in the inner city area, but if done too soon, the revenue base of Yangon would decline and consequently affect its future ability to fund infrastructure investments.

**4) New Policy Directions**

With a long-term historical perspective and a deep awareness of sector constraints, the need for new policy directions becomes clear.

A key feature of this new direction is greater reliance on the private sector in the building of transport infrastructure and operation of major transport functions, which is consistent with

the national policy towards a market-based economy. Myanmar is already moving towards this end, but success will rely on creating acceptable partnership agreements to provide greater investor confidence. This will require various policy reforms and public sector practices – such as in the method of procuring infrastructure projects, price regulation, and in the operation of governmental or semi-governmental enterprises. Such reforms may need to be triggered by privatizing existing enterprises (whether profitable or not) involves in activities where the private sector can/should make a useful contribution.

Parallel to this initiative is developing commercial public sector entities that are profit-oriented and business-like in their operations. This will also allow the public sector to compete on a level playing field with the private sector and between foreign and local companies.

Commercialisation of public service provision will ensure better efficiency and combined with private sector participation (PSP), will deliver more sustainable projects. For infrastructure projects, Yangon needs a pro-active approach; conducting feasibility studies to establish the business case for PSP, including the level of government support required in each project, and marketing these opportunities to the private sector.

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

This specifically includes developing ‘partnering relationships’ with the private sector to deliver public transport services, with sustainable business models under franchise or PPP arrangements. The public sector may take partnership risks where it is in the best position to manage such risk. Sharing risk and supporting industry with appropriate regulations will strengthen its participation and control.

Building investor trust in the regulatory framework is a key requirement and will require the public sector to set high standards of governance, eradicating conflict of interests and create a system of regulatory independence and fairness.

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

(a) Adoption or promulgation by law of the future road network in undeveloped areas, in a flexible rather than rigid sense, that will allow minor changes in alignment without altering the overall network,

(b) Removing these future roads, at least the primary or major arterials, from the

land market.

(c) Preparation of a new urban plan for Yangon as started by SUDP, preferably on a GIS foundation.

Inter-city and interagency collaboration will become increasingly necessary, as the urban development spreads outside traditional city boundaries thus requiring more coordinated and integrated transport solutions. Some examples include: a road hierarchy spreading several local government units; relocation of a port may be a loss to one of the townships, but a gain to another. A metropolitan-type of institution should be discussed and the need of an Urban Transport Authority seriously studied.

Aside from the aforementioned three policy directions, a number of issues could also emerge to affect future policies. These are: sustainability, resettlement, and environmental issues, which all require a long-term outlook. Aside from economic and technical viability, transport projects need to be planned for sustainability (maintained, operated, and supported with funds over its life), minimum dislocation, and environmental soundness.

### 4.1.2 YUTRA Overall Transport Development Strategy

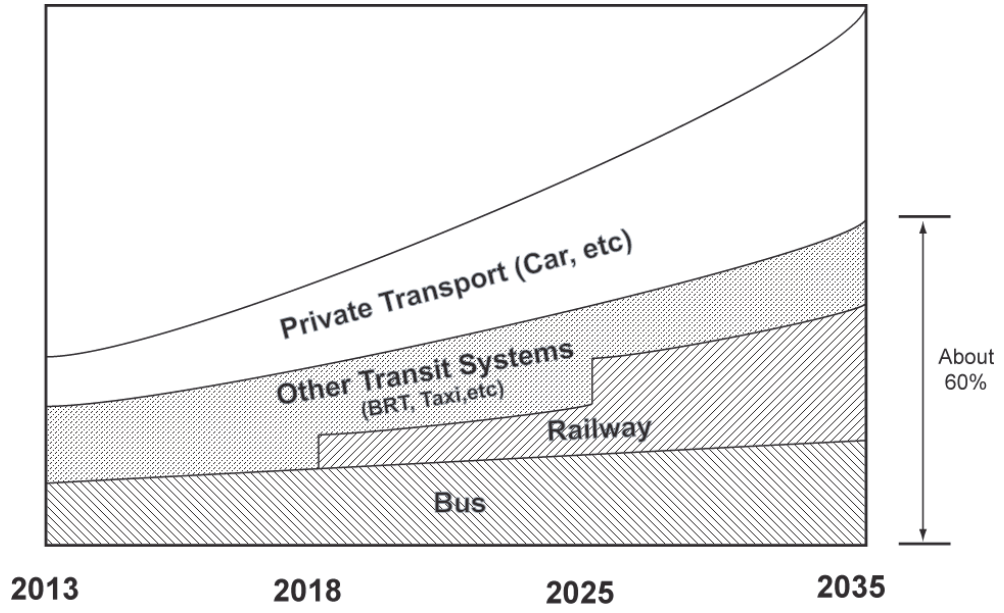
#### 1) Vision and Goal

A bleak future can be expected for the study area, without making some strategic interventions. Over-utilization of private cars is not tenable in a conurbation of nearly 10 million inhabitants with heightened expectations, active social lives, and diversified activities. An aging urban population will also demand a different quality of transport services. Yangon of the future should be livable as well as globally competitive and attractive for industries, leading Myanmar's international trade, and the transport sector must be designed to make this a possibility. The overall goal of urban transport is the following:

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

A combination of supply-type and demand-type strategies is required to maintain the present advantage of high modal share of more than 65%.

It should be noted that the modal shift is indicative (Figure 4.1.2.1). If at least the 60% share for public transport is not maintained, the resulting plan would overestimate the requirement for bus-rail capacity, but underestimate vehicular volume on roads, thereby affecting feasibility of many road projects.




Source: YUTRA Project Team

**Figure 4.1.2.1 Indicative Target for Modal Share for 2035**

### 2) Objectives and Strategies

The overall goal has been developed into eight specific objectives and strategies, as follows:

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

No transport policy and project would work effectively unless a wide and profound understanding of transport problems, issues and future directions is shared by the society. To achieve this objective the following five strategies are suggested:

*A1. Conduct of consecutive transport campaigns;*

*A2. Expansion of transport education;*

*A3. Strengthening of transport studies;*

*A4. Information disclosure.*

**B. Effective Management of Urban Growth and Development**

Defining a vision of the future is highly important in the study area because a fast increasing population and economy will have huge impact on urban development and people's lives. The transport sector is a critical part of urban growth and management. To achieve this objective, the following five strategies are suggested:

*B1. Policy coordination within the Greater Yangon area;*

*B2. Authorization of City and Transport Master Plans;*

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

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

**C. Promotion and Development of Attractive Public Transport**

Without public transport, the city's future is untenable. Future public transport must be provided in sufficient quantity and quality. An attractive public transport system is the only solution which both city authorities and the people expect. Suggested strategies are:

*C1. Development of a hierarchal mass transit system;*

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

*C3. Upgrading the present rail system;*

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

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

**D. Efficient Traffic Control and Management**

The current road capacity is not efficiently utilised due to widespread on-road parking, various types of encroachments and poor traffic control and management. Infrastructure capacity is largely dependent on how it is operated, managed and maintained. Better traffic management will improve capacity as well as improve safety, amenity, and environment of the city and its people. It is also reliant on better regulation, management and enforcement combined with facility improvement and ICT technology.

Suggested strategies are:

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

*D2. Strengthening of traffic regulation, enforcement and management;*

*D3. Management of freight transport;*

*D4. Establishment of parking policy and controls;*

*D5. Development of well-coordinated traffic control system.*

**E. Effective Transport Demand Management (TDM)**

The problem of traffic congestion should not be addressed merely from the supply side, i.e. expansion of infrastructure capacity. To ensure smooth traffic as well as share in a more equitable manner the cost and benefit of traffic and transport among stakeholders, various demand management measures (TDM) would need to be introduced, such as:

*E1. Integrating urban development and transport (TOD);*

*E2. Providing efficient public transport alternatives;*

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

**F. Comprehensive Development of Transport Space and Environment**

Transport infrastructure provides important public space for the use of traffic – comprising different modes including walking – and for various urban services and activities. For this, it is important to design and develop transport infrastructure and services comprehensively to enhance the quality of urban areas and activities. Suggested strategies are:

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

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

*F3. Establishment of township transport development strategy.*

**G. Enhancement of Traffic Safety**

Worsening traffic safety and an increase in traffic accidents are threatening the well-being of the city and its inhabitants; especially pedestrians. Road safety is also a priority issue at union government level. Suggested actions include:

*G1. Establishment of traffic safety audit system;*

*G2. Elimination of traffic accident black spots;*

*G3. Improvement of licensing and vehicle inspection system;*

*G4. Strengthening of traffic enforcement system;*

*G5. Strengthening of first aid response system.*

**H. Strengthening of Transport Sector Administrative and Management Capacities**

The tasks to be accomplished for the city's present and future are enormous and require a comprehensive and coordinated approach involving a wider range of players. The role of the related authorities in leading the process is very important. Suggested measures are:

*H1. Reform of transport- related organizations;*

*H2. Promotion of private sector participation;*

*H3. Strengthening of planning and management capacity;*

*H4. Securing of development funds.*

### 3) Main Features of YUTRA Master Plan

YUTRA has identified a series of transport development strategies as stated above. The main focuses or features of the Master Plan exist on the following points:

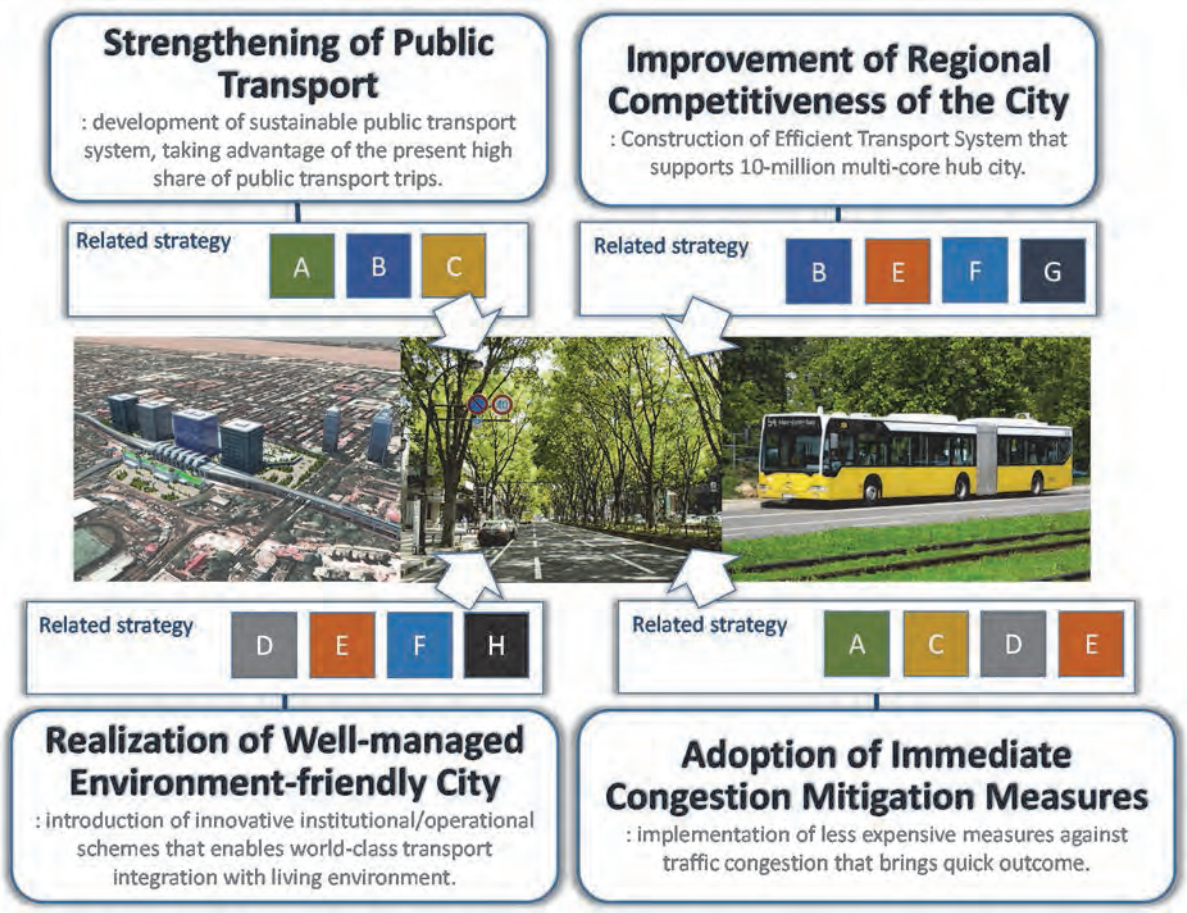
1. **Strengthening of Public Transport:** development of sustainable public transport system, taking advantage of the present high share of public transport trips.

2. **Improvement of Regional Competitiveness of the City:** Construction of Efficient Transport System that supports 10-million multi-core hub city.

3. **Realization of Well-managed Environment-friendly City:** introduction of innovative institutional/operational schemes that enables world-class transport integration with living environment.

4. **Adoption of Immediate Congestion Mitigation Measures:** implementation of less expensive measures against traffic congestion that brings quick outcome.

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




Source: YUTRA Project Team

**Figure 4.1.2.2 Main Features and Strategies of YUTRA Master Plan**

## 4.2 Budget Envelop

### 4.2.1 Economic Growth Scenarios

The master planning and budgeting process is based on annual reference level updates as an input to the development of notional budget allocations to sectoral responsibility centers and other planning dimensions, including authorities, objects of expenditure, program activities and projects. Notional budget allocations are envelopes within which sectoral government agencies develop their detailed annual budgets. Where expanded infrastructure investments to pump-prime the national economy are part of the development strategies, benchmarking with peer countries' experiences is utilized to temper aggressive investment plans.

#### 1) Myanmar Economic Performance

The Myanmar Union Government has undertaken significant steps in liberalizing the country's economy, increasing growth, and improving the future economic outlook since 2011. It is currently pursuing reconciliation and peace talks with ethnic minorities to widen the geographic base of socio-economic development. With minimal development in the past 20 years and the lowest GDP per capita and human development index within ASEAN (Table 4.2.1.1), Myanmar faces considerable challenges, particularly because of its limited macro-economic management capacity and institutional weaknesses.

**Table 4.2.1.1 GDP per Capita and HDI in ASEAN**

| ASEAN Countries | GDP per Capita, 2012, in US$ | Human Development Index, 2012 |
|---|---|---|
| Singapore | 51,162 | 0.895 |
| Brunei | 41,703 | 0.855 |
| Malaysia | 10,304 | 0.769 |
| Thailand | 5,678 | 0.690 |
| Indonesia | 3,592 | 0.629 |
| Philippines | 2,614 | 0.654 |
| Vietnam | 1,528 | 0.617 |
| Lao PDR | 1,446 | 0.543 |
| Cambodia | 934 | 0.543 |
| *Myanmar* | *835* | *0.498* |

Source: The Global Competitiveness Report 2013–2014, World Economic Forum and 2013 Human Development Report, UNDP

The administration of President Thein Sein, which was brought to office following elections in 2010, has signaled its intent to chart a new direction for the country. In March 2011, President Thein's inaugural speech to the Parliament outlined economic reform as a key priority of his government. The government has implemented a series of reforms to remove economic distortions. Among the most significant of these was the floating on April 1, 2012 of the Myanmar kyat, an important first step in abolishing a multiple exchange rate regime that had been identified by successive IMF Article IV missions as a key constraint on the economy.

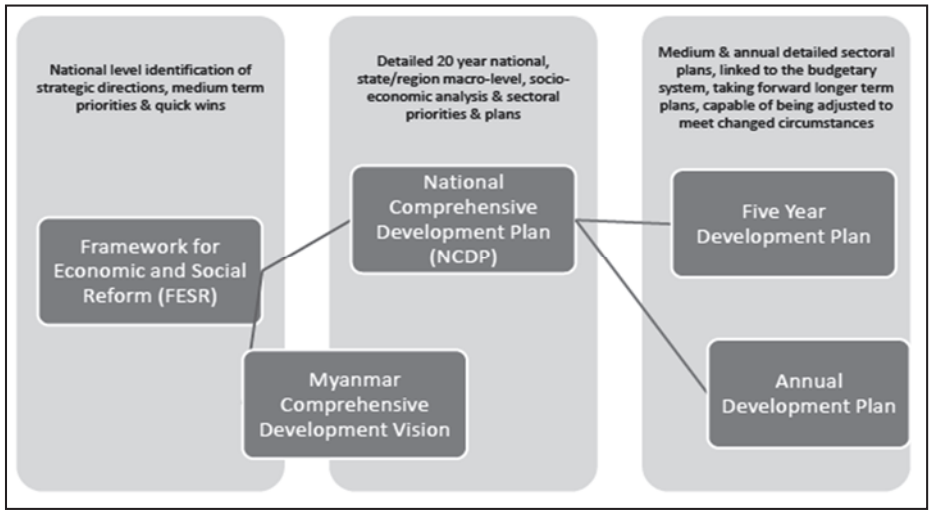
Other reforms have included a sizeable increase in state pensions, a series of tax reforms, and changes of regulations to ease the cost and time for importing vehicles, which

contributed to significant reduction transport costs mainly for small and medium enterprises.

In June 2012, President Thein announced a "second wave" of economic reforms aimed at developing the private sector. New laws on foreign direct investment and telecommunications were enacted by Parliament. The government is also undertaking a review of the financial sector, including regulations related to microfinance and private banks, to promote access to finance and create an environment conducive to job creation for both men and women and the development of non-extractive industry sectors in the economy. Furthermore, the government has advanced the program in the establishment of a number of special economic zones to promote manufacturing.

In January 2013, during the 1st Myanmar Development Cooperation Forum, The Union Government officially announced the adoption of the Framework for Economic and Social Reforms (FESR), which outlines the policy priorities for the government in the next three years while identifying key parameters of the reform process that will allow Myanmar to become a modern, developed and democratic nation by 2030. This development framework will be detailed into a long-term National Comprehensive Development Plan covering rural development and poverty alleviation plan; human resources development plan; investment plan - trade sector development plan; industrial development plan; financial and currency sector development plan; regional/state plans; and sector plans.

Figure 4.2.1.1 presents the relationship of the national strategies under FESR and the various development plans.




Source: Set Aung, Deputy Minister of National Planning and Economic Development, presentation during the 1st Myanmar Development Cooperation Forum, 19-20 January 2013, Nay Pyi Taw

**Figure 4.2.1.1 Relationship between National Strategies and Plans**

### 2) Official GDP Estimates

Official reports of sustained double-digit economic growth for over a decade led to studies by experts in Myanmar and abroad, raising questions over the growth rates claimed by the Government, especially those in the post FY1999/2000 period. The GDP values in nominal terms and growth rates are presented in Table 4.2.1.2.

**Table 4.2.1.2 Official GDP Statistics**

| Fiscal Year | Nominal GDP, Kyats Billion | Real Annual GDP Growth, % |
|---|---|---|
| 2000-01 | 2,553 | 13.7 |
| 2001-02 | 3,548 | 11.3 |
| 2002-03 | 5,625 | 12.0 |
| 2003-04 | 7,717 | 13.8 |
| 2004-05 | 9,079 | 13.6 |
| 2005-06 | 12,255 | 13.6 |
| 2006-07 | 16,853 | 13.1 |
| 2007-08 | 23,336 | 12.0 |
| 2008-09 | 29,233 | 10.2 |
| 2009-10 | 33,894 | 10.6 |
| 2010-11 | 39,847 | 10.4 |
| 2011-12 | 43,368 | 5.9 |
| 2012-13 | 47,433 | 6.7 |

Source: Central Statistical Organization
Note: Annual GDP growth rates from FY2000/01 to FY2010/11 are overstated.

The International Monetary Fund (IMF) and World Bank noted that no developing country anywhere in the world has ever achieved such growth and noting the regional and international situation during the periods. The robust growth claimed by Myanmar Government was highly controversial. In a paper "Economic Growth and Development in Myanmar, 2001 - 2010, and Strategies and Plans for 2011 - 2020," Tin Htoo Naing (2012)[1] noted several reasons why Myanmar GDP growth figures were overestimated, notably: (i) weakness of the system of national accounts as manifested by frequent revisions; (ii) observed errors were often due to gaps and inaccuracies in the data, particularly in considering formal and informal economic activities; and more importantly, (iii) the use of exchange rates in constructing GDP estimates. With multiple exchange rate system, i.e., an official exchange rate that co-exists with informal parallel market exchange rates, from FY2000/01 to FY2010/11, the reported real GDP annual rates were overstated with the economic distortions.

The IMF re-estimated the average growth at around 4.5%–5% over the past decade. Re-estimation of GDP statistics were made by applying a weighted exchange rate, where the official and market rates are weighted with about 8 and 92 percent, based on the respective shares of public and private sectors in GDP.

For the revised Union Budget for FY2013/14, the official GDP target is MMK 59,249 billion. Under the approved five-year short-term national development plan (FY2011/12 to 2015/16), **the Union government projected a 7.7-percent annual average GDP growth based on FY2010-11 market prices.**

### 3) Economic Outlook by Development Partners

The international community, particularly the major development partners such as the Asian Development Bank, World Bank, and International Monetary Fund, as part of a re-

[1] Tin Htoo Naing, Proceedings of the International Conference on GMS 2020: Balancing Economic Growth and Environmental Sustainability, February 2012, Bangkok.

engagement program with Myanmar, carried out structural reviews of Myanmar's development opportunities and constraints.

**(1) Asian Development Bank**

In 2012, ADB developed a roadmap toward resumption of normal operations after its last development loan in 1986. The activities included initial assessments of the economy and key economic sectors, provision of technical assistance projects, and development of an interim country partnership strategy for 2012-2014.

ADB noted that Myanmar's economy performed well in 2012 with real growth in the economy of about 6.3 percent. ADB revised its GDP growth forecasts to 6.5% in FY2013/14 and 6.8% in FY2014/15 considering observed investor optimism following policy reforms, the reinstatement of Myanmar in the European Union's Generalized System of Preferences for duty-free and quota-free market access, and the gradual easing of restrictions on financial institutions that facilitates credit to the private sector.

A recent ADB report entitled "Myanmar in Transition"[2] reported that the **Myanmar economy could grow at 7%-8% each year for a decade or more**. At such growth rates, its GDP per capita would reach $2,000-$3,000 by 2030. The identified key constraints are: the weak macroeconomic management framework devoid of market mechanisms, insufficient fiscal resources and inefficient domestic fund mobilization, limited access to finance, and deficient infrastructure.

**(2) World Bank**

In its Myanmar Economic Monitor: October 2013, the World Bank reported that the economy continued to accelerate in FY2012/13. Real GDP growth was estimated to reach 6.5% from 5.9% in FY2011/12. The drivers were strong growth in gas production, services, construction, as well as foreign direct investment and exports of commodities. The boom in services and construction was in response to opportunities opening up as the country continues with political and economic reforms and in preparation for the South East Asia (SEA) games that Myanmar will be hosting in December 2013. Foreign direct investment grew from US$1.9 billion in FY2011/12 to US$2.7 billion in FY2012/13. Most of this investment was in the energy sector, garment industry, information technology, and food and beverages.

The World Bank further noted that fiscal deficit in FY2012/13 declined to 3.7% of GDP, down from 4.6% in FY2011/12, due to strong revenue performance. There were expenditure increases on account of increased civil service salaries and higher allocations to education and health. However, these increased sector spending were compensated for by higher gas and tax revenues. Tax revenues increased from 3.9% of GDP in FY2011/12 to 6.4% in FY2012/13 due to exchange rate revaluation following the introduction of a managed float exchange rate system, and also on account of improved tax administration.

For the short to medium-term period, the World Bank projected **Myanmar's economy to grow at 6.8% in 2013/14 and rising further to 6.9% in the medium-term from FY 2014/15 up to FY 2015/16**. Continued strong growth is driven by continued increase in gas production, increased trade, and stronger performance in agriculture. Gas production is

[2] Asian Development Bank, Myanmar in Transition, 2012, Manila.

expected to increase significantly with new fields coming on stream in FY2013/14.

**(3) International Monetary Fund**

In the June 2013 Staff Report for the 2013 Article IV Consultation and First Review under the Staff-Monitored Program,[3] IMF reported that Myanmar has made impressive strides in opening and liberalizing the economy, boosting growth and the economic outlook, but the formerly isolated country faces considerable challenges, particularly because of its limited macroeconomic management capacity. The Staff-Monitored Program, which is being jointly monitored by the Government of Myanmar and IMF staff, is designed to maintain low inflation and increase international reserves to provide a buffer against shocks during the reform process. It also aims to build the institutional capacity and tools necessary for lasting macroeconomic stability.

IMF economists estimated that the country's economy grew around 6.5% in FY2012/13, driven by gas production, construction, and services. These drivers, along with further investment in telecommunication and transport, will continue to support economic activity, raising growth to 6.8% in FY2013/14. IMF confirmed that **Myanmar has significant economic potential, which could yield growth of around 7% in the medium term**, with a stable external balance. The Staff Report further noted, "*In addition to abundant natural resources, it has fertile land; a young, cheap labor force; and a strategic geographic position, which could provide an entry point into Asian supply chains. Investor interest is high. However, to translate these favorable endowments into high, sustained and inclusive growth, institutions and policies to manage the economy and supervise the financial system need to be built rapidly. In addition, policies supportive of private-sector investment, as well as public spending on infrastructure, health, and education are required*".

However, IMF economists warned that the country's limited macroeconomic management capacity is being stretched by the broad-based economic transition. Developing a modern financial sector and building a structure for monetary policy transmission are also important priorities and will take time. To begin the process, the Myanmar authorities should strengthen supervision, including of foreign exchange operations, and develop a clear licensing regime for foreign banks as recommended by the Staff Report.

Moreover, IMF prescribed that higher non-resource revenues are needed to boost much-needed development expenditure and reduce dependence on natural resources. In this regard, reforming tax policy and strengthening tax administration are deemed critical, particularly: (i) reforming the taxation of special consumption goods into a separate tax as a precursor to introducing a VAT; (ii) expanding the taxation of services as soon as administrative capacity allows; and (iii) clarifying policy on tax incentives, including in the forthcoming small and medium enterprise and special economic zone laws, with a view to limiting such incentives to the largest extent possible so as not to undermine the tax base and place a larger burden on non-exempt taxpayers.

The IMF Debt Sustainability Analysis Framework presents the projected path of Myanmar's external and public sector debt burden indicators, and draws some conclusions on the forward-looking sustainability of debt. More specifically, the baseline scenario is

[3] IMF Country Report No. 13/250, August 2013.

characterized by:

(i) Real GDP growth is assumed to average about 7% over the medium term, driven by commodity exports and higher foreign direct investment (FDI) due to the implementation of Myanmar's structural reform plans, with the support of the international community, and suspension of sanctions; and

(ii) Over the long term, **real GDP growth is expected to increase to 7.5% in FY2033/34**, supported by prudent macroeconomic policies and robust FDI and related investments.

However, stress tests indicate the presence of vulnerabilities. In particular, public debt sustainability is vulnerable to lower real GDP growth, and large and persistent primary fiscal deficits. The stabilization of the debt-to-GDP ratio at a relatively high level under the baseline scenario and the vulnerabilities indicated by the stress tests highlight the need for a prudent fiscal policy, through improvements in tax policy and public financial management including strengthening of debt management functions, and project assessment (i.e. ability to identify projects with good economic returns) and capacity to obtain more concessional financing. Under this alternative scenario, **long-term real GDP growth is projected to average at 6%**.

Table 4.2.1.3 presents the GDP growth estimates for Myanmar.

**Table 4.2.1.3 Real GDP Growth, in percentage**

| Fiscal Year | IMF | World Bank | ADB | MNPED-CSO |
|---|---|---|---|---|
| 2003/04 | 13.8 | | 13.8 | 13.8 |
| 2004/05 | 13.6 | | 13.6 | 13.6 |
| 2005/06 | 4.5 | 4.5 | 12.2 | 13.6 |
| 2006/07 | 7.0 | 7.0 | 12.7 | 13.1 |
| 2007/08 | 5.5 | 5.5 | 11.9 | 12.0 |
| 2008/09 | 3.6 | 3.6 | 3.6 | 10.2 |
| 2009/10 | 5.1 | 5.1 | 5.1 | 10.6 |
| 2010/11 | 5.3 | 5.3 | 5.3 | 10.4 |
| 2011/12 | 5.9 | 5.9 | 5.5 | 5.9 |
| 2012/13 | 6.5 | 6.5 | 6.3 | 6.7 |
| 2013/14 | 6.8 | 6.8 | 6.5 | 7.7 |
| 2014/15 | 6.9 | 6.8 | 6.8 | 7.7 |
| 2015/16 | 6.9 | 6.9 | | 7.7 |
| 2016/17 | 7.0 | | | 7.7 |
| 2017/18 | 7.1 | | | |
| 2018/19 | 7.1 | | | |

Sources: IMF Country Report No. 13/250, August 2013; World Bank Myanmar Economic Monitor: October 2013; ADB Basic Statistics 2013; and Myanmar Central Statistical Organization

### (4) Private Organizations

IHS Global Insight (2013)[4] forecasts that Myanmar's GDP growth will strengthen to 6.9% in FY2013/14 and 7% in FY2014/15. The medium-term economic projections indicate sustained strong economic growth with average GDP growth of 7.1% per year in the

[4] Asia Economic Outlook: Myanmar, IHS Global Insight, November 2013.

FY2014-16 period. IHS Global Insight, however, noted that Myanmar also faces key risks and vulnerabilities to the economic outlook as follows:

(i) The rapid pace of economic growth could trigger economic imbalances, notably risks of high inflation and rising asset prices, with a key risk being from a potential property bubble developing in Yangon due to surging land and property prices.

(ii) Poor physical infrastructure and lack of sufficient skilled labor create vulnerabilities to infrastructure bottlenecks and could result in rapidly rising wages and other input costs.

(iii) Political risk remains high, with general elections due to be held in 2015, which could raise tensions within the ruling party as the elections draw nearer.

(iv) Weak governance is a key challenge, requiring accelerated institutional capacity building in government departments, the financial regulatory system and the judicial system.

In an in-depth research on Myanmar's economy, McKinsey (2013)[5] stated that Myanmar has the potential to quadruple its economic output to US$200 billion by 2030 from US$50 billion in 2010 or an average GDP growth of about 7.7% per annum. This optimistic growth scenario would be achieved if Myanmar taps the full potential of seven driver sectors, notably: manufacturing, agriculture, infrastructure, energy/mining, tourism, financial services and telecommunications (Figure 4.2.1.2). If the current population trends continue and labor productivity remains the same as in the past two decades, McKinsey estimated that annual GDP growth could be as low as 3.7%.

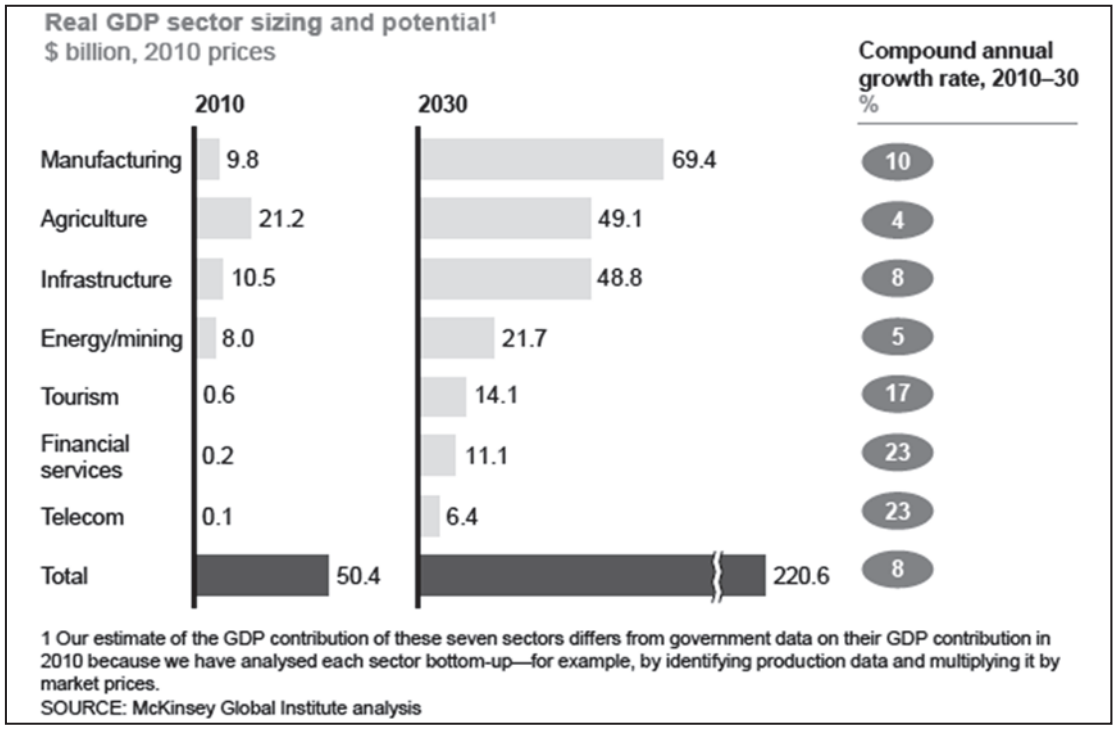



**Figure 4.2.1.2 Growth Sectors for Myanmar High Economic Growth Path**

[5] Myanmar's Moments: Unique Opportunities, Major Challenges, McKinsey Global Institute, June 2013.

#### 4) Long-Term GDP Growth Scenarios

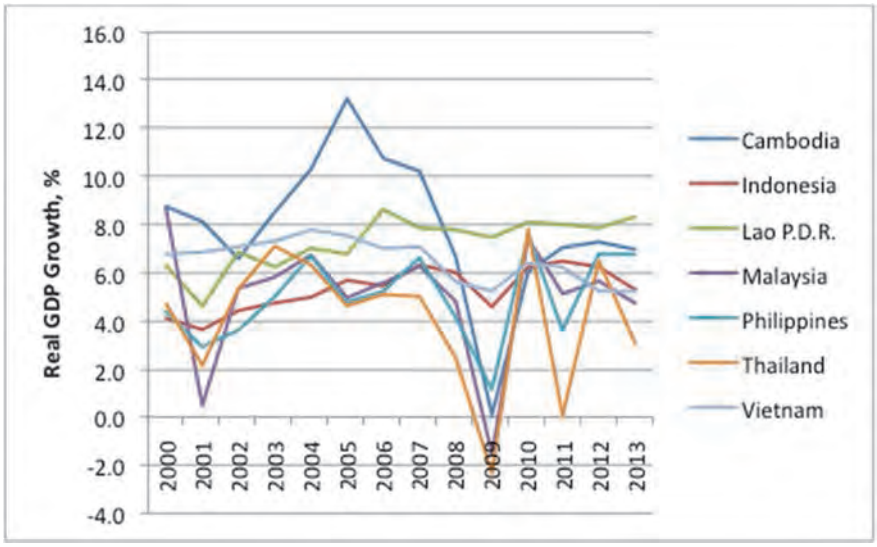
As presented above, various international institutions projected rapid, long-term economic growth for Myanmar, subject to major reforms in macro-economic systems. The following growth scenarios were formulated:

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

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

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

In order to determine whether such sustained rapid, long-term growth is feasible, an analysis of economic growth in ASEAN peer countries was undertaken. In observing economic development trends, the analysis revealed that all selected peer countries experienced GDP growth of between 5% and 8% as shown in Figure 4.2.1.3. The main comparator countries are Cambodia, Lao PDR, and Vietnam, which are part of the CLMV countries in transition to middle income country status. Through the adoption of its “Doi Moi” policy reforms, Vietnam has progressively transitioned from a centrally planned economy to a market economy with an average growth rate of 7.3% per year in the two decades from 1991-2010. On the other hand, Cambodia’s economy grew at almost 10% per year between 1998 and 2008, although this remarkable growth was interrupted by the global economic downturn in 2008-09. Cambodia’s growth momentum is expected to continue with projected growth rates of 6.7% in 2013 and 7% in 2014 as driven by strong exports, private investment, agriculture, diversification, and a solid macroeconomic position. Finally, Lao PDR’s economy has expanded on average by 7.1% per year from 2001 to 2010, and is expected to grow by 7.6 percent per year in 2011-2015 according to the World Bank.




Source: IMF/World Bank Country Economic Monitor reports

**Figure 4.2.1.3 Selected ASEAN Countries' GDP Growth**

Based on this analysis, it is highly probable that Myanmar has the potential to achieve such rapid economic development over the next three decades.

### 5) Long Term GDP Forecasts

Estimates of Myanmar's GDP values have been conflicting even among development partners as shown in Table 4.2.1.4.

**Table 4.2.1.4 Nominal Myanmar GDP Estimates, in US$ Billion**

| Fiscal Year | IMF | World Bank | ADB |
|---|---|---|---|
| 2010/11 | 49.628 | 45.380 | 35.200 |
| 2011/12 | 56.170 | 52.663 | 45.400 |
| 2012/13 | 55.273 | 51.849 | 51.900 |
| 2013/14 | 59.427 | 56.661 | n.a. |

Sources: IMF Country Report No. 13/250, August 2013; World Bank Myanmar Economic Monitor: October 2013; ADB Interim Country Partnership Strategy, October 2012.

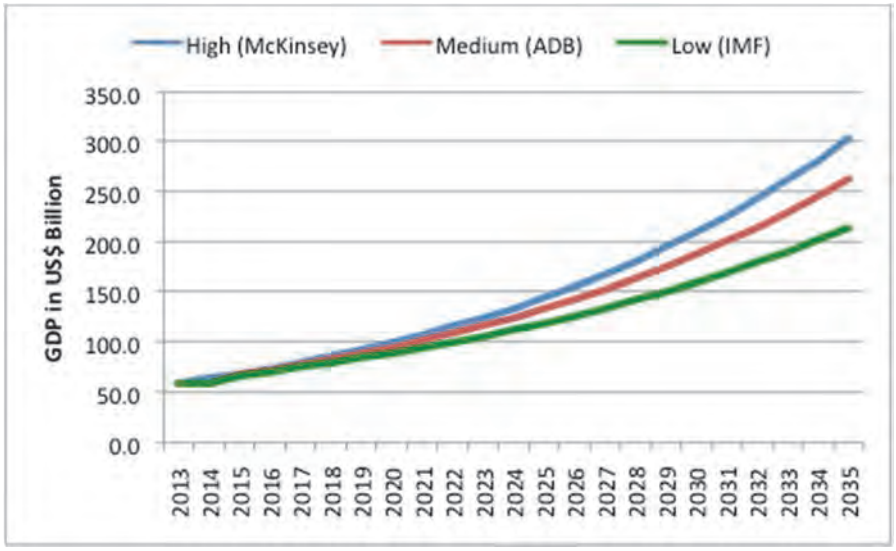
Noting that the Myanmar Government has generally agreed to the IMF findings and recommendations of the June 2013 Staff Report for the 2013 Article IV Consultation and First Review under the Staff-Monitored Program, the FY2013/14 IMF estimate of GDP of US$59.427 billion was taken as the base year GDP value for determining the long term GDP forecasts under the three growth scenarios. Table 4.2.1.5 presents the GDP forecasts, while Figure 4.2.1.4 shows these estimates in graphical forms.

**Table 4.2.1.5 Myanmar GDP Forecasts, in US$ Billion at 2013 prices**

| Fiscal Year | High (McKinsey) | Medium (ADB) | Low (IMF) |
|---|---|---|---|
| 2012/13 | 55.273 | 55.273 | 55.273 |
| 2013/14 | 59.427 | 59.427 | 59.427 |
| 2014/15 | 64.003 | 63.587 | 63.527 |
| 2015/16 | 68.931 | 68.038 | 67.339 |
| 2016/17 | 74.239 | 72.801 | 71.379 |
| 2017/18 | 79.955 | 77.897 | 75.662 |
| 2018/19 | 86.112 | 83.349 | 80.202 |

| Fiscal Year | High (McKinsey) | Medium (ADB) | Low (IMF) |
|---|---|---|---|
| 2019/20 | 92.742 | 89.184 | 85.014 |
| 2020/21 | 99.883 | 95.427 | 90.115 |
| 2021/22 | 107.575 | 102.107 | 95.522 |
| 2022/23 | 115.858 | 109.254 | 101.253 |
| 2023/24 | 124.779 | 116.902 | 107.328 |
| 2024/25 | 134.387 | 125.085 | 113.768 |
| 2025/26 | 144.735 | 133.841 | 120.594 |
| 2026/27 | 155.879 | 143.210 | 127.830 |
| 2027/28 | 167.882 | 153.235 | 135.500 |
| 2028/29 | 180.809 | 163.961 | 143.629 |
| 2029/30 | 194.731 | 175.438 | 152.247 |
| 2030/31 | 209.725 | 187.719 | 161.382 |
| 2031/32 | 225.874 | 200.859 | 171.065 |
| 2032/33 | 243.266 | 214.919 | 181.329 |
| 2033/34 | 261.998 | 229.964 | 192.209 |
| 2034/35 | 282.172 | 246.061 | 203.741 |
| 2035/36 | 303.899 | 263.285 | 215.966 |

Source: YUTRA Project Team




Source: YUTRA Project Team

**Figure 4.2.1.4 Myanmar GDP Forecasts by Growth Scenarios**

### 4.2.2 Greater Yangon Budget Estimates

#### 1) Infrastructure Spending and Economic Growth

There is an abundance of studies that concluded that investing in infrastructure generates economic and social benefits for individuals, communities, regions and the country as a whole. In a paper on emerging markets infrastructure, the Royal Bank of Scotland (2011)[6]

[6] The Roots of Growth: Projecting Emerging Markets infrastructure demand to 2030, The Royal Bank of Scotland, September 2011.

analyzed the relationship between infrastructure, economic growth and demographics for 40 countries in five emerging market regions, namely: Asia, Emerging Europe, Middle East, Africa and Latin America. The report concluded that investment in infrastructure in emerging markets could provide high returns for governments and meaningful improvements for populations in terms of increased incomes and job creation.

The study showed that Asia would account for the lion's share of infrastructure demand with around US$15.8 trillion spending needs, followed by Emerging Europe (US$1.3 trillion), Latin America (US$1.2 trillion), Africa (US$0.7 trillion) and the Middle East (US$0.2 trillion). In terms of the infrastructure breakdown, more than half of all investment needs (US$12.7 trillion) to be related to electricity generation, followed by road development (US$4.2 trillion), mobile telecommunications (US$2.0 trillion), fixed phone lines (US$0.2 trillion) and rail development (US$0.2 trillion).

**2) Planned Myanmar Public Investment and Transport Sector Allocation**

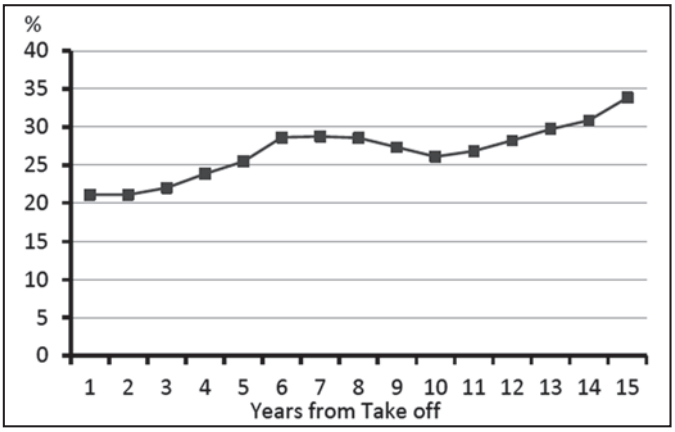
Set Aung (2013)[7] noted the levels of public investment for economic take-off in South Korea, Malaysia, Thailand, China, and Vietnam in Figure 4.2.2.1. In these comparable countries, total investment as % of GDP rose by about 8% in the early phase of reforms/take-off. For Myanmar, Set Aung stated that public investment/GDP:

(i) Starting from about 8.7% (average for FY11/12 and FY12/13);

(ii) Projected to rise to about 10% for the next few years;

(iii) May need to be raised by another 2.5% or 12.5% in future years; and

(iv) Reasonable to expect that 50% of public investment will come from the public sector, particularly for energy and economic zone projects.




Source: Set Aung, "Financing and Development", 2013

**Figure 4.2.2.1 Economic Take-Off and Investment in Selected Asian Countries**

Based on the above, the assumed public investment ratios are: 2011-2017 at 8.7% GDP (current level); 2017-2029 at 10% GDP (programmed, MNPED); and 2030-2035: 12.5%

[7] Set Aung, "Financing and Development", presentation during the First Myanmar Development Forum, 19-20 January 2013.

GDP (planned).

Noting from the Royal Bank of Scotland study on infrastructure investment in emerging markets, it was further assumed that 50% of total investments would be allocated for the transport sector of Myanmar.

Table 4.2.2.1 indicates the total and transport investment estimates for Myanmar from FY2014/15 - FY2035/36.

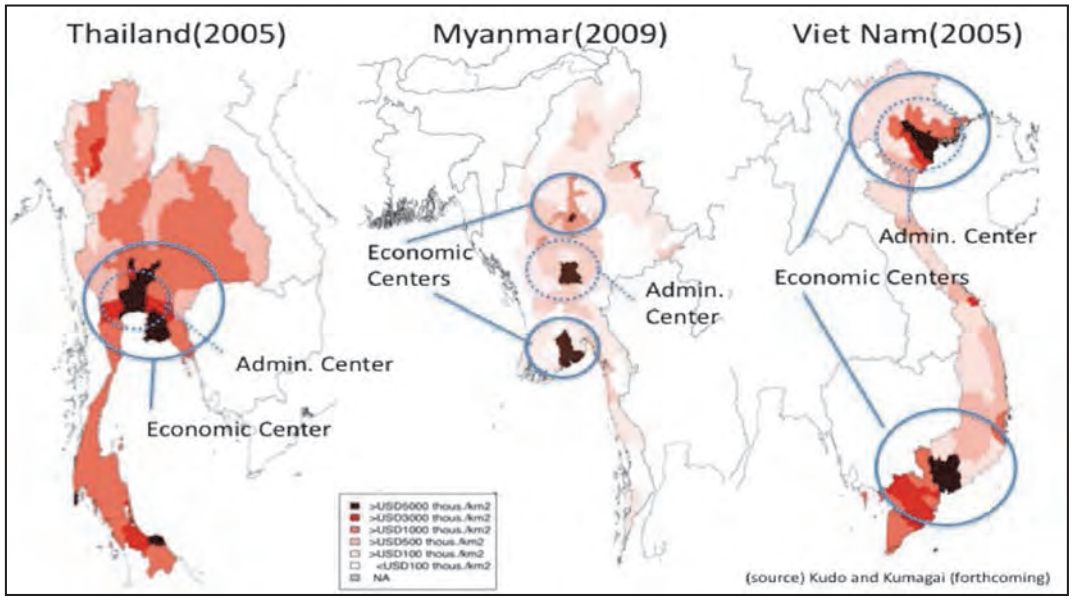
**Table 4.2.2.1 Total Public Investment and Transport Sector Allocation (US$ Billion at 2013 Prices)**

| Fiscal Year | Total Public Investment | | | Total Transport Investment | | |
|---|---|---|---|---|---|---|
| | High (McKinsey) | Medium (ADB) | Low (IMF) | High (McKinsey) | Medium (ADB) | Low (IMF) |
| 2014/15 | 5.568 | 5.532 | 5.480 | 2.784 | 2.766 | 2.740 |
| 2015/16 | 5.997 | 5.919 | 5.809 | 2.999 | 2.960 | 2.905 |
| 2016/17 | 6.459 | 6.334 | 6.158 | 3.229 | 3.167 | 3.079 |
| 2017/18 | 6.956 | 6.777 | 6.527 | 3.478 | 3.389 | 3.264 |
| 2018/19 | 7.494 | 7.301 | 7.032 | 3.747 | 3.651 | 3.516 |
| 2019/20 | 8.072 | 7.864 | 7.574 | 4.036 | 3.933 | 3.788 |
| 2020/21 | 8.699 | 8.475 | 8.162 | 4.349 | 4.238 | 4.082 |
| 2021/22 | 9.367 | 9.126 | 8.789 | 4.684 | 4.564 | 4.395 |
| 2022/23 | 10.084 | 9.825 | 9.463 | 5.042 | 4.913 | 4.732 |
| 2023/24 | 10.864 | 10.585 | 10.194 | 5.432 | 5.293 | 5.098 |
| 2024/25 | 11.700 | 11.399 | 10.979 | 5.850 | 5.700 | 5.490 |
| 2025/26 | 12.599 | 12.274 | 11.822 | 6.299 | 6.138 | 5.912 |
| 2026/27 | 13.567 | 13.218 | 12.730 | 6.783 | 6.610 | 6.366 |
| 2027/28 | 14.618 | 14.242 | 13.717 | 7.309 | 7.122 | 6.859 |
| 2028/29 | 15.740 | 15.335 | 14.769 | 7.870 | 7.668 | 7.386 |
| 2029/30 | 16.951 | 16.515 | 15.906 | 8.476 | 8.259 | 7.954 |
| 2030/31 | 18.257 | 17.787 | 17.131 | 9.129 | 8.895 | 8.567 |
| 2031/32 | 19.664 | 19.158 | 18.451 | 9.832 | 9.580 | 9.227 |
| 2032/33 | 21.178 | 20.633 | 19.872 | 10.589 | 10.318 | 9.937 |
| 2033/34 | 22.807 | 22.220 | 21.401 | 11.404 | 11.112 | 10.702 |
| 2034/35 | 24.567 | 23.935 | 23.052 | 12.284 | 11.969 | 11.528 |
| 2035/36 | 26.457 | 25.776 | 24.825 | 13.228 | 12.890 | 12.415 |
| **FY2014-2017** | **24.980** | **24.562** | **23.974** | **12.490** | **12.282** | **11.988** |
| **FY2018-2025** | **78.879** | **76.849** | **74.014** | **39.439** | **38.430** | **37.013** |
| **FY2026-2035** | **193.806** | **188.819** | **181.853** | **96.903** | **94.423** | **90.941** |

Source: YUTRA Project Team

### 3) Greater Yangon Transport Investments

In common with historical budget allocation, significant public investments for infrastructure needs are directed to key economic centers/capital regions in Asia. For Thailand, Myanmar and Vietnam, these economic centers (Figure 4.2.2.2) provide at least 20% of the country's GDP.




Source: YUTRA Project Team

**Figure 4.2.2.2 Economic Centers of Thailand, Myanmar and Vietnam**

If Greater Yangon is to be an important source of Myanmar's economic growth, then the metropolitan area investment plan must provide basic infrastructure to accommodate a population that is both larger in size and better off than the rest of the country's citizens. Greater Yangon is almost certain to become a key engine in the nation's economic development as Myanmar's largest city, commercial capital, most important port and tourist destination, and most logical site for export-oriented manufacturing.

In estimating the transport funding envelope for Greater Yangon, the key principle in allocating Myanmar's resources is to invest in areas with the greatest potential to contribute to economic outputs. For FY2011/12 to FY2012/13, Yangon Region's economic contribution is about 22% of the country's GDP. The Interim Report (2013) of the JICA Survey Program for the National Transport Development Plan, the GRDP estimates of Yangon Region are: 25% in the medium-term and 30% in the long-term. On this basis, the Greater Yangon transport budget envelopes are assumed to be equal to the GRDP estimates as follows:

(i) 2011-2017: 22% share (prevailing GRDP of Yangon Region);

(ii) 2018-2029: 25% share (JICA National Transport Study estimate); and

(iii) 2030-2035: 30% (JICA National Transport Study estimate)

Table 4.2.2.2 presents the expected budget allocation for Greater Yangon transport requirements.

**Table 4.2.2.2 Greater Yangon Transport Sector Budget Envelopes (US$ Billion at 2013 Prices)**

| Fiscal Year | Greater Yangon Transport Investment | | |
|---|---|---|---|
| | High (McKinsey) | Medium (ADB) | Low (IMF) |
| 2014/15 | 0.613 | 0.609 | 0.603 |
| 2015/16 | 0.660 | 0.651 | 0.639 |
| 2016/17 | 0.710 | 0.697 | 0.677 |
| 2017/18 | 0.765 | 0.745 | 0.718 |
| 2018/19 | 0.824 | 0.803 | 0.774 |
| 2019/20 | 0.888 | 0.859 | 0.820 |
| 2020/21 | 0.957 | 0.919 | 0.869 |
| 2021/22 | 1.030 | 0.983 | 0.921 |
| 2022/23 | 1.109 | 1.052 | 0.977 |
| 2023/24 | 1.195 | 1.125 | 1.035 |
| 2024/25 | 1.287 | 1.205 | 1.097 |
| 2025/26 | 1.386 | 1.289 | 1.163 |
| 2026/27 | 1.492 | 1.379 | 1.233 |
| 2027/28 | 1.608 | 1.475 | 1.307 |
| 2028/29 | 1.731 | 1.579 | 1.385 |
| 2029/30 | 1.864 | 1.689 | 1.468 |
| 2030/31 | 2.008 | 1.807 | 1.557 |
| 2031/32 | 2.163 | 1.933 | 1.650 |
| 2032/33 | 2.329 | 2.069 | 1.749 |
| 2033/34 | 2.508 | 2.214 | 1.854 |
| 2034/35 | 2.702 | 2.369 | 1.965 |
| 2035/36 | 2.910 | 2.535 | 2.083 |
| **FY2014-2017** | **2.748** | **2.702** | **2.637** |
| **FY2018-2025** | **8.675** | **8.234** | **7.656** |
| **FY2026-2035** | **21.314** | **19.048** | **16.252** |

Source: YUTRA Project Team

## 4.3 Land Use and Transport Integration

### 4.3.1 Planning Approach

The level of transport services and choice in the city of Yangon and the surrounding areas are very limited as of today, while a number of real estate development by the private sector are happening in the city thanks to the removal of the unilateral trading and investment sanctions policy. In addition to such private sector's activities in the city, major projects that are initiated by the public sector are also happening. Those major projects include Thilawa SEZ and the associated new port, capacity expansion of the existing ports in Yangon, Yangon circular rail improvement, Yangon rail station area re-generation, Yangon International Airport terminal expansion, etc. Such major projects will lead to a significant change of travel patterns and volumes in the near future.

Land use development patterns and corresponding transport network influence transportation choices and transport environment as experienced in the past. It is needless to say that integrating transportation and land use planning is essential, especially to meet the ever growing transport needs of a vibrant city like Yangon.

It is obvious that the existing and future transport needs in Yangon cannot be accommodated through road capacity expansion and improvement of the existing public transport systems alone. People know already that such limited supply side approach does not work to meet the rapidly increasing transport needs. In order to alleviate the current traffic congestion and other traffic related problems, some minor countermeasures should be taken as short-term measures, and they may work to a certain extent. In parallel, an integrated transport planning effort should be made to achieve a better transport environment and a liveable city in a long-term perspective.

The Project for the Strategic Urban Development Plan for the Greater Yangon (2013, JICA) (hereinafter called as SUDP) provides fundamental ideas of the future land use in the Greater Yangon area (Yangon and the surrounding areas). SUDP proposes a multi centric and balanced development pattern as the major spatial structure of the Greater Yangon, which is expected to reduce excessive traffic concentration to/from the existing downtown area.

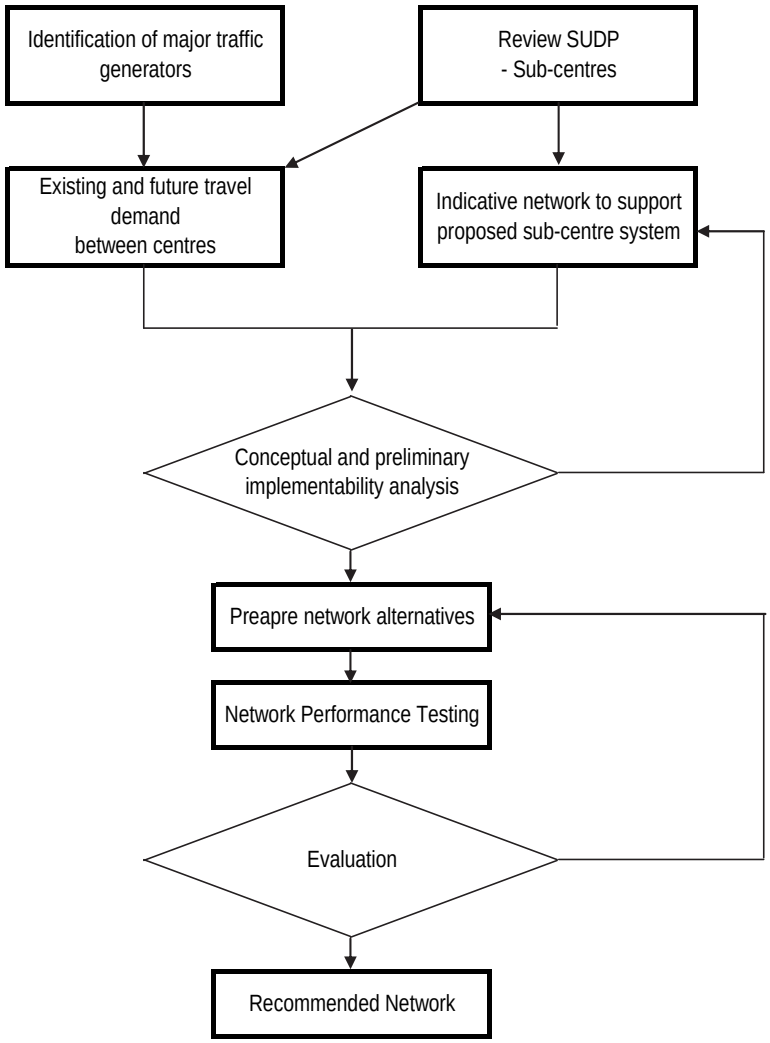
A well-designed "Transit Oriented Development (TOD)" is highly expected at each newly designated centre, that is, development of compact (mid- to high-dense development), mixed-use infill development with streets having priority to transit systems, and preferential design for pedestrians should be encouraged in order to meet variety of quality of life objectives.

Whilst trunk transport systems of high speed and large capacity should be developed between such centres in order to accommodate the social, commercial and other transport needs of the residents, visitors, business people and goods movement. Accordingly a strategic investment plan in the trunk transport system development is needed to ensure that the transportation network can meet such variety of travel needs. Through effective coordination between land-use (SUDP) and transportation planning early in the planning stage, it is expected that better outcomes that meet the city's overall quality of life goals are achieved.

The process to identify a better strategic networking plan of the trunk urban transport systems in the city of Yangon and the surrounding areas is composed of five major tasks:

- Identification of major traffic generators including the existing, on-going and committed projects;
- Review of SUDP, focusing on centre locations and newly proposed industrial areas;
- Evaluation of the existing transport network from a view of future spatial development pattern;
- Integration with the existing and proposed national level transport systems; and
- Recommended conceptual plan of urban transport network

Further detailed evaluation of the component projects with corresponding demand forecast and associated economic evaluation is made in the following chapters




Source: YUTRA Project Team

**Figure 4.3.1.1 Planning Approach**

### 4.3.2 Strategic Urban Development Plan

#### 1) "Sub-centres with Green Isle System"

SUDP recommended "Sub-centres with Green Isle System" development pattern (decentralized urban functions) as the preferred option by comparing three different urbanization patterns. This development pattern has the following features in general (see Figure 4.3.2.1):

(1) Urbanization Pattern - decentralization

- Removal and transfer of some major urban functions in the existing downtown areas (CBD) to newly designated sub-centres and new town centres.
- Promotion of corridor development (called "sub-centre growth belt") between newly identified sub-centres
- Urbanization shall be limited within the designated outer ring road (ORR), while the urbanization within the ORR shall be encouraged.

(2) Distribution of Main Urban Functions

- New sub-centres shall be developed on the circumference of around 10 – 15 km radius from CBD. Such sub-centres are Hlaing Tharya, Mindama, Dagon Myothit, Thanlyin, and Thilawa.
- Limit excessive urban development in the CBD.
- Removal and transfer of some major urban functions in the existing downtown areas (CBD) to newly designated sub-centres and new town centres.

(3) Conservation of Green area

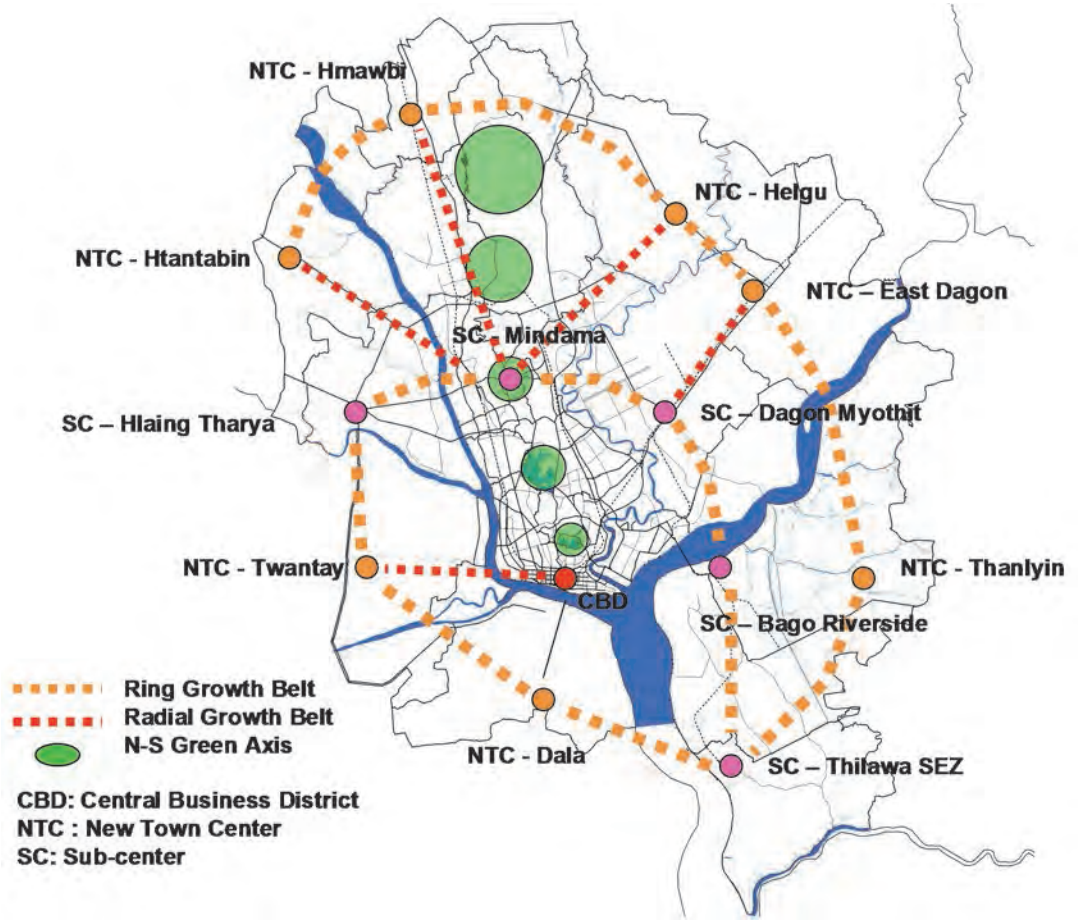
- Designated conservation areas: Hlawga protected area, and Inya Lake
- Development of "North – South Green Axis" using the existing conservation areas.
- Conservation of agricultural area

#### 2) Centre System

SUDP recommends multiple city centres in a hierarchical manner:

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

The development scale of sub-centre is 120ha (300 acre) for each except Thilawa SEZ sub-centre (50 ha or 125 acre). While that of new town centres is 200 ha (500 acre) for each.




Source: SUDP, JICA (2013)

**Figure 4.3.2.1 Sub-Centres with Green Isle System by SUDP**

### 4.3.3 Networking Concept

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

This pattern of centre distribution suggests a corresponding network in a hierarchical manner as follows;

- CBD – Sub-centre Link
- Link between Sub-centres
- Sub-centre – New Town Core area Link
- Link between New Town Core areas

This hierarchical network (or links) indicates necessary feature of transport facilities served along each link in terms of capacity, speed, and modes.

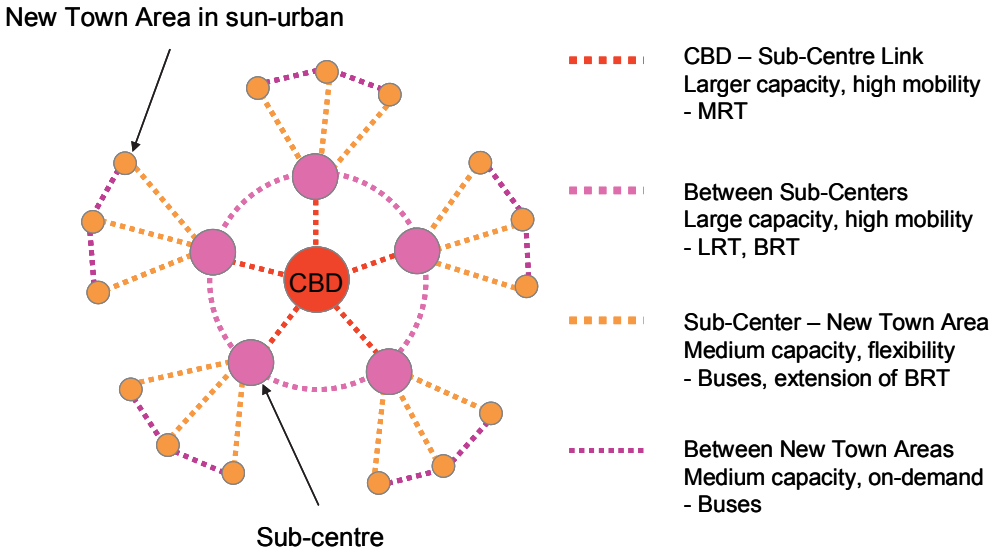
Links between CBD and Sub-centres in general require larger capacity, higher speed, punctuality, etc. such as Mass Rapid Transit (MRT) as a preferred mode of transport.

Links between sub-centres require medium capacity, higher mobility and accessibility for

circumference direction, etc. such as Light Rail Transit (LRT) and Bus Rapid Transit (BRT) on a ring road.

Links between sub-centres and surrounding new town core areas require medium capacity, on-demand service, etc.,; such services can be provided by extension of BRT spur line, regular buses, and taxis.

Figure 4.3.3.1 shows a generic concept of networking with the given hierarchical urban structure.




Source: YUTRA Project Team

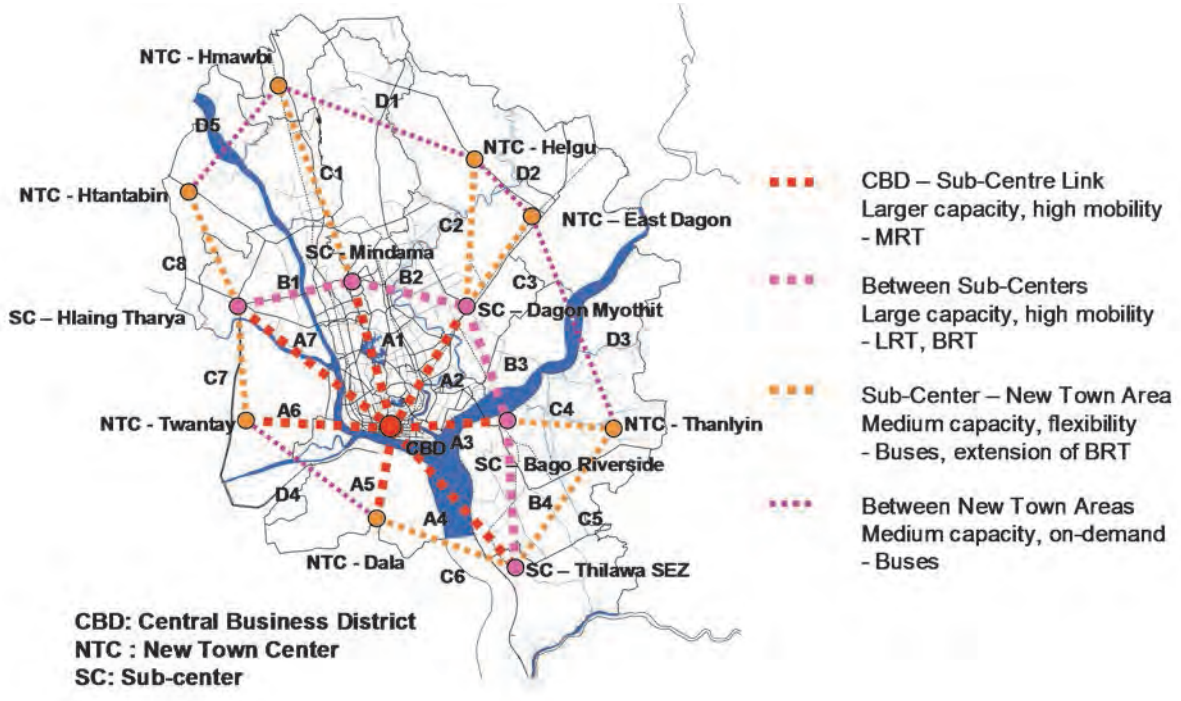
**Figure 4.3.3.1 Hierarchical Centre System and Links**

### 4.3.4 Evaluation of the existing network

#### 1) Methodology statement

As suggested in the previous section, major kinks connecting proposed centres are identified as shown in Figure 4.3.4.1.

In principle, transit services should be provided for every link connecting centres, and such transit services shall also be provided in a hierarchical manner, which is supported by a hierarchical road network. For example, BRT should be served on a higher order arterial road (6-lane or more with median), while it is not recommended to have BRT on a lower order road such as 4-lane single carriageway (except such road segments in highly urbanized area where terminal BRT stations are normally provided). UMRT is generally recommended to connect CBD and surrounding sub-centres, while extension of such high order public transport system to surrounding town centre areas and strategic destinations such as airport and port area should be carefully considered from a demand point of view.




Source: YUTRA Project Team

**Figure 4.3.4.1 SUDP Hierarchical Centre System and Corresponding Links**

### (1) CBD – Sub-Centre Link

In total seven links are identified for consequent link analysis.

- A1: CBD and SC Mindama
- A2: CBD and SC Dagon Myothit
- A3: CBD and SC Bago Riverside
- A4: CBD and SC Thilawa SEZ
- A5: CBD and NTC Dala
- A6: CBD and NTC Twantay
- A7: CBD and SC Hlaingtharyar

The other links have limited road connectivity, that is, they have only 4-lane road capacity or less as major connectors.

The other links have limited road connectivity, that is, they have only 4-lane road capacity or less as major connectors.

Table 4.3.4.1 summarizes link characteristics as of year 2013 in term of road capacity and available modes.

**Link A1**: CBD - SC-Mindama forms a main north-south axis of the city, having the largest carrying capacity of 12-lane (Pyay Rd. + Kaba Aye Pagoda Rd.) in the city. The exiting traffic volume on these major roads are reaching the carrying capacity (design capacity), accordingly heavy traffic congestion is observed at almost every intersection along this corridor.

**The existing link capacity of Link A2**: CBD - SC-Dagon Myothit is limited because of limited crossing opportunities at the Nga Moe Yeik Creek, including Nga Moe Yeik bridge and Parami bridge.

Similarly the existing link capacity of Link A3: CBD - SC-Bago Riverside is limited because of limited crossing opportunities at the Nga Moe Yeik Creek, including Thaketha bridge and Thuwunna bridge.

**Link A4**: CBD – NTC Dala has a rail connection (single track), but the existing level of service is very limited, and the road capacity is also small.

**There is no land transport link for Link A5**: CBD – NTC Dala as of today, which is connected by regular ferry boats and small boats called “sampans” of limited capacity. (See Figure 4.3.4.3)

The other links have limited road connectivity, that is, they have only 4-lane road capacity or less as major connectors.

**Table 4.3.4.1 CBD – Sub-centre Links, 2013**

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

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

Source: YUTRA Project Team

Source: YUTRA Project Team

**Figure 4.3.4.2 Thanlyin Rail and Road for Link A4**

Source: YUTRA Project Team

**Figure 4.3.4.3 Ferry and Sampans Crossing at Link A5**

**(2) Link between Sub-Centres**

Four links are identified for consequent link analysis.

- B1: SC Hlaingtharyar and SC Mindama
- B2: SC Mindama and SC Dagon Myothit
- B3: SC Dagon Myothit and SC Bago Riverside
- B4: SC Bago Riverside and SC Thilawa SEZ

Table 4.3.4.2 summarizes link characteristics as year 2013 in term of road capacity and available modes.

**Link B1**: SC-Hlaingtharyar and SC-Mindama is connected via the Hlaing River Bridge and Aung Zaya bridge. The Aung Zaya bridge is heavily used by heavy vehicles which have their destinations in the Hlaing Thayar industrial areas (See Figure 4.3.4.4).

**The existing capacity of Link B2**: SC-Mindama and SC-Dagon Myothit is limited because of limited crossing capacity at the Nga Moe Yeik Creek.

**Connectivity of Link B3**: SC Dagon Myothit and SC Bago Riverside is limited because of the limited rail (MR Yangon – Bago line) crossing.

**Link B4**: Bago Riverside and SC Thilawa SEZ is connected via the Dagon bridge, which is currently underutilized in terms of traffic volume.

**Table 4.3.4.2 Link between Sub-centres, 2013**

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

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

Source: YUTRA Project Team

Source: YUTRA Project Team

**Figure 4.3.4.4 Hlaing River Bridge (left) and Aung Zaya Bridge (right) for Link B1**

**(3) Link between Sub-Centre and New Town Area**

In total eight links are identified for the consequent link analysis.

- C1: NTC Hmawbi and SC Mindama
- C2: NTC Hlegu and SC Dagon Myothit
- C3: NTC East Dagon and SC Dagon Myothit
- C4: NTC Thanlyin and SC Bago Riverside
- C5: NTC Thanlyin and SC Thilawa SEZ
- C6: NTC Dala and SC Thilawa SEZ
- C7: NTC Twantay and SC Hlaingtharyar
- C8: NTC Htantabin and SC Hlaingtharyar

The existing national (union) highway network is available for Link C1 (NH 4), C3 (NH2), and C5 (NH6).

There is no land transport connection nor water transport service for Link C6: NTC Dala and SC Thilawa SEZ at present.

In general road connectivity in the suburban area, where these sub-centre – town centre links are expected, is very limited. Table 4.3.4.3 summarizes link characteristics between proposed sub-centres and town centres.

**Table 4.3.4.3 Link between Sub-centre and Town Centre, 2013**

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

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

Source: YUTRA Project Team

### (4) Link between New Town Areas

A total of five links are identified as follows:

- D1: NTC Hmawbi and NTC Hlegu
- D2: NTC-Hlegu and NTC East Dagon
- D3: NTC-East Dagon and NTC Thanlyin
- D4: NTC-Dala and NTC Twantay
- D5: NTC Htantabin and NTC Hmawbi

These links form a ring surrounding the future (planned) urbanized area of the Greater Yangon as informed by SUDP. The existing connectivity between the proposed town centre locations are generally very weak. Table 4.3.4.4 summarized characteristics of each link as of today.

**Table 4.3.4.4 Link between Town Centres, 2013**

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

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

Source: YUTRA Project Team

### 2) Link Analysis

#### (1) Desire line analysis (refer to Figure 4.3.4.5)

Major passenger travel demand in 2013 is observed along the north-south axis (between CBD and Mindama area) in the area between the Yangon River and the Nga Moe Yeik Creek. Another heavy demand is observed between CBD and the eastern part of old Yangon, namely Oakkalapa township and surrounding area.

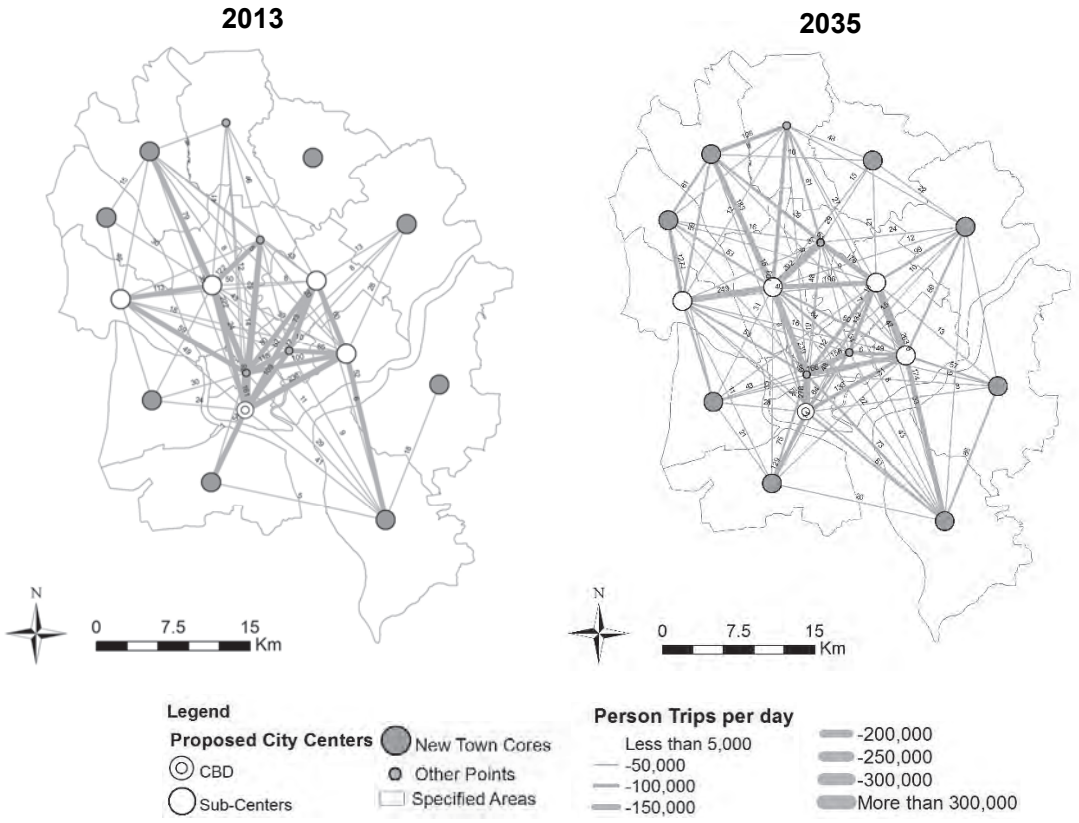
The year 2035 desire line informs that:

- The north-south movement demand pattern is further extended to the proposed Town Centre Hmawbia area.
- Some significant demand in the western side of the Yangon river is generated in the proposed Town Centre Htanttabin area.
- Another significant demand is generated in the proposed New Town Centre Dala.
- A travel demand pattern of circular movement is observed

#### (2) Link volume on a spider network (refer to Figure 4.3.4.6)

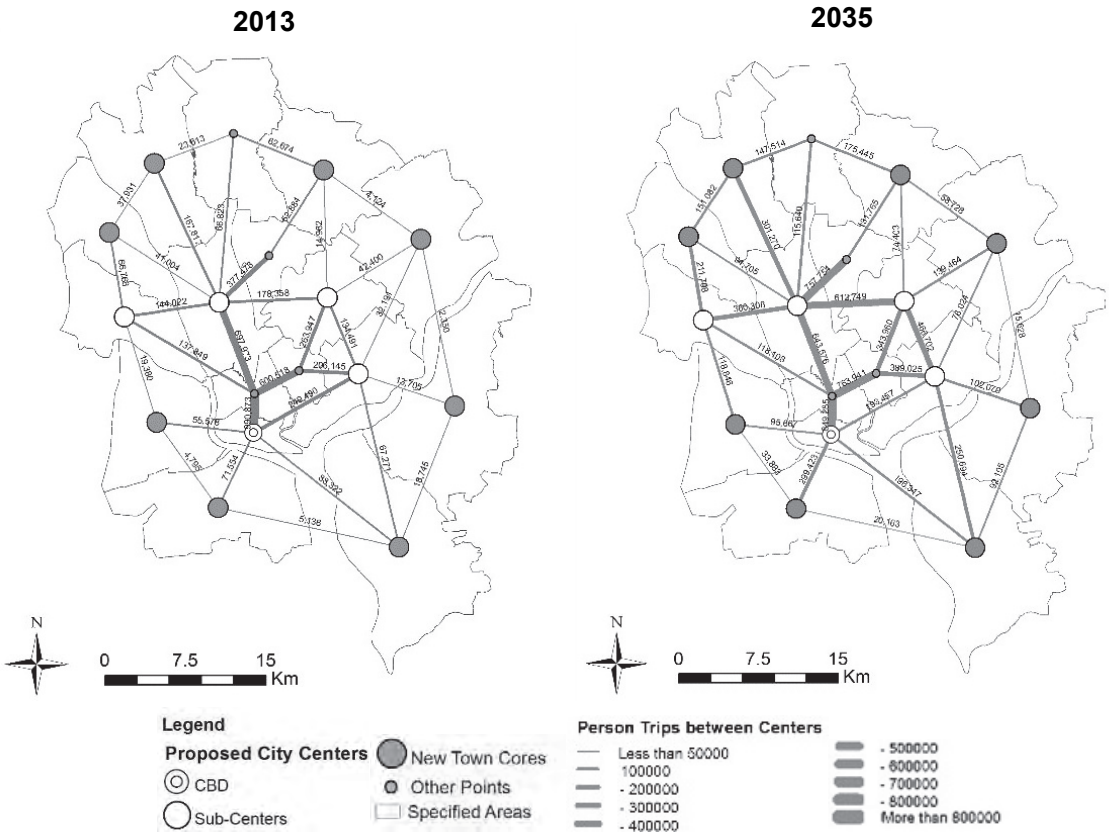
Assuming 60% of the total passenger demand of each link is carried by public modes of transport, a likely public mode of transport is indicated. If a 60% of the link volume exceeds 10,000 passenger per peak-hour per direction, a form of mass transit is suggested, while such demand is below 10,000 but above 6,000 passenger per peak-hour per direction, a transit system of medium carrying capacity such as BRT/LRT is suggested (refer to Table 4.3.4.5).

The remaining 40% of the total demand is assumed to be carried by private mode of transport, namely passenger cars. The estimated peal-hour vehicular traffic suggests necessary road capacity in terms of the number of lane (refer to Table 4.3.4.6).




Source: YUTRA Project Team

**Figure 4.3.4.5 Desire Line between centres, 2013 and 2035**




Source: YUTRA Project Team

**Figure 4.3.4.6 Person Trips on Link between centres, 2013 and 2035**

Assessment of each link is summarized as follows:

(A) Link between CBD and Sub-centre

A1: CBD – S/C Mindama (main N-S axis)

- 2013 passenger volume – UMRT
- 2035 passenger volume – UMRT + road capacity increase (additional 2 lane)
- The existing demand (698,000 person trips per day) requires high order transit system already. The future demand will remain the same or slightly smaller because of a series of S/C development.
- MR Circular Rail is serving, but limited LOS.

A2: CBD – S/C Dagon Myothit

- 2013 passenger volume – BRT/LRT
- 2035 passenger volume – UMRT + road capacity increase (4-lane)
- The existing demand (264,000 person trips per day) requires high order transit system already. This will increase to 344,000 person trips per day in 2030, which will require UMRT.

A3: CBD – S/C Bago Riverside

- 2013 passenger volume – UMRT
- 2035 passenger volume – UMRT + road capacity increase (10-lane)
- The existing demand (456,000 person trips per day) requires high order transit system already. This will increase to 582,500 person trips per day in 2030.
- Possible road capacity increase (NH No.1) will be very limited. MR Yangon – Bago line is serving, but limited LOS as of today. A significant improvement of the existing MR service is required.

A4: CBD – S/C Thilawa SEZ

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + road capacity increase (4-lane)
- MR Thanlyin line is serving, but LOS is very limited.

A5: CBD – NTC Dala

- 2013 passenger volume – Bus / Ferry
- 2035 passenger volume – BRT / LRT + road capacity increase (8-lane)
- The existing demand (72,000) is accommodated by mainly water transport (ferry and sampans), which will increase to 299,000 (4.15 times). A significant capacity increase is required by providing PT (UMRT or BRT) and bridges/tunnels by 2030.

A6: CBD – S/C Twantay

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + no road capacity increase

- The existing demand is about 55,600 persons per day, which will increase to 95,600 (1.72 times). This demand can be accommodated by buses.

A7: CBD – S/C Hlaing Thayar

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + no road capacity increase
- The existing demand is 138,000 person trips per day, which will decrease 118,000 (0,86 times) because a larger trips will be attracted to SC Mindama.

(B) Link Between Sub-centres

B1: S/C Hlaing Thayar and S/C Mindama

- 2013 passenger volume – Bus
- 2035 passenger volume – UMRT + additional road capacity (2-lane)
- The existing demand (144,000 person trips per day), which can be accommodated by buses. This will increase to 360,300 (2.5 times) in 2030, which will require a high order transit system.

B2: S/C Mindama – S/C Dagon Myothit

- 2013 passenger volume – Bus
- 2035 passenger volume – UMRT + additional road capacity (10-lane)
- The existing demand (178,400 person trips per day), which will increase to 612,700 (3.43 times) in 2030. This demand requires a higher order transit system such as UMRT and a high order road system such as urban expressway.

B3: S/C Dangon Myothit – S/C Bago Riverside

- 2013 passenger volume – Bus
- 2035 passenger volume – UMRT + additional road capacity (8-lane)
- The existing demand (134,500 person trips per day), which will increase to 466,700 person trips per day in 2030. This demand will require a higher order transit service and a high order road system.

B4: S/C Bago Riverside and S/C Thilawa SEZ

- 2013 passenger volume – Bus
- 2035 passenger volume – BRT + additional road capacity (2-lane)
- The existing demand (67,3000 person trips per day), which can be accommodated by buses. This will increase to 250,700 (3.73 times) in 2030, which will require a high order transit system such as BRT/LRT.

(C) Link between Sub-Centre and New Town Centre

C1: NTC Hmawbi – S/C Mindama

- 2013 passenger volume – Bus
- 2035 passenger volume – BRT + additional road capacity (6-lane)

- The existing demand (167,800 person trips per day), which will increase to 301,300 person trips per day (1.8 times) in 2030. This demand will require a higher order transit service such as BRT/LRT.

C2: NTC Hlegu – S/C Mindama

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + no road capacity increase
- The existing demand (52,900 person trips per day), which will increase to 131,800 person trips per day (2.49 times) in 2030. This demand can be accommodated by buses.

C3: NTC East Dagon and S/C Dagon Myothit

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + no road capacity increase
- The existing demand (42,400 person trips per day), which can be accommodated by buses. This will increase to 139,500 (3.29 times) in 2030, which still can be accommodated by buses.

C4: NTC Thanlyin – S/C Bago Riverside

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + no road capacity increase
- The existing demand (13,700 person trips per day), which will increase to 102,100 (7.45 times) in 2030. This is a significant increase, but which can be accommodated by sues.

C5: NTC Thanlyin – S/C Thilawa SEZ

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + no road capacity increase
- The existing demand (18,700 person trips per day), which will increase to 92,100 person trips per day (4.93 times) in 2030. The growth rate is high, but this demand can be accommodated by buses.

C6: NTC Dala and S/C Thilawa SEZ

- 2013 passenger volume – Ferry
- 2035 passenger volume – Bus / Ferry + new road (2-lane)
- The existing demand (5,100 person trips per day), which will increase to 20,200 (3.96) in 2030. If a bridge is provided such demand can be accommodated by buses.

C7: NTC Twantay and S/C Hlaing Thayar

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + additional road capacity increase (2-lane)
- The existing demand (19,400 person trips per day), which will increase to 118,800 (6.12 times) in 2030. This is a significant increase, but which can be accommodated

by sues.

C8: NTC Htantabin and S/C Hlaing Thayar

- 2013 passenger volume – Bus
- 2035 passenger volume – BRT / LRT + additional road capacity increase (2-lane)
- The existing demand (66,800 person trips per day), which will increase to 211,700 person trips per day (3.17 times) in 2030. The growth rate is high, and this needs a higher order PT system such as BRT/LRT.

(D) Link between New Town Centres

D1: NTC Hmawbi and NTC Hlegu

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + no additional road capacity increase
- The existing demand (62,700 person trips per day), which will increase to 175,400 (2.80 times) in 2030. This is a significant increase, but can be accommodated by buses.

D2: NTC Hlegu and NTC East Dagon

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + no additional road capacity increase
- The existing demand (4,100 person trips per day), which will increase to 58,700 (14.32 times) in 2030. This is a significant increase, but still can be accommodated by buses.

D3: NTC East Dagon and NTC Thanlyin

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + additional road capacity increase (2-lane)
- The existing demand (2,400 person trips per day), which will increase to 15,600 (6.50 times) in 2030. This is a significant increase, but can be accommodated by buses.

D4: NTC Dala and NTC Twantay

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + additional road capacity increase (2-lane)
- The existing demand (18,700 person trips per day), which will increase to 33,900 (1.81 times) in 2030. This is a significant increase, but can be accommodated by buses.

D5: NTC Htantabin and NTC Hmawbi

- 2013 passenger volume – Bus
- 2035 passenger volume – Bus + additional road capacity increase (2-lane)
- The existing demand (37,900 person trips per day), which will increase to 151,100 (3.99 times) in 2030. This is a significant increase, but still can be accommodated by buses.

## Table 4.3.4.5 Link Volume Analysis (public transport)

| Link | | Link between | | Person trip / day | | | Indicative PT modes, 2013 | | | Indicative PT modes, 2035 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 2013 | 2035 | 2035/2013 | Target passenger volume by PT (60%) per day | Peak-hour volume (passenger per hour per direction) | System | Target passenger volume by PT (60%) per day | Peak-hour volume (passenger per hour per direction) | System |
| CBD - Sub center Link | A1 | CBD | SC-Mindama | 698,000 | 644,000 | 0.92 | 418,800 | 20,940 | MRT | 386,400 | 19,320 | MRT |
| | A2 | | SC-Dagon Myothit | 264,000 | 344,000 | 1.30 | 158,400 | 7,920 | BRT | 206,400 | 10,320 | MRT |
| | A3 | | SC-Bago Riverside | 249,500 | 193,500 | 0.78 | 149,700 | 7,485 | BRT | 116,100 | 5,805 | Bus |
| | A4 | | SC-Thilawa SEZ | 88,300 | 196,000 | 2.22 | 52,980 | 2,649 | Bus | 117,600 | 5,880 | Bus |
| | A5 | | NTC-Dala | 72,000 | 299,000 | 4.15 | 43,200 | 2,160 | Bus | 179,400 | 8,970 | BRT |
| | A6 | | NTC-Twantay | 55,600 | 95,600 | 1.72 | 33,360 | 1,668 | Bus | 57,360 | 2,868 | Bus |
| | A7 | | SC-Hlaingtharyar | 138,000 | 118,000 | 0.86 | 82,800 | 4,140 | Bus | 70,800 | 3,540 | Bus |
| Link Between Sub-cebters | B1 | SC-Hlaingtharyar | SC-Mindama | 144,000 | 360,300 | 2.50 | 86,400 | 4,320 | Bus | 216,180 | 10,809 | MRT |
| | B2 | SC-Mindama | SC-Dagon Myothit | 178,400 | 612,700 | 3.43 | 107,040 | 5,352 | Bus | 367,620 | 18,381 | MRT |
| | B3 | SC-Dagon Myothit | SC-Bago Riverside | 134,500 | 466,700 | 3.47 | 80,700 | 4,035 | Bus | 280,020 | 14,001 | MRT |
| | B4 | SC-Bago Riverside | SC-Thilawa SEZ | 67,300 | 250,700 | 3.73 | 40,380 | 2,019 | Bus | 150,420 | 7,521 | BRT |
| Sub-center and New Town Link | C1 | NTC-Hmawbi | SC-Mindama | 167,800 | 301,300 | 1.80 | 100,680 | 5,034 | Bus | 180,780 | 9,039 | BRT |
| | | Corridor inbetween C1 and C2 | | 66,800 | 115,600 | 1.73 | 40,080 | 2,004 | Bus | 69,360 | 3,468 | Bus |
| | C2 | NTC-Hlegu | SC-Dagon Myothit | 52,900 | 131,765 | 2.49 | 31,740 | 1,587 | Bus | 79,059 | 3,953 | Bus |
| | C3 | NTC-East Dagon | SC-Dagon Myothit | 42,400 | 139,500 | 3.29 | 25,440 | 1,272 | Bus | 83,700 | 4,185 | Bus |
| | C4 | NTC-Thanlyin | SC-Bago Riverside | 13,700 | 102,100 | 7.45 | 8,220 | 411 | Bus | 61,260 | 3,063 | Bus |
| | C5 | NTC-Thanlyin | SC-Thilawa SEZ | 18,700 | 92,100 | 4.93 | 11,220 | 561 | Bus | 55,260 | 2,763 | Bus |
| | C6 | NTC-Dala | SC-Thilawa SEZ | 5,100 | 20,200 | 3.96 | 3,060 | 153 | Bus | 12,120 | 606 | Bus |
| | C7 | NTC-Twantay | SC-Hlaingtharyar | 19,400 | 118,800 | 6.12 | 11,640 | 582 | Bus | 71,280 | 3,564 | Bus |
| | C8 | NTC-Htantabin | SC-Hlaingtharyar | 66,800 | 211,700 | 3.17 | 40,080 | 2,004 | Bus | 127,020 | 6,351 | BRT |
| Link Between New Towns | D1 | NTC-Hmawbi | NTC-Hlegu | 62,700 | 175,400 | 2.80 | 37,620 | 1,881 | Bus | 105,240 | 5,262 | Bus |
| | D2 | NTC-Hlegu | NTC-East Dagon | 4,100 | 58,700 | 14.32 | 2,460 | 123 | Bus | 35,220 | 1,761 | Bus |
| | D3 | NTC-East Dagon | NTC-Thanlyin | 2,400 | 15,600 | 6.50 | 1,440 | 72 | Bus | 9,360 | 468 | Bus |
| | D4 | NTC-Dala | NTC-Twantay | 18,700 | 33,900 | 1.81 | 11,220 | 561 | Bus | 20,340 | 1,017 | Bus |
| | D5 | NTC-Htantabin | NTC-Hmawbi | 37,900 | 151,100 | 3.99 | 22,740 | 1,137 | Bus | 90,660 | 4,533 | Bus |

Source: YUTRA Project Team

**Table 4.3.4.6 Link Volume Analysis (private mode of transport)**

| Link | | Link between | | Available Direct Network, 2013 | | | Indicative road capacity, 2013 | | | Indicative road capacity, 2035 | | | | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Road | No of Lanes per direction | Major Road Links | Target passenger volume by car (40%) per day | Peak hour passenger car units per direction | No. of lane required per direction | Target passenger volume by car (40%) per day | Peak hour passenger car units per direction | No. of lane required per direction | Additionally required roads (No. of lane per direction) | |
| CBD - Sub center Link | A1 | CBD | SC-Mindama | ○ | 6 | Pyay Rd<br>Kaba Aye Pagoda Rd. | 279,200 | 6,070 | 8 | 257,600 | 5,600 | 7 | 1 | |
| | A2 | | SC-Dagon Myothit | ○ | 2 | No.2 Main Rd | 105,600 | 2,296 | 3 | 137,600 | 2,991 | 4 | 2 | |
| | A3 | | SC-Bago Riverside | ○ | 2 | Yadanar Rd | 99,800 | 2,170 | 3 | 77,400 | 1,683 | 3 | 1 | |
| | A4 | | SC-Thilawa SEZ | ○ | 1 | Kyaik Khouk Pagoda Rd | 35,320 | 768 | 1 | 78,400 | 1,704 | 3 | 2 | |
| | A5 | | NTC-Dala | × | 0 | NA | 28,800 | 626 | 1 | 119,600 | 2,600 | 4 | 4 | PT should be more increased |
| | A6 | | NTC-Twantay | △ | 2 | No.5 Main Rd<br>Twantay Main Rd | 22,240 | 483 | 1 | 38,240 | 831 | 2 | 0 | |
| | A7 | | SC-Hlaingtharyar | ○ | 2 | No.5 Main Rd | 55,200 | 1,200 | 2 | 47,200 | 1,026 | 2 | 0 | |
| Link Between Sub-cebters | B1 | SC-Hlaingtharyar | SC-Mindama | ○ | 3 | Lanthit Rd | 57,600 | 1,252 | 2 | 144,120 | 3,133 | 4 | 1 | |
| | B2 | SC-Mindama | SC-Dagon Myothit | ○ | 2 | Pin Lon Rd<br>Thanthumar Rd | 71,360 | 1,551 | 2 | 245,080 | 5,328 | 7 | 5 | PT should be more increased |
| | B3 | SC-Dagon Myothit | SC-Bago Riverside | ○ | 2 | Ayer Wun Rd | 53,800 | 1,170 | 2 | 186,680 | 4,058 | 6 | 4 | PT should be more increased |
| | B4 | SC-Bago Riverside | SC-Thilawa SEZ | ○ | 3 | Dagon bridge<br>Thanlyin bridge | 26,920 | 585 | 1 | 100,280 | 2,180 | 3 | 0 | |
| Sub-center and New Town Link | C1 | NTC-Hmawbi | SC-Mindama | ○ | 1 | No.4 Main Rd | 67,120 | 1,459 | 2 | 120,520 | 2,620 | 4 | 3 | PT should be more increased |
| | | Corridor inbetween C1 and C2 | | ○ | 3 | Pyay Rd | 26,720 | 581 | 1 | 46,240 | 1,005 | 2 | 0 | |
| | C2 | NTC-Hlegu | SC-Dagon Myothit | △ | 2 | Min Yae Kyaw Swar Rd | 21,160 | 460 | 1 | 52,706 | 1,146 | 2 | 0 | |
| | C3 | NTC-East Dagon | SC-Dagon Myothit | ○ | 2 | No.2. Main Rd | 16,960 | 369 | 1 | 55,800 | 1,213 | 2 | 0 | |
| | C4 | NTC-Thanlyin | SC-Bago Riverside | ○ | 2 | Yangon Thilawar Rd | 5,480 | 119 | 1 | 40,840 | 888 | 2 | 0 | |
| | C5 | NTC-Thanlyin | SC-Thilawa SEZ | ○ | 2 | No.6 Main Rd | 7,480 | 163 | 1 | 36,840 | 801 | 2 | 0 | |
| | C6 | NTC-Dala | SC-Thilawa SEZ | × | 0 | - | 2,040 | 44 | 1 | 8,080 | 176 | 1 | 1 | |
| | C7 | NTC-Twantay | SC-Hlaingtharyar | △ | 1 | Twantay Main Rd | 7,760 | 169 | 1 | 47,520 | 1,033 | 2 | 1 | |
| | C8 | NTC-Htantabin | SC-Hlaingtharyar | △ | 2 | Amauk Pine University Rd | 26,720 | 581 | 1 | 84,680 | 1,841 | 3 | 1 | |
| Link Between New Towns | D1 | NTC-Hmawbi | NTC-Hlegu | △ | 2 | No.7 Main Rd | 25,080 | 545 | 1 | 70,160 | 1,525 | 2 | 0 | |
| | D2 | NTC-Hlegu | NTC-East Dagon | △ | 2 | No.7 Main Rd | 1,640 | 36 | 1 | 23,480 | 510 | 1 | 0 | |
| | D3 | NTC-East Dagon | NTC-Thanlyin | × | 0 | - | 960 | 21 | 1 | 6,240 | 136 | 1 | 1 | |
| | D4 | NTC-Dala | NTC-Twantay | × | 0 | - | 7,480 | 163 | 1 | 13,560 | 295 | 1 | 1 | |
| | D5 | NTC-Htantabin | NTC-Hmawbi | △ | 1 | No.4 Main Rd | 15,160 | 330 | 1 | 60,440 | 1,314 | 2 | 1 | |

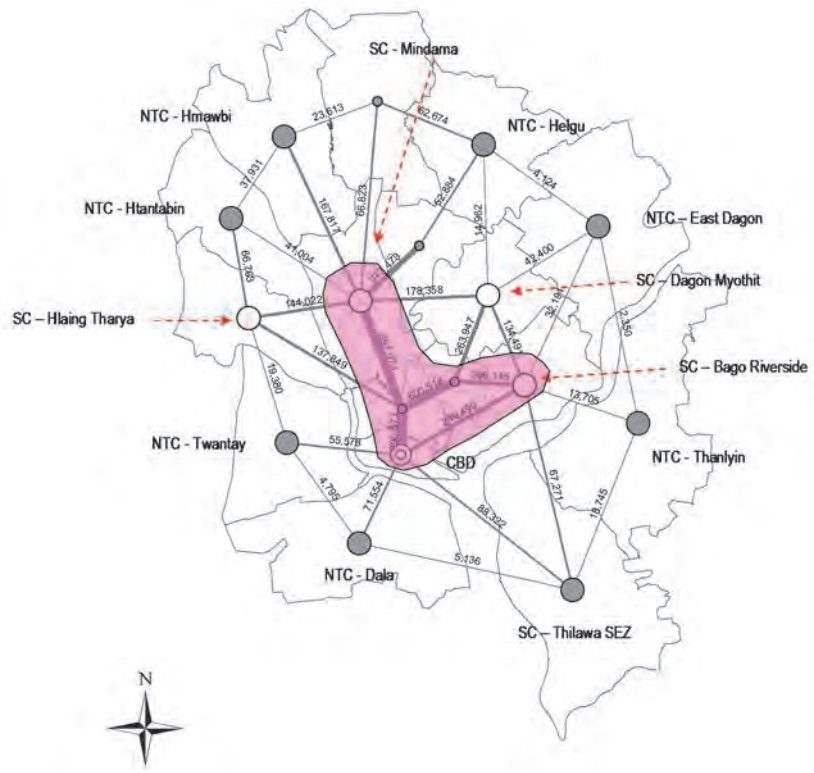
Source: YUTRA Project Team

## 4.3.5 Indicative Transport Network with the Sub-Centre System

### 1) Service coverage by high order public transport systems

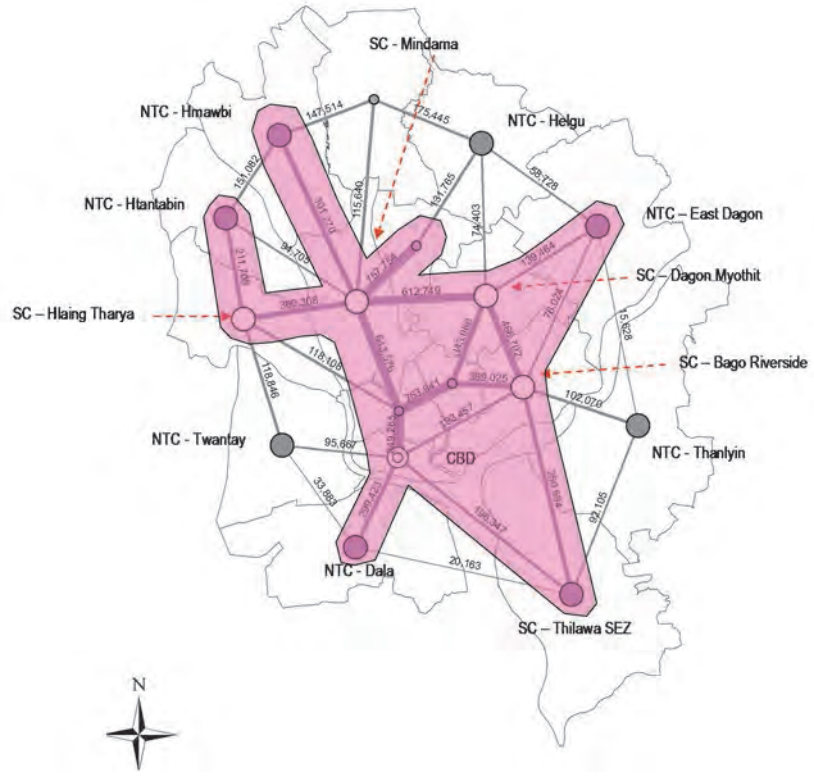
The link analysis informs the area which needs a higher order transit system. A triangular area formed by three centres, namely CBD, SC Mindama and SC-Bago Riverside needs such higher order transit system already in 2013. Actually Myanma Railway service is provided in this triangular area, but its level of service (LOS) is very limited (refer to Figure 4.3.5.1).

The area that needs high-order transit system will be extended to cover a wider area including proposed sub-centres and some town centres as shown in Figure 4.3.5.2. This shape of service coverage indicates a few number of high-order transit lines of radial direction.




Source: YUTRA Project Team

**Figure 4.3.5.1 Area needs high-order transit service in 2013**




Source: YUTRA Project Team

**Figure 4.3.5.2 Area needs high-order transit service in 2035**

### 2) Indicative Mass Transit Links and Routes in 2035

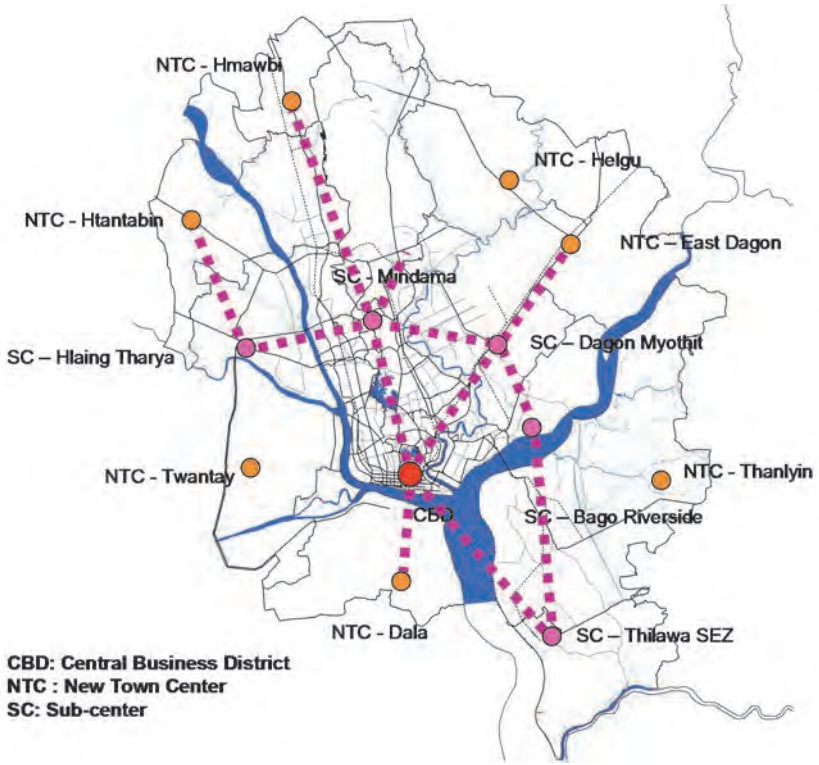
It is highly recommended that the red shaded area shown in Figure 4.3.5.2, including CBD, the four proposed sub-centres and the three proposed town centres namely Hmawbi, Dala, and Thilawa SEZ are served by a form of mass transit system.

These centres should be directly connected by mass transit systems including the improved MR lines (the Yangon circular lines, part of the Yangon – Mandalay line, and the Thanlyin line) and new mass transit system. Figure 4.3.5.3 shows ideal direct connection between the centres, but it is understood such direct connection might be difficult due to some physical constraints. Figure 4.3.5.4 gives a preliminary idea of mass transit network with consideration on such physical constraints as well as the existing conditions.

### 3) Indicative Road Capacity Increase

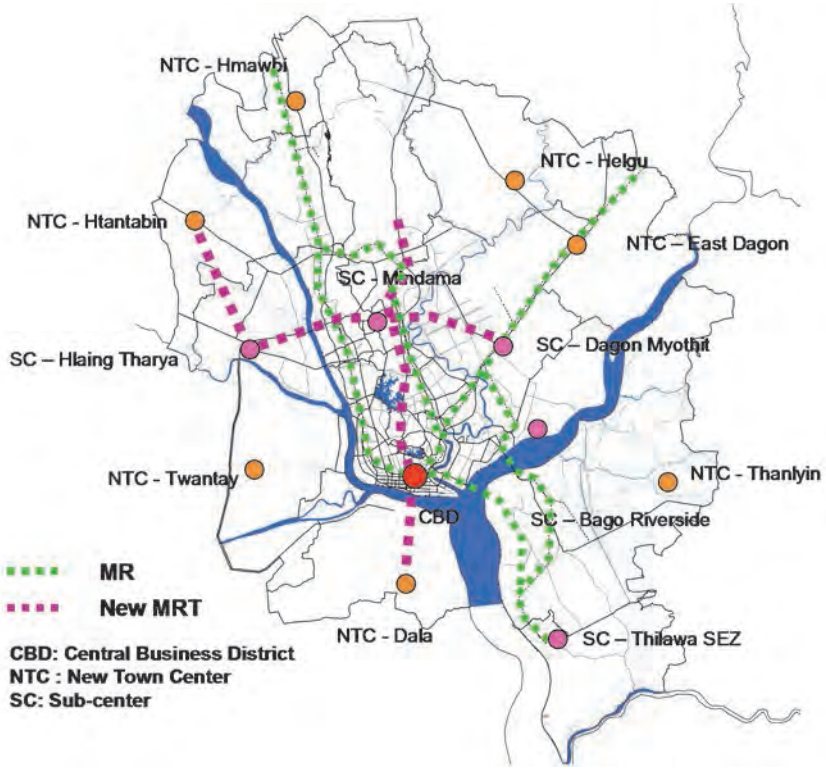
Development of the two sub-centres (Dagon Myothit and Bago Riverside) in the eastern bank of the Nga Moe Yeik creek requires a significant road capacity increase. The link analysis suggests that additional 10 lanes or more road crossing the creek (refer Figure 4.3.5.5) will be required by 2035. The link between SC Dagon Myothit and SC Mindama requires 6 lanes or more, CBD and SC Dagon Myothit and SC Bago Riverside also require additional 6 lanes in total.

The link between CBD and SC Dala requires 6 lanes or more in order to carry 40% of the total demand. It is recommend to increase the capacity of public modes of transport of this link, that is, from BRT to UMRT. Therefore an extension of the UMRT network to Dala area is highly recommended in order to support the planned development in this area.



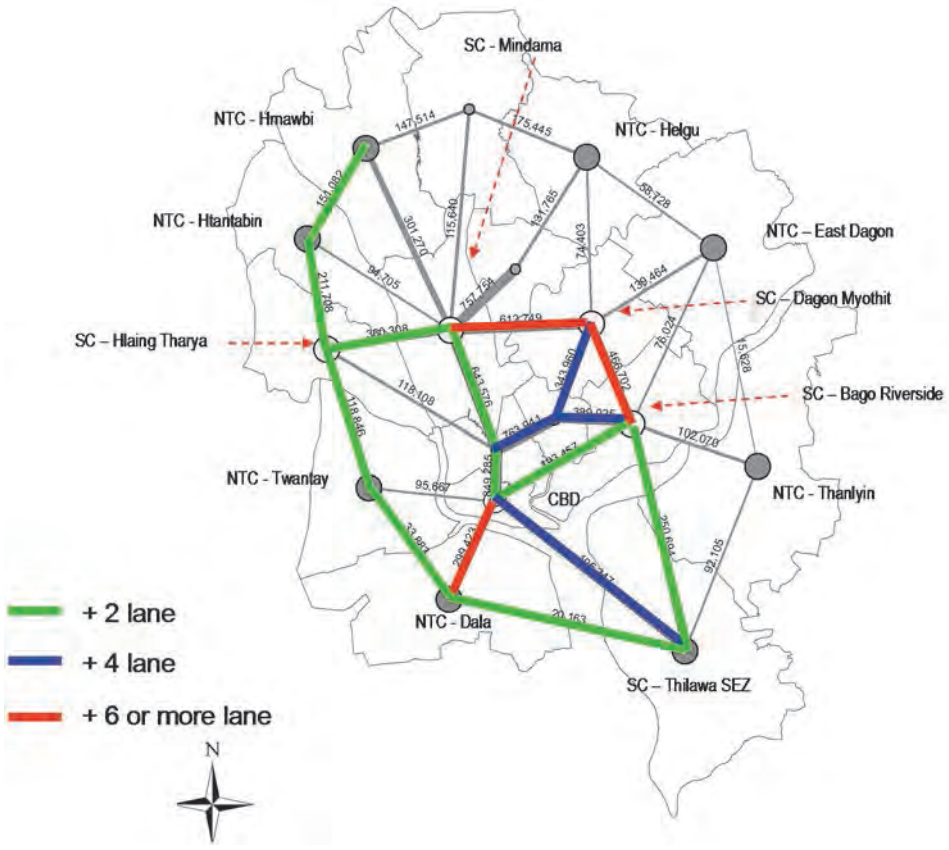

Source: YUTRA Project Team

**Figure 4.3.5.3 Suggested direct link by mass transit, 2035**




Source: YUTRA Project Team

**Figure 4.3.5.4 Possible mass transit routes, 2035**




Source: YUTRA Project Team

**Figure 4.3.5.5 Suggested road capacity increase between the centres**

## 4.4 Public Transport

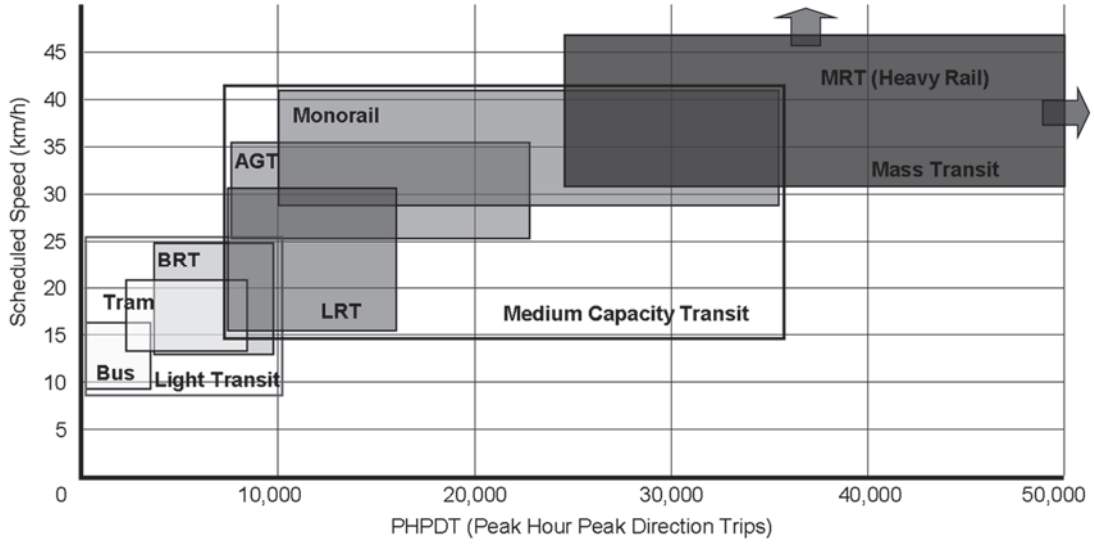
### 4.4.1 General

#### 1) Feature of Public Transport

Public transport modes have several features including advantages and considerations in comparison of the other modes like private vehicles as below.

**(1) High Transport Capacity and Travel Speed**

Figure 4.4.1.1 shows transport capacity and schedule speed among each transport mode. The figure shows public transport modes have large transport capacity and high schedule speed. Especially, heavy railway and UMRT have the largest capacity and fastest speed among the modes. Monorail, BRT, LRT, etc. categorized as Middle Capacity Transit have also quite larger capacity than conventional bus, private car, etc.




Source: Prepared based on Guidance for LRT Development Plan in harmonization with Urban Planning, MLIT of Japan, 2005, etc.

**Figure 4.4.1.1 Comparison of Transport Capacity and Speed among Each Transit Mode**

**(2) Appropriate System can be selected among Various Transit Systems**

Table 4.4.1.1 shows the general feature among each public transport mode. The table shows heavy rail/UMRT is superior to the other modes in terms of the capacity, speed and environmental aspect although it requires huge construction cost. On the other hand, conventional bus is superior in terms of cost although the capacity and speed are low. The other middle capacity transits are middle among them. It is important to allocate transit modes appropriately in consideration of future demand, required cost and site condition.

**Table 4.4.1.1 General Comparison of Public Transport System**

| System / Item | (a) Bus (surface) | (b) Bus (elevated) | (c) LRT (at grade) | (d) AGT (elevated) | (e) Monorail (suspension type) | (f) Monorail (straddle type) | (g) Heavy Rail (elevated) | (h) Heavy Rail (underground) |
|---|---|---|---|---|---|---|---|---|
| System Appearance |  |  |  |  |  |  |  |  |
| Capacity | Small | Small | Small – Medium | Medium | Medium | Medium – Large | Large | Large |
| Speed | Low | Low – Medium | Low – Medium | Medium | Medium | Medium – Large | Large | Large |
| Cost for Construction | Lowest | Low – Medium | Low – Medium | Medium | Medium – High | Medium – High | Medim – High | Highest |
| Cost for O&M | Low – Medium | Medium | Low – Medium | Medium | Medium | Medium | Medium – High | Medium – High |
| Required Space | Large | Medium | Large | Small – Medium | Small – Medium | Small – Medium | Medium – Large | Small |
| Environmental Impact (air / noise / landscape) | Large / Large / Small | Large / Medium / Large | Medium / Medium / Small | Small / Medium / Large | Small / Medium / Medium | Small / Medium / Small | Medium / Medium / Large | Small / Small / Small |
| Past Experiences | Many | A few | Many | Many | A few | Many | Many | Many |
| Features | – Small capacity<br>– Lowest cost<br>– Limited effect | – Small capacity<br>– Less E&M facilities<br>– Few experiences | – Small to medium capacity<br>– Passenger friendly system<br>– Disturbing road traffic | – Medium capacity<br>– Unmanned operation is possible | – Medium capacity<br>– Heavier structure than straddle type | – Medium to large capacity<br>– Simple track structure<br>– Less environmental impacts | – Large capacity<br>– Higher speed<br>– Large space for depot and workshop | – Large capacity<br>– Higher speed<br>– Highest construction cost<br>– Less environmental impacts |

Source: Study on Light/Middle Capacity Transit for Bangkok Metropolitan, ECFA

**(i) Railway and UMRT are recommended as permanent countermeasure for middle and long-term**

Most opinions accept that rail (such as an UMRT) is suitable for high demand requirements and has commensurate high costs. UMRT systems are more feasible for high demand corridors where there are large end-to-end passenger volumes. There is sufficient evidence to support the notion that where BRT capacities exceed 25,000 - 30,000 pphpd, an UMRT system is a better choice.

Particularly when traffic congestion worsens, demand for land and property which is close to mass transit increases, causing densification of development around these corridors. This helps to guide city development, centralising development around mass transit, thereby helping to reduce congestion and pressure on road building budgets. Bangkok is such an example, as development over the past decade has concentrated around the Skytrain and UMRT.

Present constraints and opportunities and current city context needs to guide the immediate implementation steps, but this YUTRA study also considers the medium to long term requirements. Early actions to develop mass transit corridors using bus-based systems can develop the required patronage levels that will support future plans and financial feasibility for UMRT. Also long-term trends toward increased car ownership must be countered by the availability of good public transport alternatives and restrictive measures on car use in selected areas to mitigate traffic congestion.

**(ii) BRT is recommended for short-term countermeasure**

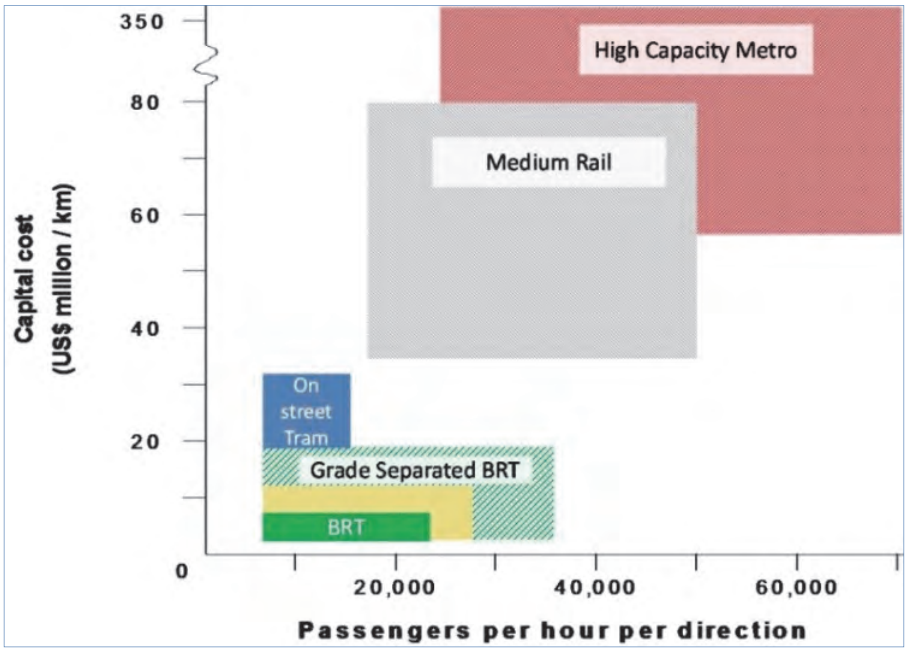
Source: BRT Planning Guide 2007 (updated by YUTRA Project Team)

Figure 4.4.1.2 shows the relative comparisons of systems according to cost and passenger capacity indicating for BRT a relatively high capacity compared to cost. This

large cost difference indicates that for a set budget, BRT will deliver a larger network, which is an important consideration. A clear benefit of BRT is its ability to be better integrated into a city (better coverage and access) and is more affordable to build into an early network (critical in being able to compete with car traffic).

As Source: BRT Planning Guide 2007 (updated by YUTRA Project Team)

Figure 4.4.1.2 shows, there are three BRT design types: Solid green is using existing road space and built for US$ 1.6 - 2.0 Mil. per km (as would be the case in Yangon). The light yellow band shows more expensive systems to achieve higher capacity, through to shaded green higher cost 'grade separated' systems to reduce intersection impacts. The cost of 'high end' BRT is proportional to the level of infrastructure built.




Source: BRT Planning Guide 2007 (updated by YUTRA Project Team)

**Figure 4.4.1.2 Cost vs. Capacity Comparisons between Modes**

Single mass transit corridors do not address the wider needs of the city. Only the wide coverage of an integrated network can offer the necessary access and travel connectivity that will convince motorists they do not need to buy (or use) their cars. This is why a public transport network is the most critical element of the transport strategy; it is the only way to avoid a future where the city is dominated by cars.

There is presently a high dependency on public transport in Yangon with over 49% of trips (excluding walk) made by some form of bus (and 1% by rail) and car ownership is low at 12% of households owning a car. Maintaining such a high level of mode share for public transport will only happen if access and quality of service can be improved.

This emphasises the need to build a fully integrated and complete transport network in the short term.

**(3) Prominent Safety and Environmental Aspect**

Current Yangon city is quite beautiful city with some lakes and green areas, and these will

be remained according to SUDP. In order to maintain such a beautiful city in the future, it is required to install public transport which has safety, low environmental burden, high energy efficiency, low CO2 emission, and low accident risk, positively and diligently.

Public transport has become a key instrument in the design of modern and advanced cities following the increasing motorisation of the 20th century. While cities still consider good road systems as an essential requirement for mobility, dependence on private vehicles for daily works trips unsustainable, causing chronic traffic congestion, environmental pollution; wasted energy and non-productive time. It is also found that traffic congestion can cripple essential road based transport with severe consequences (cost of freight and deliveries, life-saving duties such as ambulances, mobility of police etc. to name a few).

Recent severe air pollution problems in China (Beijing) and India (Delhi) have caused alarm, warning cities on the severe health dangers posed by air pollution, particularly in the light of recent statements by the World Health Organization's (WHO) International Agency for Research on Cancer (IARC) declaring air pollution as a Group 1 carcinogenic — the same category as tobacco, UV radiation and plutonium, and in 2010 is estimated to be the cause of 2,230,000 deaths worldwide.

Many cities have taken bold and decisive steps to encourage public transport (and actively discourage private car travel). This has usually entailed improving access and quality of public transport, while at the same time restricting private modes, through increasing costs, (price mechanisms) or enforced restriction on private car use.

Cities like Copenhagen and Tokyo have made public transport a lifestyle choice, actively promoting strategies and activities that work toward protecting the city environmental assets, as a clean and healthy city in which to live and emphasise the quality of life aspects to convince the population to make wise travel choices.

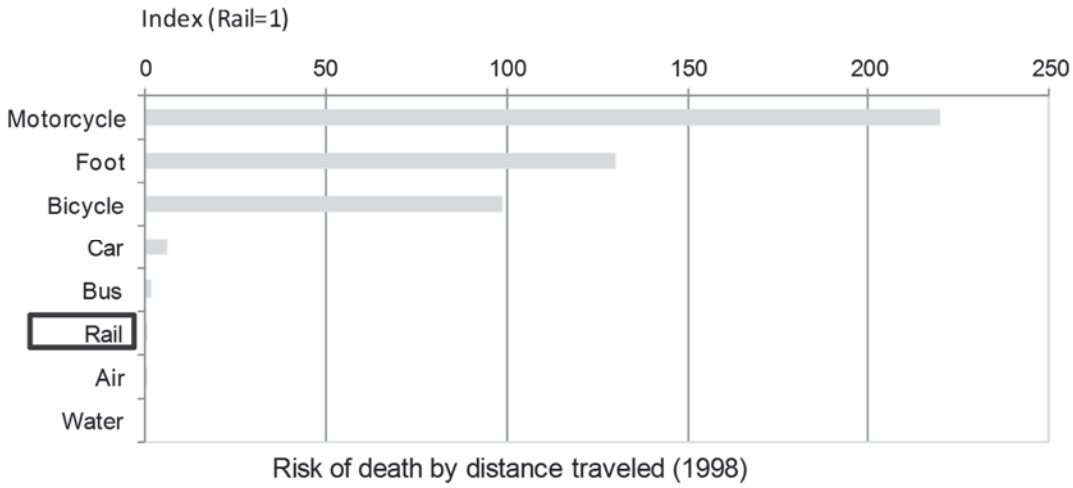
Similarly, Yangon city is a beautiful city with some lakes and green areas, and these are protected in the urban development plan. To maintain such a beautiful city for the future, will require bold decisions on transport, particularly the extent of road development and an increased dependence on public transport as the backbone of travel in Yangon.

Public transport modes offer many tangible advantages in comparison to private modes of travel, particularly speed, safety, energy efficiency and reduction in emissions.

Mass transit offers improved travel speed especially over longer distances and due to their separation from mixed traffic. The time required to access public transport remains an issue which may increase the overall passenger travel time and this emphasizes the need for planning to consider the whole of trip experience for the passenger.

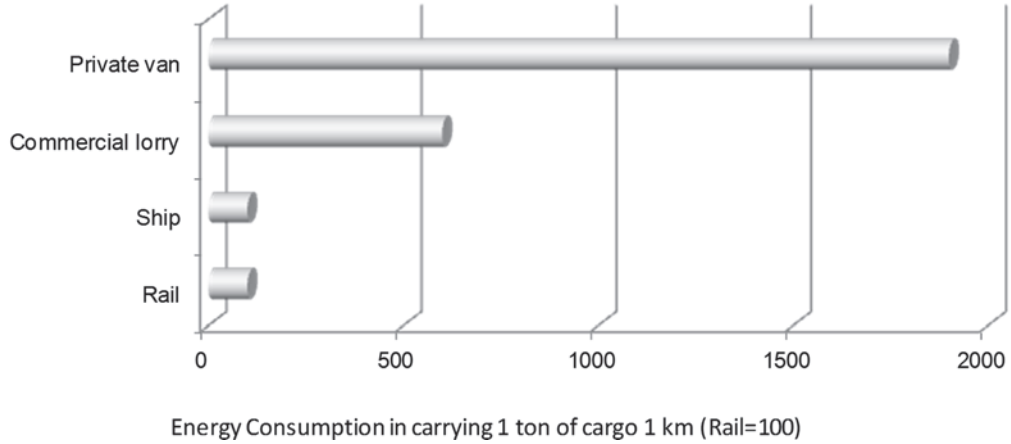
Public transport provides a safe mode of travel with lower risk of death and injury that any other form of urban travel and vastly less emissions, CO2 and energy use on a per passenger basis than car travel.

Figure 4.4.1.3 to Figure 4.4.1.5 show public transport especially railway has large advantages of these aspects.



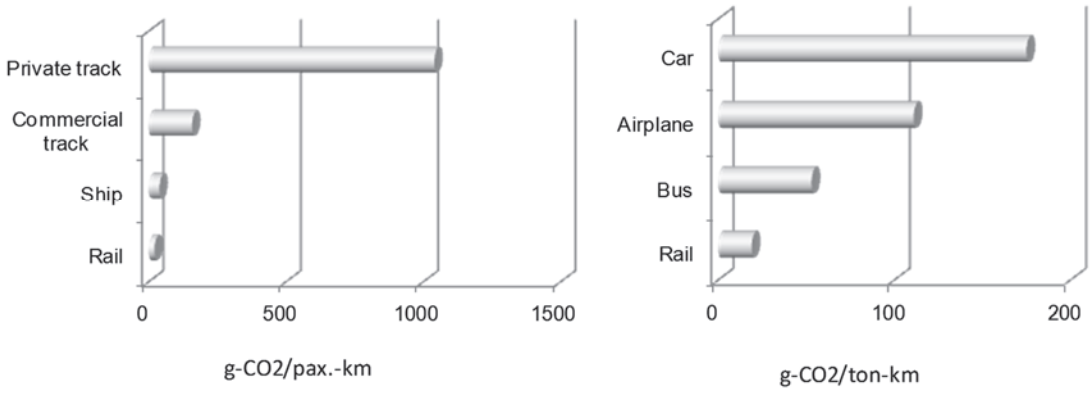

Source: Ministry of Land, Infrastructure and Transport, Japan

**Figure 4.4.1.3 Comparison of Risk of Fatal Accident among Transportation Mode**




Source: Ministry of Land, Infrastructure and Transport, Japan

**Figure 4.4.1.4 Comparison of Energy Consumption Rate among Transportation Mode**




Source: Ministry of Land, Infrastructure and Transport, Japan

**Figure 4.4.1.5 Comparison of CO2 Emission Rate among Transportation Mode**

**(4) Financial viability cannot be ignored – we must build what we can afford**

On the premise that all infrastructure must be paid for, the business case supporting any public transport system is a key consideration, involving national and city budgets, funding availability (including cost of funds), fare levels and levels of affordability, subsidy support etc.

Expensive public transport projects ultimately need to be paid for, either by the user or the government. In 2010, the UK Rapid Transit Monitor[8] identified 30 LRT projects in the UK (including extensions to existing systems) to be struggling financially. While public transport subsidy can be considered a necessary investment in mobility; or motivated by social considerations, such as marginal cost pricing (welfare optimisation), affordability or to attract ridership from cars, governments increasingly are reluctant to fund 'loss-compensating' subsidies.

With any public transport investment, cost recovery is the issue; being is the ability of the fare revenue to cover costs. With affordability and price sensitivity in Yangon a key consideration, the business model calls for focussed attention.

**2) Development Strategy**

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

The following development strategies were selected from overall transport strategy established in "4.1.2: YUTRA Overall Transport Development Strategy" as public transport strategies

| | |
|---|---|
| Applied Strategies | [B1] Policy coordination within the Greater Yangon area<br>[B2] Authorization of City and Transport Master Plans<br>[B4] Promotion of integrated urban and transport development, particularly Transit-Oriented Development (TOD)<br>[C1] Development of a hierarchal mass transit system<br>[C2] Early introduction of an integrated public transport system (BRT) in the effort to maintain public transport share<br>[C3] Upgrading the present rail system<br>[C4] Development and improvement of bus transport system, including reform of management systems and the business model<br>[C5] Promotion of public transport use and expansion of services<br>[E1] Integrating urban development and transport (TOD) |

[8] Rail Industry Performance July 2010 TAS Publications UK Source: http://www.taspublications.co.uk

### 4.4.2 Urban Railway Development

#### 1) Previous Study

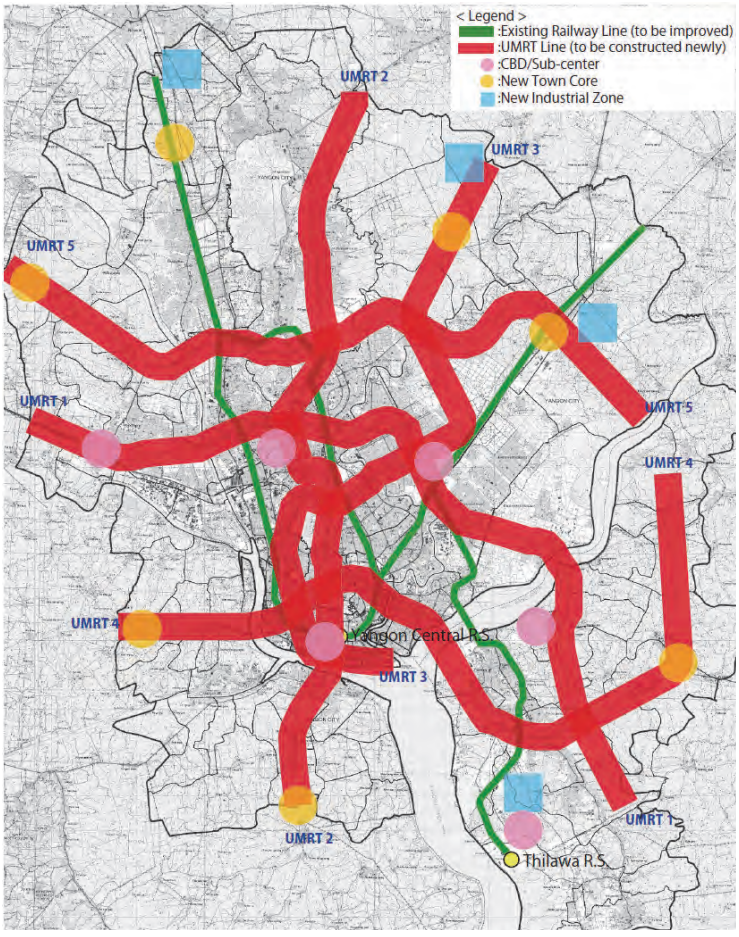
The Strategic Urban Development Plan of the Greater Yangon (SUDP) was formulated by YCDC and JICA in 2013, and SUDP covered all infrastructure sectors including railway. The railway development plan proposed in SUDP is summarised below.

**Table 4.4.2.1 SUDP's Development Goals and Effect Indicators for Railway**

| Development Goal | Effect Indicators |
|---|---|
| a) Improvement of Convenience and Accessibility | Total Route Length (present:122 km - 2040: 350 km) |
| b) Speed-up Enhancement | Average Operational Speed (present: 15 km/hour – 2040: 30 km/hour) |
| c) Accomplishment of Modal Shift | Modal Share Rate (present: 3% - 2040: 30 %) |

Source: SUDP, JICA (2013)

The railway network in 2040 planned by SUDP is shown in Figure 4.4.2.1. The total network length is 354.3km consisting of the four (4) improved existing lines of 122.1km and five (5) new UMRT lines of 232.2km. The proposed network length was estimated from i) macro demand forecast with target modal share rate, ii) example of the other major cities, and iii) comparison of alternative networks. In addition, the network configuration was prepared in harmony with the future layout plan of urban function and land use. The rough cost was estimated as US$ 34 billion.




Source: SUDP, JICA (2013)

**Figure 4.4.2.1 Future Railway Network planed by SUDP**

Target modal share rate was set at 30% in consideration of the actual data of the modal share of railways in major metropolitan areas of developed countries.

The Development Goals, Effect Indicators, and Future Network Plan of Railway planed by SUDP should be the basis for the planning of this YUTRA study. However, regarding the future railway network and the total length, the plan did not consider the modal shares of other transit systems including BRT. In addition, quantitative traffic demand forecast was not conducted based on surveys, and financial constraint for railway development was not considered then. These aspects were reviewed and the plan was adjusted by YUTRA based on transport demand forecast.

**2) Basic Principle for Urban Railway Development**

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

***Conformity with Urban Master Plan / National Transport Master Plan (related to Strategy No. B1, B2, and E1 – refer to Section 4.1.2)***

- Public transport network composed of railway and BRT shall fit with layout of urban development plan / land use plan / future urban function plan prepared by Urban Master Plan (SUDP) in 2012.
- To consider the railway network plan prepared by SUDP as a conceptual plan.
- To keep conformity with the railway plan of the National Transport Development Plan (MYT-Plan).

***Total Coordination among Public Transport Mode (related to Strategy No. B4, C1, and E1 – refer to Section 4.1.2)***

- To fulfil required function by total public transport network including not only railway network but also BRT network in order to save initial cost. Required trips to be shouldered by public transport shall be shared by both railway and BRT networks.

***Railway Utilization Promotion (related to Strategy No.C5 – refer to Section 4.1.2)***

- To conduct integrated development of railway line with the station plaza / wayside in order to realize synergy effect
- To have railway/UMRT lines radiating out from CBD as main axes, and connecting East-West line as sub-axis.

***Realistic Development Planning (related to Strategy No.C2 and C3 – refer to Section 4.1.2)***

- In order to save initial cost, to endeavour ) existing railway utilization, b) in case of UMRT, installation of at-grade/elevated section as much as possible, and c) active use of BRT with relatively lower cost per km.
- Regarding existing railway modernization, to give high priority to current population density area.
- To consider utilization of actual vacant land lots for depot, workshop, transport hub, etc. in order to establish a practical plan.
- To consider who will be an implementation, operation, management body for UMRT project in order to succeed in the UMRT project.

### 3) Development Goals and Target Indicators

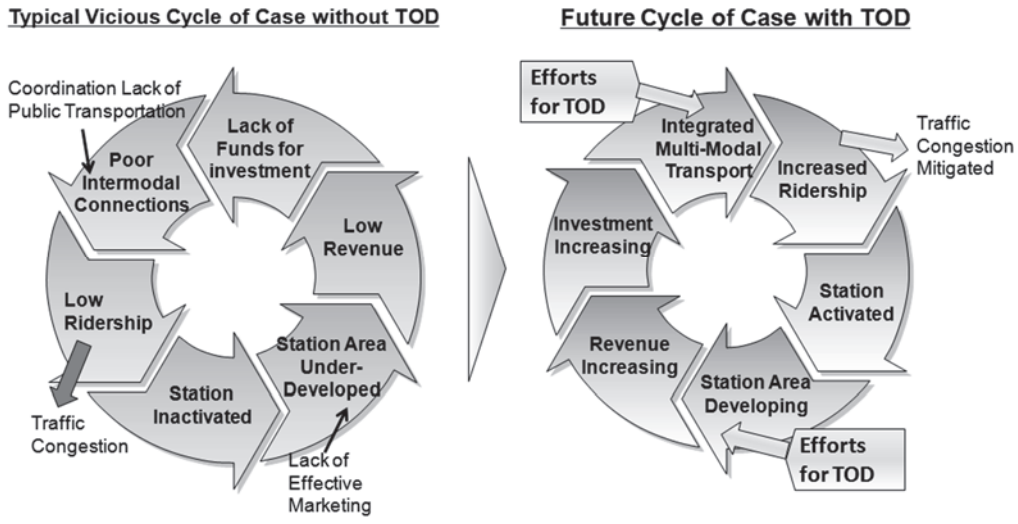
As mentioned above, Development Goals and Target Indicators set by SUDP is basically followed by YUTRA. However, the railway network length was reviewed in terms of budget envelope and the number of UMRT line was reduced from 5 lines to 2 lines. In addition, the length of each line was also shortened. It is planned that the reduced length is covered by BRT network.

### 4) Infrastructure Layout

#### (1) Required Function to enhance Railway Utilization

##### (i) Passenger Transport

Even if the railway network is completed, it will not function in case of no related facilities. It is essential to establish feeder service from/to station and station plaza as transfer facility in order to act railway properly. Figure 4.4.2.2 shows typical virtuous and vicious cycle by with/without integration among transport modes. As shown in the figure, in case of poor intermodal connections, it will be vicious cycle that the number of passengers and station users decreases due to inconvenience, station area development is not proceeded due to low number of passengers, and few fund for intermodal connection function enhancement can be allocated due to low revenue. In order to stop the vicious cycle and change it to virtuous cycle, it is important to enhance connecting function between railway and the other transit modes at station.




Source: YUTRA Project Team

**Figure 4.4.2.2 Virtuous and Vicious Cycle by with/without Integration among Transport Mode**

The schematic figure of the current MR line is shown as “at-present” in the figure below. It is pointed out that low network density, deteriorated infrastructure, low travel speed, low punctuality and low comfortability, etc. lead to low modal share of the current railway. These are a part of main reasons, but not all. The current railway stations are not incorporated in the current public transport network, even bus network which is usually integrated to railway networks in case of the other cities. The current bus

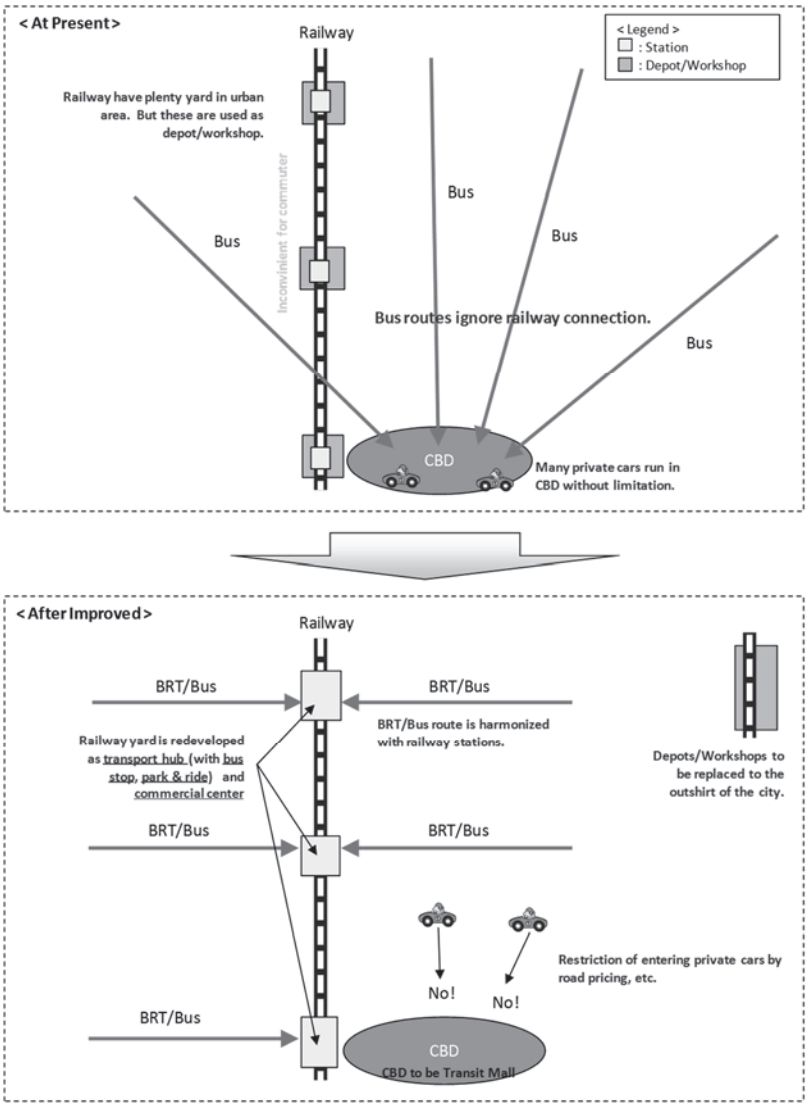
network ignores railway stations and connect the origins and the destinations directly. Although some railway stations have potential yard for transport hub, these are currently used as depot, workshop, etc. The yard usage causes poor station access of both buses and neighboring people who can access on foot.

In order to change the situation, the following countermeasures should be conducted.

a) Improvement and expansion of railway network

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

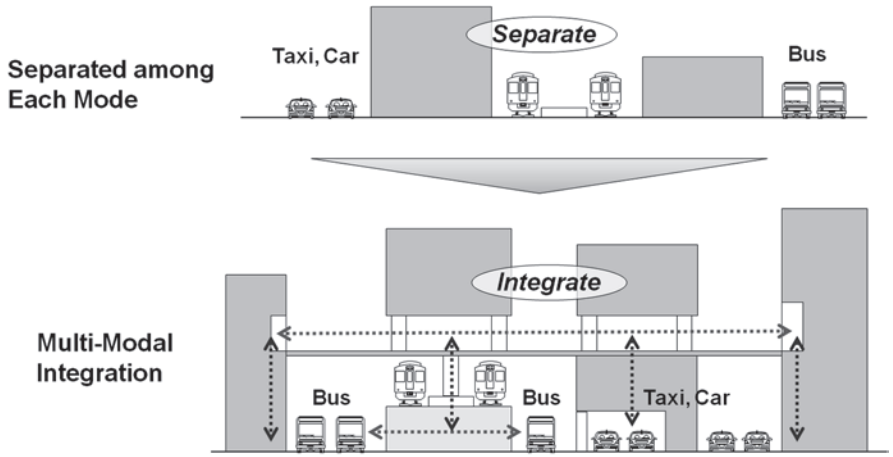
In addition, as shown as “after improved” in Figure 4.4.2.3, it is important to conduct measure for entering restriction of private car to CBD concurrently (changing CBD to transit mall), in order to realize convenience of public transport emphasizing mass transit and walking.




Source: YUTRA Project Team

**Figure 4.4.2.3 Schematic Image among Railway Improvement/Modernization, Railway Land Development and Integrated Multi-Modal Transport**

Image of transport hub function improvement at railway station is shown in Figure 4.4.2.4. Integration among each transport mode would be a key of TOD because the non-Integration cause time-loss and uncomfortable transfer for passengers, and results in less-use of public transportation. The integration should be designed by combination of horizontal movement and vertical movement for passenger smooth transfer.

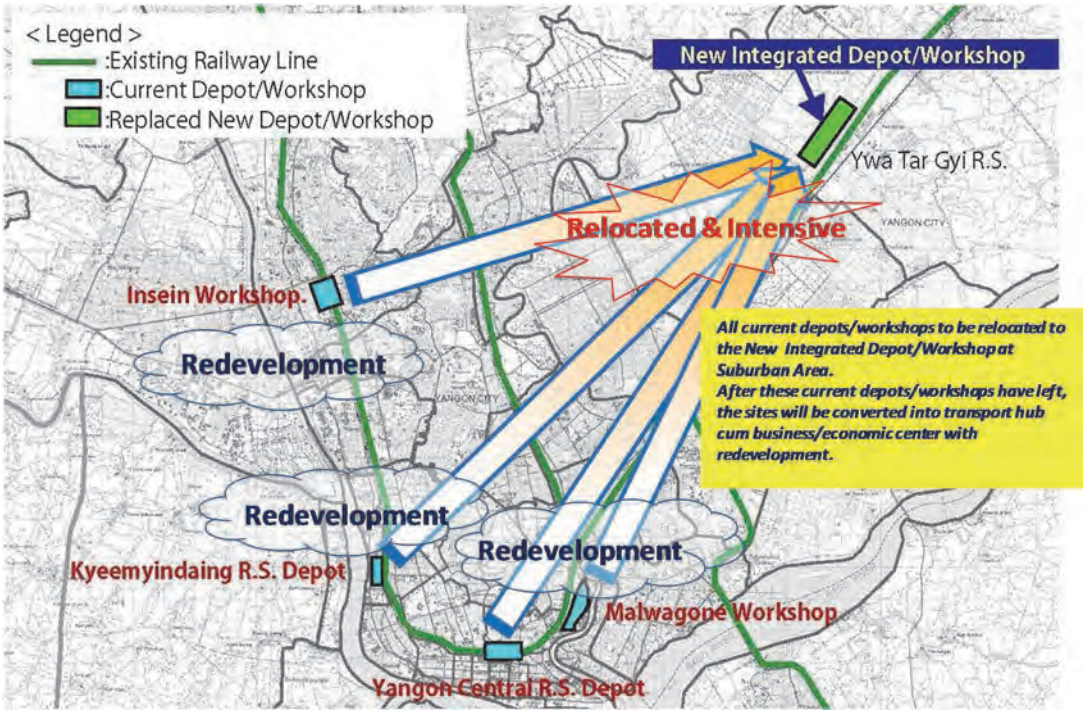



Source: YUTRA Project Team

**Figure 4.4.2.4 Schematic Image of Station Improvement for Multi-Modal Facility Integration**

Furthermore, in order to realize abovementioned “b)”, redevelopment of the current station yard is essential in middle/long-term, although small station plaza improvement with transfer function enhancement is effective in short-term.

In case of implementing yard development, it is necessary to relocate the current depots and workshops in MR yard to any substitute yard. Therefore, project for relocation and integration of depots and workshops should be conducted. The northwest area of Ywa Tar Gyi station along Yangon-Mandalay line is a strong candidate for substitute land because MR has large land beside Ywa Tar Gyi station. (Figure 4.4.2.5) (Note: There is an information that the area owned by MR is about 303ha. However, it is informed the possible use area is unsettled due to dispute with the other ministries about the ownership.)




Source: YUTRA Project Team

**Figure 4.4.2.5 Schematic Figure of Relocation of Existing Depots and Workshops to New Integrated Depot/Workshop**

### (ii) Freight Transport

Railway freight transport plan should be adjusted to a freight transport plan prepared by MYT-Plan which is ongoing as JICA study, because railway freight transport is applied for middle/long distance transport due to cost aspect and no freight transported by railway concludes inside Yangon area.

The future railway freight transport plan is prepared by MYT-Plan. Phasing development from Step1 to Step2 is planned in the study as shown in Figure 4.4.2.6.

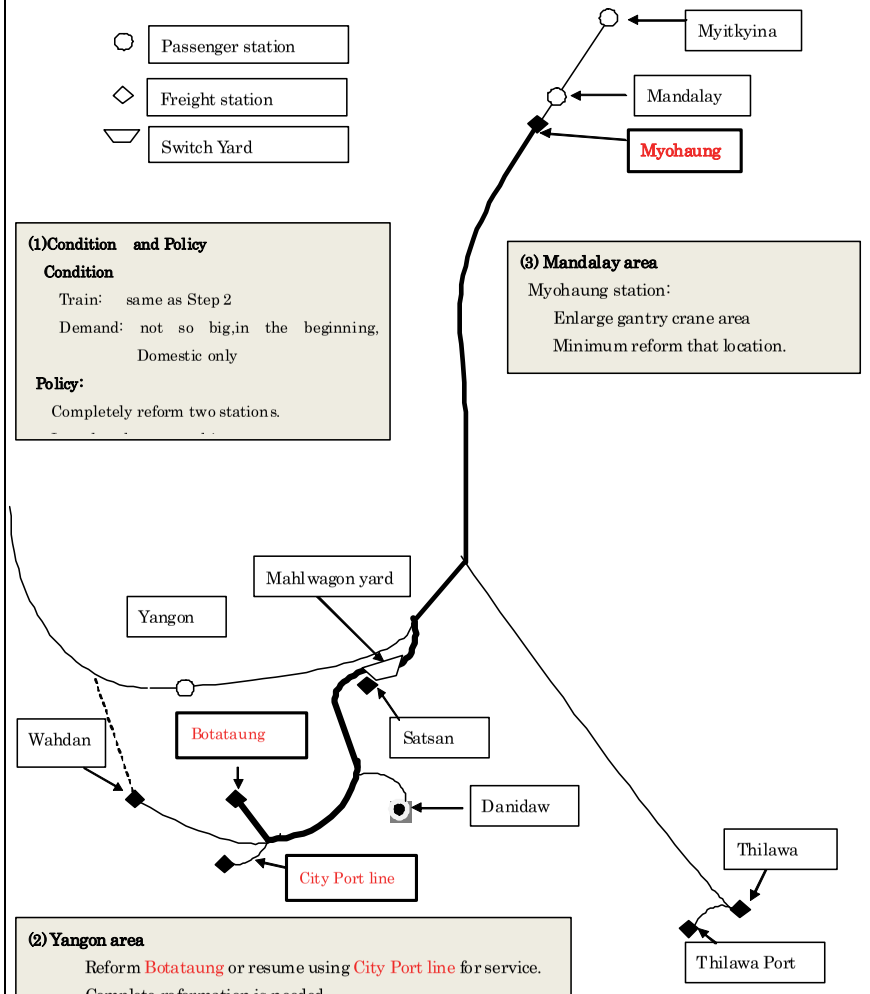
At present, there are four freight stations (Satsan freight station, Botataung freight station, Wahdan freight station, and Danidaw oil station) near Yangon port. These freight stations will be used without any relocation in the future. It seems that the plan is prepared in consideration of the intention from Myanmar side that Yangon port will be used even after starting full-scale operation of Thilawa port. Therefore, this study proposes to maintain the function of the four freight stations and the access lines in order to harmonize with the plan.

Step 1

## Container Freight

### Y～ M Freight Renovation plan Container Train Step1

**Container Only between Botataung and Myohaung**




**(1)Condition and Policy**

**Condition**

Train: same as Step 2

Demand: not so big,in the beginning, Domestic only

**Policy:**

Completely reform two stations.

**(3) Mandalay area**

Myohaung station:

Enlarge gantry crane area

Minimum reform that location.

**(2) Yangon area**

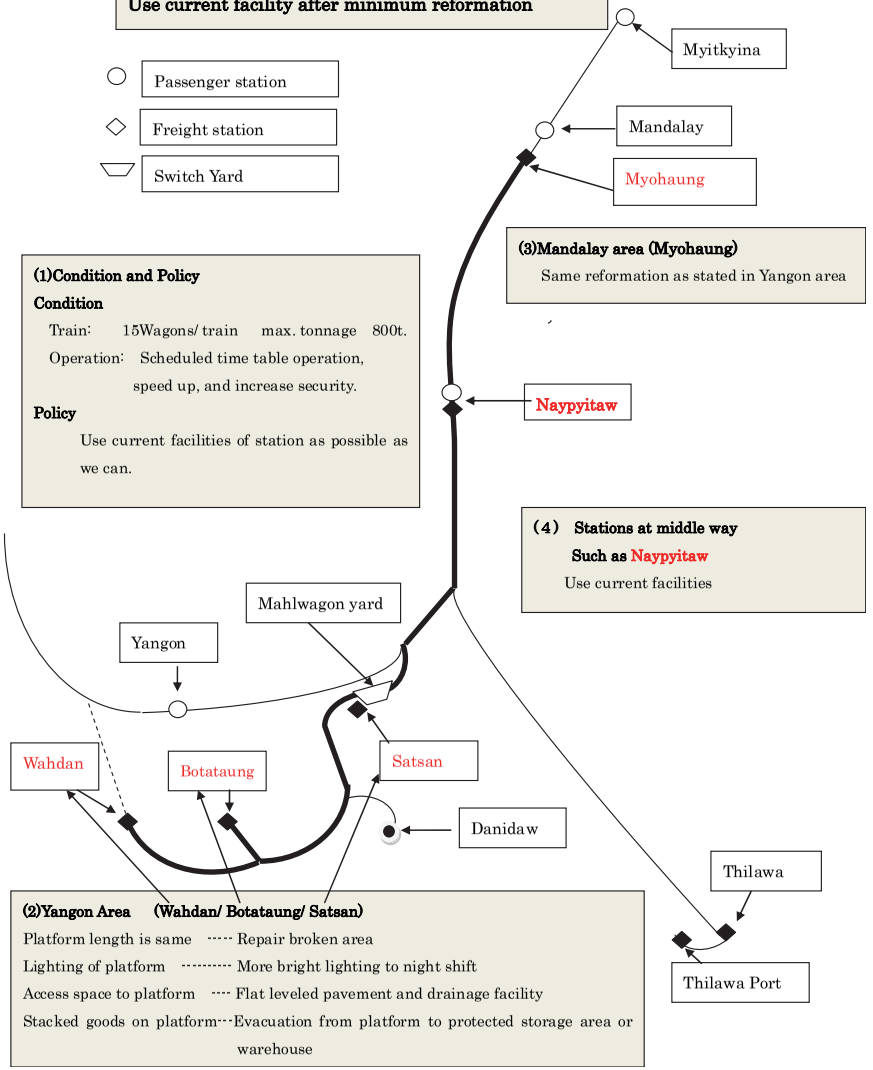
Reform Botataung or resume using City Port line for service.

Complete reformation is needed

## Wagon Freight

### Y～ M Freight Renovation Plan Wagon Train Step1

**Use current facility after minimum reformation**




**(1)Condition and Policy**

**Condition**

Train: 15Wagons/ train max. tonnage 800t.

Operation: Scheduled time table operation, speed up, and increase security.

**Policy**

Use current facilities of station as possible as we can.

**(3)Mandalay area (Myohaung)**

Same reformation as stated in Yangon area

**(4) Stations at middle way**

**Such as Naypyitaw**

Use current facilities

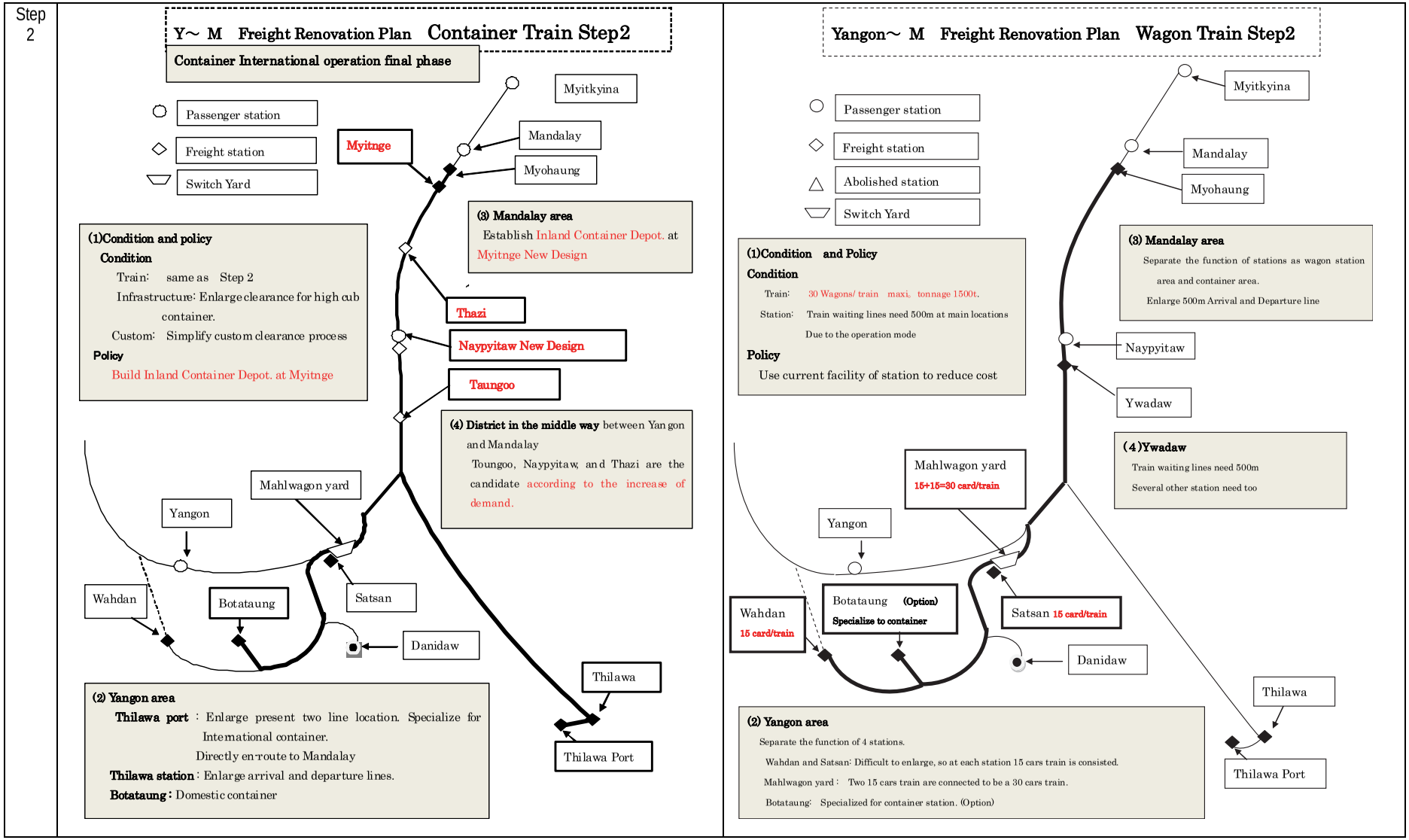
**(2)Yangon Area (Wahdan/ Botataung/ Satsan)**

Platform length is same ----- Repair broken area

Lighting of platform ---------- More bright lighting to night shift

Access space to platform ---- Flat leveled pavement and drainage facility

Stacked goods on platform---Evacuation from platform to protected storage area or warehouse




Source: MYT-Plan, JICA (2013)

**Figure 4.4.2.6 Future Railway Freight Transport Plan prepared by MYT-Plan**

### (2) Infrastructure Development Plan for Selected Route Network (Short, Middle and Long Term)

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

- Short-term projects shall have high maturity status
- To give first priority to existing line improvement in terms of cost aspect
- First UMRT installation should be planned in consideration of feasible timing in order to avoid being dream
- To realize a development scenario harmonizing with the railway infrastructure projects and the related projects such as station plaza development or land development along railway with depots'/workshops' relocation
- To fulfil the scenario of railway yard redevelopment which benefit can be allocated to the next railway infrastructure project
- To apply modernization of existing lines step-by-step such as electrification, grade separation and etc.

How to reflect the above principles to the planning is explained below.

#### (i) Short-term projects shall have high maturity status.

Short-term target year of the study is set as 2018 which is 5 years later from now. On the other hand, whole required period of railway project from beginning of study phase to the completion of implementation reaches nearly 10 years in case of new line construction, and at least 5 years even shortest case. Therefore, the following two projects are proposed as short-term project, because these are already recognized as "project to be implemented as soon as possible".

- Improvement of Yangon suburban section in Yangon-Mandalay Main Line
- Improvement of Western Half of Yangon Circular Railway

#### (ii) To give first priority to existing line improvement in terms of cost aspect

All infrastructures in Myanmar are deteriorated due to long time economic blockade. In order to modernize all the infrastructures, henceforth it is required to allocate huge amount budget for the renovation. Therefore, it is required to prepare an improvement plan with maximum effect by minimum cost input. In case of railway, exiting railway improvement is the most inexpensive among three types of railway projects categorized as existing railway improvement, existing railway electrification, and new UMRT construction. Therefore, it is decided to give first priority to existing line improvement in terms of cost aspect. (Table 4.4.2.2)

**Table 4.4.2.2 Comparison of Project Cost per Km**

| | Unit Project Cost per km (unit mil. US$) | Remarks | Source |
|---|---|---|---|
| **MRT/Heavy rail (At-Grade [AG] Section)** | | | |
| Existing Line Improvement (Single Track) | 8 | exc. Depot/WS/Rollingstock | adjusted based on Note 3. |
| Applied cost per km for this study | **8** | | |
| Existing Line Improvement (Double Track) | 13 | exc. Depot/WS/Rollingstock | adjusted based on Note 3. |
| Applied cost per km for this study | **15** | | |
| Double-tracking of Existing Single Line | 10 | exc. Depot/WS/Rollingstock. | adjusted based on Note 3. |
| Applied cost per km for this study | **10** | | |
| Electrification for Double Track | 10 | exc. Depot/WS/Rollingstock | adjusted based on Note 3. |
| Applied cost per km for this study | **10** | | |
| **MRT/Heavy rail (Underground [UG] Section)** | | | |
| MRT "A" | 150 | 17km length / Engineer's Estimate | own source |
| MRT "B" | 162 | 2.3km length / Contract Price & Engineer's Estimate | own source |
| MRT "C" | 145 | 10km length / Preliminary estimate | own source |
| MRT "D" | 130 | 5.9km length / Engineer's Estimate | own source |
| Applied cost per km for this study | **150** | | |
| **MRT/Heavy rail (Elevated [EV] Section)** | | | |
| MRT "B" | 47 | 17.2km length / Contract Price & Engineer's Estimate | own source |
| MRT "D" | 73.6 | 9.8km length / Engineer's Estimate | own source |
| BKK BTS Skytrain | 73.9 | | see Note 1. |
| General | 50-100 | | see Note 1. |
| Applied cost per km for this study | **60** | | |
| **Monorail** | | | |
| General | 35-40 | Preliminary cost estimates | own source |
| Applied cost per km for this study | **40** | | |
| **LRT** | | | |
| Lyon LRT | 18.9 | 18km length, | see Note 1. |
| Bordeaux LRT | 20.5 | 23km length, | see Note 1. |
| LA (Gold) LRT | 37.8 | 23km length, | see Note 1. |
| Zurich LRT | 42 | 20km length, | see Note 1. |
| General1 | 10-20(At-Grade)<br>30-50(Elevated) | | see Note 2. |
| General2 | 15-40 | | see Note 1. |
| Applied cost per km for this study | **20** | | |
| **Tram** | | | |
| General | 10-25 | | see Note 1. |
| Applied cost per km for this study | **15** | | |
| **BRT** | | | |
| Quito (Ecuador) | 2 | | see Note 1. |
| Taipei BRT | 0.5 | | see Note 1. |
| General | 0.5-15 | | see Note 1. |
| Applied cost per km for this study | **5** | | |

Source
1: UNCRD (United Nations Centre for Regional Development)
http://www.uncrd.or.jp/env/est/docs/BRT-Training-Materials_Nov05/1-2_Introduction_to_BRT.pdf
2: MLIT (Japanese Ministry of Land, Infrastructure and Transport)
http://www.mlit.go.jp/road/sisaku/lrt/lrt_index.html
3: Example of Railway Project Cost per KM - Manual of Transport Infrastructure Development Planning for Developping Countries, Transport Economic Research Center.

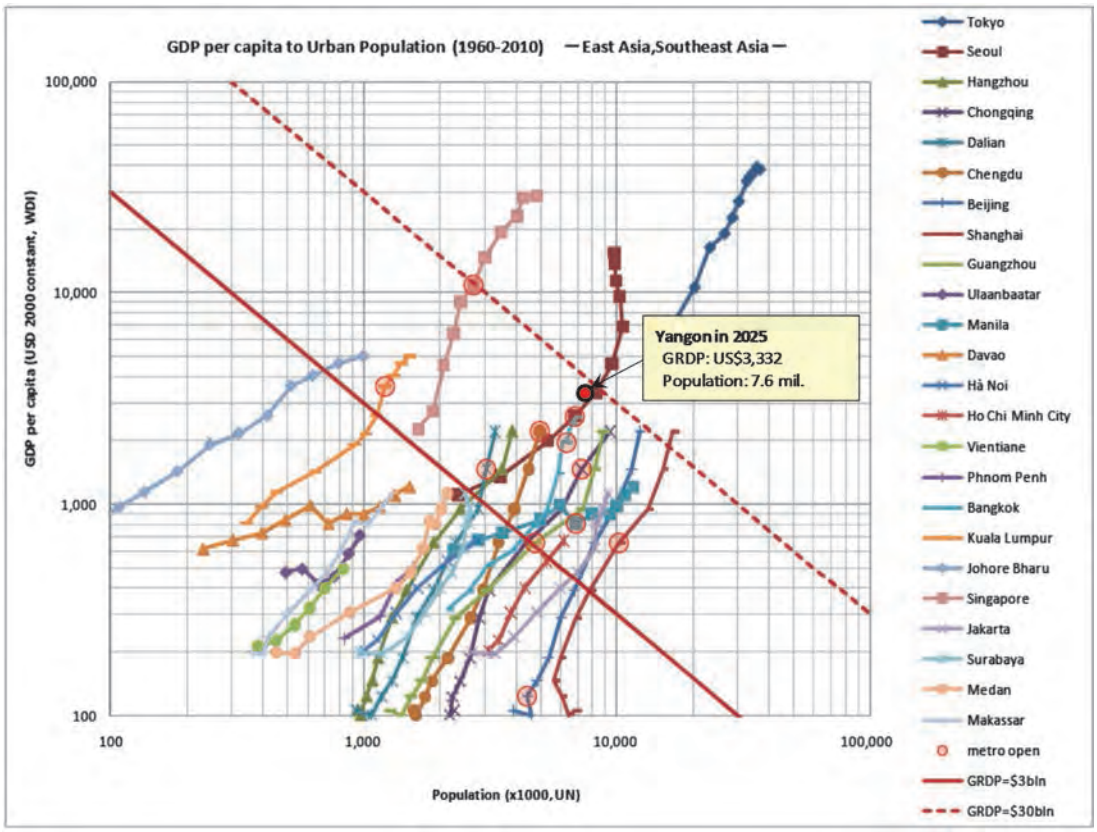
### (iii) First UMRT installation should be planned in consideration of feasible timing in order to avoid being dream

The installation timing should be considered carefully in order to avoid stopping on the way and unanticipated burden after the commencement of operation, because UMRT requires huge amount of cost for not only construction but also operation and maintenance.

There is an analysis result about relation between UMRT opening year and GRDP in

Asian major cities as shown in Figure 4.4.2.7. The figure shows almost opening years are concentrated in GRDP band between US$3bil. and US$30 bil. The figure is used for the validity evaluation of the planned opening year of the first UMRT.

The expected GRDP of Yangon in 2025 which is the middle-term target year is US$25bil., and it is in the GRDP band between US$3bil. and US$30 bil. Therefore, it is decided that UMRT Line1 is planned as the middle-term project.




Note: 1) Yangon's GRDP is constant price in 2010. To be exact, the value should be discounted by using GDP deflator because base figure was calculated by price in 2000.
2) Applied exchange rate is 1US$=1000Kyat

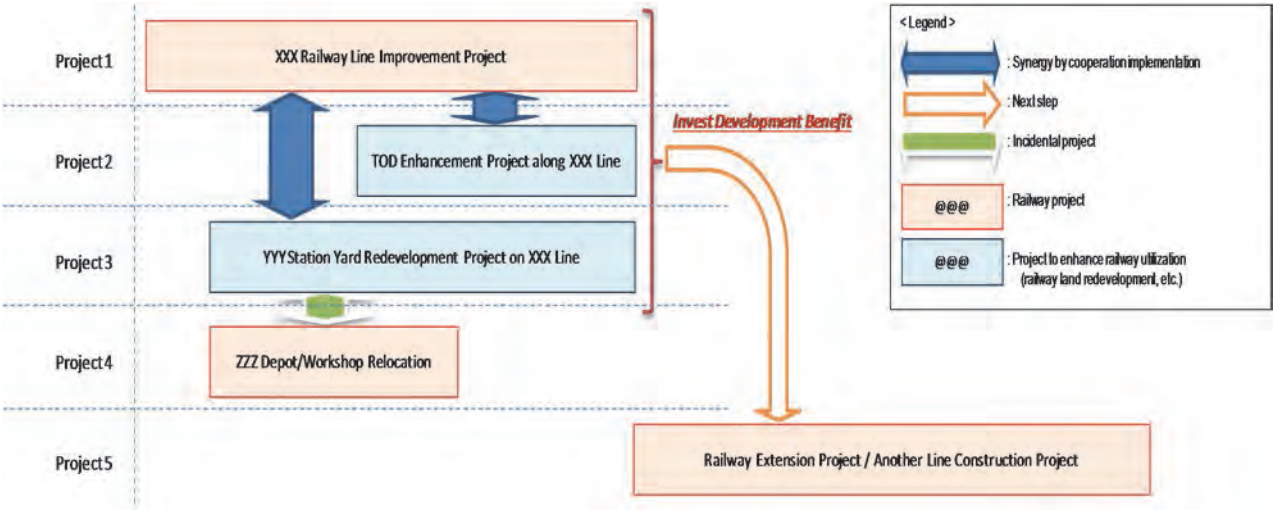
Source: The Research on Practical Approach for Urban Transport Planning, JICA, 2011

**Figure 4.4.2.7 Yangon's Position in 2025 on Relation Figure UMRT Opening Year and GRDP in Asian Major Cities**

**(iv) To realize a development scenario harmonizing with the railway infrastructure projects and the related projects**

In order to enhance railway improvement/construction project effect, it is important to conduct the related projects, which bring ability of attracting customers and induce development benefit such as public transport connection enhancement, railway yard redevelopment, etc. by matching implementation timing. In addition, implementation timing of depot and workshop relocation should be matched to the timing of railway yard redevelopment, because depot and workshop relocation should be completed before railway yard redevelopment. Therefore, the Study prepares a scenario like

Figure 4.4.2.8 which considers implementation timings between railway project and the related projects.




Source: YUTRA Project Team

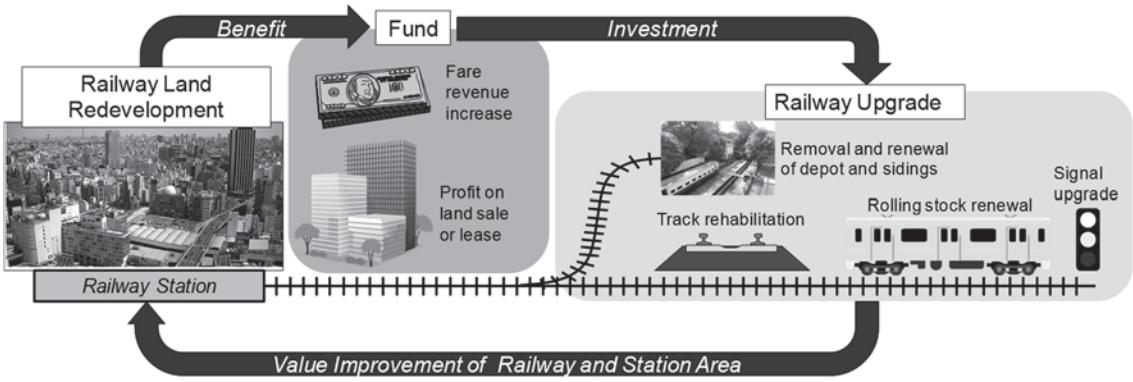
**Figure 4.4.2.8 Example of Railway Development Scenario in combination with the Related Projects**

**(v) To fulfil the scenario of the railway yard redevelopment which benefit can be allocated to the next railway infrastructure project**

Due to requiring huge investment amount for railway infrastructure development, it is essential to prepare effective scheme which uses funds obtaining from not only public but also private, PPP, etc.

MR has large yards in high-value area such as Yangon Central station yard, Malwagone depot/workshop yard, etc., and these yard redevelopments have benefit for MR with demand projection.

The demand rising will bring both fare revenue increase and investment capability expansion by rising of value in station area. Thus, MR will gain large funds with yard redevelopment scenario and could make full use of it for other investments in railway such as new line construction, upgrading existing line including electrification, rolling stock renewal, etc. in the future. Therefore, it is planned to reflow the benefits from yard redevelopment towards railway upgrades and further developments. (Figure 4.4.2.9)




Source: YUTRA Project Team

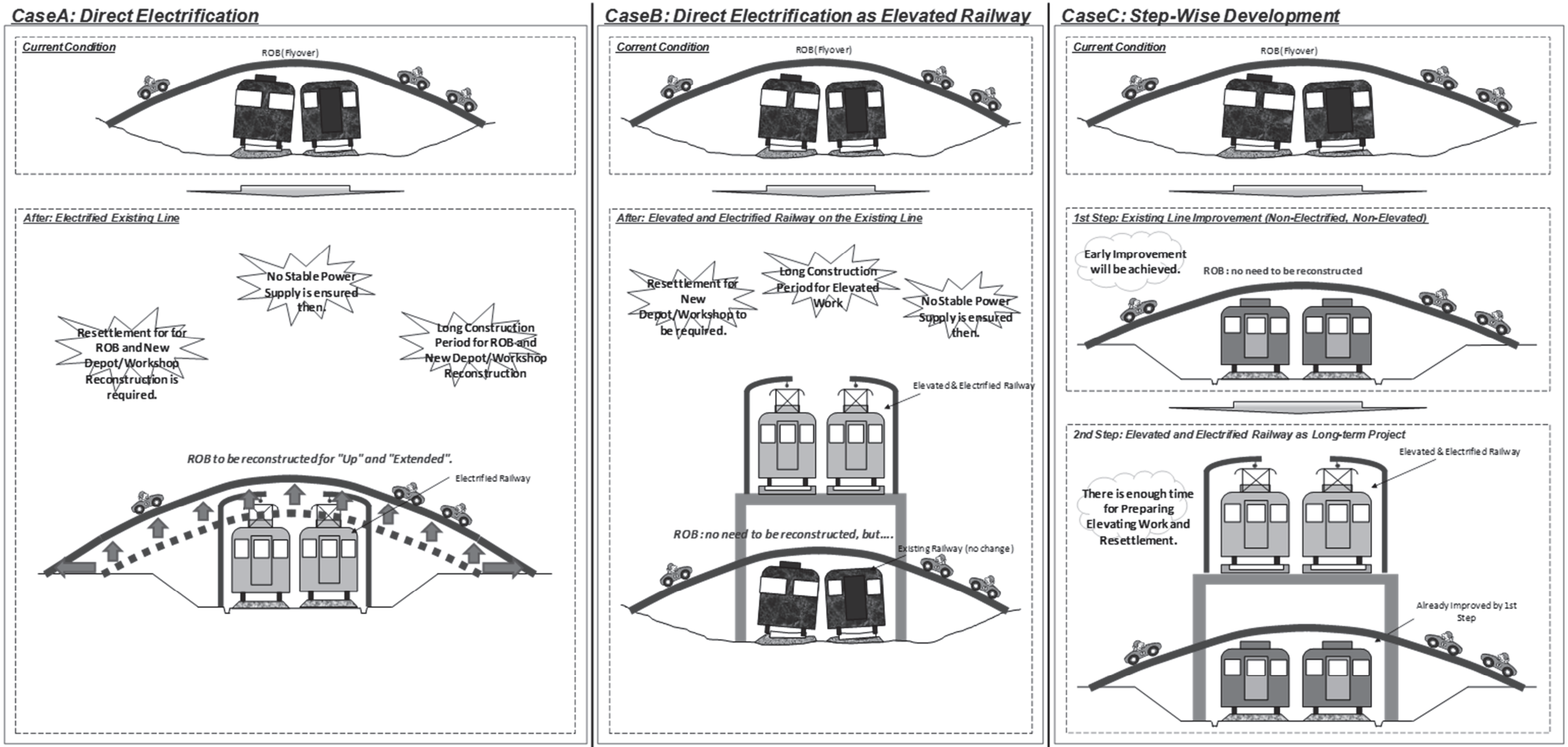
**Figure 4.4.2.9 Cycle of Railway Infrastructure Development by using Yard Development Benefit**

**(vi) To apply modernization of existing lines step-by-step such as electrification, grade separation and etc.**

In case of existing line modernization, it is a one of effective methods to apply elevated and electrified railway at the beginning. However, the method has some problems that i) long project period is required, ii) own power plant is required due to unstable power supply from power company, iii) the initial cost becomes huge due to large scale construction work, etc. Therefore, it is necessary to establish the most effective scenario how to modernize the existing railway in Yangon city, because Yangon city faces serious traffic congestion and lack of railway commuter line currently, and is required to complete transport congestion measures with short implementation period and low cost. In other word, in consideration of Myanmar government's financial strength, requirement of early operation, and power supply condition, it is necessary to study application of "step development" that means i) to improve existing line with non-electrification and at-grade in order to fulfil high speed and high frequency operation as commuting axis in early stage as first step, and ii) to conduct electrification and grade separation as next step.

Figure 4.4.2.10 shows the comparison among modernization methods for existing line. As shown in the figure, there are three cases as existing line modernization methods, which are a) direct electrification, b) direct electrification as elevated railway, and c) step-wise development (non-electrified improvement at first and elevated/electrified later). According to the comparison result, it is recommended to apply "step-wise development". Therefore, it is planned that step-wise development is applied for existing line modernization.

Based on the principles mentioned as follows, the step-wise development plan for short-term, middle-term and long-term to fulfil the final shape in 2035 is prepared.




| | | | |
|---|---|---|---|
| **Project Cost per KM** | **US$ 31mil. /km**<br>(inc. US$1mil. per KM for ROB Reconstruction) | **US$ 60mil./km** | **1st Step:** US$ 15mil. /km<br>**2nd Step: US$ 60mil./km** |
| **Construction Period** | **Longer** | **Longer** | **1st Step:** Fastest<br>**2nd Step: Longer** |
| **Land Acquisition / Resettlement** | **Many**<br>(due to ROB extention and New Depot/Workshop) | **Middle**<br>(due to New Depot/Workshop) | **1st Step:** No need<br>**2nd Step: Middle** (due to New Depot/Workshop) |
| **Necesity of Power Supply for Electrification** | **Need soon**<br>(after project completion) | **Need soon**<br>(after project completion) | **1st Step:** No need<br>**2nd Step: Need soon** (after project completion) |
| **Evaluation Result** | **not recommended** | **not recommended** | ***Recommended*** |

Source: YUTRA Project Team

**Figure 4.4.2.10 Comparison of Development Method and Sequence for Existing Railway Modernization**

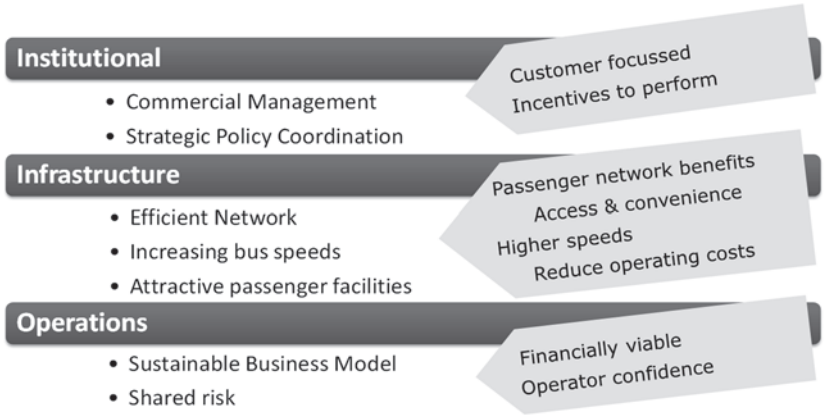
### 4.4.3 BRT and Conventional Bus Services

#### 1) BRT Features

A Bus Rapid Transit (BRT) system is the only option that will allow Yangon to develop a fully integrated public transport system in the short term, which is essential to the effort to retaining public transport mode share. It also addresses the key issues of bus system reform, by creating a sustainable business model.

BRT is more than just buses operating on a busway and more than just an improved bus service. It is a new urban transit strategy that will fundamentally change the way the city operates its transport.

As shown in Figure 4.4.3.1, BRT development encompasses three main areas, being 1) institutional, 2) infrastructure and 3) operations).




Source: YUTRA Project Team

**Figure 4.4.3.1 Components of BRT**

BRT provides broad-based benefits for all stakeholders. The city benefits with an efficient and convenient passenger transport network that will reduce dependence on cars; making growth more sustainable and maintain the quality of life in the city. Passengers benefit from high standard of service which is reliable, convenient, safe and affordable, with improved accessibility and connectivity. The bus industry itself benefits from a shared risk management model where the public sector is more involved; a new business model that enables fleet investment into clean and efficient technology; and operating contracts that provide financial security.

BRT also leads the way for bus system reform, implementing a sustainable business model and the way operators are engaged into the system. As BRT routes are implemented, regular bus routes will be amended and rationalised.

Some specific benefits of BRT are:

**(1) BRT is affordable to build and can deliver an early and complete transport network**

Providing a fully integrated public transport network in the next 5 years will be critical to providing an early alternative to car ownership and use. Good network coverage with

seamless connections is essential for citizens to be able to access the service easily and once on the system, be able to easily reach a range of destinations. Access and integration is improved through good physical transfer facilities (station facilities and safe pedestrian walkways etc.); a *'one-ticket'* operation across the network and feeder services. A BRT system costs less than 5% of the cost of building a similar capacity rail system, meaning that many more miles of BRT system can be built for the available budget.

**(2) BRT defines strong mass transit corridors**

BRT is clearly identified by BRT stations and busways along the main arteries of the system. Over time these corridors will attract more dense land use developments as the convenience of mass transit becomes evident helping to define the development pattern of the city. Transit-oriented development nodes can also be created along the BRT corridors so people live and work close to efficient transport, helping to reduce pressure on car traffic. The BRT network must serve the main origin-destination (O-D) travel patterns of the city to make Yangon a city where it is easy to live without owning a car or a motorcycle.

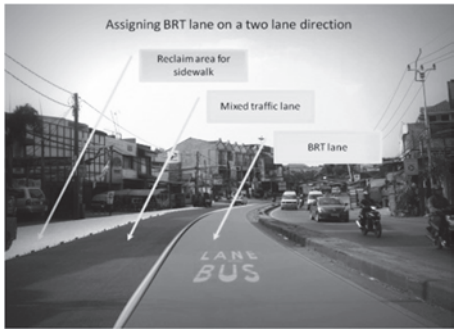
**(3) BRT is adaptable to changing needs and future growth**

Another reason that BRT is highly efficient is that services can be continually optimised, to adjust to changing needs and demands. Service levels can be increased to handle large passenger volumes, and over time build patronage to levels that can support a UMRT. When UMRT services commence along part of a BRT corridor, the BRT service can be adjusted but will not be dismantled as the integrity of the network should be maintained.

**(4) BRT improves road capacity usage**

BRT has a major impact on improving road capacity as on BRT lane can carry 8-10 times the volume of passengers than a typical car traffic lane. Assigning one lane in each direction of a typical 4- 6 lane road means that overall road capacity can be increased 3-4 times. A proposal for a typical single directional bus lane on a 4 lane roadway is shown in Figure 4.4.3.2.

BEFORE: 2 lane directional with mixed traffic – Total directional capacity 2400 pphpd




AFTER: With a single lane BRT – Total directional capacity 9600 pphpd (4 times)

Note: Calculations assume present lane capacity of 1200 passengers per hour and BRT operates one articulated bus per minute.

Source: YUTRA Project Team

**Figure 4.4.3.2 Before and after (proposed) road layout on a 2 lane directional roadway**

**(5) BRT improve traffic flow through channelization**

Dedicated lanes for buses are sometimes perceived negatively, but this overlooks the fact that buses already use a significant amount of road space. With BRT, existing bus services operating parallel to the BRT will cease, thus removing the 'stop-start' bus activity from the mixed traffic lane and improve general traffic flow. Jakarta's experience is shown below:

Source: YUTRA Project Team

**Figure 4.4.3.3 Before and After – Jakarta**

**(6) BRT helps mitigates traffic growth**

In Yangon's urban transport strategy managing traffic growth will be a major challenge. BRT, while not being the total solution, is nevertheless and essential component of a traffic mitigation by improving the availability and quality of public transport.

There are three action areas for traffic mitigation being: 1) reducing travel demand; 2) improving public transport and 3) making the road system efficient and improving traffic management. BRT contributes in large part by being able to absorb a large amount of traffic demand, as well as improving the quality of public transport, attracting more passengers to an efficient transport mode.

**(7) BRT is supported by commercial management and business models**

While the focus of BRT is often on the infrastructure, the actual success of BRT lies with the management structures and the business model. It also addresses a number of critical issues affecting present bus operations such as monetary constraint, revenue control and unmanageable risk as discussed in Chapter 2 of this report.

The network manager, being a commercial business, creates management incentives to serve passengers well, grow system revenue, maintain efficient services and keep costs under control and manage risk. The bus operating companies contracted to provide services to the are fully funded in this business model to reduce tendency for cost-cutting with service quality standards enforceable under contract.

The business model is supported by efficient infrastructure allowing the system to maintain commercially viable speeds (approximately 15 mph). This requires a segregated busway and intersection control to maintain reliable schedules and avoid 'red-light' interference and bus 'bunching'. Increasing average bus operating speeds improves service levels (reduced travel time, attracting passengers and improving revenues) and reduces operating costs

(increasing productivity and reducing fleet requirements). Network management also allows the system manager to deliver and benefit from network efficiencies and increased level of service to passengers.

**2) Opportunities, Risks and Constraints**

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

The opportunities are:

- Where the population becomes increasingly inconvenienced by traffic problems they will demand action, and are likely to support bold and decisive leadership;
- A present benefit is a high dependency on bus transport and low car ownership in Yangon. It will easier to maintain this (with decisive steps) than at a later time win back public transport modal share.
- Yangon has well-developed arterial roads sufficient to accommodate BRT (preliminary surveys indicate BRT can be accommodated within existing road widths).

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

The risks and constraints are:

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

BRT requires a higher level of management to ensure it operates efficiently.

**3) BRT Design Objectives**

Three main design objectives need to be upheld for a successful BRT. These are:

1 *Build a quality mass transit system - to attract passenger. This will include:*

- Placing BRT at the centre laneways (median) to reduce kerbside conflicts and provide traffic priority. Median stations also provide unique transfer opportunities where BRT lines intersect.
- Using technology-assisted control systems to ensure bus priority, to provide a high standard of reliability and safety;
- Modern and attractive (and clean) facilities that treats passengers with respect;
- A modern bus fleet to increase system profile (buses are an important part of the mass transit image).

2 *Service the main travel demand corridors and provide a fully integrated network*

- BRT prioritized as the as the backbone of the network supported by secondary and feeder bus routes, and integrated with commuter rail lines.

3 *Commercial management, sustainable business models and maintain commercial speeds*

- Ensuring the system provides a high standard of service; is financially feasible and sustainable, and avoiding operational subsidy.

**4) BRT design guidelines**

There are three important design requirements for a successful and sustainable BRT, these are:

*1 Adequate station capacity and intersection control*

- The size and capacity of BRT stations must be adequate to accommodate buses according to schedules. Any interference with bus flow will cause bus 'bunching' that will overcrowd stations and reduces system speeds.

*2 Adequate overall system capacity*

- Passenger capacity (bus type) and service frequency must be sufficient to meet travel demand;
- When demand is high, larger but fewer buses are more manageable.

*3 Infrastructure to guarantee commercial speeds*

- Infrastructure must be capable of maintaining the necessary commercial operating speeds/cycle time and maintain the required Level of Service (LOS);

**(1) Design Issue 1 - Exclusive Median Busway and BRT Traffic Priority**

Median BRT bus lane design is the only realistic option as kerbside bus lanes face many conflicts that can slow speed and reduce efficiency. Median BRT lanes are actually easier to implement due to less competition for kerbside space and it also creates a better mass transit image.

BRT passing lanes at BRT stations are often provided to allow express buses to by-pass stations, however in Yangon where road space is limited, a single busway is recommended with longer high-capacity buses operating similar to a metro rail system. This will allow busway capacity in excess of 20000 pphpd with a bus-platooning system. Bus platooning is used where BRT service density is high (up to 80 buses per hour). Platooning uses a method of grouping buses into a convoy leaving a time–gap between platoons of 90-100 seconds to allow cross-traffic on corridors. Note that in 80 seconds four buses can serve a 2 berth station each with a 20 second dwell time. This means that buses will operate along the corridor at a maximum of 4 buses every alternative 90-100 seconds and each platoon is synchronised with the traffic light signals at intersections. This will require a bus signal at the BRT station to signal bus departure. A four-bus platoon system (at 210 passengers per bus) and operating 18 platoons per hour will carry a static load of 15,210 pphpd. With a passenger turnover of 1.5+ passenger loads could exceed 22,000 pphpd.

Should bus platooning not be used, the BRT system will have slower speeds and a reduced capacity. This also means that platooning need not be implemented at an early stage, but can be introduced as travel demand increases.

**(2) Design Issue 2: BRT stations**

BRT stations must offer a high standard of passenger facilities and convenient access. The main features of station design are:

| | |
|---|---|
| ***Attractive architectural design and good passenger access*** | ▪ Integrated into surrounding urban area with convenient and safe access<br>▪ Modern, clean lines, easy to maintain<br>▪ Signalised pedestrian crossings/ also to cater for disabled and elderly people |
| ***A bus platform that is 90 cm high to provide level boarding including a bus docking system*** | ▪ Safe and easy passenger boarding and alighting<br>▪ Bus guidance at platforms for easy and precise bus docking and minimum boarding gap for passengers |
| ***Closed stations (pay on entry to station) to reduce bus dwell times*** | ▪ Fares paid upon entering the station using Smart Card technology<br>▪ 'Point of Sale' for tickets and convenient fare/ticketing facilities |
| ***Station Management*** | ▪ Good passenger information for services and directions<br>▪ Video surveillance for security and monitoring |
| ***Passing lanes for buses on arterial road sections*** | ▪ Allowing express buses to pass stations to increase the capacity of the system (may not be necessary at CBD sections). |

**(3) Design Issue 3: Control and management**

A major defining feature of BRT is central control to allow 'real time' management and a quick response to any safety issue and disruption in operating schedules. It enables accurate passenger information (such as 'next bus' arrival information and informs an 'operating log' which records all bus movements at can be useful for monitoring performance and future service planning.

Features of the control system include:

- Automatic bus tracking linked to the traffic controller at the Control Centre
- Intersection control for buses (synchronizing bus movements with traffic signals)
- High level of communications (buses and stations) to control centre.

**(4) Design Issue 4: Bus Fleet Design**

The type of bus fleet used on a BRT is determined according to the service plan and is based on travel demand and service frequency. Options include 75 passenger city bus (rigid body), 130 passenger articulated bus, or 210 passenger bi-articulated buses (see below). Contrary to popular belief, the turning radius for a 25 metre bi-articulated bus is the same as a 12 metre city bus (due to the articulation).

Buses used on a BRT must include the following features:

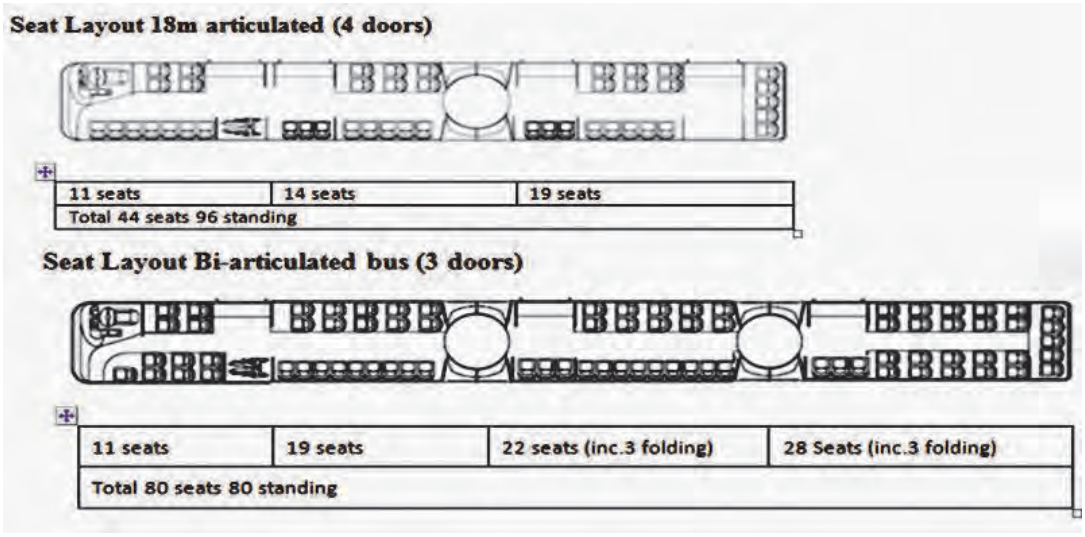
- Multiple and wide doors for fast boarding and alighting;
- Good internal access and a good balance between seating and standing passengers (see conceptual layout in Figure 4.4.3.6). Length of trip and passenger turnover during the trip will determine levels of seating and standing;
- Air suspension for superior ride quality and height control at stations.

Source: YUTRA Project Team

**Figure 4.4.3.4 City Bus with a Carrying Capacity of 70 passengers**

Source: YUTRA Project Team

**Figure 4.4.3.5 Bi-articulated bus with a Carrying Capacity of 160-210 passengers**




Source: YUTRA Project Team

**Figure 4.4.3.6 Seating Layout for Articulated and Bi-articulated Buses**

### (5) Design Issue 5: Network Integration

The development of an integrated network is a primary objective in making public transport accessible and convenient. Network integration includes a number of aspects, as follows:

**- Seamless connections**

The design of the BRT network allows passengers to interchange at any BRT station where bus routes overlap. This is the most efficient way for passengers to transfer and does not require building bus interchange stations that require buses to deviate from the route. Note that overlapping routes are no problem in a BRT system as operators do not need to compete for passengers, and the system manager can assign buses across the system wherever demand requires.

**- Fare integration and ticketing**

Fare integration and E-ticketing should not be confused.

*Fare integration* is where passengers can transfer onto another bus during a journey and not pay a second 'flagfall' – paying only for the extra distance travelled. This can be accomplished with a simple paper transfer ticket if need be. The main issue with implementing integrated fares is how to share revenue between operators. In the BRT this is solved by the system manager collecting revenue and paying operators for passengers or miles of services provided.

*E-ticketing* refers to the use of stored-value cards (Smart Card) to manage fare collection and ticketing. Its major benefit is passenger convenience, and for the agency that revenue is protected against leakage due to cash-handling.

With a Smart Card the passenger pays an initial deposit and then can top up value as required. It uses a swipe-by system upon entry and exit to the BRT station platform and charges a fare according to distance. The system recognises bus transfers and allows 15-20 minutes for the passenger to board the next trip; charging only the extra distance travelled. E-ticketing technology allows intermodal transfer and interchange ability with other transport systems such as rail.

Source: YUTRA Project Team

**Figure 4.4.3.7 Closed system of ticketing turnstiles**

Source: YUTRA Project Team

**Figure 4.4.3.8 Contactless card reader**


Source: YUTRA Project Team

**Figure 4.4.3.9 Automated Ticket Vending machine Brisbane**

While E-Ticketing is often thought to be just a 'technology issue', its main consideration is the Fare Policy and its protocols (although it relies on technology). It is the Fare Policy that informs the system design and not vice versa.

The Fare Policy is actually the 'rules of operation' and will include:

- The fare matrix – fare stages by section point or zones and how the fare is charged to the card;

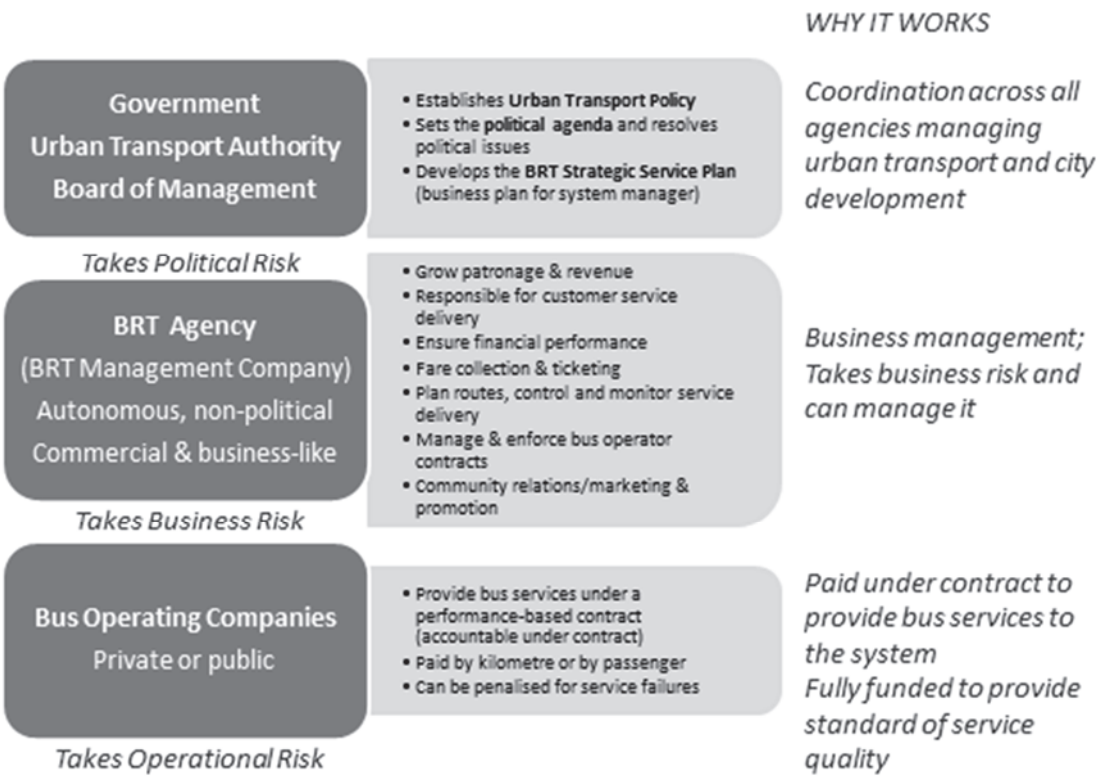
- Swipe on/swipe off methodology to capture the trip distance and the passenger boarding and alighting data;
- A definition of features that need to be included for the passenger such as:
  - discounts and concessions (students etc.)
  - time based travel incentives (such as cheaper off-peak travel or weekend travel)
  - whether personal ID is applied to the card (in case of loss)
  - Safeguards against misuse and fraud. Etc.

**(6) Design issue 6: The institutional framework and the management model**

For a BRT system three distinct institutional levels are proposed, with each level having a defined role and responsibility, with accountability and respective risks assigned at each level. The proposed Urban Transport Authority (political level) manages the strategic policy direction, while at the mid-level; the proposed system manager (the BRT Agency) manages the business of public transport. At the level below is the bus operations performed under contract. Under this model risk is assigned to where it can be best managed. Figure 4.4.3.10 shows these three levels as:

1. **An Urban Transport Authority** – a single authority (a lead agency) to manage coordination and joint cooperation of all players involved in urban transport. This Authority also develops the Operational Plan for the BRT, to guide the BRT Agency in the operation of the business. When bus and rail systems are using a common ticket, the Authority can also act as a central clearing house for fare revenue.
2. **A BRT Agency** –a state-owned enterprise (SOE) as the BRT management company to 'system- manage' the route network including central fare collection and managing the bus operator contracts. The agency manages the 'business' of the BRT network (and also secondary and feeder routes as the system expands).
3. **The Bus Operating Companies** – are bus operating companies formed by a consortium or individual bus operators (the existing affected operators) to provide bus services under performance-based contract under management of the BRT Agency. Contractors are fully funded to provide services to set quality specifications and service failures can be penalised under the contract.

The main role of an Urban Transport Authority is to coordinate all urban transport functions in the city and to ensure transport is integrated with land use and development policies. The aim is to treat urban transport as a single integrated function in order to meet the considerable urban transport challenges facing Yangon. It is also essential for the smooth implementation and operation of a BRT as BRT has many interfaces that will impact on its operations. A detailed discussion on the Urban Transport Authority is contained in Section 4.8.




Source: YUTRA Project Team

**Figure 4.4.3.10 Roles and Responsibilities under the Shared-Risk Management Model**

**5) The key to BRT sustainability – the commercial business model and performance - based contracts**

The key to the good performance of a BRT; its financial viability and its sustainability, is revenue dependant commercial business model which incentivises management to focus on customer service, developing revenues, managing efficient operations and managing costs. It is also supported by the BRT infrastructure that ensures cost efficient operations and better levels of service, such as reduced travel time.

Further to the commercial incentives that improve management performance, 'system managing' the network can create revenue opportunities not available under single bus route arrangements. This is achieved through the fare policy mechanism, the ability to capture full revenue (protection against revenue leakage) and the creation of revenue surplus (exploiting the passenger's willingness to pay for network benefits)

The Bus Operating Companies that provide services to the system under performance-based contracts can be either private or public entities as the contract structure is equally effective in setting the 'rules of the game' either type of entity.

**6) Role of Conventional Bus Services**

Even after UMRTs and BRTs are developed, the role of conventional bus services are important. It is not only because the patronage for conventional bus services will remain at least the current level, or most likely will gradually increase towards the future, but also the present poor levels of service should be upgraded. Enhancement of the quality of bus and

other public transport services is not an end in itself. It is a prerequisite to look for any general improvement of the traffic and transport situation in the whole Yangon Region. Therefore, public bus transport projects should be selected and proposed according to the following basic policies:

**(1) To provide better level of public bus transport services**

At present, the provision of bus services in Yangon Region is largely low in both quality and quantity, highly inefficient, uncoordinated, lacking in comfort and cleanliness, and dangerous at all times. It has a poor image with a high number of old polluting buses offering a low standard of passenger comfort and safety. Such poor public bus transport system has a detrimental effect on the country's development, as well as economy and then worsening people's quality of life. Therefore, short-term improvement of existing public bus transport system are desperately needed and it could be a major step towards sustainability and mobility.

**(2) To mitigate traffic congestion**

In the recent years, the rapid motorization in Yangon Region is creating traffic congestion that are getting more serious year by year. A complete solution to traffic congestion needs people to be able and willing to travel on public transport more. Therefore, short-term projects for public bus transport system are required that could help to reduce the tendency for passengers to shift to private transport such as cars and motorcycles as soon as they can afford to.

**(3) To improve the efficiency of bus operation**

Typically, bus network in Yangon Region has evolved incrementally in response to changes in demand, or requests from the bus operators without systematic bus route planning. Therefore, a poorly planned system resulted in bus route overlapping, add to traffic congestion, and reduce the capacity of public bus transport system. Therefore, restructuring of bus network is required to improve the efficiency of bus operation.

This restructuring should be done according to the following directions:

1. A new business model that enables investment on clean and efficient fleet and other modern facilities should be introduced; such as by operating contracts between the proposed BRT (or BRT/Bus) Agency that takes business risk and operators that take operational risk.
2. Rerouting of buses should be conducted as UMRTs and BRTs are constructed. Conventional bus should shift step-wise from trunk services to feeder services. In this case, major railway/BRT stations or terminals should provide buses with enough space for the convenience of transferring passengers.

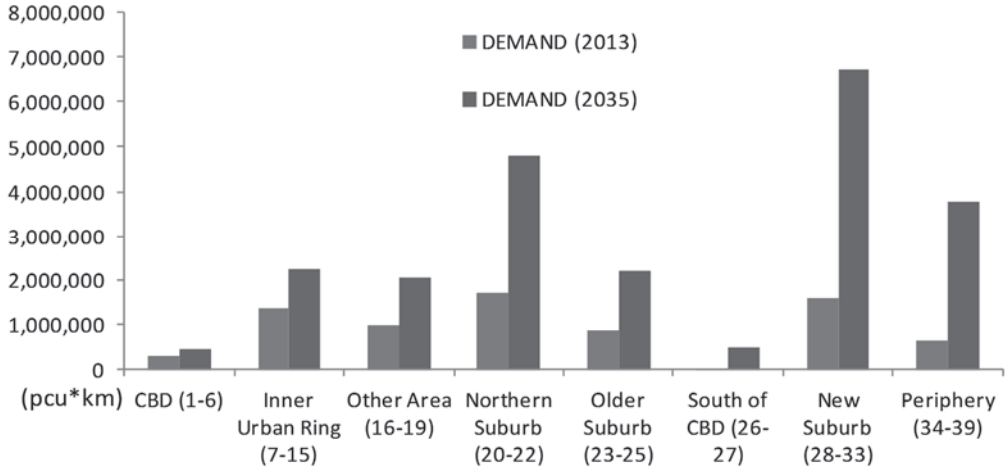
## 4.5 Road Network Development

### 4.5.1 Road Traffic Demand

Movement of people is a basic function of the city's levels of economic and social activity. The trend of the movement was obtained thorough the Person-Trip Survey conducted by YUTRA Project Team in 2013 and the travel demand model was developed for the assessment of strategic development options.

#### 1) Demand Increase in Townships

Figure 4.5.1.1 shows the road traffic demand between 2013 (existing condition) and 2035 ("*Do-nothing*" condition) on the current road network. "Do-nothing" means that no project is implemented under the demand of the targeted year (2035). The vehicle-km (pcu*km) by each township was estimated for demand volume. The vehicle-km is expressed as a measure of traffic flow, determined by multiplying the number of vehicles on a given road or traffic network by the average length of their trips measured in kilometers.



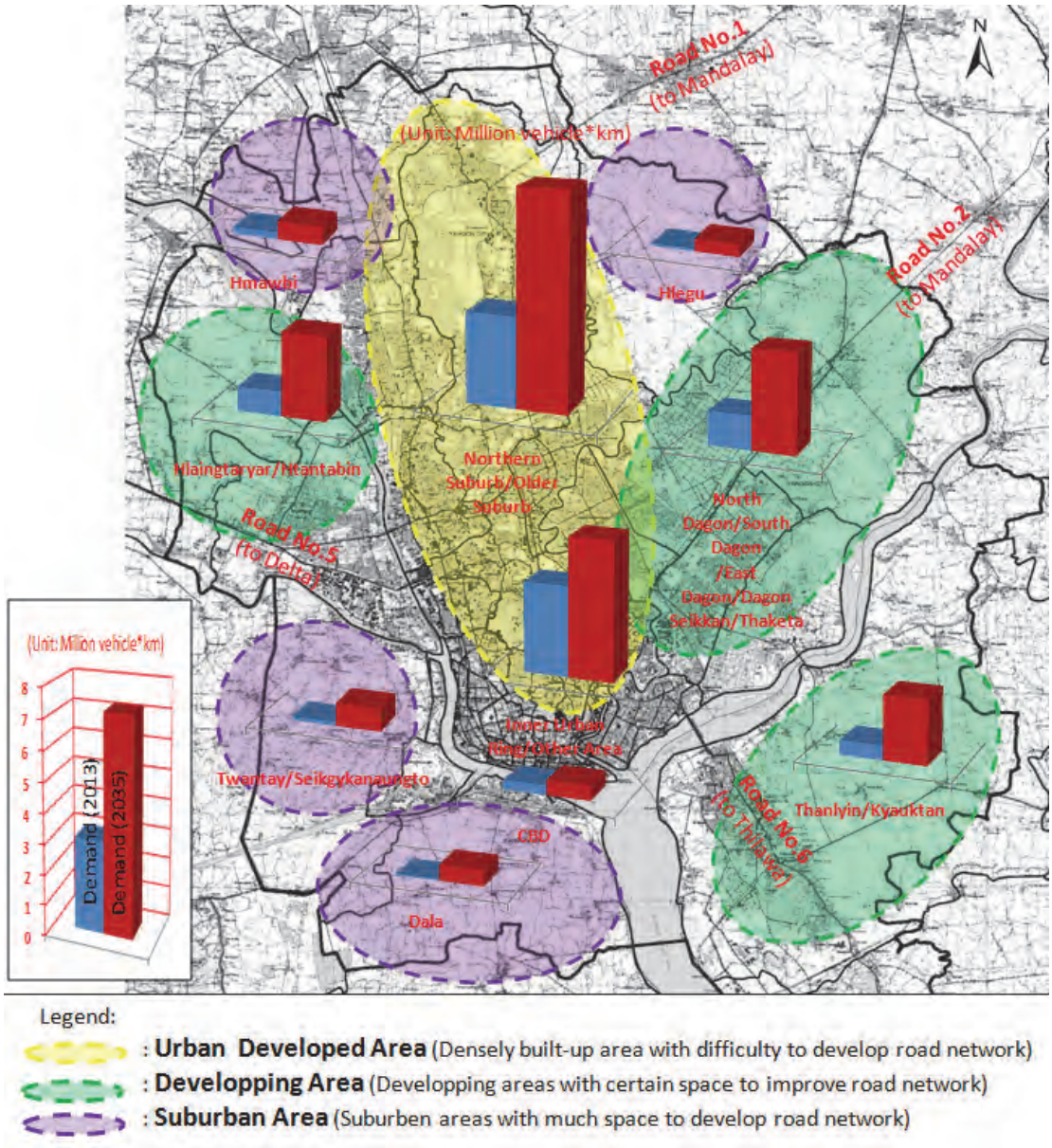

**(Model for 2013 on Current Road Network)**

Note: **(CBD)** 1: Latha, 2: Lanmadaw, 3: Panbetan, 4: Kyauktada, 5: Botataung, 6: Pazundaung, **(Inner Urban Ring)** 7: Alone, 8: Kyeemyin daing, 9: San Chaung, 10: Dagon, 11: Bahan, 12: Tarmwe, 13: Mingalar Taung Nyunt, 14: Seikkan, 15: Dawpon, **(Other Area)** 16: Kamayut, 17: Hlaing, 18: Yankin, 19: Thingankyun, **(Northern Suburb)** 20: Mayangone, 21: Insein, 22: Mingalardon, **(Older Suburb)** 23: North Okkalapa, 24: South Okkalapa, 25: Tharkayta, **(South of CBD)** 26: Dala, 27:Seikgyikanaungto, **(New Suburb)** 28: Shwepyitar, 29: Hlaingtaryar, 30: North Dagon, 31: South Dagon, 32: East Dagon, 33: Dagon Seikkan, **(Periphery)** 34: Kyauktan, 35: Thanlyin, 36: Hlegu, 37: Hmawbi, 38 : Htantabin, 39: Twantay

Source: YUTRA Project Team

**Figure 4.5.1.1 Demand / Supply Gaps on Current Road Network**

Figure 4.5.1.2 shows the above data graphically on the map. For clarity, the 39 zones (townships) are grouped into 4 areas,1) CBD Area, 2) Urban Developed Area, 3) Urban Developing Area, 4) Suburban Area, in this figure.




Source: YUTRA Project Team

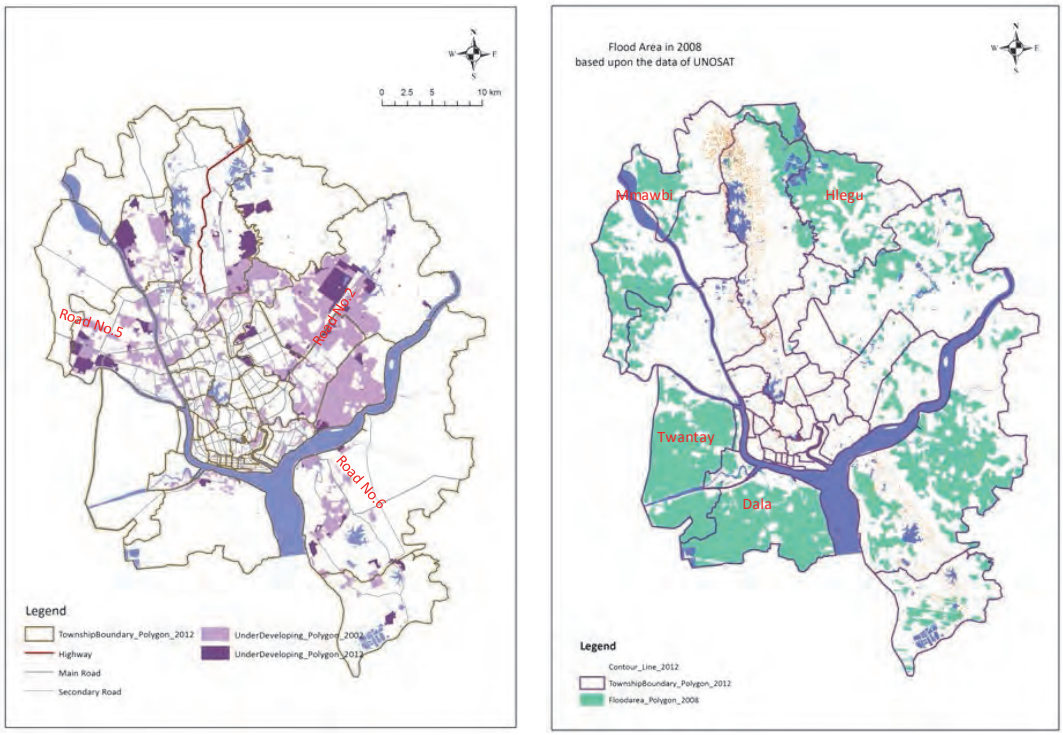
**Figure 4.5.1.2 Demand Increase between 2013 and 2035 showing by "pcu*km" on Current Road Network**

Followings are general implications found on the demand increase and the future demand increase of the road network in each township;

- All townships would need additional road capacity to meet the projected 2035 demand.
- CBD Area (6 townships) is already densely-developed and further increase of the demand by the road development would be limited. To alleviate the current traffic congestion and to control the future increased demand will be controlled by TOD measures instead of the road development.
- Vast traffic demand will be expected in the existing Urban Developed Area located at the north of CBD. However the land availability for the road development is quite

limited and attractive public transport system shall be developed to encourage the modal shifting to the public transport.

- The traffic demand of Urban Developing Area along Road No. 2 (to Mandalay), Road No. 5 (to Delta) is rapidly increased. Figure 4.4.3 indicates the developing trend in the city showing the rapid development along the corridors. The demand of the area along Road No.6 (to Thilawa) is also increased in connection with the development of Thilawa area (SEZ/Port). Existing road network in these areas is still vulnerable even the land is relatively available to strengthen the road network such as road widening and new road construction. In parallel with the road network development, public transport systems integrated with the developed area mentioned above shall be introduced to alleviate the road demand in the developed area.
- Suburban Area such as Dala, Hmawbi. Hlegu, Twantay Townghips are still less developed and it is unlikely to immediately accelerate the development due to land constraints of these areas as indicated in Figure 4.5.1.3 below. Accordingly, the traffic demand toward 2035 is estimated relatively lower than the other areas.




(Under developing area 2002-2012) (Flooding Prone Area in 2008)

Source: SUDP, UNOSAT Data

**Figure 4.5.1.3 Under Developing Area and Flooding Area**

### 2) Demand / Supply Gaps at Screen Lines

In order to grasp the further details of the traffic movement, the demand and supply of the road network across each specific screen lines shown in Figure 4.5.2.1 is estimated by pcu per day.

#### (1) River Crossings

Yangon City is surrounded by the rivers and bridges are served for the road network. In general, river crossing is one of bottleneck points of the road network. This section compares traffic capacity and demand across the river lines. If the traffic demand exceeded the capacity along a river, capacity expansion by new bridges (or tunnels) can be identified as an important transport issue for the establishment of the future networks.

Followings are general findings on the demand and supply gaps of each river crossing screen line;

- Demand of the traffic across Hlaing River is rapidly increased. MoC is constructing New Bayintnaung Bridge (4 lanes) to alleviate the current traffic congestion on this section. Also the feasibility study of Dala Bridge between CBD and Dala is in progress. However further additional bridges would be required to accommodate the future demand.
- Along Bago River, the total number of lanes (Thanlyin Bridge and Dagon Bridge) is likely to be adequate for the current demand. The future demand in 2035 is nearly saturated. Additional bridge(s) would be required for the future demand by a development of Thanlyin area (i.e. new housing areas, Thilawa SEZ).
- Pazundaung Creek is dividing the urban developed area and 10 bridges (total 27 lanes) are currently served for the road transport. The future demand would be excessive than the current capacity and additional bridges shall be required.

#### (2) North-South Corridors

Major north-south arterial roads already serve 6-lane (3+3) and the capacity of these roads is currently adequate based on the result of the demand and supply gaps of the screen lines.

However traffic congestion especially in peak hours (morning/evening/school pickup) becomes serious mainly starting at intersections along the roads. It is essential to expand the road capacity of these intersections by improvement of the traffic signal system, geometric design of the intersections, lane marking, etc.

As shown in Figure 4.5.2.1, traffic demand at the north-south corridors is also increasing toward 2035. However the road development inside the urban developed area such as construction of new roads or widening of the existing roads will be quite difficult as the roadside has already densely built-up. The construction of elevated road on the existing road might be an alternative solution to enlarge the road capacity.

#### (3) East-West Corridors

The capacity of the existing east-west corridors is adequate for the current traffic demand according to the results of the demand and supply gaps and the future demand in 2035 of the east-west corridors will be double as shown in Figure 4.5.2.1.

The roadside condition of the east-west corridors is relatively not densely developed and the widening of several roads might be possible. Also, as well as the north-south corridors, the construction of elevated road on the existing road might be an alternative solution to enlarge the road capacity.

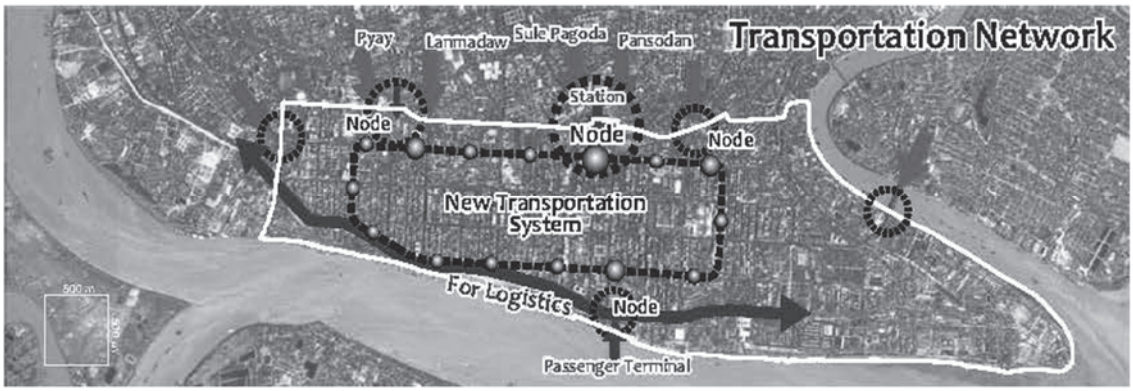
### 4.5.2 Road Development Strategy

The city consists of several areas which have different characteristics such as “developed area”, “developing area”. In reference to the overall transportation development strategy presented in the section 4.1 and also the general findings as mentioned in the section 4.5.1, the road development strategy is identified for the following each specific area.

#### 1) CBD Area

CBD area is already densely developed and the increase of the traffic demand in future will be limited. The mode of the current road traffic in and around CBD area is broadly classified into 2 types such as “passenger vehicles” inside the road grid of CBD area and “logistic vehicles” (port related traffic) which are especially observed on Strand Road.


In the road grid of CBD area, traffic congestion mainly by passenger vehicles is daily observed. However it will be difficult to expand the road capacity (widening of existing roads or construction of new roads) in this densely developed area. To regulate or prohibit the current on-road parking will be important to enlarge the capacity of the roads. In addition, TOD (Transit Oriented Development) policy shall be introduced developing the new transportation system (BRT and/or LRT network) to control the vehicle volume inside CBD area.




Source: SUDP, JICA (2013)

**Figure 4.5.2.1 Urban Development Concept of CBD Area**

Yangon Main Port is located in front of CBD area and Strand Road is the sole road to access the port area by logistic vehicles (port related traffic) under the cargo route regulation of YCDC. According to the Preparatory Survey for the Project for Expansion of Yangon Port in Thilawa Area, JICA (2012), the future annual container throughputs of Yangon Main Port

in 2025 was estimated in the range from 3.1 million TEU (low demand case) to 4.0 million TEU (high demand case).

Table 4.5.2.1 presents the daily traffic volume of the port related traffic roughly estimated by YUTRA Project Team. The capacity of Strand Road (i.e. 4 lanes of the exclusive port access lanes operated by Asian World) will be adequate for the future port related traffic.

**Table 4.5.2.1 Traffic Volume of Port related Traffic**

| Type of Containers | Assumed TEU Volume toward 2035 (TEU/year) | Converted to Number of Trucks (trucks/year) | Average Number of Trucks | |
|---|---|---|---|---|
| | | | (trucks/day) | (pcu/day) |
| 20' Boxes | 1,200,000 | 1,142,857 | 3,131 | 7,828 |
| 40' Boxes | 2,300,000 | 1,150,000 | 3,151 | 7,877 |
| Total | 3,500,000 | 2,292,857 | 6,282 | 15,705 |
| Reference: Capacity of Asian World Road is estimated to be 24,000 (pcu/day/direction) which is more than 15,705 (pcu/day) above.<br>Note: 1) Num. of 20' containers is converted to TEU with 5% of double loaded trucks. 2) Proportion of the type of containers is derived from a similar sized port in other asian country. | | | | |

Source: YUTRA Project Team

Accordingly, the following basic development strategy is derived for road network development based on the review of current conditions of existing transportation infrastructures, the overall transport policy in the section 4.1 and the analysis in this section.

**Table 4.5.2.2 Road Development Strategy for CBD Area**

| *Objectives and Strategies derived from Section 4.1* |
|---|
| *C: Promotion of Development of Attractive Public Transport*<br>*D: Efficient Traffic Control and Management*<br>*E: Effective Management of Transport Demand*<br>*F: Comprehensive Development of Transport Space and Environment* |
| Road Development Strategy for CBD Area |
| **1) Improvement of public transport system**<br>Improvement of road network in CBD could be quite limited due to land constraint and attractive public transport system would be requisite.<br>**2) Establishment of parking policy and control**<br>On-road parking reduces the road capacity in CBD and proper parking supply and control policy shall be established.<br>**3) Improvement of traffic signals and introduction of ITS**<br>To enhance the intersection capacity, existing old traffic control devices shall be renewed.<br>**4) Detachment of port related traffic from public traffic**<br>Yangon Port is located adjoining CBD. The existing exclusive lanes for port related |

traffic (Asian World's toll road) shall be retained and shall be a main access for the port related traffic in the road network.

**5) Introduction of appropriate Traffic Demand Management Systems**

TDM measures such as road pricing might be considered for alternative solution if required.

**6) Improvement of pedestrian facilities**

In parallel with the introduction of the public transport system, pedestrian facilities shall be improved.

Source: YUTRA Project Team

### 2) Urban Developed Area

The existing urban area is mostly developed or developing and a few sub-centers will be also created around 10-15km radius area from CBD as proposed by SUDP. Accordingly, the traffic demand in future will be significantly increased as shown in Figure 4.5.1.1. As shown in Figure 4.5.1.2, the vast traffic demand takes place especially in Northern Suburb and New Suburb areas wholly within the northern half of the proposed outer ring road.

Substantial road widening or construction of the new roads will require the resettlement in the developed area. A substantial modal shifting to the public transportation system such as commuter railways, UMRT would be requisite to accommodate the vast traffic demands under the mid/long-term development.

In parallel with the above, it will be urgently required to enlarge the capacity of the existing road under the short/mid-term development. In order to increase the capacity, the road improvement measures such as minimum widening, pavement overlay, proper lane marking shall be implemented and the bottleneck points of the road network such as river crossings, intersections shall be strengthened.

The construction of double deck roads along major arterial roads such as Kyee Myindaing Kanner Road/Bayint Naung Road, Waiza Yan Tar Road, which carriageways are relatively wide (6 lanes) as seen in photos below, is one of the possible options to expand the road capacity.

Bayint Naung Road

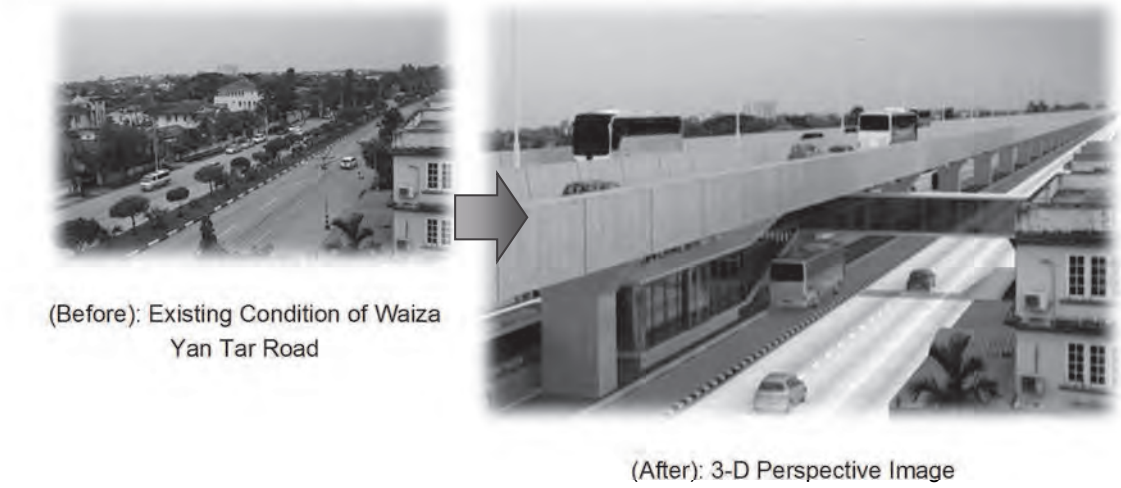
4(-6) lanes with on-road parking

Waiza Yan Tar Road

6 lanes with wide center median

**Figure 4.5.2.2 Major arterial roads in Yangon**

SUDP proposed the inner elevated expressway (double decked toll road) and the expressway has been further studied in YUTRA to identify its necessity based on the transport demand forecasting model to determine the appropriate size of the project such as route, number of lanes. Figure 4.5.2.3 presents the perspective image of the expressway.




Source: YUTRA Project Team

**Figure 4.5.2.3 Image of Double Deck Road (Waiza Yan Tar Road)**

Accordingly, the following basic development strategy is derived for road network development based on the review of current conditions of existing transportation infrastructures, the overall transport policy in the section 4.1 and the analysis in this section. (See Table 4.5.2.3)

**Table 4.5.2.3 Development Strategy for Urban Developed Area**

| *Objectives and Strategies derived from Section 4.1* |
|---|
| *B: Effective Management of Urban Growth and Development*<br>*C: Promotion of Development of Attractive Public Transport*<br>*D: Efficient Traffic Control and Management*<br>*E: Effective Management of Transport Demand*<br>*F: Comprehensive Development of Transport Space and Environment* |
| Road Development Strategy for Urban Developed Area |
| **1) Improvement of public transport system**<br>Improvement of the road network in the existing urban developed area is quite limited due to land constraint and the attractive public transport system such as UMRT, BRT shall be requisite.<br>**2) Widening of the existing arterial roads to maximize its road capacity**<br>Selected arterial roads shall be widened before further roadside development is accelerated.<br>**3) Introduction of the double deck roads to enlarge the road capacity**<br>Urban elevated expressway might be considered for an alternative to enlarge the |

road capacity inside the urban area.

**4) Improvement of traffic signals and introduction of ITS**

To enhance the intersection capacity, old traffic control devices shall be renewed. Other ITS solutions shall be also introduced in future.

**5) Improvement of pedestrian facilities**

In parallel with the introduction of the public transport system, pedestrian facilities shall be improved.

**6) Relocation of logistic terminals to suburb areas**

Existing logistic terminals currently located inside the urban area shall be relocated to suburb area.

Source: YUTRA Project Team

### 3) Urban Developing Area

SUDP proposed “Sub-centers with Green Isle System (Decentralized Urban Pattern)” as the definitive urban structure to alleviate the centralization to CBD area. As shown in Figure 4.5.1.3, urban development is progressing mainly along the union highways.

Accordingly, the traffic demand of the urban developing areas classified in Figure 4.5.1.2 will be also increased in future.

Current road network of these areas is still vulnerable for the future development. However there are possible spaces even along the union highways for the road widening in this area and the road network can be strengthened by the construction of new roads and improvement of the existing roads. (See Figure 4.5.2.4)

Source : YUTRA Project Team

Road No. 5 (Hlaingtaryar TS) Rod No.2 (North/South Dagon TS)

**Figure 4.5.2.4 Possible spaces even along the union highways**

The following basic development strategy in Table 4.5.2.4 is derived for road network development based on the review of current conditions of existing transportation infrastructures, the overall transport policy in the section 4.1 and the analysis in this section.

**Table 4.5.2.4 Development Strategy for Urban Developing Area**

| *Objectives and Strategies derived from Section 4.1* |
|---|
| *B: Effective Management of Urban Growth and Development*<br>*C: Promotion of Development of Attractive Public Transport*<br>*D: Efficient Traffic Control and Management*<br>*E: Effective Management of Transport Demand*<br>*F: Comprehensive Development of Transport Space and Environment* |
| Road Development Strategy for Urban Developing Area |
| **1) Construction of new road network including the expressways**<br>New road network including the expressways shall be constructed to support the decentralization of the urban area.<br>**2) Widening of the existing arterial roads to maximize its road capacity**<br>Improvement of the existing road shall be implemented to support the decentralization of the urban area.<br>**3) Improvement of public transport system**<br>Capacity of the road network in the future urban developed area is limited and the attractive public transport system such as UMRT, BRT shall be required.<br>**4) Effective response to freight transport**<br>The logistic route shall be detoured from the urban area to the suburban area to alleviate the traffic congestion.<br>**5) Improvement of traffic signals and introduction of ITS**<br>To maximise the intersection capacity, proper traffic control devices shall be installed. Other ITS solutions shall be also introduced in future.<br>**6) Improvement of pedestrian facilities**<br>In parallel with the introduction of the public transport system, pedestrian facilities shall be improved. |

Source: YUTRA Project Team

#### 4) Suburban Area

The traffic demand of the suburban areas would be also increased toward 2035 in connection with the decentralization of the city. The existing road network of these areas is still vulnerable and substantial upgrading of the road network shall be required to support the development of these areas. As the logistic traffic volume is increased with the economic development, it is recommended to shift the existing truck route inside the urban developed area to the suburban area to alleviate the traffic congestion inside the developed area. In parallel with the shifting of the truck route, the logistic centres such as truck terminals, inland container depots would be also relocated along the newly proposed truck route.

Road No.7 (Hlegu TS)

Bago River Road (Thanlyin TS)

The road network shall be strengthened by the construction of new roads and improvement of the existing roads to formulate the effective road network.

As represented by above photos, there is still adequate space in this area for development of the road network.

The following basic development policy in Table 4.5.2.5 is derived for road network development for the suburban area based on the review of current conditions of existing transportation infrastructures, the overall transport policy in the section 4.1 and the analysis in this section.

**Table 4.5.2.5 Development Strategy for Suburban Area**

| *Objectives and Strategies derived from Section 4.1* |
|---|
| *B: Effective Management of Urban Growth and Development* |
| **Road Development Strategy for Suburban Area** |
| **1) Development of basic road network**<br>Road network shall be developed to enhance the sustainable development of the suburban area for the decentralization of the city. |
| **2) Widening of the existing arterial roads to maximize its road capacity**<br>Prior to accelerate the roadside development, the capacity of existing roads shall be strengthened by substantial road widening for future demand. |
| **3) Effective response to freight transport**<br>The logistic route shall be detoured from the urban area to the suburban area to alleviate the traffic congestion. |

### 4.5.3 Road Network Hierarchy

#### 1) Road Classification

In the Yangon region, for all types of surfaces, a total length of 980km is under the authority of MOC, while 3,928 km is under the YCDC. Road Classification is defined by MOC (DHSHD and PW) and YCDC. Differences of classification between each regulation are shown in Table 4.5.3.1.

**Table 4.5.3.1 Differences of Road Classification**

| Agency | MOC (DHSHD) | MOC (PW) | YCDC |
|---|---|---|---|
| **Road Classification** | Expressways | Super Highway | - |
| | Major Roads | Highway | Main Road |
| | Secondary Roads | Divisional Road | Collector Road |
| | Collector Streets | Township Road | Minor Road |
| | Local streets | - | - |
| | Cul-de-sac | - | - |

Source: YUTRA Project Team from data of MOC and YCDC

The standards of MOC (DHSHD) were issued in 2010. DHSHD's classifications are widely covered from Expressways to Local streets in mainly urban area. "Geometric Design Standards for Highways" of MOC (PW) was regulated in 1696. PW's classifications are mainly for inter-city roads. In addition, YCDC's classifications are only three types, so that it is insufficient to cover various roads in the Greater Yangon. DHSHD's classification seems comparatively suitable for appropriate road classification. Therefore, proposed classification shall be considered based on DHSHD's classification.

To define appropriate road classification, the followings shall be considered. Expressways shall be divided into Inter and Intra Urban Expressway. In case of Arterial Major Roads with BRT shall be considered separately. Pedestrian way shall be installed to secure passenger's safety in urban area.

Relationship between DHSHD's classification and Proposed Road Classification is shown in Table 4.5.3.2.

**Table 4.5.3.2 Proposed Road Classification**

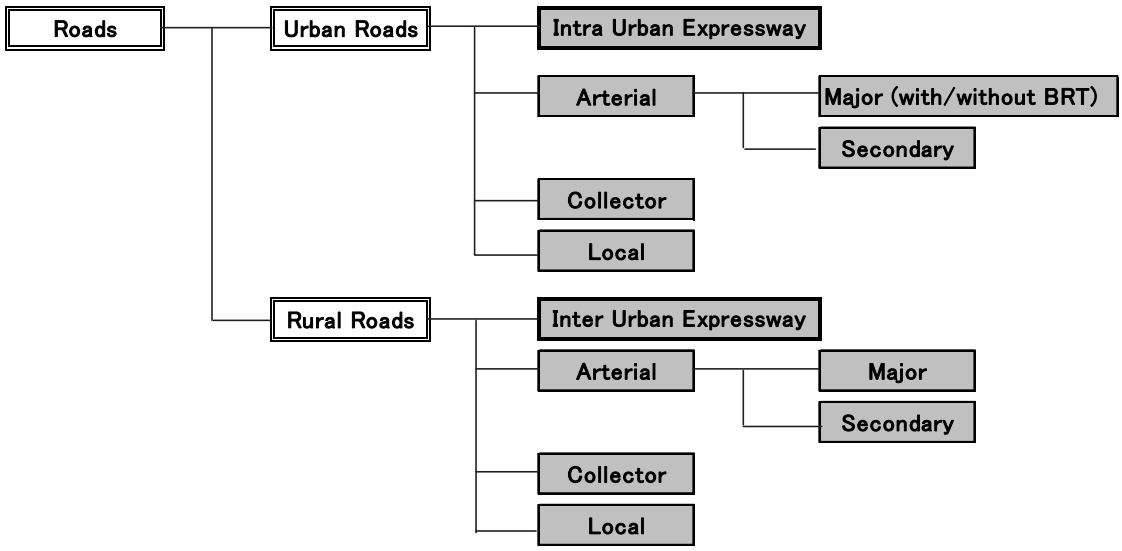
| | MOC (DHSHD) | Proposed Road Classification by YUTRA |
|---|---|---|
| **Road Classification** | Expressways | **Expressway**<br>**- Inter Urban Expressway**<br>**- Intra Urban Expressway** |
| | Major Roads | **Arterial Road**<br>**- Major Road**<br>**- Major Road with BRT**<br>**- Secondary Road** |
| | Secondary Roads | |
| | Collector Streets | **Collector Streets** |
| | Local streets | **Local Streets** |
| | Cul-de-sac | **Cul-de-sac** |

Source: YUTRA Project Team

### 2) Functional Classification

A road hierarchy creates a functional classification of the roads to allow the specific roads to concentrate on either facilitating high capacity or property access. An important factor in

the development of road hierarchy is road classification standards. Functional classification of roads differs in urban area and rural area. Road hierarchy contains expressways, arterial roads (major roads and secondary roads), collector streets, local streets and cul-de-sac. This hierarchy gives additional functional subdivision to the roads. While rural roads are connecting urban areas, they include expressway, major arterial roads, secondary arterial roads, collector roads and local roads. The four functional hierarchies for urban roads are also arterial roads (major and secondary), collector streets and local streets. The difference between the nature and density of rural and urban areas leads to the difference in the characteristics of roads in rural and urban areas. Figure 4.5.3.1 illustrates the hierarchical functional classification of urban and rural roads.

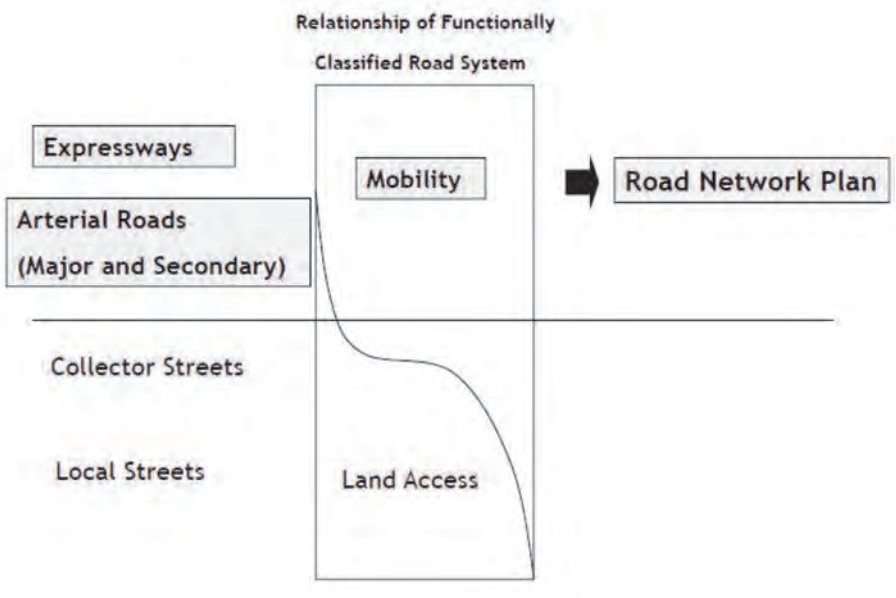



Source: YUTRA Project Team

**Figure 4.5.3.1 Hierarchy of Road Functional Classification**

### 3) Road Network to be planned

The relationship of functionally classified road system is schematically illustrated in Figure 4.5.3.2 based on AASHTO guidelines. An integrated road network development plan based on the consistent principle is imperative especially on expressway and arterial road network across Yangon region. In this study, the road network development plan on expressways and arterial roads is taken into consideration. The arterial roads are defined as major roads, major roads with BRT and secondary roads. In addition, some additional minor roads such as collector streets are taken into account with a view to complementing the arterial road network mentioned above.



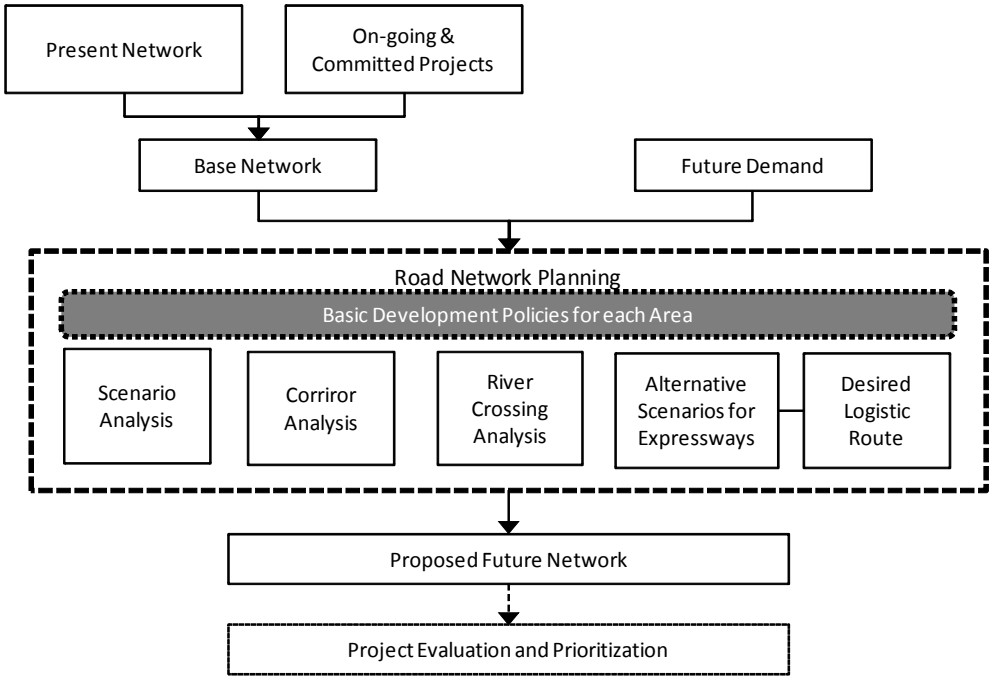

Source: YUTRA Project Team

**Figure 4.5.3.2 Relationship of Functionally Classified Road System**

### 4.5.4 Road Network Planning

Prior to the establishment of the master plan 2035 of the road network, the basic development strategy of the road network in the classified 4 areas, 1) CBD Area, 2) Existing Urban Area, 3) Urban Developing Area, 4) Suburban Area, were identified in the section 4.4 taking into account the characteristics of each areas.

Figure 4.5.4.1 illustrates the flow of the process for the road network planning.




Source: YUTRA Project Team

**Figure 4.5.4.1 Procedure for Road Network Planning**

The first step of the planning is to determine a basic road network that can be regarded as the minimum investment case and the basic scenario for demand and supply analyses. Based on the basic road network, the following analyses were conducted taking into account “the basic development policies” of the road network presented in Section 4.4.2.

**1) Scenario Analysis**

This analysis includes several scenarios to grasp weak sections of the existing road network. “Do-nothing Scenario” shows what will happen if no project is implemented other than the on-going and committed projects. Similarly, “Do-minimum Scenario” shows that following minimum improvements are implemented.

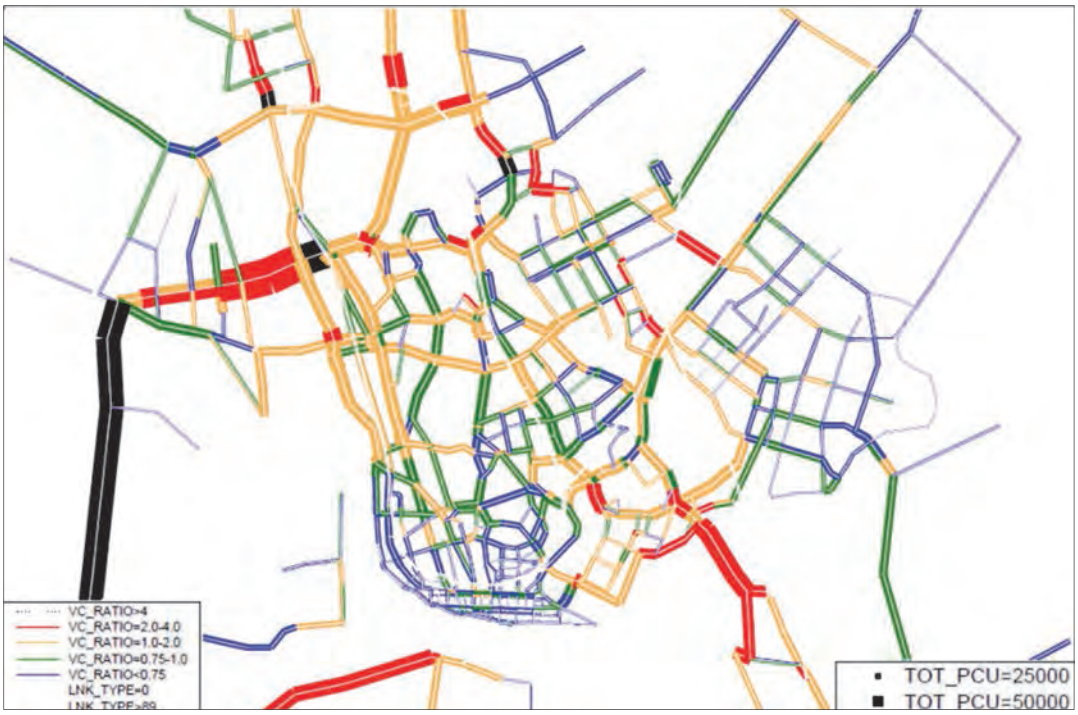
- Enlarge the road capacity by elimination of on-road parking mainly in CBD and the existing urban developed area
- Increase 10% of the road capacity for all the existing roads which will be achieved by minimum road upgrading and/or improvement of roadside friction factors

Figure 4.5.4.2 and Figure 4.5.4.3 give the description of the traffic assignment results of the above mentioned scenarios. The daily traffic volume is expressed as the width of each link and volume to capacity ratio is expressed with five categories. The major findings on the traffic assignment are summarized below for the road network planning.

- The volume to capacity ratio inside CBD area and the adjoining areas is much improved (V/C<0.75) in case of “Do-minimum Scenario”.
- No significant improvement is found in other areas between the scenarios and the road capacity of major north-south corridors such as Insein Road, Kabaye Aye Pagoda Road, Pyay Road is nearly saturated (V/C=0.75-1.0). It is noted that the traffic condition of intersections would be much worse.
- The road capacity of major east-west corridors such as Kyaik Wine Pagoda Road, Lanthit Road, Khayae Road is significantly saturated (V/C=1.0-2.0).
- There is less road quantity in the western and southern area of the city (Twante Township, Dala Township) so the volume to capacity ratio of the existing roads is quite high.


Source: YUTRA Project Team

**Figure 4.5.4.2 Do-nothing Scenario (2035)**



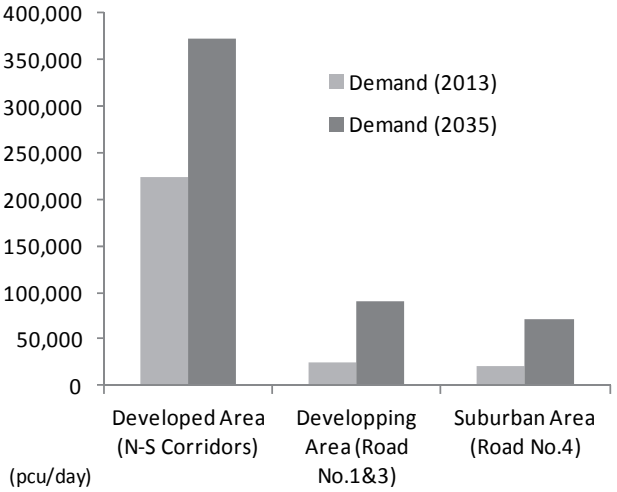

Source: YUTRA Project Team

**Figure 4.5.4.3 Do-minimum Scenario (2035)**

### 2) Corridor Analysis

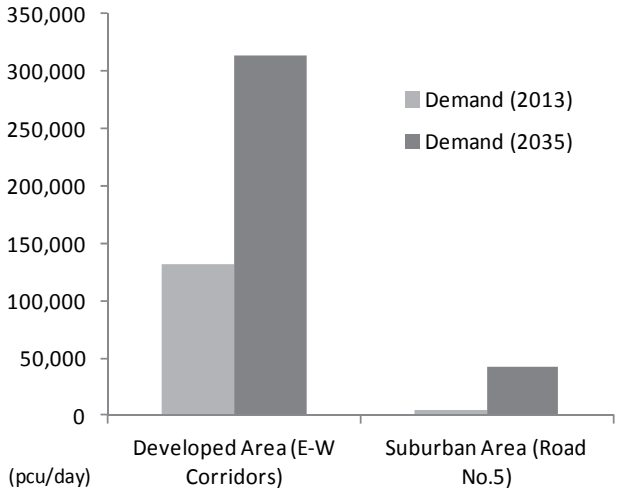
This analysis compares traffic demand of 2013 and 2035 of transport corridors at the selected screen lines to obtain the general guideline for the additional road network toward 2035.

Figure 4.5.4.4 and Figure 4.5.4.5 present the results of the traffic demand increase of the north-south corridors and the east-west corridors respectively.




Source: YUTRA Project Team

**Figure 4.5.4.4 Demand Increase of North-South Corridors**




Source: YUTRA Project Team

**Figure 4.5.4.5 Demand Increase of East-West Corridors**

The traffic demand of the existing urban developed area (both the north-south and the east-west corridors) is rapidly increased. As a widening of the existing roads and a construction of new roads in the urban area is difficult to be implemented, elevated roads is included in the proposed road network.

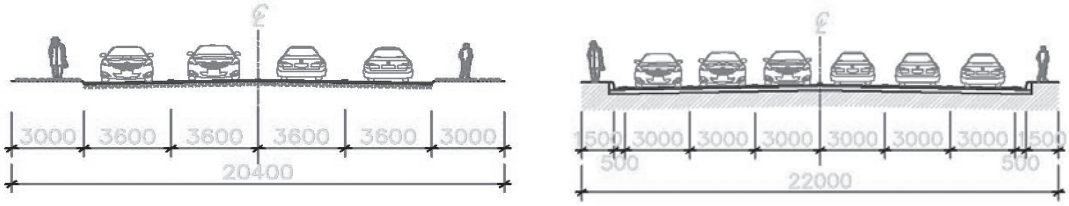
Table 4.5.4.1 presents the target number of lanes for the proposed road network.

**Table 4.5.4.1 Target Number of Lanes for Proposed Road Network**

| Corridors | Demand Increase (pcu/day) | Capacity of lane (pcu/day/lane) | Additional Required Lanes | Target Number of Lanes by Elevated Roads | Target Number of Lanes by Widening of Roads |
|---|---|---|---|---|---|
| | A | B | C=A/B | D | C-D |
| Urban (N-S Corridors) | 148,492 | 15,000 | 10 | **4+4** | **2** |
| Urban (E-W Corridors) | 181,893 | 15,000 | 12 | **4+4** | **4** |
| Suburban (Road No.1&3) | 65,579 | 15,000 | 4 | **4** | **0** |
| Suburban (Road No.4) | 49,958 | 15,000 | 4 | **-** | **4** |
| Suburban (Road No.5) | 37,576 | 15,000 | 4 | **4** | **0** |

Source: YUTRA Project Team

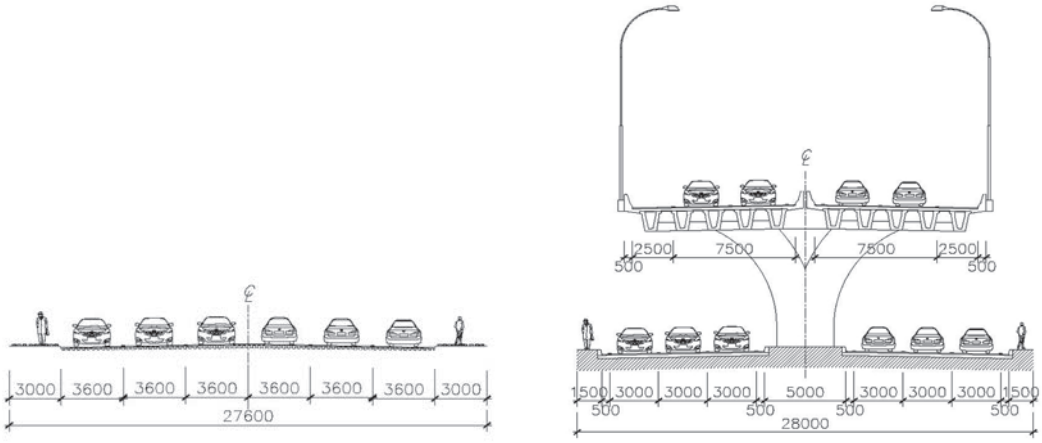
A road widening of the north-south corridors such as Insein Road, Kyee Min Daing Kaner Road, Kabar Aye Pagoda Road, Wai Za Yan Tar Road is likely to be achieved such by restriction of the on-road parking and/or applying “3.0m lane width” which is generally applied in many urban city in the world in accordance with AASHTO geometric design standard as introduced in Figure 4.5.4.6 and Figure 4.5.4.7.




(Existing Lane Configulation) (Proposed Lane Configulation)

Source: YUTRA Project Team

**Figure 4.5.4.6 Introduction of 3.0m Lane Width in Urban Area**




(Existing Lane Configulation) (Proposed Lane Configulation)

Source: YUTRA Project Team

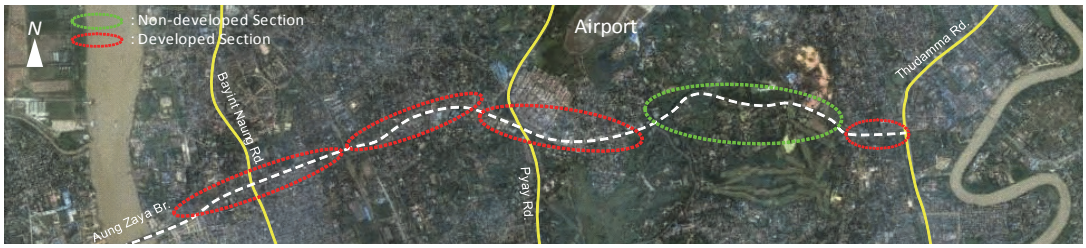
**Figure 4.5.4.7 Introduction of 3.0m Lane Width in Urban Area with Elevated Road**

Although the land acquisition of the existing urban area is difficult, several arterial roads will be necessary to be upgraded for the urban backbone of the city. YUTRA has proposed the improvement of Lanthit Road-Oakkala Road and Parami Road with elevated roads and Kyaik Wine Pagoda Road with BRT. A comparison of the improvement candidate of the roads is summarized in Figure 4.5.4.9.

**Khayae Pin Road**


**POSITIVE:** There is undeveloped land along the road. The road can be the northern outer "East-West Corridor" with the proposed elevated inner ring road.

**Lanthit Road – Oakkala Road**




**POSITIVE:** There is undeveloped land and low-rise buildings/housings along the road adjacent to the airport and the proposed sub-center (Mindama). The road can be an "East-West Corridor". The road is located close to the airport and it will be difficult to build the elevated road.

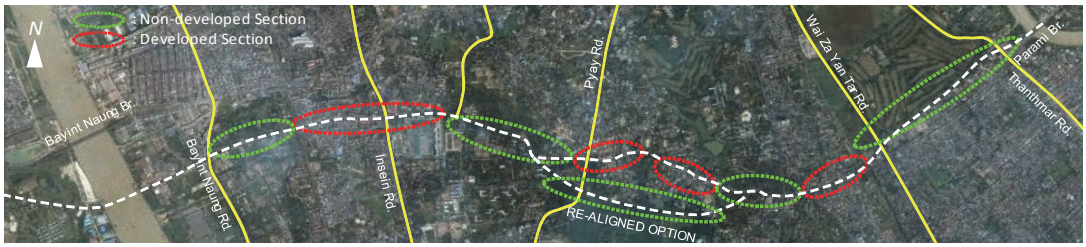
**Kyaik Wine Pagoda Road**


**NEGATIVE:** There are many low-rise buildings/housings along the road. However the width of the existing road is relatively wide. Modal shifting to the public transport such as BRT is recommended to enlarge the capacity.

**Parami Road**

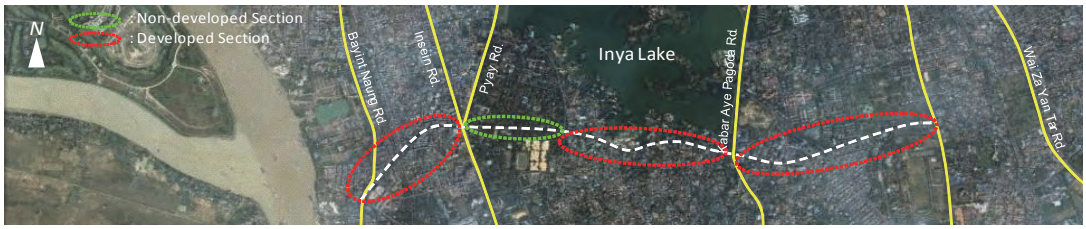
Source: YUTRA Project Team

**Figure 4.5.4.8 Comparison of Possible "East-West Corridors" (1/2)**




**POSITIVE:** There is undeveloped land and low-rise buildings/housings along the road. The road is extended to Hlaintaryar and Dagon areas through Bayint Naung Bridge (6 lanes in future) and Parami Bridge (4 lanes). The road will be most preferable for an "East-West Corridor".

**University Avenue Road**




**NEGATIVE:** There are many low-rise buildings/housings along the road adjacent to Inya Lake (recreational area). Land rearrangement to high-rise buildings will not be practical.

Source: YUTRA Project Team

**Figure 4.5.4.9 Comparison of Possible "East-West Corridors" (2/2)**

### (1) River Crossing Analysis

Yangon City is divided by three rivers (Yangon River, Bago River, Hlaing River), Twante Canal and Pazundaung Creek and the river crossings is one of the bottleneck points of the road transportation. Table 4.5.4.2 shows the existing, under-construction and under-planning river crossing bridges in the city.

**Table 4.5.4.2 Existing, Under-construction and Under-planning Bridges**

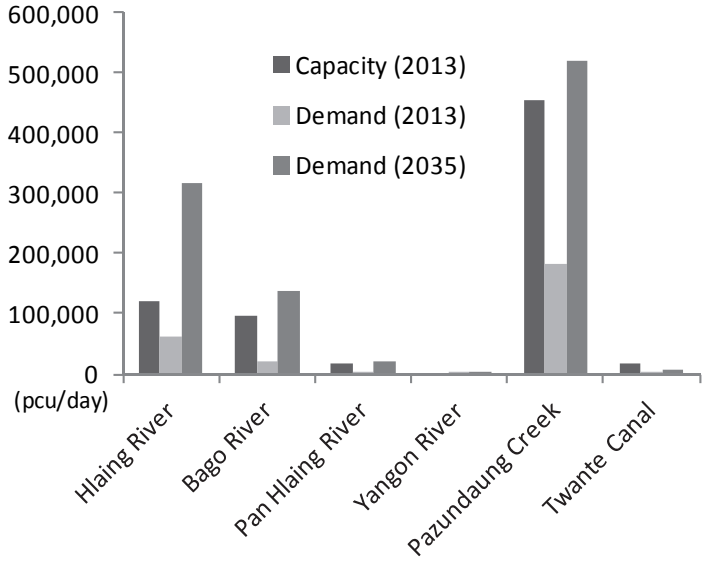
| Name of Bridge | Name of River/Creek | Total Number of Lanes of River/Creek | Type of Superstr. | Length (m) | Width (m) | Number of Lanes | Year of Completion |
|---|---|---|---|---|---|---|---|
| Bayintnaung | Hlaing River | 14 lanes | Steel Truss | 500 | 12.8 | 2-lane, 2-way | 1994 |
| Bayintnaung (under const.) | | | Steel Truss (Arch) | 496 | 15.5 | 4-lane, 2-way (3+1) | (2014) |
| Aung Zaya | | | Cable Stayed | 1,152 | 16.0 | Dual 2-lane | 2000 |
| Shwe Pyi Thar | | | Steel Truss | 1,041 | 19.7 | Dual 2-lane | 2001 |
| Thanlyin | Bago River | 12 lanes | Steel Truss | 1,822 | 21.0 | 2-lane, 2-way | 1993 |
| Bago River (under planning) | | | Steel Cable Stayed/ Box | 1,928 | 22.3 | Dual 2-lane | (2020) |
| Dagon | | | PC/RC | 1,384 | 25.6 | Dual 3-lane | 2007 |
| Mahabandoola | | 26 lanes +1 lane | Cable Stayed | 1,110 | 25.6 | Dual 3-lane | 2000 |

| Name of Bridge | Name of River/Creek | Total Number of Lanes of River/Creek | Type of Superstr. | Length (m) | Width (m) | Number of Lanes | Year of Completion |
|---|---|---|---|---|---|---|---|
| Thaketa | Pazundaung / Nga Moe Yeik Creek | | Bascule | 285 | - | 2-lane, 2-way | 1967 |
| New Thaketa (under planning) | | | PC – Extradozed | 253 | 11.0 | 2-lane, 2-way | (2016) |
| Nga Moe Yeik | | | Steel Truss | 290 | - | 1-lane, 1-way | - |
| Thuwunna | | | PC Box | 300 | 11.8 | 2-lane, 2-way | 1985 |
| New Thuwunna | | | PC/RC | 296 | 18.3 | 2-lane, 2-way | 2007 |
| No.2 Road | | | RC | 213 | 25.6 | Dual 3-lane | 1999 |
| Parami | | | RC | 202 | 12.2 | 2-lane, 1-way | 1997 |
| 2nd Parami | | | RC | 202 | 12.2 | 2-lane, 1-way | 2012 |
| Industrial Road | | | | 200 | - | 2-lane, 2-way | - |
| Twante | Twante Canal | 2 lanes | Suspension | 1,088 | 11.0 | 2-lane, 2-way | 2006 |
| Pan Hlaing | Pan Hlaing River | 2 lanes | PC/RC | 591 | 11.0 | 2-lane, 2-way | 2005 |

Source: YUTRA Project Team

In order to provide the general orientation for the bridge planning of the future road network, the capacity and demand gaps at the river crossing sections are estimated as shown in Figure 4.5.4.10. Current river crossing capacity across Hlaing River and Pazundaung Creek cannot accommodate the future demand in 2035 and additional bridges/tunnels will be required.

The future lane requirement at river crossing sections in the city is estimated in Table 4.5.4.3 for the planning of the future road network.




Source: YUTRA Project Team

**Figure 4.5.4.10 Demand/Supply Gaps of River Crossings**

**Table 4.5.4.3 Target Number of Lanes for Rivers/Creek/Canal Crossings**

| River | Demand (pcu/day) | | Current Number of Lanes | Required Number of Lanes | **Target Number of Lanes by New Bridges** |
|---|---|---|---|---|---|
| | 2013 | 2035 | | | |
| | | A | B | C=A/15,000 | D=C-B |
| Hlaing River | 61,624 | 316,159 | 14 | 22 | **8** |
| Bago River | 20,527 | 137,205 | 12 | 10 | **0** |
| Pan Hlaing River | 3,277 | 19,441 | 2 | 2 | **0** |
| Yangon River | 209 | 2,471 | 0 | 0 | **0** |
| Pazundaung Creek | 183,524 | 520,280 | 26 | 36 | **10** |
| Twante Canal | 508 | 5,915 | 2 | 2 | **0** |

Source: YUTRA Project Team

Hlaing River and Pazundaung Creek will require at least 2 bridges (4-lane bridges) and 3 bridges (4-lane bridges) more respectively. The target number of lanes by new bridges indicated above is an orientation of the minimum requirement and new bridges are proposed even the target number of lanes indicate nil in the above table taking into account an interzonal connectivity, continuity of the road network, etc.

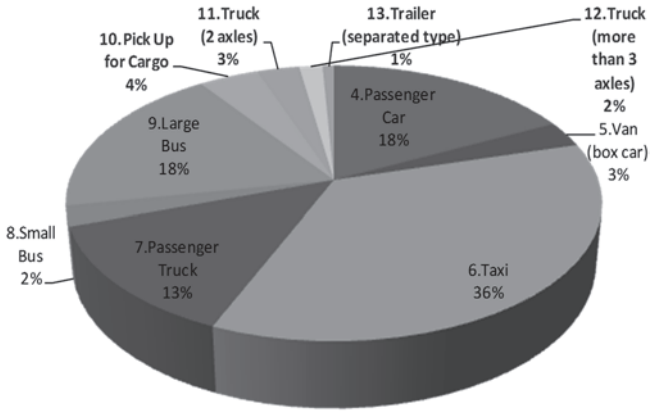
**(2) Desired Logistic Route**

Logistics is playing a fundamental role in the sustainable economic development in the city. In the situation where a large increase in trade and freight transport volumes in Myanmar through a main gateway in Yangon is expected, effort to achieve more integrated and sustainable transport network are needed.

Figure 4.5.4.12 shows the existing major logistic centres such as a truck terminal in Baint Naung and Inland Container Depot (ICD) in the vicinity of Yangon Main Port. As presented in the figure, there are 3 logistic route, 1) Yangon-Bago Route, 2) Yangon-Pyae Rote, 3) Yangon-Delta Route, and Yangon-Bago Route which connects between Yangon and Mandalay via Road No.1 is handling the largest amount of the inland cargo.

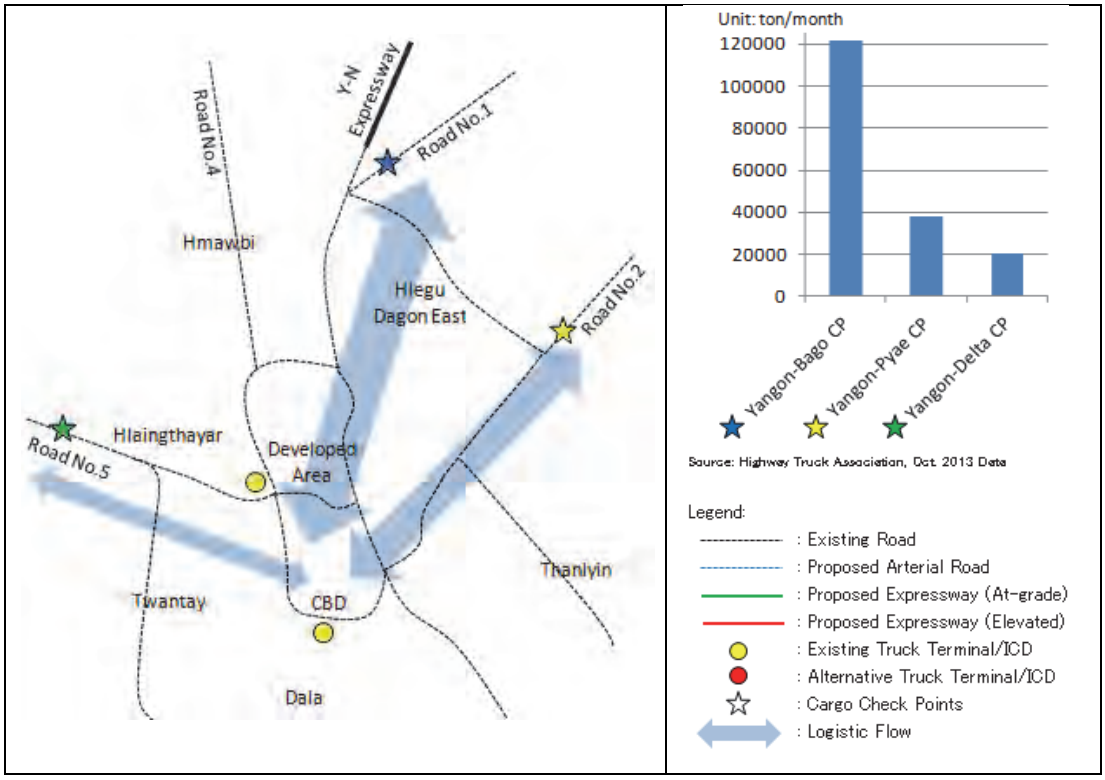
The Highway Freight Transportation Services Association (HFTSA) is monitoring the volume of cargo at 3 check points on these routes. As the existing logistic centres are located in the urban developed area in the city, the logistic traffic is using the arterial roads such as Baint Nung Road, Kyee Min Daing Road, Pazundaung Road inside the developed area as indicated in Figure 4.5.4.11 and Figure 4.5.4.12.

Currently the traffic volume (pcu/day) of the logistic vehicles are relatively small as shown in the right graph for the composition of traffic volume of Kyee Min Daing Kaner Road. However the traffic congestion is daily observed especially around the logistic centres. Furthermore, the future cargo volume is much increasing during the economic growth of the country and also for the completion of Thilawa SEZ/Port.




Source: YUTRA Project Team

**Figure 4.5.4.11 Traffic Volume Composition of Kyee Min Daing Road**




Source: YUTRA Project Team

**Figure 4.5.4.12 Existing Road Network and Logistic Traffic Flow**

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

- Realignment of the current logistic route which is passing on arterial roads inside the developed area
- Effective utilization of the existing infrastructure such as Dagon Bridge (dual 3-lane) which across Bago River
- Restructuring of the logistic transport network with the proposed outer ring road by MoC/YCDC and SUDP

- Implication of the relocation of the existing logistic centres
- The new arterial road network and the expressway (probably toll road) is proposed in the road network for both logistic vehicles and passenger vehicles.

## 4.6 Traffic Management and Safety

### 4.6.1 Traffic Management Development Strategies

Compared to other major cities in South East Asian countries, traffic demand in Yangon is not so high at present and the traffic accidents caused by motor cycles which are dominant in other Asian cities are also not very many, partly because there is the government regulation on the vehicle import and the restriction for the use of motorcycle.

As mentioned in the previous section, people's mobility in Yangon is low. Bus serves as the prime mode of transport for their personal mobility, in particular, to and from places of work. However, bus system is beleaguered with perennial problems and services provided are often regarded as inadequate. This results in people preferring to live near their places of work, particularly in old and narrow houses around the CBD area.

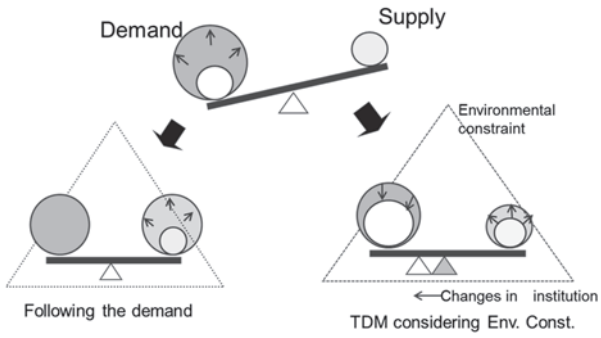
Recently, the foreign investments in Myanmar are growing rapidly in parallel with the relaxation of economic sanctions. New industrial zones and the urban development projects will be constructed around the urban area of Yangon Region. The current population of 6 million is projected to increase up to 10 million in 2035. Ownership and use of the motor vehicles will expectedly expand along with increasing urban size, population, economic activities and incomes.

There are some major cities which have more than 10 million populations such as Bangkok, Manila and Jakarta. Those cities have the common urban transport problems such as serious traffic congestion and accompanying air pollution, traffic accidents, among others. The shortage of available parking spaces in the urban canters is also a serious problem in those cities. Although the respective city governments attempt to promote the use of public transportation by way of controlling or regulating the private mobility, these may not automatically result in a fast modal shift from the private to public modes due to the convenience of using private cars which provide for "door-to-door" transfer of passengers. Consequently, roles of traffic management become more important as well as to be permanent and long term policy not limited to the short or temporally measures until sufficient road network be developed (See Figure 4.6.1.1).

Principal traffic management policy shall be to develop a comprehensive management policy in coordination with overall transport policies and urban development policy as well. The proposed comprehensive traffic management policy will include traffic control and information system, traffic demand management system (TDM) and education/ propaganda, as illustrated in Figure 4.6.1.2.

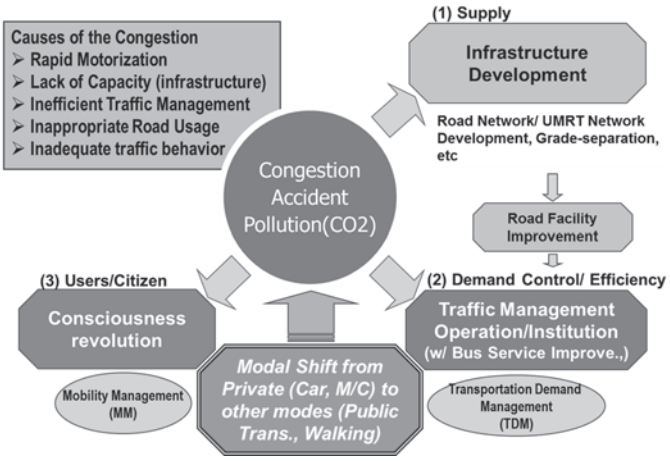
Traffic control and information system is aiming to control traffic flows for smooth and safety traffic. Traffic signal system and traffic regulation and traffic guidance will be categorized into this area, and TDM is the application of strategies and policies to reduce travel demand (specifically that of single-occupancy private vehicle) and/or to redistribute this demand in space or in time. One more significant measure is education and propaganda activities. Whether traffic flows and traffic demand control measures are workable or not, it will be

much depend upon traffic participants' consciousness. If they cannot understand or accept the control measures, the measures would not be implemented effectively




Source: YUTRA Project Team

**Figure 4.6.1.1 Concept of Traffic Demand Management (TDM)**




Source: YUTRA Project Team

**Figure 4.6.1.2 Image of the Proposed Comprehensive Traffic Management Policy**

**Table 4.6.1.1 TDM Measures**

| Type | Measures |
|---|---|
| Economic Measures | ▪ Fuel tax, road user charge<br>▪ Parking charge<br>▪ Subsidizing public transport, etc. |
| Land Use | ▪ Land use and transportation strategies such as car-free developments, and finding the right location for the new developments<br>▪ Park and ride facilities, etc. |
| Information for Travelers | ▪ Travel information before a trip is undertaken<br>▪ Car sharing, etc. |
| Alternative Communication Methods for Travel | ▪ Tele-working<br>▪ E-shopping, etc. |
| Administrative Measures | ▪ Parking controls<br>▪ Pedestrianized zones<br>▪ Alternative working patterns, etc. |

Source : YUTRA Project Team

### 4.6.2 Parking Development Strategies

Parking problems are getting serious not only in the urban center in Yangon also most of the major cities in the world are facing parking issues due to the expansion of motorization and making numerous efforts to mitigate the problems. In order of mitigate traffic congestions due to the vehicles parked along the curb, various countermeasures have been employed in the major cities respectively based on their parking policies. Basically, most of the cities control on-street parking particularly on main streets and promote the development of off-street public parking facilities. And also they establish appropriate rules and regulations on obligated parking facility including garages. In the past, most of the cities had focused on how to develop and manage off-street parking sufficient enough for the increasing automobile demand. However nowadays from global climate changes and environmental point of views, the parking policies have changed to control parking demand so as to promote modal shift from private mode to public mode of transport system. They set out a low upper limit of the parking space for the designated urban area. Instead, they have encouraged Park and Ride parking facilities at major public transport stations.

On the other hand, rapid cutting down number of the parking spaces would be affect peoples' daily activities and may induce messy distractions, subsequently the new parking polices would be given up. Therefore the parking policies have to implement carefully in coordination with development of off-street parking facilities and public transport improvement as well as coordination with communities. Without appropriate space of off-street parking, it will be difficult to reduce on-street parking facilities. Without improvement of public transport system, discussion of park and ride facilities would be meaningless.

Accordingly, YUTRA proposes phased parking policies and strategies for the urban center in Yangon. They are;

***First Phase (arrangement of usages of existing facilities)***

- Relocation of parking spaces from congested road sections to less congested road sections. Reduce parking spaces in the main business/commercial districts and provide proper space for the parking in the outskirt of the business/commercial district.
- Charge parking fees and control parking duration in the major business/commercial districts. Long parking time would be charge higher fees to enhance short time of parking so that efficiency of parking facilities will be improved. For that, long time of parking have to be led to the parking areas in the outskirt of the business/commercial districts, thus minimum parking information system would be required.

***Second Phase (Development of Off-street Parking Facilities)***

- Development of Off-street Parking Facilities at strategic places and remove on-street parking, providing sufficient parking capacity in the total.
- In line with public transport system development, develop parking facilities for enhancing Park & Ride in the adjacent areas to the urban center and at major stations in the suburbs.
- Strengthening obligated parking facilities in the commercial and office buildings

***Third Phase (Reduce Parking Demand)***

- Based on the public transport system development, parking facilities both on-street and off-street will be reduced and convert to urban environment space
- Relocate facilities or businesses depending on the automobile such as warehouse, wholesale and transport business, etc., from urban center to suburb.

In order to implement the policies mentioned above, following rules and regulations and organizational setup will be required..

- Parking Laws and Garage Law, which are including basic policies, definition of Parking Development Area or Parking Control Area, Obligated Parking Facilities, approval and licensing for parking development, organizations and their responsibilities and etc.,)
- Parking Fee and Parking Development Fund
- Development and Technical Guidelines for Parking Facilities, and
- Establishment rules and guidelines for Parking Management organizations including enforcement system for illegal parking and others

Parking issues in the Yangon reason, as mentioned before, are getting serious particularly in the CBD. Most of the road sections excluding some of major road sections are occupied by the parked vehicles. They occupy for long hours sometimes such as their garages. Currently due to the limited modal choice or limited peoples' mobility such as insufficient public bus services, moreover lack of off-street public parking, it is not so easy to control on-street parking. With such situation, it is important to identify the sections where parking is prohibited and sections where parking is permitted and to develop a system which will be able to lead vehicles to the appropriate parking lots as well as to develop a system to remove vehicles parked illegally.

In addition, when parking policies and plans are prepared, parking characteristics both for vehicles owned by residence and vehicles coming from outside areas should be examined carefully so that the policies and plans can be accepted comparatively easily. However it will be principal that owner of vehicles should have sufficient space/garage to park their vehicles with their own responsibility, separated from the public parking spaces. For that Parking Laws or Garage Laws will be indispensable.

Once motorization rate reaches certain level, parking will be no longer free. They have to share the cost for parking facilities as well as cost for environmental preservation. In past days, YCDC charged parking fees in the center of CBD, however they abolished the system, then now on-street parking is all free. Now the new charging system shall be redeveloped and save as a fund for new public parking development.

Locations of public parking shall be examined carefully and identify more strategic locations in the middle of distance from traffic congested areas and preservation areas. The strategic locations may be a bit far from their destination, but desirably it will be located within 500m distance. If the distance more than 500m, appropriate feeder transit system should be available. However there are difficulties to find sufficient spaces for the public parking in the urban center, thus usages of underground space of roads or parks can be taken into consideration.

Public parking facilities are not for the urbanized areas. Nowadays they are playing significant roles for the development of transit based society. They are parking facilities

provided at major transit terminals for “Park and Ride”. People can transfer internal transit system from the Park & Ride parking station avoiding serious traffic congestion in the CBD.

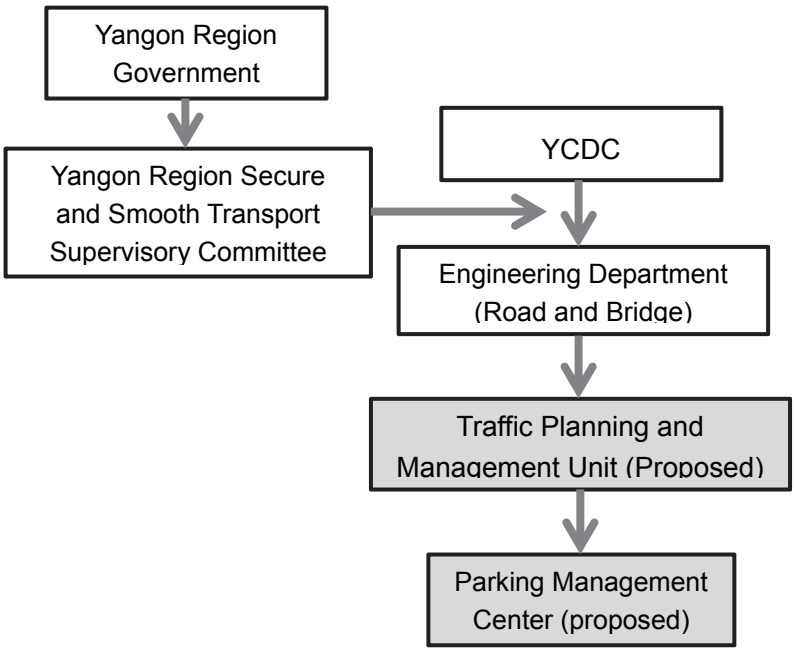
Lastly, for the smooth implementation of the proposed parking policies, institutional establishment will be indispensable. Figure 4.6.2.1 shows proposed organizational set for the parking policy. Under Engineering Department YCDC, Traffic Planning and Management Unit (TPMU) will be proposed and Parking Management Center (PMC) will be established under TPMU. Responsibility of TPMU and PMC will be as follows;

**(a) Traffic Planning and Management Unit**

- Examination of parking policy
- Preparation of parking development plan
- Development of parking rules and regulation and guidelines
- Parking fee structure
- Construction of parking facilities
- Supervising Parking Management Center

**(b) Parking Management Centre**

- Maintenance and operation of public parking
- Parking fee collection
- Enforcement illegal parking (cooperation with traffic police)




Source; YUTRA Project Team

**Figure 4.6.2.1 Proposed Organizational Setup for Public Parking Development and Operation**

### 4.6.3 Traffic Safety Improvement Strategies

Traffic accident become one of social issues, particularly pedestrian and bus related traffic accidents is significant issue on aiming public transport oriented society in Yangon (see Table 4.6.3.1). Therefore development goal proposed in SUDP is aiming to reduce accident rate on bus into 1 /10 of the existing extremely high accident rate (749/10,000buses).

**Table 4.6.3.1 Development Goals and Effect Indicators**

| Development Goal | Effect Indicators |
|---|---|
| Traffic safety | Accident rate/ 10,000 vehicles<br>(Bus : 749 → 75)<br>(Total: 96 → 10) |

Source: YUTRA Project Team

In order to achieve the goal, YUTRA proposes following basic strategies.

1) Covering the three elements of Person, Vehicle and Road Traffic Environment, following eight measure areas are identified for implementation of effective and efficient traffic safety measures.
    (i) Development of safety road traffic environment
    (ii) Enhancement of safe driving
    (iii) Ensuring safety in vehicles
    (iv) Effective and efficient traffic control and enforcement
    (v) Enhancement of traffic safety education and propaganda
    (vi) Development of post-accident countermeasures
    (vii) Improvement of research and development on traffic safety
    (viii) Reinforcement of the traffic safety administrative system
2) Promotion of comprehensive traffic safety measures for both accident prevention and post-accident measures, including 4Es (Engineering, Enforcement, Education and medical Emergency).
3) Establishment of necessary institutions and database for sustainable traffic safety development
4) Focus on peoples' behaviour culture in the traffic society. Many people say that major cause of traffic accident is human errors particularly lack of safety consciousness. However, the lack of consciousness is sometime because of peoples' habit acquired before motorization society coming, thus the comprehensive measures shall include how to change peoples' dangerous traffic behaviour.
5) Sustainable human and financial resource development. Key area for the human resource development will be systematic collaboration with higher education institute. For financial resource development, a new mechanism with private involvement shall be examined.
6) Introduction of practical reasonable advanced technology balanced with investments on human resource development.

## 4.7 Goods movement and corresponding plans

### 4.7.1 Major freight traffic generators

This section summarizes the existing and future major traffic generators that will affect freight movement pattern and volume in the city of Yangon and the surrounding areas (refer to Chapter 2 and 5).

#### 1) Major traffic generators

**(1) Industrial areas**

There are 18 industrial zones in the country as of today. Among them 12 industrial zones are located in the Yangon Region. A total allocation of 4,362 ha for industrial zones exists in the city of Yangon, which consists of the land area of 3,668 ha developed by Deaprtment of Human Setelements and Housing Development (DHSHD) and four private industrial zones with a total land area of 694 ha.

In addition, Special Economic Zone (SEZ) in Thilawa area will be developed shortly. An industrial area of 1,560 ha will be made available to invite foreign investors and some major local industries in this SEZ.

**(2) Thilawa SEZ**

The Thilawa SEZ is one of the national level strategic industrial development projects, which has been supported by the Government of Japan as well. The Master Plan for Thilawa (METI, 2013) informs the target figures population of this development: 163,000 residential population, 204,000 job opportunities in the manufacturing sector, and 3,000 job opportunities in the commercial sector in the SEZ of 24,000 ha. Assuming the employment participation rate of 0.44 (this figure is estimated from YUTRA HIS) in SEZ, about 72,000 workers (163,000 x 0.44) live in SEZ, and most of them have their jobs in the SEZ. The differential between this figure and the planned job opportunity (204,000 + 3,000) is calculated at 135,000, which indicates that this number of people should commute to SEZ from outside SEZ areas. Accordingly residential places of those commuters will affect the traffic movement patterns within and/between surrounding areas of Thilawa SEZ. In addition to the commuter traffic movement, a large volume of freight traffic to/from this SEZ is also expected.

**(3) Highway truck terminal**

The Bayint Naung Warehouse (YCDC Truck Terminal), which is located near the Bayint Naung bridge in Insein Township, Yangon is the only highway truck terminal in Yangon, and almost all the long-distance truck trips are generated at this terminal.

The survey carried out by the Highway Truck Association during the week of 16 – 22 February 2013 informs that an average of about 11,000 ton general cargo was carried by about 730 trucks per day on the Yangon – Bago (Mandalay) route. Similarly, general cargo of about 1,400 ton was carried by about 120 trucks per day on the Yangon – Pyay route, and about 1,100 ton of cargo by about 110 trucks on the Yangon – Delta route. In total about 1,000 inter-city (long-distance) truck trips are generated at the Bayint Naung Warehouse. Even though the current traffic generation volume is not so significant, the highway truck association has an idea to move the existing terminal function to sub-urban area of Yangon in order to avoid traffic congestion in the already urbanized area.

A new truck terminal with some residential facilities is under construction near the Aung Mingalar Highway Bus Terminal.

**(4) Container truck movement**

In total there are 827 container trucks owned by the member companies of Myanmar Container Trucks Association (MCTA) as of early 2013, which carry about 350 containers a day in average. Assuming one container truck handles 1.3 TEUs (30%: 40 ft container 70%: 20 ft container), a maximum container carrying capacity by the existing container trucks (MCTA) is calculated at 392 thousand TEUs (1.3 TEUs x 827 vehicles x 365 days) per year, which is almost equal to the containers currently handled at the Yangon ports (about 380 thousand TEU per year).

**(5) Highway Bus Terminal**

Inter-city bus transport services are available at the Aung Mingalar Highway Bus Terminal in Mingalardon Township and the Dagon Ayer Highway Bus Terminal in Hlaing Tharyar Townshop. In total more than 1,200 buses are scheduled as of today.

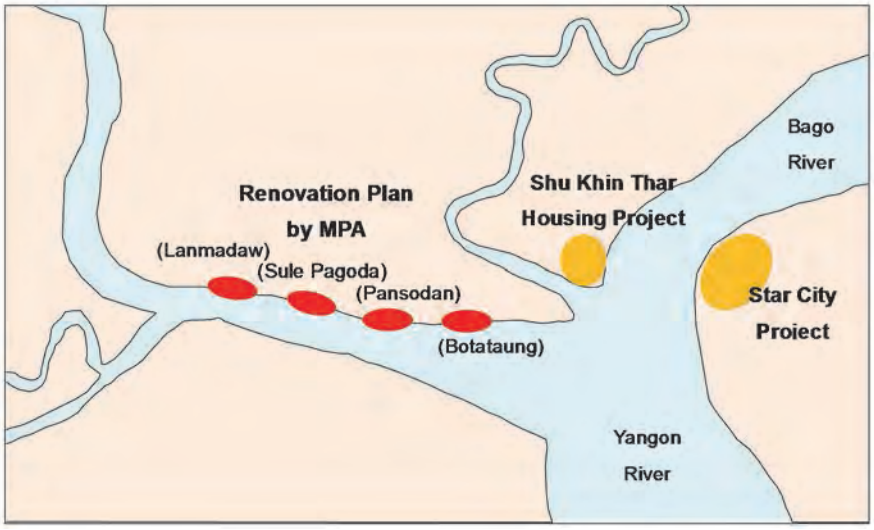
Most of the inter-city bus services are provided at the Aung Mingalar Highway Bus Terminal, whilst the Dagon Ayer Highway bus terminal serves the Ayeyarwady Delta area.

In a sense, these highway bus terminals are isolated, that is, accessibility to those highway bus terminals needs to be improved by providing more well-coordinated feeder bus services in a short-tem.

In the future a joint development with Myanma Railway can be considered, that is, a new highway bus terminal can be developed close to a MR rail station near the proposed sub-centres by SUDP. By doing so, accessibility to such highway bus terminals will be significantly improved.

**2) Waterfront Development Plans**

Myanmar Port Authority (MPA) has a series of waterfront development plans for improvement of cargo and passenger terminals and commercial / business activities in the Yangon Main Port areas as shown in in Figure 4.7.1.1.




Source: YUTRA Project Team (2013)

**Figure 4.7.1.1 Location of Waterfront Development Plan**

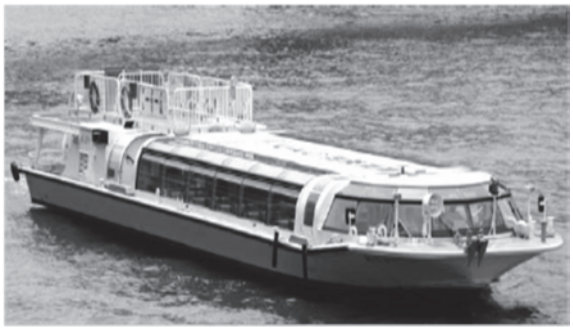
### 4.7.2 Passenger Transport by Inland Water Transport Services

IWT and small boat (sampans) operators provide passenger boat service crossing the Yangon River. The passenger OD survey by YUTRA informs that about 65,000 person trips are accommodated by such ferry services between the existing Yangon downtown area and Dala area. Since the existing ferry boats owned by IWT is very aged and dangerous, three new ferry boats having carrying capacity of 1,000 passengers will be provided by the Government of Japan by the end of 2014.

The role of ferry boat service crossing the Yangon River will be decreased when bridges (ot tunnels) are built between the two areas in the future, accordingly demand characteristics of ferry boat users will be changed.

Commuter shuttle boat (called as water bus / taxi) have been successfully developed in some major cities / towns as part of supplemental transport services or specialized services for particular riverfront development (See Figure 4.7.2.1). In many cases, such riverfront areas are developed as high-end residential, commercial and office zones and these are connected by special water bus / taxi services.

Similarly the Yangon riverfront area has a great potential to develop such high-end facilities with specialized water transport services.



Source: Tokyo Metropolitan Park Association.

Source: City Cat, Brisbane, Australia

**Figure 4.7.2.1 Water Buses**

### 4.7.3 Current Goods Movement Management and Development Potential

#### 1) Truck Routes

The Yangon regional government designates routes (roads) for container trailers, log trucks and other heavy trucks (refer to Chapter 2).

Container trucks generated from the ports in Yangon use the road paralleling Strand Road and Bayint Naung road paralleling the Yangon River to/from the Haling Tharyar industrial area and other industrial zones along No. (4) Main road.

Another north-south truck route is No. (3) Main road, stretching from the 0 mile point of the Yangon – Mandalay Expressway in the north, passing through the Mingalardon Industrial Park, down to south along Thanthumar road. This route is also heavily used by buses owned by companies in the industrial zones along the main road No. (3).

### 2) International Container Cargo

In the intra-Asian container shipping network, container shipping size has been increasing, that is, small container vessels are being replaced with larger container vessels. Size of major container vessels used in the intra-Asian container shipping routes is around 3,000 TEUs (vessel size: length overall: 240 m, draft: 12 m). The existing Yangon ports and Thilawa Port cannot accommodate such large vessels because of shallow water depth of the ports of about 9 m (refer to Cai-Mep Port in Viet Nam having 14m depth., Laem Chabang Port in Thailand, 16m depth).

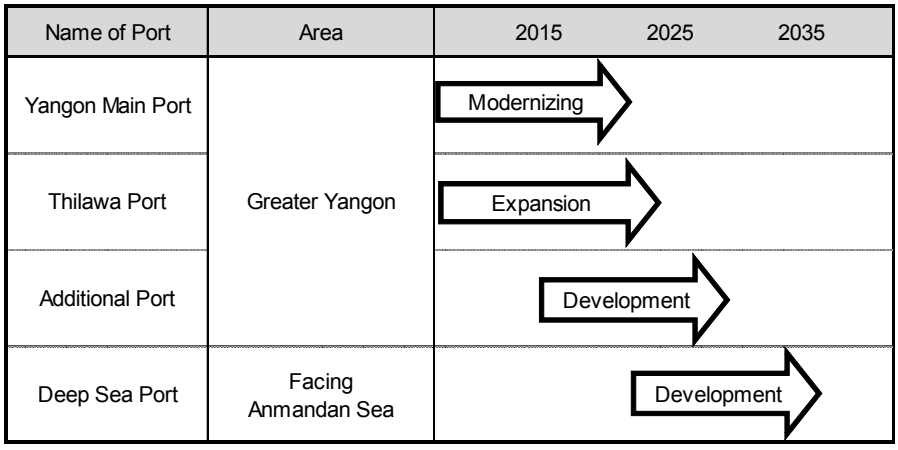
It is very obvious that Myanmar needs a deep seaport of which depth should be 12m or more in order to accommodate large container vessels (Panamax container ships, 3,000 TEUs) as a national gateway in the near future.

It is recommended to develop such international gateway port at off-shore of the Yangon Rivermouth, facing with the Andaman Sea. The location is close to the existing consumption and production places, easy to reach other modes of transport, namely the rail and the expressway (if they are extended), and the international shipping routes.

### 3) Expansion of Thilawa Port

A “Preparatory Survey for the Project for Expansion of Yangon Port in Thilawa Area” informs that the cargo throughput at the Yangon main ports and the newly developed Thilawa port will exceed the existing cargo handling capacity (assuming that the existing Yangon main ports are fully modernized and Thilawa Port is fully developed as well) immediately after 2025.

Ideas to accommodate such demand include development of the opposite shore of the Thilawa Port, north side of Thilawa Port and opposite shore of Seikkan Township.




Source: YUTRA Project Team

**Figure 4.7.3 Indicative Development Scenario of the Ports in the Greater Yangon Area**

### 4) Inland Water Cargo Transport

#### (1) Yangon – Pyay - Mandalay Route

Wood and stone products are the major goods transported by the inland water transport (by barges) from Mandalay area to Yangon. A limited amount of various goods are transported by passenger cum cargo ships from Yangon to Mandalay direction.

A large-scale industrial area and special economic zone (SEZ) will be developed near Mandalay, which may need container transportation services. Further detailed planning work will be required in this regard.

#### (2) Yangon - Pathein Route

Primary industrial products such as rice, egg, and fish products are the major goods transported from Pathein to Yangon, while construction materials, daily necessities and miscellaneous goods are transported from Yangon to Pathein. Water transport is a dominant mode of transport and very important to maintain in the delta area because roads are very difficult to use in the rainy season.

#### (3) Future Potential

It takes about six days to navigate a ferry boat from Mandalay to Yangon at present. The speed of vessel operation can be improved by replacing old ferry vessels with new ones, improving the river channel and corresponding navigation system.

Lead time is one of the most critical logistic performance parameters for consignees/consignors, which will be improved by introducing mechanical cargo handling facilities at each port along the river.

By doing such comprehensive improvement with regard to the inland water transport services, there will be a huge potential for IWT and private water transport service providers to play a dominant role in carrying bulk and liquid cargoes.

In addition to this, there will be an opportunity to use container barges in line with the industrial development along the Ayawaddy River. There is a good reference, namely self-navigation barge between Phnom Penh Port (Cambodia) and Cai Mep Port (Vietnam) through Mekong River (refer to Figure 4.7.3.1). Container cargo transport business in this section has been thriving thanks to well-maintained navigation channel and corresponding navigation system.


Source: Saigon New Port Website

**Figure 4.7.3.1** Self‐Navigation Barge (Mekong River)

### 4.7.4 Future Goods Movement Management

#### 1) Demarcation of Yangon Main Port and Thilawa Port

The role existing Yangon Port will remain for the time being in line with the increasing demand of international and general cargo. However, further large-scale cargo terminal development is not appropriated for the Yangon Main Port area, which is suggested by SUDP and from the viewpoint of traffic control and management. Improvement in the existing Yangon ports should be limited to modernization of the cargo handling facilities and on-going port expansion. The existing port areas, the waterfront area of Thanlyin and the Bago riverfront (designated new town center by SUDP) need to be regenerated for residents and visitors in the future such as high-end residential, hotel, office and commercial building development

Whilist, Thilawa area is suitable for industrial activities including SEZ, port and logistic industries. Accordingly the role of international gateway will be shifted from the existing Yangon Main Ports to the Thilawa Port. In order to make the Thilawa Port fully functioning as the country's gateway, corresponding land transport systems should also be improved in parallel.

#### 2) Goods Movement Network and Terminal Improvement

With regard to the future goods movement management some preliminary ideas are generated conceptually for the consequent sub-sector transport network and facility planning.

The concept includes:

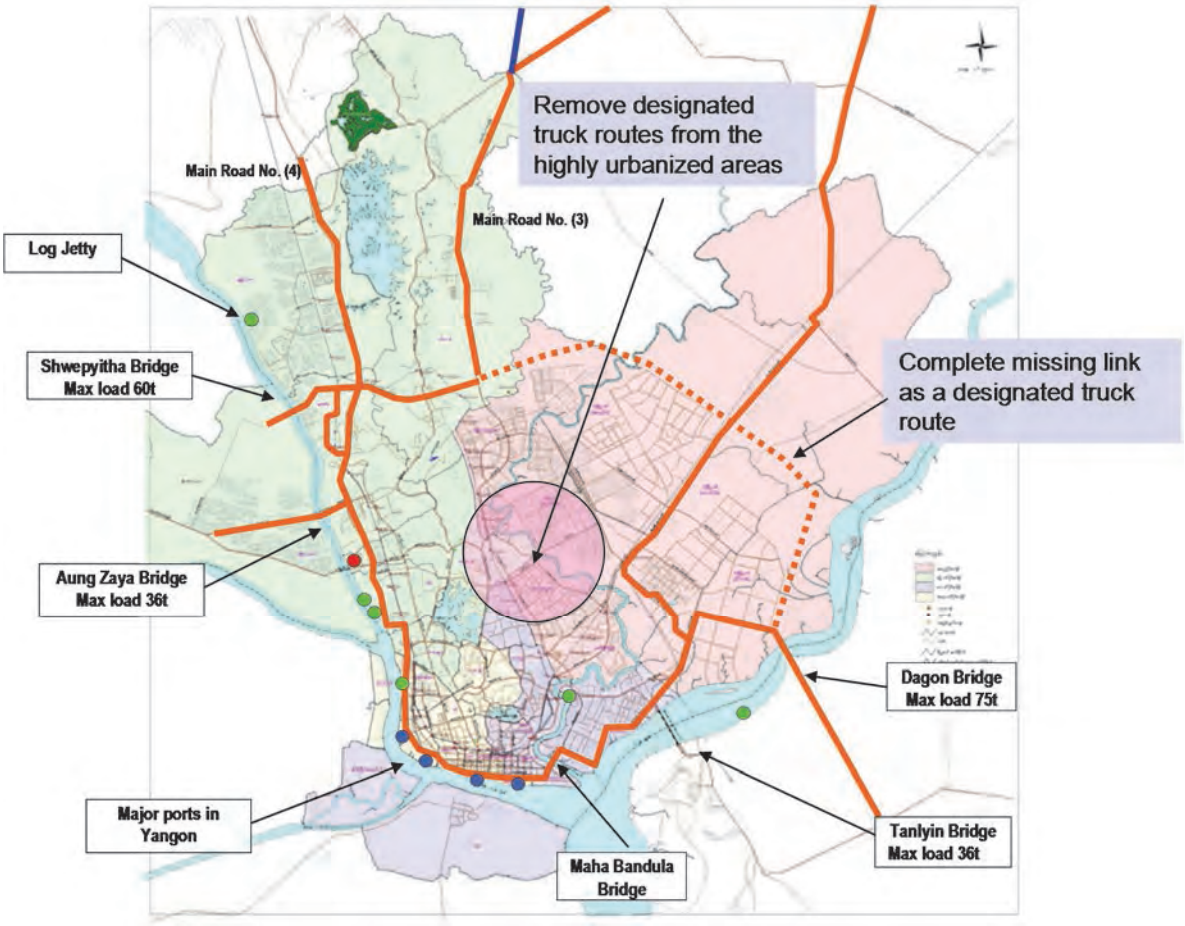
- New Truck Route designation with missing link development, and
- Extension of the Expressway to Thilawa with new MR ICD and Truck Terminal,

**(1) New Truck Route designation with missing link development,**

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

However, it is not practical to remove the truck route along the Yangon River because accessibility to / from the existing Yangon ports should be maintained for the time being. While, the truck route running along Thanthumar Road (along Nga Moe Yeil Creek) can be removed.

A new truck route can be developed, passing though East Dagon township, connecting Main Road No. 3 in the west, Main Road No. 2 and the Dagon Bridge (See Figure 4.7.4.1).




Source: YUTRA Project Team

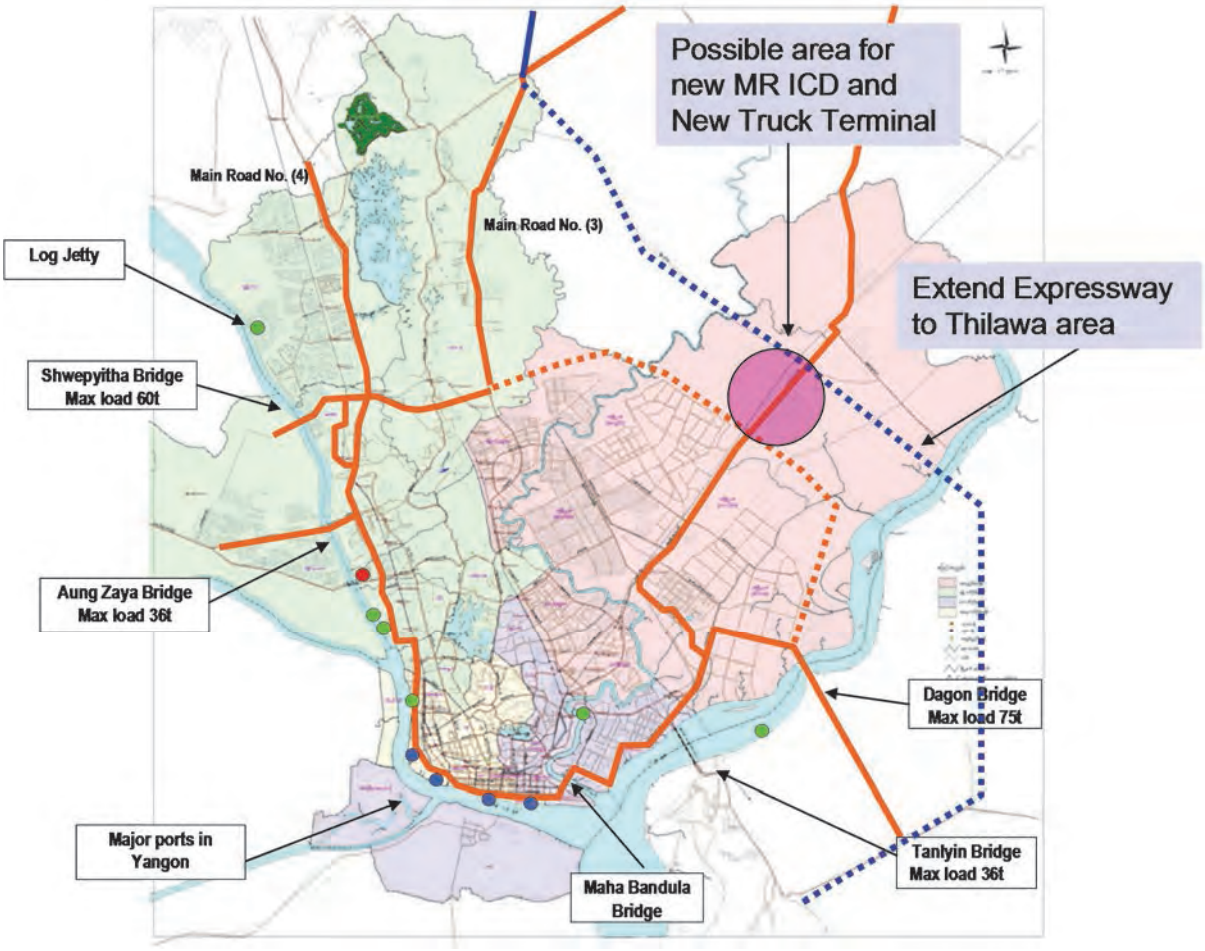
**Figure 4.7.4.1 New Truck Route**

### (2) Extension of the Expressway to Thilawa,

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

Once the expressway is extended to Thilawa and trucks are allowed to use the expressway many hidden development potential or benefit will be revealed, such as:

- To connect the Thilawa area with the national transport system (Yangon – Mandalay Expressway) will encourage industrial activities along the expressway (not only Thilawa but also Bago, Taung Oo, Nay Pyi Taw, Meiktila, and Mandalay.
- To attract more investment to Thilawa SEZ, and
- To encourage real estate development by private sector in Thanlyin and Thilawa area




Source: YUTRA Project Team

**Figure 4.7.4.2 Extension of the Expressway and New Truck Terminal & MR ICD**

## 4.8 Institutional Reform and Strengthening

### 4.8.1 Establishment of "Yangon Urban Transport Authority (YUTA)"

#### 1) Introduction

##### (1) Current Status

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

As analysed in Chapter 2.4 and as per the organizations involved in the transport sector in Yangon Region illustrated in Figure 2.4.1.1, it is identified that transport sector is under the responsibilities of several ministries and agencies of both central government and regional government, with no single agency with clear oversight of the sector. Despite the multiplicity of agencies, there is unclear and illogical division of responsibilities among them. The most essential points to note from the institutional and administrative system are as follows:

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

##### (2) Rationality of "Yangon Urban Transport Authority (YUTA)"

The Office of the President announced on 7 January 2013 the formulation of Yangon City Public Transport Authority (YCPTA) consisting of ten members chaired by Mr. Kyi Thein to manage daily smooth transportation of the people in Yangon City area.

In the decision, its duties and responsibilities were described as follows:

(i) To manage road, rail, boat, etc. for daily smooth transportation of peoples;

(ii) To study to explore possible means and ways to overcome the problems and difficulties on traffic accident, pollution, etc.;

(iii) To obtain technical assistance from international organizations;

(iv) To support Yangon Region Government for rules of law by abiding transportation rules and regulations;

(v) To draw plans intended for future socio-economic and urban development and establish transport basic infrastructures;

(vi) To provide necessary legal advices and plan administrative organizations and to establish financial resources funding to support transport; and

(vii) On behalf of Yangon Region Government, necessary coordination shall be carried out in collaboration with YCDC for smooth transportation.

However, this decision was cancelled by the President on 29 May 2013 as it was against the constitution of 2008, because local area authority should not be established directly under the president.

Although the YCPTA was cancelled, a similar organization is very essential and should be newly established to manage and coordinate the increasing transportation demand more effectively and efficiently. The Yangon Urban Transportation Authority (YUTA) should be established under Yangon Region Government.

Although duties and responsibilities for the previous YCPTA are well stated, the following problems and issues are identified:

(i) There is no dedicated organization and staff to fulfil tasks and responsibilities;

(ii) There is no clear demarcation or role sharing framework among related agencies;

(iii) There is no clear financial mechanism to implement the measures;

(iv) It covers not only public transportation but also other aspect areas such as road infrastructure and traffic management; etc.

In considering the abovementioned issues, the concept of ideal and practical institutional set-up of YUTA is to be proposed in order to support smooth implementation of the proposed master plan projects.

**2) Purpose of YUTA**

To meet the increasing challenges of managing urban transport, urban transport must be managed as a single ‘function’ and not as an array of responsibilities under different departments. The purpose of establishing YUTA is to provide such a strategic policymaking umbrella to improve coordination of urban development and transport and to improve planning within urban transport itself.

YUTA is not to be regarded as just another layer of bureaucracy in the management of transport, or as just a coordinating committee. It is in fact the ‘apex’ body for urban transport policy; holding full responsibility for urban development and transport outcomes and full responsible and accountable for addressing urban transport issues.

Its role is that of a strategic coordinating and management body, through the involvement of key stakeholders in the Board of Management and Executive Committee structure. It governs the executing agencies that implement policy and provide services.

YUTA would be established as a statutory authority under a relevant act referred to as the Urban Transport and Passenger Services Act designed to support its establishment and exercise of its functions. YUTA's mission and objectives are outlined in the Act.

**3) Inclusive Representation**

YUTA is a government body and therefore all Board Members are required to be political and government officers (except for selected positions for key stakeholders as nominated by the Board). Its workings are fully inclusive with the full involvement of its Board members in policymaking which will help guarantee coordination and cooperation at both strategic and tactical levels. While the Authority takes over all strategic policymaking responsibilities presently held by executing Agencies it is an inclusive structure; does not replace departments, and creates no losers. In fact, the status of each department 'head' is enhanced by membership on the YUTA Board, and their individual roles are strengthened through improved coordination and cooperation.

**4) Urban Transport and Passenger Service Act**

**(1) Objectives of the Act**

The objectives of this Urban Transport and Passenger Services Act are to benefit the public of Greater Yangon through the design of city planning and creation of an efficient urban transport network and delivery of quality passenger services.

The Act authorizes strategic city planning and creation of an efficient urban transport network to ensure that:

- Planning follows city vision and a developed strategic city development plan;
- Land-use planning is integrated with mobility, with the aim of managing travel demand; mitigating traffic congestion and promote transit-oriented development (TOD);
- Priority is given to maintain and promote urban mobility through efficient use of road infrastructure, the provision of efficient public transport and the promotion of non-motorized transport (NMT) such as walking and cycling;
- All land use planning and new infrastructure is approved only where the impacts on traffic have been assessed and mitigated and where mobility measures have been implemented.
- That road safety is prioritized, respecting all road users equally through a balanced allocation of road space, provision of appropriate and safe road crossings and markings; driver education and awareness for road safety and for responsible and respectful driving.

**(2) The Act authorizes the delivery of quality passenger service:**

- That provides an integrated public transport network with high connectivity and access including an rail and bus system, feeder services and NMT provisions;
- Is focused on good customer service, providing reliable, safe and affordable transport for all; promoting social justice and access for the disadvantaged.
- Is environmentally friendly, minimizing harm to the environment;
- Makes efficient use of physical and financial resources;

The Act promotes transport governance that:

- Establishes viable business models for sustainable provision of public transport;
- Emphasis on quality customer service to promote public transport and grow revenues;
- Develops quality management standards and procedures for the safe and efficient operation of passenger transport services and maintenance of vehicles including a system of accreditation and licensing of drivers;
- Manages integration of the network through service coordination, integrated fares and ticketing, passenger information and other integration aspects designed to deliver (both in in appearance and function) an integrated, seamless system network, such as a common fleet, bus stop identification etc.
- Provides good information to the public to promote public transport use and awareness of its services
- Is empowered to take any necessary measures to restrict, control and monitor the movement and parking of private motor vehicles and taxis, and freight vehicles in sensitive and urban areas to maximize the transport efficiency and assignment of road space.

**(3) The Act empowers the establishment of YUTA to carry out the function of administering the Act and is given the following powers:**

- To act as a coordinating body with executive powers to coordinate and integrate all policy and planning functions that relate to city development, land use and urban transport;
- To carry out the strategic planning function and develop Strategic Urban Transport Policy and assign various responsibilities for its implementation and monitor progress and performance;
- Convene a Board of Management that is representative of all the concerned executing agencies and key stakeholders;
- To develop budgets and financial mechanisms to support the strategic planning;
- To delegate its responsibilities for service delivery to the executing agencies;

**(4) Ministerial duties under the Act:**

- At the request of the Minister, the Board is to carry out any inquiries in relation to passenger transport within the City;
- To report to the Minister on the operation of passenger transport services, and on such other matters as the Minister or the Board thinks fit;
- To provide advice to the Minister as may be appropriate;
- To carry out other functions assigned to the Board by or under this or any other Act, or by the Minister;
- To maintain a direct line to the Minister for certain policy issues.

### 5) Roles and Functions of YUTA

The primary tasks of the YUTA are:

- to formulate short-term and action plans based on the transportation master plan;
- to enhance the services of public transportation and develop necessary infrastructure;
- to manage traffic demand;
- to enhance transit oriented development; and
- to budget and execute the planning and monitor them.

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

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

(ii) strengthen urban public transport services;

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

(iv) implement traffic demand management (TDM);

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

(vi) monitor and evaluate the implementation of the transportation master plan and programs to develop integrated transport services in the region;

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

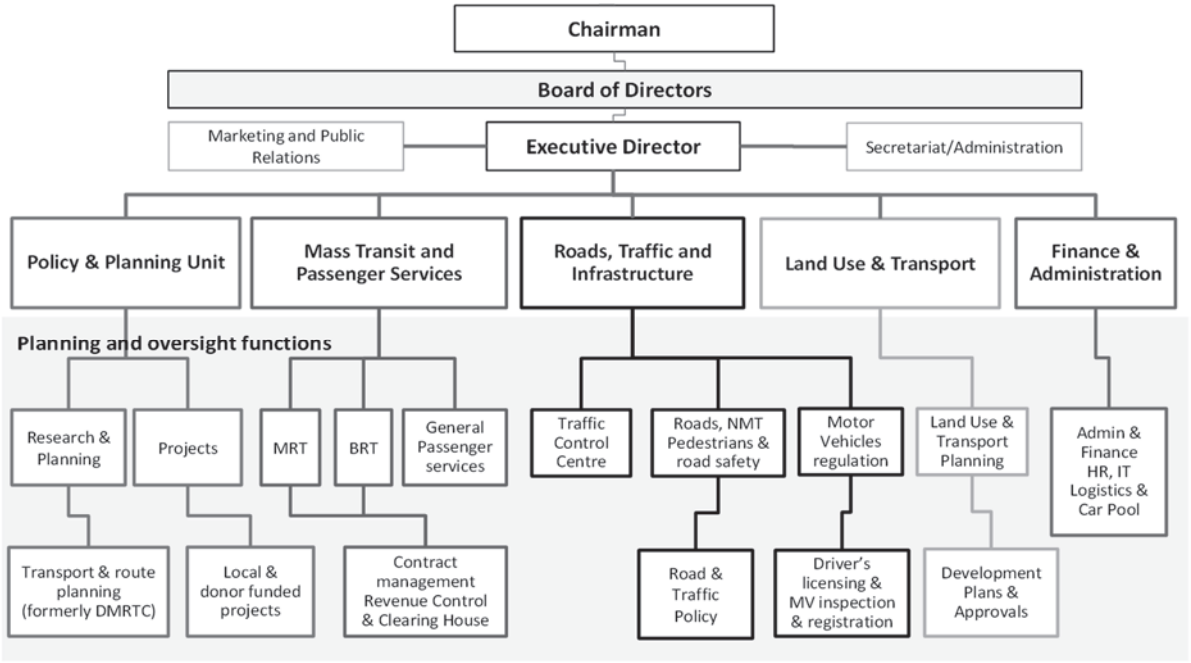
(viii) manage the wealth of the nation; and

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

### 6) Organizational Structure and Representation of YUTA

#### (1) Overall Structure

Figure 4.8.1.1 shows the proposed organization chart of YUTA. YUTA is established under the Urban Transport and Passenger Service Act as a legal body.




Source: YUTRA Project Team

**Figure 4.8.1.1 Possible Organizational Structure of YUTA**

### (2) Board of Management

The Chairman of the Board of Management shall be nominated by Yangon Region Government. .

The members of the Board will have full input to the development of policy. Representation must include the most senior decision-makers, who manage the responsibilities of their organisations.

Board membership can include the heads of implementing agencies but to avoid conflict of interest cannot include the heads of operating entities (such as bus operators). However selected nominations of key stakeholders such as head of Central Bus Line committees can be made at the discretion of the Board. Furthermore stakeholders may be invited to form or support Standing Committees.

The Executive Director of YUTA shall be a member of the Board with full voting rights.

**Attendance:** All Board members are mandated to attend officially scheduled Board Meetings. Absence shall be properly explained to the Chair, apologies properly tendered and actions taken by the absent member to mitigate their absence by nominating an ad-hoc replacement member on a case by case basis. Such a replacement member shall inform the absent member of meeting proceedings but shall not be entitled to vote.

**Removal and replacement of members:** Board Members shall retain their membership only for the period they hold office in their respective position at their representative organisation. Retirement/ transfer to non-eligible positions shall be handled with propriety, and ensuring current work of the Board is properly handed over and all responsibilities to the Board are fulfilled. The Chair can request ongoing attendance for a retiring member for

a set period as circumstances require, ensuring smooth transfer to a new Member.

**(3) Executive Director**

The Executive Director of YUTA shall be appointed by through a merit-based recruitment process managed by Yangon Region Government and approved by the Minister for a term of 3-5 years or shorter period as may be specified, and be eligible for reappointment.

He/she will have responsibility for the day to day management of YUTA's functions and control financial expenditure as approved by the Board of Management and under the scope of the Act. He/she will ensure proper management of the Authority's funds, property and business, and for the management of the organisation, its personnel, control and discipline of the employees and performance of sub-contracted parties.

The Executive Director shall serve the nominated contract term and is subject to conditions of employment.

**(4) Planning Units of YUTA**

YUTA shall establish a number of planning units which serves as its executive arm with each unit headed by a Director who shall be appointed through a merit-based recruitment process managed by the Executive Director and approved by the Board to ensure skills and competence in these positions.

Each Director is responsible for their specific portfolio in planning, control and oversight of their assigned implementing agencies.

The planning Units shall be:

- Policy and Planning Unit
- Mass Transit and Passenger Services Unit
- Roads, Traffic and Motor Vehicle Unit
- Land Use and Transport Coordination Unit
- Finance and Administration Unit

The functions of these departments are:

**(i) Policy and Planning Unit**

Tasks for the policy and planning unit covers the main functions of research, creating transport policy and supporting it and developing projects and interacting with donors agencies.

Its policy domain includes developing urban transport policies that:

- Reduce road congestion
- Make public transport a more attractive option
- Promote NMT and walking modes
- Protect the natural environment and improve air quality
- Reduce greenhouse gas emissions.
- Support economic growth and productivity

Furthermore, it will develop the Public Transport and Urban Mobility Plan in cooperation with the Mass Transit Division, and create a priority program for short, medium and long term plans.

It must manage political imperatives within the planning framework and work to gain political support for the transport plans as well secure the financial conditions for a sustainable public transport system.

**(ii) Mass Transit and Passenger Service Unit**

This planning unit has the sole responsibility of oversight of urban transport providers and be responsible for planning and oversight of all public transport functions including UMRT, BRT, Commuter Rail, the general bus network, Para-transit, taxis, NMT and river ferry services.

Responsibilities include planning of public transport strategies, making rules, regulations, developing contractual and permit arrangements (and managing them) and monitoring service delivery standards and passenger safety. It shall liaise with local authorities on the supply and management of public transport infrastructure. In some cases, service provider contracts will be managed by the service provider agencies.

**(iii) Roads, Traffic and Motor Vehicle Unit**

This unit is responsible for the planning and oversight of roads and traffic within Greater Yangon, working in close cooperation with the roads management executing agency to ensure proper traffic management strategy, and road conditions such as safety and guidance systems including signage, for all road users including NMT and pedestrians.

It is also responsible for road safety and awareness including public information and education etc. working with the relevant executing agencies.

Motor vehicle policy relates to strategic policymaking and regulatory matters such as import controls, ownership, roadworthiness inspection policy and any matter relating to registration fees/ taxes/ charges on motor vehicles including strategic parking policy. This planning unit will liaise with the agency that sets national vehicle policies, but have the authority to define standards for the Greater Yangon area.

**(iv) Land Use and Transport Coordination Unit**

The role of this unit is to define the planning and policies to coordinate transport with land use and development. It will carry out research; develop strategies and plans primarily targeted at improving access, and reducing travel demand through city development policies.

The specific aims are to:

- Reduce the growth in passenger and vehicle kilometres travelled
- Increase transport access to jobs, education and services
- Plan for communities that house people closer to where they work
- Improve air quality and reducing greenhouse gas emissions

It carries specific responsibilities for promoting Transit-Oriented Development (TOD)

and to coordinate with YCDC to ensure these objectives are realized, with local government in particular having a major role in applying these broader strategies for land use and transport issues, in ways appropriate to their local conditions.

**(v) Finance and Administration Unit**

The unit manages all the internal workings and support for the YUTA, including administration, budgets, finances, revenues and borrowings.

It also manages the information technology function, covering the collection and storage of data and information, managing the technical aspects of the intranet/ internet facilities, and the management information systems.

**(vi) Public Relations and Marketing Unit**

Annexed to the office of the Executive Director is a bureau managing marketing and public relations. This unit will monitor media outlets, develop press releases, and manage press relations. The corporate image of YUTA, its logos, presentations come under the scope of this unit's responsibilities. It will support the other planning units in the communications area, developing a web site and electronic and printed materials and public information.

### (5) YUTA Staffing

YUTA is designed to be an efficient and streamlined. YUTA is expected to operate as a lean and efficient organisation with a total of 50 staff (tentative). It will aim to develop a high standard of technical competence with each department being capable of the necessary research and planning to develop policy guidance in the area of responsibility.

In some cases such as the Mass Transit and Roads and Traffic department some staff will conduct monitoring and inspection to ensure service delivery is meeting the required standards. Table 4.8.1.1 shows indicative staffing for YUTA (tentative).

**Table 4.8.1.1 YUTA Staffing (tentative)**

| | |
|---|---|
| **Executive Director** | 1 |
| **Secretariat** | 2 |
| **Public Relations and Marketing** | 3 |
| **Legal Counsel** | Outsourced |
| **Security & Audit** | 2 |
| **Policy & Planning Unit** | |
| Director | 1 |
| Staffing strength | 4 |
| **Mass Transit and Passenger Services Unit** | |
| Director | 1 |
| Staffing strength | 6 |
| **Roads, Traffic & Motor Vehicles Unit** | |
| Director | 1 |
| Staffing strength | 15 |
| **Land use & Development Coordination Unit** | |
| Director | 1 |
| Staffing strength | 6 |
| **Finance & Administration Department** | |
| Director | 1 |
| Staffing strength | 6 |
| **TOTAL** | **50** |

Source: YUTRA Project Team

### 7) Demarcation of Functions of YUTA

The proposed functions of the YUTA and the demarcations of the functions in terms of public transport services and associated infrastructure development is presented in Table 4.8.1.2 for further discussion. It will be examined further to figure out which function would overlap with existing functions at related agencies.

Besides above, financial resources for the operation of the YUTA and infrastructure development, business operation and mechanism of subsidy or grant to the local governments should be further discussed.

### 8) Establishment Process of YUTA

Upon establishment of YUTA, it needs to be institutionalized by law (Urban Transport and Passenger Service Act) by the union government. For this purpose, it is essential to support the establishment of YUTA by providing a regulatory authority under the Urban Transport Department of Ministry of Railway and Transportation (MORT).

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

**Table 4.8.1.2 Possible Functions of YUTA**

| Sector | Sub-sector | Planning | | | | Regulation | | Fares/ Marketing | | Infrastructure Development | | | Asset Management | | | Operation and Management | | | | | Law |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Strategic planning | Service Planning, Bus/Railway Integration | Planning Public Transport Infrastructure Development | License and Permit Approval | Administrative & Technical Standards, Norms, Minimum Service Standards and Guidelines | Fare Setting/Approval | Managing Fare Collection System | Marketing Public Transportation Services | Financial planning, budgeting and Procurement | Infrastructure Development (Construction) | Construction Supervision & Technical Inspection | Land | Base Infrastructure | Upper Infrastructure (Facility) | Operation and Maintenance of Constructed Infrastructure | Operation and Management of Facilities and Equipment for Public Transport | Financial Arrangement | Business Operation | Business Operation Performance Evaluation | Law Enforcement |
| Road Network | Urban Expressway | YUTA | YUTA | - | UG | MOC | UG | OPR | - | MOC/ OPR | MOC/ OPR | MOC/ OPR- | UG | UG | UG | OPR | - | OPR | - | - | POL |
| | Major Road (Union Road) | YUTA | YUTA | YUTA | UG | MOC | - | - | - | YUTA | UG | UG | UG | UG | UG | UG | - | - | - | - | POL |
| | Secondary Road | YUTA | YUTA | YUTA | YRG | MOC | - | - | - | YUTA | YRG | YRG | YRG | YRG | YRG | YRG | - | - | - | - | POL |
| | Collector/Local Streets | YCDC/ TG | YCDC/ TG | YCDC/ TG | YCDC/ TG | MOC | - | - | - | YRG | YCDC/ TG | YCDC/ TG | YCDC/ TG | YCDC/ TG | YCDC/ TG | YCDC/ TG | - | - | - | - | POL |
| | BRT Road *1 | YUTA | YUTA | YUTA | UG/ YRG | MOC | - | - | - | YUTA | YUTA/ BRTA | YUTA/ BRTA | UG/ YRG | UG/ YRG | UG/ YRG | YUTA/ BRTA | - | - | - | - | POL |
| | Access Road to station *2 | YUTA | YUTA | YUTA | YCDC/ TG | MOC | - | - | - | YUTA | YCDC/ TG | YCDC/ TG | YCDC/ TG | YCDC/ TG | YCDC/ TG | YCDC/ TG | - | - | - | - | POL |
| Railway/ UMRT | Myanma Railway (inter-city service) | MORT/ MR | MORT/ MR | MORT/ MR | UG | MORT | UG | MR | MR | MORT/ MR | MORT/ MR | MORT/ MR | UG | UG | UG | MR | MR | MR | MR | MORT | MORT |
| | Myanma Railway (city commuter service) | YUTA/ MR | YUTA/ MR | YUTA/ MR | UG | MORT | UG | MR | MR | MORT/ MR | MORT/ MR | MORT/ MR | UG | UG | UG | MR | MR | MR | MR | MORT | MORT |
| | UMRT (MRT/LRT) | YUTA | YUTA | YUTA | YRG | MORT | YRG | OPR | OPR | YUTA | OPR | OPR | UG/ YRG | UG/ YRG | UG/ YRG | OPR | OPR | OPR | OPR | YUTA | YUTA |
| | UMRT (BRT *1) | YUTA | YUTA | YUTA | YRG | MORT | YRG | BRTA | BRTA | YUTA | BRTA | BRTA | UG/ YRG | UG/ YRG | UG/ YRG | BRTA/ OPR | BRTA/ OPR | BRTA | OPR | YUTA | YUTA |
| Bus Transport | Inter-region Bus Service to/from Yangon Region | YUTA | YUTA | YUTA | YRG | MORT | YRG | OPR | OPR | YUTA | YUTA/ BRTA | YUTA/ BRTA | YRG | YRG | YRG | OPR | OPR | OPR | OPR | OPR | YUTA |
| | Intra-region Bus Service (small-large) | YUTA | YUTA | YUTA | YRG | MORT | YRG | BRTA | OPR | YUTA | YUTA/ BRTA | YUTA/ BRTA | YRG | YRG | YRG | OPR | OPR | OPR | OPR | OPR | YUTA |
| | City Bus Service (small-large) | YUTA | YUTA | YUTA | YRG | MORT | YRG | BRTA | OPR | YUTA | YUTA/ BRTA | YUTA/ BRTA | YCDC/ TG | YCDC/ TG | YCDC/ TG | OPR | OPR | OPR | OPR | OPR | UTA |

| Sector | Sub-sector | Planning | | | | Regulation | | Fares/ Marketing | | Infrastructure Development | | | Asset Management | | | Operation and Management | | | | | Law |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Strategic planning | Service Planning, Bus/Railway Integration | Planning Public Transport Infrastructure Development | License and Permit Approval | Administrative & Technical Standards, Norms, Minimum Service Standards and Guidelines | Fare Setting/Approval | Managing Fare Collection System | Marketing Public Transportation Services | Financial planning, budgeting and Procurement | Infrastructure Development (Construction) | Construction Supervision & Technical Inspection | Land | Base Infrastructure | Upper Infrastructure (Facility) | Operation and Maintenance of Constructed Infrastructure | Operation and Management of Facilities and Equipment for Public Transport | Financial Arrangement | Business Operation | Business Operation Performance Evaluation | Law Enforcement |
| Supporting Infrastructure | Traffic Signal Control | YUTA | YUTA | - | - | UG | - | - | - | YUTA | YUTA | YUTA | YCDC/ TG | YUTA | YUTA | POL | POL | YUTA | - | - | - |
| | Traffic Information System | YUTA | YUTA | - | - | UG | - | - | - | YUTA | YUTA | YUTA | YCDC/ TG | YUTA | YUTA | OPR | OPR | YUTA | - | - | - |
| | TDM (Road Pricing) | YUTA | YUTA | - | UG/ YRG | UG | YRG | OPR | - | YUTA | YUTA | YUTA | YCDC/ TG | YUTA | YUTA | OPR | OPR | YUTA | OPR | YUTA | POL |
| Other | Transit Oriented Development | YUTA | YUTA | YUTA | YCDC/ TG | UG | - | - | - | YCDC/ TG/ Private | YCDC/ TG/ Private | YCDC/ TG/ Private | YCDC/ TG/ Private | YCDC/ TG/ Private | YCDC/ TG/ Private | YCDC/ TG/ Private | YCDC/ TG/ Private | YCDC/ TG/ Private | YCDC/ TG/ Private | - | - |

Source: YUTRA Project Team
YUTA: Yangon Urban Transportation Authority, UG: Union Government, YRG: Yangon Region Government, TG: Township Government, MR: Myanma Railway, BRTA: BRT Agency, OPR: Business operator, POL: Police
Note: 1/ "BRT road" includes road widening, sidewalk adjustment, pedestrian bridge construction, etc. Bus stop construction and associated facilities are included in "BRT development".
2/ Access road to station includes station square development

### 4.8.2 Development of BRT Management Agency

#### 1) Introduction

Under the Transport Development Strategy on the subject of *New Policy Directions*, it was stated that:

> *"Parallel to this initiative is developing commercial public sector entities that are profit-oriented and business-like in their operations. This will also allow the public sector to compete on a level playing field with the private sector and between foreign and local companies."*

This infers a strengthening of the public sector, not just through a 'capacity-building' exercise as regulator over private sector business, but establishing the public sector as a key player in business operations.

This aspect is keenly important for the bus sector, where the public sector (as bus operator) has withdrawn services either through loss of financial support or being unable to compete with the private sector. Consequently, it has relinquished its role as public service provider leaving the task to the private sector who struggle to survive under difficult conditions. In Yangon it has been left to Ma-Hta-Tha to organise bus services; however the bus sector is difficult to regulate, with each individual operator struggling to survive or prosper, often trying to cope with unmanageable risk (such as rising energy costs and traffic congestion) on a low fare base. The result is a 'regulatory dilemma' where regulations are ineffective against the economic forces driving the behaviour of operators.

Solving this dilemma requires a 'willingness' for the public sector to take some of the risk it can better manage taking a more meaningful role in public transport delivery; with a more sustainable business model for bus operation.

The new policy approach for bus service delivery (and critical for the BRT) is that:

- Government reasserts its role in the business of public transport; accepting some risk to strengthen its hand in the control of the outcomes;
- It should take a managerial role as network manager, taking responsibility for customer service delivery;
- The business model is the key element in determining sustainability and is supported by efficient transport infrastructure;
- The partnership risk between public and private sector must be assigned to where it can be best managed;
- Subsidy must be approached from a commercial perspective, and used to produce positive outcomes and not support operational losses.

Consequently it is recommended to:

- Implement a shared risk management model – assigning political, business and operational risk between the players.
- Involve the public sector as network manager (not bus operator) under a commercial business management framework – this is the BRT Agency role;

- Improve bus priority infrastructure to increase operational efficiency of (increase speeds, reduce cycle time, reduce travel times).

The success of the business model is a result of 1) Commercial management which is customer focused; 2) an efficient operating environment (bus priority/BRT); and 3) network management, where network efficiencies create customer value and efficient use of resources. These three elements will also contribute to quality service delivery.

The shared risk management model involves three distinct institutional levels with each level having a defined role and responsibility, with accountability and respective risks assigned at each level.

(i) The political level is the Urban Transport Authority that manages the strategic policy direction. This Authority provides oversight, coordination, manages cross- jurisdictional issues and sets the Strategic Policy and strategic service plan for public transport.

(ii) The business level is the BRT Agency (the system manager) that 'manages the business' of the public transport network. It will be revenue-driven, commercial and be responsible for customer service. It will collect the revenue and pay operators to provide services to the system under the bus operator contracts which it manages. It takes the business risk of the network (but can also manage it).

(iii) The Bus Operator level where companies are contracted to provide services under performance-based contract (being paid for kilometres of services or per passenger). The Contract is fully enforceable to ensure quality of service delivery, but is fully funded to meet the required quality and service standards.

**2) Role and Function of BRT Management Agency**

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

- Generate patronage/build revenue/manage efficiency
- Plan routes, control and monitor service delivery
- Manage BRT infrastructure
- Be responsible for customer service delivery and complaints
- Ensure financial performance
- Manage fare policy and collection
- Manage and enforce bus operator contracts
- Manage community relations and the marketing and promotion of the system

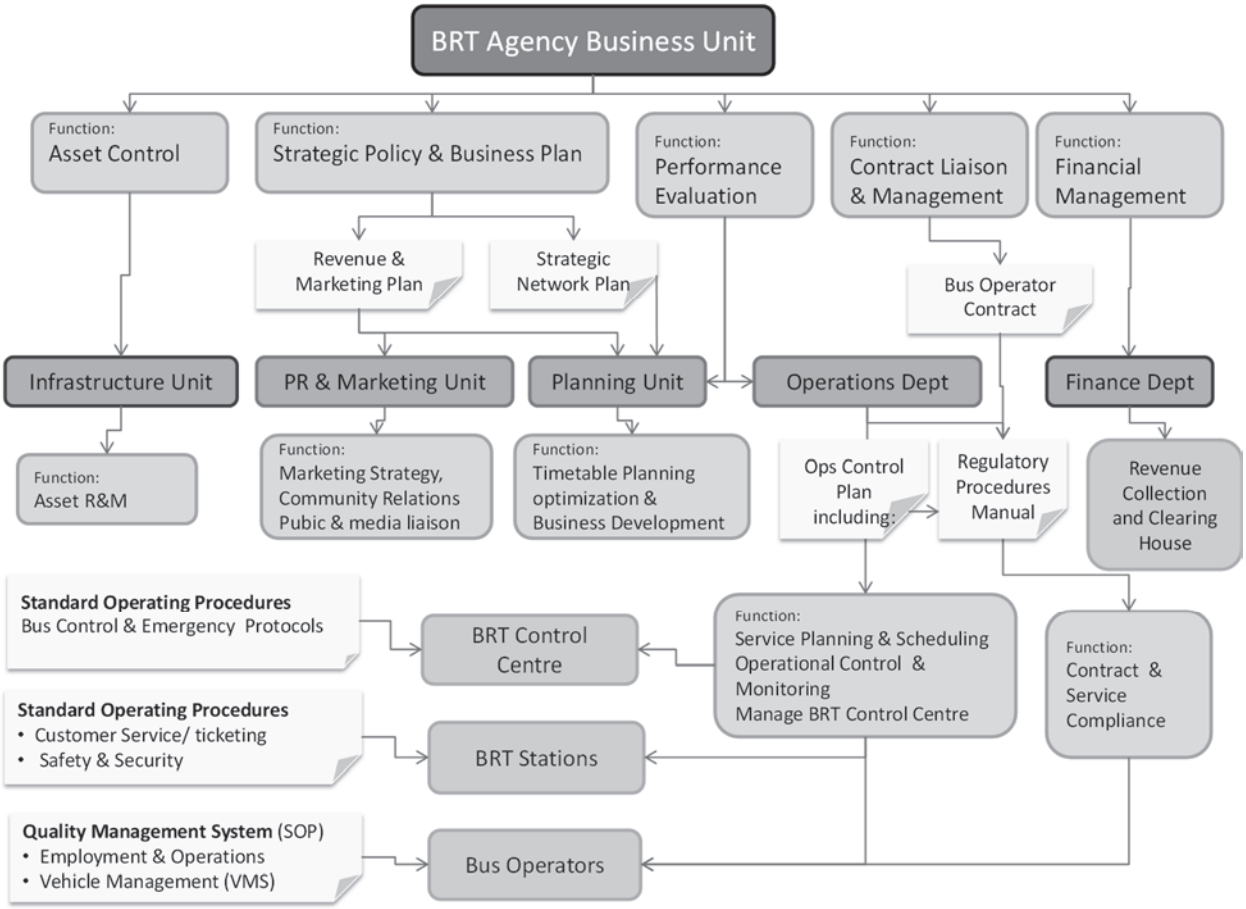
The BRT agency should be a corporate and autonomous entity such as public corporation or state-owned enterprise, free from the constraints of the civil service and political interference. Where the Agency manages the total bus network, it is preferable to be government – owned to retain public control; however under certain conditions (such as the presence of a strong Public Transport Authority) a private concessionaire could be used; should the city doubt public sector capacity.

The Agency should be profit-focused; able to hire staff on a merit basis; dismiss staff for

poor performance; be able to borrow funds; sue and be sued. Such an agency is often misconstrued as the being the regulator, but regulators do not take business risk; they regulate the 'risk takers'. This Agency takes the business risk but can manage it with the business control levers at its disposal.

**3) Organizational Structure**

Figure 4.8.2.1 shows the proposed organization chart of BRT Management Agency. The Agency is established under the YUTA as a management body for BRT System.




Source: YUTRA Project Team

**Figure 4.8.2.1 Possible Organizational Structure of BRT Management Agency**

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

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

## 4.8.3 Operator Licensing and Contracts

The BRT Agency will contract Bus Operating Companies (BOC) to provide services to the BRT system on a performance-based contract (paid per mile which defines the terms of the

contract (duration, level of service and service standard requirements). The BOC can be either private or public entities as the contract structure is equally effective in setting the 'rules of the game' either type of entity.

Contract frameworks can vary, but in all cases must have clear and enforceable performance standards. A contract will pay the operator the 'gross-cost' of supplying miles of service to the system (payment by mile) or alternatively pays operators the 'net-cost' (payment by passenger). This choice between 'per mile' or 'per passenger' depends on who is capable of managing the patronage risk. Gross cost (per mile) contracts are usually favored where the system manager can closely monitor services, as is the case in a BRT. Net cost (per-passenger) payments are more suited where operators are not closely monitored; where operators can be encouraged to attract passengers through better quality services (otherwise operators just may just generate kilometres without regard for passengers). Under a net-cost contract, operators may also contribute to service planning to help develop their business.

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

The contract system gives the BRT Agency a strong 'hand of control' over operator performance, with penalties for service failures. Contracts define the relationship between the system manager and the operator and spells out the respective responsibilities of each party. In any operator contract, the key issue is that the right incentives are in place to ensure good behaviour and performance and that risk is managed.

The contract will outline the responsibilities and obligations of both the BRT Agency and the Bus Operator. The bus fleet can be purchased by either the companies themselves (owned and operated with assistance from financial packaging if necessary) or buses can be purchased as part of the BRT system and operators given an 'operate –only' contract. While traditionally operators are expected to purchase and own the buses and the depots, an 'operation-only' contract gives the BRT Agency a stronger hand of control to dismiss a non-performing operator. It is preferential for the BRT agency to own buses and depots.

The BOC contract will:

- Indicate the number of miles of service to the system under set quality standards;
- Provide a set manual of procedures and guidelines for operation;
- Have quality standards that are enforceable with service failures penalised;
- Provide a sustainable and profitable business for the operator.

The BRT Agency will have a written set of contract management procedures to manage the contracts, to ensure all contractors are treated fairly and consistently. This is important to build transparency and confidence in the industry.

**1) Quality Management System**

Annexed to the Bus Operators Contract is a **Quality Management System (QMS)** that outlines the standard operating procedures (SOP) the company is required to follow. It provides both a driver's manual, and a management manual. It comprises four parts showing not just the standards to adhere to, but how to perform so as to meet those

standards.

**Part 1:** Company Policies including communications; employment policies; safety policy; drug and alcohol policy; workplace health and safety; harassment discrimination and victimisation policy.

**Part 2:** Drivers' employment conditions – including recruitment; training; dress and presentation; operational procedures; employee monitoring and review program.

**Part 3:** Daily operations procedures - start-up & close down; bus problem/fault procedures; emergency and accident procedures.

**Part 4:** Management processes: Risk, Safety Planning & Audits, and Safety Management Plan.

**Part 5:** Vehicle Maintenance Program (VMP).

**2) Assigning bus operator contracts: Competitive Tendering vs. Negotiation**

Competitive-tendering for bus operator contracts is typically supported by donor agencies as it implies a fair and transparent process for selecting operators, and 'tests' the operating cost in the market.

However, in the case of BRT being introduced under an inclusive process that engages with existing operators, a negotiated contract can be more suitable and can achieve the same outcome as competitive tendering, in that:

- It can achieve the 'right' price, being an efficient cost per km. Under the business planning, operating costs are known and therefore need not be tendered or negotiated;
- It avoids tenders that are too low to succeed and the attitude of 'business as usual' (low price /poor quality) which may be reflected in a low tender bid;
- It avoided creating 'losers' who may demand compensation and allegations of corruption by unsuccessful tenderers;
- Addresses social issues; respecting operator's rights and includes experienced operators.

It is therefore evident that a negotiated contract process can achieve all the price and transparency objectives of a competitive tender and more. Cost per km (the fee paid to the operator) is a combination of variable costs (bus operation and staffing), overhead costs and profit. Where costs are likely to vary over time; for example fuel or salary increases, indexing can be applied throughout the period of the contract.

The BRT Management Company may also consider a bonus based on sharing revenue growth with operators to create an incentive for good performance. Conversely, reduced profit margins may also be considered where passenger numbers decline.

**3) Operators of conventional bus services**

For the operators of conventional bus services, their engagement will also be on a contract basis, being related to the BRT as either:

1. A secondary Bus Route operating across BRT corridors to provide cross suburb services and also act as feeders to the BRT. Secondary routes are often fare-integrated so may

also be under a performance-based contract, where the BRT Agency collects revenue and pays then operator for services provided.

2. Feeder Bus services where buses operate as community services from local areas servicing routes to a BRT (or rail) station. Feeder routes are often not fare integrated meaning the operator collects and keeps fares. However fare integration is technically possible.

Generally existing bus operators are removed from routes that duplicate the BRT route. If they are not removed they may not be able to compete and retain business and eventually cease operations. Short overlaps will not be a problem. In some cases however, government may choose not to exclude parallel operations, such as Johannesburg, where despite a successful engagement of operators into the BRT operations, no operator was prevented from operating in competition to the BRT.

Affected operators, those who are displaced by the BRT routes or have their routes cut short, can be offered new business opportunities, either as BRT trunk operators or as feeder service providers on the surrounding route network.

The following principles are recommended when managing the affected bus operators during an introduction of BRT services:

- That the private sector is given the opportunity to provide bus services in the BRT system under performance-based contracts or under cooperative to provide feeder services.
- To approach this is an inclusive process that addresses the problems of the bus industry, understanding that existing operators are key stakeholders and will respond to commercial opportunity and more secure business arrangements;
- To emphasize on transitioning to new a business and new employment opportunities without wielding a ‘stick’ of regulation or offering compensation. Expectation of compensation distorts the negotiation process. The ‘compensation ‘offered is the opportunity to take up new business and/or employment opportunities.
- Government may seek to encourage the bus line committees to assist in facilitating the transition process, to help unify operator representation.
- A clear understanding of the operator’s business model, the contract conditions and expectations on the government side will assist in convincing the operators of its future viability. A level of trust building is likely to be required. Experience has shown that a good trust-building initiative is when key decision makers at government level engage with operator’s representatives.
- All contract relationships and negotiations must deliver a ‘win-win’ outcome. Building a strong sense of partnership is beneficial, firmly grounded in commercial reality, mindful that both the BRT Agency and the Bus Operators are commercial enterprises.

**4) Methodology for transitioning operators to new routes**

The process of managing the operator’s route reassignment is as follows:

1. When an operator’s route is 100% replaced, or where the remaining route is not viable to operate independently, they qualify to join with others to form a Bus Operating

Company (BOC) to negotiate a BRT bus operation contract with the BRT Agency. Their present route permission can convert to a percentage shareholding.

2. When an operator's route is partially affected they can either take a smaller proportional percentage of a BOC shareholding, or operate the shorter route as a feeder, or another route can be assigned so business is retained. Many operators find shorter routes more profitable.
3. Operators that operate secondary routes that connect with the BRT on a common ticket can also operate on a contract basis with the BRT agency either as a net-cost or gross cost contract. However, individual-owned buses would not be eligible to participate, as the BRT Agency would only contract with registered companies.
4. However, many small operators operating a 1-2 vehicles may not wish to join a company and in this case could form (or join) cooperatives, under which they can continue their present style of operations. These cooperatives can provide formal feeder services to the BRT system, where they collect their own fares (and keep their own revenue) but can have a contract arrangement where they are officially part of the BRT feeder system (with branding rights) but in return must maintain certain set operating standards, such as age and condition of vehicle, insurance and driver standards. This will assist the BRT agency exercise some quality control over the feeder system.

As the BRT network expands across the city the bus operators will be rationalised, and will transition into new business arrangements. Ma-Hta-Tha will be instrumental in working with the BRT Agency and the operators to facilitate the reform progress.

The above options show that virtually all categories of present operators can be catered for in some way. In many cases affected parties may just want employment, and this can be managed by establishing a register of affected employees giving preferences for employment with the BRT.

### 4.8.4 Possible Technical Assistance for the Development of YUTA and BRT Management Agency

#### 1) Project Rational and Objectives

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

Objectives of this technical assistance project includes mainly as follows:

(i) Assistance with setting up YUTA

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

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

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

### 2) Project Scope

It is expected that this project will create the necessary institutional capacity of Yangon Urban Transport Authority (YUTA) and BRT Management Agency to assist the development of its roles and functions, sustainable urban transport policy and coordination of all urban transport through technical assistance and training in the areas described in Table 4.8.4.1 and Table 4.8.4.2.

**Table 4.8.4.1 Scope of Capacity Development Project for YUTA**

| Area | Activities |
|---|---|
| **Vision and Mission** | • Develop confidence within the YUTA in its role as an Authority, understanding its role and purpose and its relationships with the executing agencies and clarifying its jurisdiction, function and authority.<br>• Creating the image, branding and identity of YUTA Creating a transparent organization managing a good relationship with the general public. |
| **Create an efficient and capable organization** | • Define the internal organization and responsibilities and develop the planning units and the internal personnel structure within each planning unit.<br>• Provide training and support to ensure YUTA manages its affairs competently and efficiently, with professional staff capable of a high level of research and analysis; critical thinking; and strategic and tactical policymaking.<br>• Training will include a range of skill development related to the functions of the technical planning units. Training may also include practical casework projects that have tangible outputs. |
| **Protocols, policies and procedures** | • To develop the protocols for the Board of Directors to understand their role and function and the mechanics of policy setting and strategic planning. |
| | • Establish Policies, Standard Operating Procedures and Protocols within the YUTA organisation to facilitate its orderly function.<br>• Provide ongoing administrative support during the project. |
| **Communication and integration** | • Establish internal communication channels between the planning units and externally with the outside agencies and stakeholders. |
| **Personnel Training and Technical Skills** | • Perform training and build technical know-how in transport planning and operations sector. |
| | • Develop the research and planning function.<br>• Skills for the planning, development and oversight of BRT, Rail and UMRT projects. |
| | • Identify staff capabilities and identify training needs and develop capacity through coaching and training. |
| **Information Technology and Information and data management Corporate Identity** | • Assistance to develop a credible and well-organized data base of research materials and information sources. |

Source: YUTRA Project Team

**Table 4.8.4.2 Scope of Capacity Development Project for BRT Management Agency**

| Area | Activeties |
|---|---|
| **Business Strategy and Purpose** | • Create within the BRT Agency its mission, identity and purpose, encompassed in its business strategy, image and branding, and its relationship with its customers. |
| **Business Planning and Management** | • To develop the Service Plan (transport planning and service optimization )<br>• To develop the Revenue and Marketing Plan (business planning and marketing)<br>• Risk Management and Security Protocols<br>• Operational Control (Control Centre) and Quality Management Systems;<br>• Contract Management and Regulatory Procedures<br>• Benchmarking system cost recovery<br>• Financial and Administrative Management |
| **Create an efficient and capable organization** | • Define the internal organization and responsibilities and develop its divisions and the internal personnel structure within each division.<br>• Provide training and support to ensure competent management, with professional staff capable to plan and manage operations efficiently, deliver quality customer service and build revenues.<br>• Training will need to include a range of skill development tasks including scheduling, fare policy, marketing financial management etc., related to the individual functions of each division. |
| **Protocols, policies and procedures** | • Establish Policies, Standard Operating Procedures and Protocols within the organisation to facilitate its orderly function.<br>• Help design safety and security and control procedures for the BRT Control Centre.<br>• Provide ongoing administrative support during the project. |
| **Contract management** | • Provide technical training for contract development and management for external contracted functions such as bus operations, cleaning, maintenance and security. |
| **Personnel Training and Technical Skills** | • Perform training and build technical know-how in planning, operations, marketing, and customer relations. |
| | • Identify staff capabilities and identify training needs and develop capacity through coaching and training. |

Source: YUTRA Project Team