Development of Toolkit under “Sustainable Urban Transport Project”

Compendium of Toolkits

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May 2014
The Institute of Urban Transport (India) is a premier professional non-profit making organization under the purview of the Ministry of Urban Development, Government of India (MoUD). The National Urban Transport Policy (NUTP), 2006 has empowered IUT to serve as a National Level Facility for continuous advice and guidance on the principles of sustainable urban transport. The objective of the Institute is to promote, encourage and coordinate the state of the art of urban transport including planning, development, operation, education, research and management at the national level.

The Institute has been nominated as the project monitoring unit for Component 1A of the SUTP. IUT is responsible for overseeing the preparation of the training modules, subject toolkits and conduct of training of 1000 city officials in urban transport.

The Ministry of Urban Development (MoUD), Government of India (GoI) has initiated the Sustainable Urban Transport Project (SUTP) with support of Global Environment Facility (GEF) and the World Bank to foster a long-term partnership between GoI and state/local governments in the implementation of a greener environment under the ambit of the NUTP. The aim of the project is to achieve a paradigm shift in India’s urban transport systems in favour of sustainable development. The MoUD is the nodal agency for the implementation of the project, to be implemented over a four-year period starting from May, 2010 to 30 November 2014. Project cost is Rs. 14,161.55 Million. The project’s development objective (PDO) is to promote environmentally sustainable urban transport in India and to improve the usage of environment-friendly transport modes through demonstration projects in selected cities.
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CDP City Development Plan
CEPT Centre for Environment Planning and Technology
CER Certified Emission Reduction
CFA Central Financial Assistance
CFC Central Finance Commission
CIDCO City and Industrial Development Corporation (Mumbai, India)
CMC City Municipal Corporation
CMP Comprehensive Mobility Plan
CMT Contract Management Team
CMVR Central Motor Vehicle Rules
CN Cyclist Network
CNG Compressed Natural Gas
CO2 Carbon Dioxide
CPCB Central Pollution Control Board
CPI Consumer Price Index
CRB Commercial Radio Broadcast
CSE Centre for Science and Environment
CSR Corporate Social Responsibility
CTTP Comprehensive Transport and Traffic Plan
CTTS Comprehensive Transport and Traffic Study
CUCH Ciclistas Unidos de Chile
CV Curriculum Vitae
DA Dearness Allowance
DB Design-Build
DBFO Design-Build-Finance-Operate
DBOM Design-Build-Operate-Maintain
DCF Discounted Cash Flow
DEA Department of Economic Affairs
DLF Delhi Land and Finance Limited
DMB Department of Motor Vehicles
DMRC Delhi Metro Rail Corporation
DP Data Processing
DPR Detailed Project Report
DULT Directorate of Urban Land Transport
EA Environmental Assessment
EAC Equivalent Annual Cost
EBRD European Bank for Reconstruction and Development
ECB External Commercial Borrowing
EDC External Development Charges
EDM Electronic Distance Measurers
EEA European Environmental Agency
EIA Environmental Impact Assessment
EIRR Economic Internal Rate of Return
EOI Expression of Interest
ERR Economic Rate of Return
ESG Environmental Support Group
ESMF Environmental and Social Management Framework
FAR Floor Area Ratio
FBS Fixed Budget Selection
FHWA Federal Highway Authority
FI Financial Institutions
FIRR Financial Internal Rate of Return
FLVPN First Level Private Vehicle Network
FOB Foot Over Bridge
FSI Floor Space Index
FYP Five Year Plan
GC Generalized Cost
GDP Gross Domestic Product
GEF Global Environmental Facility
GFEI Global Fuel Economy Initiative
GHG Green House Gases
GIS Geographic Information Systems
GIZ Gesellschaft für internationale Zusammenarbeit
GLA Greater London Authority
GNP Gross National Product
GoI Government Of India
GOP Gross Operating Profit
GPS Global Positioning System
GSRTC Gujarat State Road Transport Corporation
GST Goods and Service Tax
HAR Highway Advisory Radio
HB Home-based
HCM Highway Capacity Manual
HDMC Hubli Dharwad Municipal Corporation
HEAT Health Economic Assessment Tool
HHI House Hold Interview
HIA Health Impact Assessment
HOV High Occupancy Vehicles
HPEC High Powered Expert Committee
HUDA Haryana Urban Development Authority
I/C Interchange
I/M Inspection and Maintenance
I/O Input/Output
IA Implementing Agency
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<td>Urban Growth Boundary</td>
</tr>
<tr>
<td>UIDSSMT</td>
<td>Urban Infrastructure Development Scheme for Small and Medium Towns</td>
</tr>
<tr>
<td>UIG</td>
<td>Urban Infrastructure and Governance</td>
</tr>
<tr>
<td>ULB</td>
<td>Urban Local Body</td>
</tr>
<tr>
<td>UMTA</td>
<td>Unified Metropolitan Transport Authority</td>
</tr>
<tr>
<td>Acronym</td>
<td>Full Form</td>
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<td>---------</td>
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<tr>
<td>UMTC</td>
<td>Urban Mass Transit Company Limited</td>
</tr>
<tr>
<td>UNDB</td>
<td>United Nations Development Business</td>
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<tr>
<td>UNDP</td>
<td>United Nations Development Program</td>
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<tr>
<td>UNEP</td>
<td>United Nations Environment Program</td>
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<tr>
<td>UNFCCC</td>
<td>United National Framework Convention on Climate Change</td>
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<tr>
<td>URIF</td>
<td>Urban Reform Incentive Fund</td>
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<td>UT</td>
<td>Urban Transport</td>
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<tr>
<td>UTF</td>
<td>Urban Transport Fund</td>
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<td>UTI</td>
<td>Urban Transport Institutions</td>
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<td>UUDA</td>
<td>Udupi Urban Development Authority</td>
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<tr>
<td>VGF</td>
<td>Viability Gap Funding</td>
</tr>
<tr>
<td>VKT</td>
<td>Vehicles kilometre travelled</td>
</tr>
<tr>
<td>VMS</td>
<td>Variable Message Signs</td>
</tr>
<tr>
<td>VMT</td>
<td>Vehicle Miles Travelled</td>
</tr>
<tr>
<td>VoD</td>
<td>Value-of-Distance</td>
</tr>
<tr>
<td>VPH</td>
<td>Vehicles Per Hour</td>
</tr>
<tr>
<td>VTP</td>
<td>Victoria Transport Policy Institute</td>
</tr>
<tr>
<td>WB</td>
<td>World Bank</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>WMO</td>
<td>World Meteorological Organisation</td>
</tr>
<tr>
<td>WPI</td>
<td>Wholesale Price Index</td>
</tr>
<tr>
<td>WPR</td>
<td>Workforce Participation Rate</td>
</tr>
<tr>
<td>WT</td>
<td>Waiting Time</td>
</tr>
<tr>
<td>WTA</td>
<td>Willingness to Accept Compensation</td>
</tr>
<tr>
<td>WTP</td>
<td>Willingness to Pay</td>
</tr>
</tbody>
</table>
Land use and transport are intricately related. While urban structure determines travel demand, transport supply influences urban structure. Spatial development has a fundamental influence on travel patterns. At the same time, the location and characteristics of major transport infrastructure impacts the allocation of land uses both from macro and site plan perspectives.

Integrating urban landuse with transport is considered the key for moving towards sustainable development of cities. The National Urban Transport Policy, 2006 recognises “integrated land use and transportation planning” as one of the key tools for sustainable development.
1.1 Objectives of the Toolkit

The objectives of this toolkit are:

- To provide an understanding of the concept of integration with regards to land use and transport
- To provide a step by step tool for facilitating adoption of integrated land use transport decisions by the cities.

1.2 What is land use transport integration?

The concept of land use transport integration is based on the nature of interaction between spatial and transport development.

1.3 What are the benefits of land use transport integration?

When land use transport integration is effectively implemented, the following benefits can be expected:

- Sustainable use of urban land (low intensity uses in ecologically and culturally important locations; high intensity of use in locations that can support it)
- Reduced vehicle emissions and higher quality of living environment
- Less time spent in travel and therefore higher productivity as well as quality of life
- Greater access to public transport and thus to jobs; additional health and quality of life benefits by enabling and encouraging more walking and cycling.
1.4 How effective are the land use and transport decisions that the cities take?

The current approach of spatial and transport planning is not integrated and the transport planning follows a reactive approach of providing for solutions for transport problem manifestations like congestion, delays, pollution etc. Transport Plans consider spatial plan proposals as given instead of analysing the possible effects of a particular development pattern. Post NUTP, there has been an increased focus on integrating land use and transport planning, primarily to assist in sustaining or improving mobility and access while reducing private vehicle travel.

**Figure 1-2: Land use Transport Integration cycle**

1.5 What are the key elements of integration?

The integration of land use with transportation systems has to happen at all scale/levels of planning and through multiple intervention mechanisms. The most important elements of land use transport integration are listed below:

1. Enabling Urban Structure
2. Complete network and complete streets
3. Public Transit and its Strategic Alignment
4. Transit oriented development and value capture (1. Along routes 2. Around Transit interchanges)
5. Accessibility improvements in terms of local area plans (last mile connectivity)
6. Re-development & Re-vitalization & Transit (1. Inner city 2. Derelict areas 3. Slums)
7. Integrated Multimodal Transit Interchanges

Apart from the above mentioned elements Inter jurisdictional coordination is also important overarching aspect.

1.6 What are the enabling mechanisms for land use transport integration?

The enabling mechanism for smooth and effective integration of land use transport are-

**Figure 1-3: Enabling Mechanism for Land Use Transport Integration**

- Integrating Land use and transport in the planning process
  - Policy and plan integration - vertical
  - Policy and plan integration - horizontal

- Institutional Integration and legal Mechanism
  - Lead agency
  - Plan area and horizon

- Financing
  - Funding plan preparation
  - Funding the plan

- Capacity Building
  - Awareness generation
  - Setting up of transport section in the development authorities

- Stakeholder Involvement
  - Identification of stakeholders
  - Setting up process for consultation
1.7 What should be the decision making process?

The way in which cities make decisions is critical in the planning process. The decisions on land use transport integration should be long term, systematic, lead to reduction in bias, and informed choices.

**Figure 1-4: Vision led approach for land use transport planning**

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**Step 1 - Setting Vision and Objectives**

Setting a vision statement helps in directing city’s growth. It provides an overarching plan to guide the long range development and transportation planning activities of the city. Vision for a city is generally set for a long term period of 15-20 years, since it takes time for land use strategies to yield desirable results. Targets need to be set in line with the vision and objectives of the plan.

**Step 2 – Benchmarking**

It is important for cities to know where they stand as far as integration is concerned so that they are in a better position of making informed decision in adopting effective strategies that will improve the efficiency of the city. Hence Benchmarking is required for identification of target values for desirable outcome indicators. Benchmarking can be used as a means to identify target values for ‘desirable outcome indicators’.

---

**Step 1**
- Identify Indicators

**Step 2**
- Collect data - primary and secondary

**Step 3**
- Measure Indicators

**Step 4**
- Set Targets
Step 3– Problem Identification

Step 1: Identifying what kind of problem are we looking to solve

As illustrated in the figure below the kind of problems that we are trying to solve are mostly linked to the objectives.

Figure 1-5: Problem Identification Cycle

Step 2: Identifying the problem and seriousness

It is important to distinguish between source and manifestations, as it will have an impact on our choice of strategy to resolve the problem.

Figure 1-6: Problem Identification

- Source Problems
  - Increasing population
  - Increasing vehicle ownership
  - Urban sprawl
  - Inadequate and inefficient public transport system
  - Inadequate infrastructure for pedestrians, cyclists
  - Vehicle technology
  - Inadequate funding sources for transportation

- Manifestations
  - Congestion
  - Increased trip lengths and travel times
  - Increasing reliance on private transport
  - Poor accessibility levels
  - Road accidents
  - Pollution levels - Co2, NOx, SOx, SPM
  - Increased GHG emissions
  - Energy consumption

Source: Toolkit on Strategic Integrated Mobility Plan, Draft Report The World Bank 2012
1.8 What are the decision areas for land use transport integration?

In the process of planning for land use transport integration for a city the following are the main decision areas as give in the figure below.

**Figure 1-7:** Key decisions in planning process

The strategy mix to be adopted for a city will depend on the size and the location of the cities.
The figure below lists the various strategic tools for land use transport integration and the level at which they are generally used.

**Figure 1-8: Scales of implementation of Strategies**

**Regional level**
- Structuring growth
- Building scenarios

**City Level**
- Spatial development strategies
- Strategic alignments
- Networks

**Local Level**
- Inner city development
- Interchanges
- Local area access

**1.9 What are the land use decisions, transport decisions and the resultant land use-transport decisions at the regional level?**

**Step 1: Study Area Delineation**

Study areas delineation becomes a very important step in the planning process while integrating land use and transport. There are two ways in which one could decide on the study area:

**City already has a metropolitan area defined**
- In this case the same area can be adopted to decide on structuring growth

**City does not have a metropolitan area defined**
- The city will need to delineate a larger hinterland which has direct influence on the city
Step 2: Forecasting Growth

Growth scenarios for structuring the city will be developed at this stage.

Step 1
- Growth projection for the future years of the delineated area in terms of population and employment are made on the basis of High growth, Medium growth and Low growth

Step 2
- Land assessment for future growth by using land suitability Analysis process

Structuring at Regional Level

In case of metro and medium size cities owing to their growth trends and influence in the region it is important to structure growth at regional level. The size of the city in terms of the area will have to be determined as a part of this process.

Step 1
- Identification of existing and potential activity nodes as sub-centres – polycentric development

Step 2
- Strengthening sub-centres to redistribute activities to sub-centres, thereby reducing travel demand, trip lengths etc.

Developing Scenarios

Using density as a tool, different growth scenarios for the projected population and employment are built to determine the future extent of the city.

Do Minimum or Business as usual scenario
- extension of the current development pattern.

Compact scenario
- This assumes that the city will remain compact by increasing the density in the city.
1.10 What are the land use decisions, transport decisions and the resultant land use-transport decisions at the city level?

Decision on Network Development

This involves the development of network pattern for the city depending on the existing pattern the city can choose ring radial, grid or linear pattern.

- **Step 1**
  - Identify the network hierarchy using functional classification

- **Step 2**
  - Identify the missing links in the city by assessing the availability of alternate routes for users, thus distributing the load and increasing the efficiency and carrying capacity of the network as a whole.

- **Step 3**
  - Identify the missing links in the city by assessing the availability of alternate routes for users, thus distributing the load and increasing the efficiency and carrying capacity of the network as a whole.

- **Step 4**
  - Develop the major network for the city in future by identifying the arterials and sub arterials and proposing to develop these as transit ready streets.
Decision on Strategic Alignment of Multimodal Transit Network

Having provision for multimodal system in case of big cities. The transit system is to be developed considering the existing and proposed high density areas connecting work centers. The following steps can be used for strategically aligning the transit for your city.

**Step 1**
- Identify the existing and the future growth areas in your city.

**Step 2**
- Identify the low EWS and low income housing areas in your city.

**Step 3**
- Identify and develop the road network which can accommodate rapid transit modes and the ones which connects the above mentioned areas, minimum spanning tree analysis can be used in this regards.

**Step 4**
- Decide on the modes to be developed for the city.

Identification of Transit Interchanges and Activity Nodes

a) **Transit Interchanges**- The interchanges are identified on the basis of their importance in the city and the regional context.

**Step 1**
- Defining the level of Interchanges depending on the modes that meet and there regional importance.

**Step 2**
- Delineating the core and the influence area of an interchange depending on the levels.

**Step 3**
- Reserving land for transit facilities. Land can be acquired however this is a lengthy and a time consuming process hence financial tools such as TDR can be explored for the same.

**Step 4**
- Designing the interchange keeping in mind seamless connectivity for the passengers i.e. Level 1, Level 2, Level 3 and Level 4 interchanges.
b) **Identifying activity nodes** that are connected by transit system.

- **Step 1**: Identify potential areas to be developed as activity nodes keeping transit connectivity in mind.

- **Step 2**: Classify the activity nodes on the basis of predominant land use (e.g., commercial, industrial, educational etc.) and providing for mix use activities in these nodes.

---

**Transit Oriented Development**

- **Step 1**: Identify the transit network with its ROW and allowed FSI along the network.

- **Step 2**: Conduct a survey for the existing land uses and utilised FSI.

- **Step 3**: Find the carrying capacity of the infrastructure in the areas.

- **Step 4**: Propose the revised FSI norms as per the carrying capacity and the zoning mix along a 200-500 m buffer, while doing so one needs to also specify the minimum size of the plot as FSI increase will be feasible on smaller plots.

- **Step 5**: It is also important to look in for value capture as a funding mechanism; this can be used for funding and maintaining the transit network.

---

1.11 What are the decisions to be taken at the local level?

Some of the strategies like activity area and interchange area development that are adopted at the city level are actually implemented at the local level.

**Planning for neighbourhood design and street layout**

In order to plan for active use of sustainable modes of transportation the implementation of the same can be carried out as-
### Developing Local Area Access Plans

<table>
<thead>
<tr>
<th>Step 1</th>
<th>This involves identification of activity area such as schools, colleges, hospitals, community facilities etc. within walking distance of the transit stops and mark them on a map.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2</td>
<td>Identify clusters of activities in the areas/ activities that are in close vicinity and connecting clusters to nearest transit stop</td>
</tr>
<tr>
<td>Step 3</td>
<td>Identification of the network which would connect the activities and the transit stations by creating loops and identifying missing links.</td>
</tr>
<tr>
<td>Step 4</td>
<td>Complete the network by providing priority for pedestrian and cycle infrastructure connecting the activity areas to the nearest transit stop.</td>
</tr>
<tr>
<td>Step 5</td>
<td>One can also plan for altering the land uses along the identified network to support pedestrian and NMT like activities like local markets, day cares, libraries etc.</td>
</tr>
</tbody>
</table>
Developing Plans for Regeneration Areas

Step 1
• Identify the different kinds of vacant or underutilized land in the core city area—Industrial derelict land/mill lands, land under urban land ceiling, vacant public purpose land and public purpose reservation lands.

Step 2
• Increasing the density in these areas by mix land use zoning and strategically aligning transit along these areas.

Step 3
• Explore the financial mechanism for the viability of regeneration—Increase in FSI, Land pooling, and TDR etc.

1.12 What are the factors that facilitate the implementation of such strategies?

Step 1
• Sequencing the strategies adopted

Step 2
• Identifying projects and getting stakeholders involved

Step 3
• Picking up the appropriate regulatory and financial tools

Step 4
• Inter Jurisdictional Coordination
1.13 How do you evaluate Land use Transport Strategies?

<table>
<thead>
<tr>
<th>Before implementation of strategies</th>
<th>After Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cost benefit analysis</td>
<td>• Benchmarking</td>
</tr>
<tr>
<td>• Strategic Environment Assessment</td>
<td></td>
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<tr>
<td>• Multi Criteria Analysis</td>
<td></td>
</tr>
</tbody>
</table>

1.14 How do we monitor the progress/ success of land use transport strategy?

Step 1
- Identifying the indicators for monitoring progress - Benchmarking

Step 2
- Setting up a monitoring Schedule - Generally performance monitoring is carried out on an annual basis and the review of the strategy will take place after 5 years since the land use transport strategies will take time to yield result on ground.

1.15 Conclusion

The Locations and Characteristics of major Transport Infrastructure impacts the allocation of land uses from both Macro and Micro planned perspectives. The toolkit provides an understanding of the concept of Integration with regard to Land Use and Transport and the steps for facilitating adoption of Integrated Land Use Transport Decision by the City Managers.

The benefits of Land Use Transport Integration, the key elements of Integration and enabling mechanisms for Land Use Transport Integration have been discussed. The decision making process for both Land Use and Transport and the resultant Land Use - Transport decision at the City Level have been described in steps. The decisions to be taken at the local level, the factor that facilitates the implementation of such strategies and the method of evaluation of Land Use Transport Strategies both before and after the implementation have been discussed. The progress and the success of the Land use transport strategies has to be continuously monitored for updating as and when necessary and this mechanism has also been described in the toolkit.
Chapter 2

Travel Demand Modelling

Transportation demand modelling plays a vital role in land use transport decision making process. It is a tool which can be used to study the impact of alternative strategies, so that the cities can take more informed decisions.

This toolkit provides an overview of the travel demand modelling and its applicability in various urban transport contexts and decision making. It further provides a step-by-step guidance on the travel demand modelling process, its prerequisites, inputs and outputs for different level of decision makers.

The toolkit will be useful for city transport planning authorities for managing consultants undertaking travel demand modelling for the city as a part of strategic land use planning and/or public transport network planning exercise.

2.1 Role of travel demand modelling in the planning process

Travel demand modelling is a tool which helps in developing an understanding of the existing travel pattern of the city. The figure below shows the travel demand modelling process.

**Figure 2-1:** Process of Travel Demand Modelling
or the existing scenario, relationships between the land use and socio-economic factors and the trip characteristics are developed in order to explain the travel pattern of the city.

To represent the relationship, mathematical models are developed which are based on certain assumptions and data collected. The mathematical model outputs are matched with existing data to ensure the representativeness of the model. These relationships are then assumed to be valid for the future year as well.

Based on the developed relationships, for the future scenarios and the projected population, employment and land use transport characteristics, travel demand is projected and its impact on the network is analysed.

2.2 Scale of the model

The cities undertake different levels of decision making – from regional to local level. The models at each of these levels have a definitive scope in terms of its applicability for the three levels of decisions and would require differing sets of inputs and modelling framework. Hence, there cannot be a single model. The hierarchy of transport models and the decision areas which they assist in are shown below:

Figure 2-2: Hierarchy of Transport Models

**Strategic Models:** Strategic models are regional level models covering the entire metropolitan area / urban planning area and are used to evaluate land use growth scenarios and strategic transportation network options over the next 20-25 years.

**City Level models:** The city level models deal with a smaller area than the strategic models and are used to evaluate alignment options for public transport and road network and also assess impacts of various transport demand management measures like congestion pricing, peak spreading due to flexi-working hours etc.

**Local Level models:** The local level models deal with a small area, neighbourhood, corridor or junction/ set of junctions to assess impacts of various local strategies on traffic operation.

Thus, the strategic, city and local models are each at a different scale, with increasing detail as one moves
from strategic to local level. Of these only strategic and city level models can be considered as a part of travel demand models. The local level models are short-term detailed operational models.

### 2.3 Defining Travel Demand Modelling

Travel demand modelling consists of four stages. The first stage is ‘Trip Generation’ which looks at quantifying number of trips which will be made from each zone based on population and employment forecasts. The total trips produced and attracted are assumed to be a function of household and land use characteristics.

#### Figure 2-3: Process of Four Stage Modelling

- **Trip Generation**: How many trips from each zone? Function of household and land use characteristics
- **Trip Distribution**: Where to go? Function of travel time/costs, attractiveness of
- **Mode Split**: How to travel? Function of utility
- **Trip Assignment**: Which route to travel on? Function of generalised journey time

‘Trip Distribution’ links the productions and attractions by zones to form travel demand matrix. Trip distribution is carried out based on gravity model which considers trip interactions between two zones as a function of travel time and attractiveness of the two zones. ‘Mode Split’ tries to segregate trips made by various modes in the city like; private modes (cars, two-wheelers), public modes (buses, metro etc) and by walk and cycle. ‘Trip Assignment’ places the trips on to the network through path analysis and helps assess the network sufficiency and its impacts.

Thus, the travel demand models are developed to compute total number of trips being generated, connect the trip origins and destinations, predict the travel mode and assign the trips on road or public transport network.

### 2.4 Undertaking Travel Demand Modelling

The figure below shows the framework outlining various steps for cities to undertake travel demand modelling process. There are four steps of travel demand modelling:

Step 1: Defining Planning Objectives

Step 2: Developing a modelling framework

Step 3: Model Development
Step 4: Scenario Evaluation / Forecasting

**Figure 2-4:** Framework for Travel Demand Modelling

<table>
<thead>
<tr>
<th>Step 1: Defining Planning Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning for future spatial growth of the city</td>
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<table>
<thead>
<tr>
<th>Step 2: Developing a modeling framework</th>
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<tbody>
<tr>
<td>Modelling Area &amp; Zoning</td>
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<table>
<thead>
<tr>
<th>Step 3: Model Development</th>
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<tbody>
<tr>
<td>Network Development</td>
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<table>
<thead>
<tr>
<th>Step 4: Scenario Evaluation / Forecasting</th>
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</thead>
<tbody>
<tr>
<td>Model Outputs</td>
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</tbody>
</table>

### 2.4.1 Step 1: Defining Planning Objectives

There are two specific areas for which demand modelling has been discussed. The first one is for the long-term decisions of spatial growth and supporting transport development of the city, while the second one dealing with mass transport decisions like alternative corridors/alignments, route options, service design etc.

The urban development authorities in urban areas prepare a Development Plan/Master Plan for the city for 15-25 years plan horizon. The plan consists of a proposed land use plan, and development control regulations to implement the land use plan. Demand modelling in such cases can help evaluate the impacts of projected changes in population, employment, development patterns, and other socioeconomic conditions on the demand for travel on the road network and public transportation system. The outputs of this exercise can be used to develop the strategic land use and transportation plan, to identify projects for detailed study, and to prioritise transportation projects/strategies.

The second application of travel demand modelling is evaluating mass transit alignment and/or mode options. The strategic alignment of mass transit network may need to be further defined in terms of corridors and location of stops and stations or operational decisions with respect to PT service planning may have to be undertaken. Demand modelling also assists in operational decisions like routes, service frequencies, location of interchanges etc. A public transport operations plan needs inputs in terms of route structuring, service frequencies, identification of major stations and requirement of vehicles.
2.4.2 Step 2: Developing a modelling framework

Once the objective has been set out for the modelling exercise, the next stage is to define the modelling framework. These include decisions on the extent and scale of the model along with scenario specification and the software to be used.

- **Modelling area and zoning**: The study area can be taken as the modelling area. For the travel demand analysis, this would have to be sub-divided into smaller units known as Traffic Analysis Zones. The zone sizes vary depending on the scale of the model and objective of the modelling exercise.

- **Model Characteristics**: Depending on the purpose of demand modelling, the model characteristics will vary. These would include decisions on modes to be modelled, level of detail of the network to be coded, the forecast years, and model period (morning peak, evening peak or inter-peak)

- **Scenario Specification**: A scenario is a possible view of the future. The model needs to include all possible scenarios which have to be assessed for their effectiveness in meeting the plan objectives. Thus, scenario specification is critical and needs to be defined for all the alternate scenarios / strategy mixes that need to be tested.

- **Data Inputs**: Developing a model requires base data on transport demand and supply. Additionally, data also needs to be collected for checking model accuracy. The data inputs therefore needs to be collated so that these are available before proceeding to the next stage of model development.

- **Model Software**: Several transport modelling software like CUBE, TRIPS, TransCAD, Emme etc are available having similar capabilities. The features and prices vary across the different software.

2.4.3 Step 3: Model Development

The next step deals with creation of the model and its calibration to check its representativeness to the existing situation.

- **Network Development**: The study area transportation network for both roads as well as public transport would have to be coded. Apart from the network in form of links and nodes, attributes like network speeds, carriageway widths, functional hierarchy etc are also required. Similarly, public transport routes, headways, speeds etc need to be coded in. This information is required for both existing as well as future scenarios to be tested.

- **Demand development**: Developing demand data is essential for both existing situation as well as forecast years. Demand estimation for base year can be carried out through various surveys like household survey, road-side interviews, on-board passenger survey on public transport services etc.

- **Four stage modelling process**: The four stages of trip generation, trip distribution, mode split and trip assignment is carried out for travel demand forecasting.

- **Model calibration and validation**: The base year model needs to be checked for its accuracy before applying the model for forecasting future demand. This checking is known as model calibration and is carried out for every step of the four stage model to verify the ability of the model to reproduce numbers close to observed values.
2.4.4 Step 4: Scenario Evaluation and forecasting

The final stage of the travel demand modelling is scenario evaluation and forecasting. It involves analysing model outputs to assess the difference between different scenarios. For eg. model outputs like volume-capacity ratios on road network for different scenarios can help in comparing them in terms of their road congestion levels.

The travel demand modelling process helps in evaluating alternative future year scenarios. Based on the overall objectives of the planning exercise, an evaluation framework needs to be set up.

The travel demand modelling process can provide several outputs like expected mode shares in alternative scenarios, volume-capacity ratios on the network, total travel-kms, travel times etc, which can help understand how the scenarios are performing one against the other. The table below depicts the model outputs at different stages of the modelling process and how these can be used for some of the indicators.

Table 2-1: Model Output at Different Stages of Modelling

<table>
<thead>
<tr>
<th>Modelling Stages</th>
<th>Model Outputs</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For Future Spatial Growth of the City</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode Split</td>
<td>Mode share for future scenarios</td>
<td>If a shift to PT modes observed?</td>
</tr>
<tr>
<td>Trip Assignment (Private vehicle assignment)</td>
<td>Volume Capacity Ratio</td>
<td>Congestion levels on the network</td>
</tr>
<tr>
<td></td>
<td>Vehicle kms</td>
<td>Average trip lengths</td>
</tr>
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<td></td>
<td></td>
<td>Operation Costs; GHG emissions; number of accidents and accident savings between scenarios</td>
</tr>
<tr>
<td></td>
<td>Vehicle hours</td>
<td>Average travel time by private modes; travel time savings between Do Minimum (DM) and Do Something (DS) scenarios</td>
</tr>
<tr>
<td>Trip Assignment (PT assignment)</td>
<td>Passenger kms</td>
<td>Average trip length</td>
</tr>
<tr>
<td></td>
<td>Passenger hours</td>
<td>Average travel time; travel time savings between DM and DS scenarios</td>
</tr>
<tr>
<td><strong>For Public Transport Alignment &amp; Operation Decisions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mode Split (Stated Preference Surveys)</td>
<td>New ridership expected Using average occupancy levels, change in private veh-kms</td>
<td>Decongestion benefits, if shift from private modes expected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operation Costs; GHG emissions; number of accidents and accident savings between scenarios</td>
</tr>
<tr>
<td>Trip Assignment (PT assignment)</td>
<td>Passenger kms</td>
<td>Average trip length</td>
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<tr>
<td></td>
<td>Passenger hours</td>
<td>Average travel time; travel time savings between DM and DS scenarios</td>
</tr>
<tr>
<td></td>
<td>Load factors</td>
<td>Crowding levels in transit vehicles</td>
</tr>
<tr>
<td></td>
<td>Boarding, alighting and transfer passenger traffic at stations</td>
<td>Passenger ridership and revenue, facility design-identification of major stations, identification of interchange locations</td>
</tr>
</tbody>
</table>
2.5 Challenges and Recommendations

While travel demand modelling is a useful tool to analyse different growth / transit alternatives and helps to arrive at the most suitable alternative, there are some challenges. Firstly, the amount of data required for developing the model is extensive. Further, the database collection and management is also a tedious and time-consuming exercise. Again, to keep the model updated, it is important to regularly collect, collate and feed data into the model. There is also an absence of database creation and management system in our cities. Every time a study requiring travel demand modelling is commissioned, a new set of data is created having no links with the existing databases.

The developed transport model structure in terms of modeled area, zoning system, network and demand inputs are not standardized and hence it varies from one study to another. Further the model fitness and reliability of its outputs is also a concern as there is no audit mechanism in place to verify the reasonableness of assumptions and quality of model developed. Rather than updating the model over time, for every study a new model is created. As a result of this, comparability of outputs between different models becomes a problem.

Applicability of model outputs is also a concern. The use of model outputs in the strategic planning process is not clearly outlined. If it is being used for scenario appraisal, outlining the indicators for appraisal process and how it links to the model outputs is required. A methodology for appraising scenarios therefore needs to be developed.

For facilitating travel demand modelling in the city’s decision making process, it is suggested that to develop a standard model for the city which is regularly updated and used by consultants for undertaking various studies. This process should be periodically carried out every 5 years to ensure that the model is current and updated. Further, it is also suggested that the urban development authorities should encourage their staff to go for professional development courses so as to introduce them to modelling concepts and techniques. Managing and maintaining transport models requires continual data collection process which needs to be fed into the model for keeping it current. This calls for enhancing the capacity of the city officials for developing and maintaining such transportation models.

2.6 Conclusion

Transport Modelling is based on the principle that Transportation is a derivative of the Land Use. The Toolkit provides an overview of the Travel Demand Modelling and its applicability in various Urban Transport contexts and Decision making. It further provides a step by step guidance on the Travel Demand Modelling Process, its Pre requisites, inputs and outputs for different levels of decision makers.

It provides reasonably good guidance for City Transport Planning Authorities on Managing Consultants, Undertaking Travel Demand Modelling in the City as a part of Strategic Land Use Planning and/or Public Transport Network Planning Exercise

Based on the Transport Demand Modelling, the Need and the Mode of Travel can be derived and the Demand on various alternative Transport Systems can be determined. The alternative Transport Systems can be managed as per the demand on those systems.
3.1 Modes of city transport

Commuting in a city uses three basic modes:

- Walk
- Personal transport
- Intermediate Public Transport
- Public Transport

Everybody walks: full length of the trip or to access say bus stop i.e. part trip. Thus a citywide walk facility is an essential part of a city transport network. Personal transport is Car, 2-wheeler & Cycle. It may be used for full length of trip or to access say bus i.e. part trip. A citywide cycle track and road network is also an essential part of a city transport network.

IPT and PPT may be used for the full length of trip or to access say bus. Hence these are also an essential part of a city transport network. Amongst all modes of city transport MRT carries most trips in a city. All other modes provide connectivity to MRT. The table below gives an idea of the share of trips carried by different modes in cities of various sizes. This is based on Primary surveys in 30 cities representing 87 cities with population in excess of 5 lacs.

Table 3-1: Mode Share (%), 2007

<table>
<thead>
<tr>
<th>City Category</th>
<th>Population</th>
<th>Walk</th>
<th>Cycle</th>
<th>Two Wheeler</th>
<th>Public Transport</th>
<th>Car</th>
<th>IPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category-1a</td>
<td>&lt;5 lakhs with plain terrain</td>
<td>34</td>
<td>3</td>
<td>26</td>
<td>5</td>
<td>27</td>
<td>5</td>
</tr>
<tr>
<td>Category-1b</td>
<td>&lt;5 lakhs with hilly terrain</td>
<td>57</td>
<td>1</td>
<td>6</td>
<td>8</td>
<td>28</td>
<td>0</td>
</tr>
<tr>
<td>Category-2</td>
<td>5-10 lakhs</td>
<td>32</td>
<td>20</td>
<td>24</td>
<td>9</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Category-3</td>
<td>10-20 lakhs</td>
<td>24</td>
<td>19</td>
<td>24</td>
<td>13</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Category-4</td>
<td>20-40 lakhs</td>
<td>25</td>
<td>18</td>
<td>29</td>
<td>10</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Category-5</td>
<td>40-80 lakhs</td>
<td>25</td>
<td>11</td>
<td>26</td>
<td>21</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Category-6</td>
<td>&gt;80 lakhs</td>
<td>22</td>
<td>8</td>
<td>9</td>
<td>44</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>National</td>
<td></td>
<td>28</td>
<td>11</td>
<td>16</td>
<td>27</td>
<td>13</td>
<td>6</td>
</tr>
</tbody>
</table>

Source; Wilbur Smith study 2007
It will be noted that walk has a substantial share of trips in cities of all sizes. Together with cycles they carry 39% trips at national level.

3.2 Citywide multimodal network

The objective is to create a transport network with all the three basic modes: Walk, Personal & Public transport. The transport network has to be citywide as stated earlier so that the commuter is assured that he can complete his journey all the way by the mode of his choice.

Many trips may have to use more than one mode to complete a trip e.g. walk and bus. Hence network will be multi-modal. Indeed transport is inherently multimodal. In the early days people used to walk and cross the river by boat.

Thus, the need to interchange between modes / routes becomes a part of the trip. This interchange has to be made as convenient and comfortable as possible which imposes minimum time penalty on the commuter. This requires:

- Stops / Stations in close vicinity of each other.
- Single ticket for all modes.
- Integrated Passenger Information
- Integrated service schedules
- Signages and conflict free movement within the interchange.

3.3 What are the MRT Modes?

One mode is well-known – The bus. Bus services till recently were limited to about 15 cities. Funding under JnNURM Scheme 1 increased this number to 65 cities and many more small cities have been added under Scheme II, which are approximately 130 in number.

Cities that do not have standard bus services have to make do with IPT i.e., 3-W tempos. This mode cannot be called MRT, but it is in use in nearly all cities substituting for MRT. In large cities it supports bus services. In small cities, it is the main mode of city transport.

More MRT modes are now being added; bus rapid transit (BRT), Metro Rail and Mono rail. Tramway / Light rail transit (LRT) is also under consideration.

In fact Modes of MRT have evolved from stage coach of olden times to the present day Rail transit, BRT and other guided modes and continue to evolve. This evolution process has been prompted by the need to make MRT comfortable and financially viable.

The comparative features of the more commonly used modes of MRT are given in the table below:
### Table 3-2: Comparative features of MRT modes

<table>
<thead>
<tr>
<th>MODE</th>
<th>USED AS</th>
<th>GRADE SEPARATION</th>
<th>CURVES</th>
<th>GRADIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metro Rail</td>
<td>Intra-city</td>
<td>Grade separated</td>
<td>300m</td>
<td>3%</td>
</tr>
<tr>
<td>Commuter Rail</td>
<td>Suburbs</td>
<td>At-grade</td>
<td>300m</td>
<td>1-2%</td>
</tr>
<tr>
<td>Light Rail Transit</td>
<td>Intra-city</td>
<td>At-grade or Grade separated</td>
<td>25m</td>
<td>6%</td>
</tr>
<tr>
<td>Bus Rapid Transit</td>
<td>Intra-city</td>
<td>At-grade generally</td>
<td>Road bends</td>
<td>3%</td>
</tr>
<tr>
<td>Monorail</td>
<td>Intra-city</td>
<td>Grade separated</td>
<td>70m</td>
<td>6%</td>
</tr>
</tbody>
</table>

The comparative capex and opex of each mode for guidance only may be taken as follows:

### Table 3-3: Comparative Capex and Opex of MRT modes

<table>
<thead>
<tr>
<th>S no.</th>
<th>Mode</th>
<th>Capex Rs. crores per Route km (2011-12)</th>
<th>O&amp;M Rs. Crore per Route km per annum</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Metro rail (elevated)</td>
<td>182.05</td>
<td>8.8 (2016-17)</td>
<td>CAPEX DMRC, Hyderabad and Kochi O&amp;M time series of DMRC.</td>
</tr>
<tr>
<td>2</td>
<td>Monorail (elevated)</td>
<td>214.27</td>
<td>7.2 (2016-17)</td>
<td>CAPEX Kozhikode, Delhi and Mumbai O&amp;M first year of Kozhikode</td>
</tr>
<tr>
<td>3</td>
<td>Light rail (elevated)</td>
<td>159.25</td>
<td>6.05 (2016-17)</td>
<td>CAPEX Delhi LRT escalated to 2012-13 O&amp;M based on Elevated Monorail</td>
</tr>
<tr>
<td>4</td>
<td>Light rail (At grade)</td>
<td>107.36</td>
<td>6.5 (2016-17)</td>
<td>CAPEX Delhi LRT escalated to 2012-13 O&amp;M based on Monorail</td>
</tr>
<tr>
<td>5</td>
<td>BRT (At grade) 27.38 (Incl. bus)</td>
<td>14.9 (2014-15)</td>
<td>CAPEX Ahmedabad, Rajkot DTC, BEST, BMTC, MTC + OCC, Security</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>BUS (At grade) 17.67 (Incl. bus)</td>
<td>16.3 (2014-15)</td>
<td>CAPEX as per WGUT for 12th Five Year Plan. O&amp;M Cost Data for DTC, BEST, BMTC, MTC</td>
<td></td>
</tr>
</tbody>
</table>

### 3.4 Choice of mode

The first step in choice of mode is identification of corridors for MRT by generating a transport demand model.

#### 3.4.1 Demand along Corridor

The main criteria in the choice of mode for a corridor is, demand level on a corridor and capacity of the mode. Demand level on city corridors may vary from a few hundred to several thousand peak hour peak direction trips (PHPDT).
Table 3-4: Demand wise number and length of routes

<table>
<thead>
<tr>
<th>PHPDT</th>
<th>Kilometer (km)</th>
<th>Number of Routes</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 25000</td>
<td>93</td>
<td>4</td>
</tr>
<tr>
<td>20- 25000</td>
<td>57</td>
<td>4</td>
</tr>
<tr>
<td>15- 20000</td>
<td>131</td>
<td>8</td>
</tr>
<tr>
<td>10- 15000</td>
<td>179</td>
<td>13</td>
</tr>
<tr>
<td>5- 10000</td>
<td>115</td>
<td>14</td>
</tr>
</tbody>
</table>

Source: Case study for Delhi Multimodal transport network

3.4.2 Capacity of Modes

Similarly the capacity of modes varies as follows

Table 3-5: Capacity of Modes

<table>
<thead>
<tr>
<th>Bus or ETB in mixed operation</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus lane</td>
<td>upto 5000</td>
</tr>
<tr>
<td>BRT (Bus or ETB)</td>
<td>10000*</td>
</tr>
<tr>
<td>LRT at-grade</td>
<td>15000</td>
</tr>
<tr>
<td>LRT grade-separated</td>
<td>upto 30000</td>
</tr>
<tr>
<td>Monorail</td>
<td>upto 20000</td>
</tr>
<tr>
<td>Metro rail</td>
<td>&gt;30000</td>
</tr>
<tr>
<td>Suburban rail</td>
<td>upto 30000</td>
</tr>
</tbody>
</table>

Source; WB and TRRL studies

Appropriate mode has to be selected for each corridor by matching the demand level with the capacity of the mode. When PHPDT is greater than 300,000, metro rail is the only choice. In case of PHPDT below 5,000, normal bus services should be adequate. Between 5,000 – 30,000 other modes i.e., LRT, BRT and Monorail are relevant.

Thus a multi-modal MRT network will be generated with several interchange points. Based on demand level and mode capacity, the network for Delhi was developed as follows:

Table 3-6: The Multimodal Network for Delhi

<table>
<thead>
<tr>
<th>Mode</th>
<th>No. of Corridors</th>
<th>Total Kilometers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metro</td>
<td>6</td>
<td>115</td>
</tr>
<tr>
<td>BRT</td>
<td>26</td>
<td>294</td>
</tr>
<tr>
<td>LRT</td>
<td>6</td>
<td>74</td>
</tr>
<tr>
<td>Monorail</td>
<td>3</td>
<td>48</td>
</tr>
<tr>
<td>IRBT</td>
<td>2</td>
<td>44</td>
</tr>
</tbody>
</table>
3.4.3 Availability of ROW

There are other factors that influence the choice of mode e.g. energy consumption, pollution and safety. But most importantly, the engineering feasibility of introducing the chosen mode in a given corridor has to be established. At-grade modes i.e., BRT & LRT require a share in the road space. This depends on road width which again varies widely in a city. Available ROW on identified routes is as follows;

Table 3-7: RoW available along MRT Corridors in Delhi

<table>
<thead>
<tr>
<th>Right of Way Available</th>
<th>Kilometers of MRT Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 m and above</td>
<td>185 km</td>
</tr>
<tr>
<td>28m to 35 m</td>
<td>246 km</td>
</tr>
<tr>
<td>20 to 28 m</td>
<td>79 km</td>
</tr>
<tr>
<td>Below 20 m</td>
<td>65 km</td>
</tr>
<tr>
<td>Total</td>
<td>575 km</td>
</tr>
</tbody>
</table>

Source; Case study for Delhi Multimodal transport network

It is unlikely that same road width will be available in a corridor for the full length. There will be encroachments, tight spots etc. Engineering solutions have to be found including elevating the mode. When passing through sensitive areas, it may be necessary to go underground.

3.5 First and last mile connectivity

While planning for a public transport system, door to door journey should be planned in terms of time, cost and convenience. This involves six steps;

• Walk facilities within 500 m
• Vehicle access within 3 km
• Feeder service within 5 km
• Drop off & pick up at stations
• Park and ride at stations
• Land use control around stations
• Facilities for handicapped

3.6 User friendly service

A city wide network however is only the first step. Several other features are necessary to make public transport the favored mode of commuting. This includes:

• Centralized control with Intelligent Transport System
• Passenger information system
• Integrated ticketing
• Integration of route time tables
• A pleasant ambience
• Safety and security against terrorism, hoolignism and vandalism
3.7 Implementation Models

Four basic models are possible;

- Government agency for example Kolkata
- BOT or Govt. & BOT approach i.e. Government funds fixed infrastructure, and Rolling stock and O&M offered for BOT
- Government SPV approach; DMRC, BMRTL
- Public private partnership

3.8 Implementation strategy

Guided mass transit systems are capital intensive, very complex and highly multi-disciplinary. Nearly every city agency is involved in approvals and clearances and Inter-departmental issues. Ground conditions, land acquisition, utility and traffic diversions and management of traffic during construction pose special problems. Government procedures are often not conducive to quick implementation, which result in delay in project completion and increase in cost.

To ensure timely delivery of projects, it is important that the implementation agency should be the owner of the project with full technical and financial powers for quick decision making. Coordination and empowered groups should be set up to resolve inter-departmental issues. Public cooperation should be enlisted through involvement and awareness programs. Advance steps should be taken to create near green field conditions to facilitate major construction later.

3.9 Financing issues

As a rule mass transport projects require subsidy, both capital and revenue. The first step therefore is to prepare a project with the best possible financial viability to minimize the need for subsidy. Steps to keep the cost low and maximize ridership and hence estimating revenue should be a part of the project as financial sustainability is essential for ongoing growth.

Some more steps that will help improve the financial viability of the project are;

- Allocation of Government land free of cost,
- Cross-subsidy projects,
- Tax exemptions,
- Dedicated taxes on non-user beneficiaries,
- User charges to maximize economic return and to minimize the need for subsidy

As a strategy towards financing the project, the following points may be noted:

- Cost of finance used for the project is crucial to project viability and should be minimum.
- Interest liability can kill a project therefore creation of a fund to provide soft loans to the project will help in improving its sustainability.
- Adequate equity, grants and soft loans should be included so that the project once operational becomes self-sustaining.
- Funding should be independent of budgetary allocations
3.10 Privatization

Privatization is being promoted by government in all infrastructure projects; however this is not easy in rail transit projects. Private sector has additional financial liabilities:

- return on equity
- requirement of profits
- repayment of loans with commercial rates of interest
- income tax and other local tax liabilities

Typically, the cash outgo of a rail transit project in the conventional Government funded and the private BOT approach may vary in ratio of 1:4.

3.11 Conclusion

This toolkit deals with city wide multi model network describing the various MRT modes, their capacities, costs and method of choice of mode based on demand wise number and length, availability of Right of Way (ROW), first and last mail connectivity etc.

It has been emphasized that the MRT systems should be user friendly including provision of a city wide network covering all important developments.

Implementation issues, Implementation models such as Government; built operate transfer (BOT) have been discussed. Implementation strategies, financing issues, financial viability, financing strategy including possibilities and difficulties in privatisation of these projects has been discussed in detail in the toolkit.
Chapter 4
Alternatives Analysis (AA)

4.1 What is alternatives analysis?

Alternative Analysis is about finding the best alternative to solve transport and related problems in a particular corridor or sub-area of the city. Alternative Analysis is NOT a “feasibility study” where the “feasibility” of a single solution is evaluated without looking at other, potentially more cost-effective and desirable options. It is a consensus amongst various stakeholders after examining various options as pragmatically and honestly as possible in making the right choice.

Alternatives Analysis follows comprehensive planning where a corridor has been identified as a top priority. It focuses on a single corridor or sub-area rather than an entire metropolis. The high priority assigned to addressing transport and related issues in the given corridor, the planning time horizon used in alternative analysis is typically 15 years versus the 25+ years typical in comprehensive transport planning. For a given problem, a number of solutions might be feasible. The process of Alternatives Analysis identifies the best solution, NOT just the feasibility of solutions.

- Alternatives Analysis follows comprehensive planning.
- Alternatives Analysis is done for a corridor or a sub-area.
- Planning horizon for Alternative Analysis is usually 15 years.
- Alternatives Analysis evaluates a number of feasible solutions for the corridor / sub-area and identifies the best solution.

4.2 Why alternatives analysis is done?

Alternatives Analysis is done to:

- Ensure that reasonable transportation alternatives are considered.
- Evaluate all impacts due to the project.
- Consider opinion of Stakeholders
- Select the locally preferred alternative
- Have better access to Central Government funds under the Jawaharlal Nehru National Urban Renewal Mission (JnNURM).

Alternatives Analysis ensures all transportation alternatives are considered, and evaluated before the selection of the best alternative. This makes the case for a project much stronger and thus paves way for better and faster access to Government and other funds.
4.3 Do all projects have to go through AA process?
All corridor projects having different alternatives will need an Alternatives Analysis process.

4.4 How will it be decided which projects need to undergo AA process?
Alternatives Analysis is applicable to infrastructure projects for corridors. When there are different transportation alternatives available for a corridor/sub-area, a “choice” has to be made. Alternatives Analysis is the process that facilitates the “choice-making”. Alternatives Analysis is applicable to:

- Mass transit options for a corridor
- New corridor alignment options
- Different land-use scenarios for a corridor

When a “choice” needs to be made regarding transportation alternatives for a corridor, Alternative Analysis process is necessary.

4.5 Who is the lead agency for conducting the AA?
The Unified Metropolitan Transport Authority (UMTA), as in Chennai or a Metropolitan Development Authority (as in Hyderabad) formed for the purpose of planning, co-ordination, supervising, promoting and securing planned development of a city/region will be the LEAD AGENCY to conduct/co-ordinate the Alternatives Analysis.

4.6 Who will do the AA?
The Alternatives Analysis process evaluates all possible impacts of a project and thus requires inputs of a multi-disciplinary team comprising of planners, traffic engineers, design engineers, economists, etc. The following may be qualified to do the Alternatives Analysis for a corridor/sub-area.

- In-house technical team of the UMTA qualified to do the analysis
- Consultants

4.7 When AA done in the project development process?
As mentioned earlier, Alternatives Analysis follows comprehensive planning. Alternatives Analysis will be done after a Comprehensive Mobility Plan has been finalized. The Comprehensive Mobility Plan (CMP) of a City will identify priority corridor(s) that need transportation improvements. It will also spell out transportation alternatives for the corridor(s) identified. Alternatives Analysis will evaluate the alternatives for the identified corridor and select the best alternative suited to the City. For example, the CMP identifies Corridor X as a priority corridor for having mass transit. The alternatives spelled out maybe an enhanced existing bus system, transportation management alternatives, bus rapid transit system, a metro and a mono rail. Alternatives Analysis will evaluate all these alternative based on certain criteria to select the best available alternative suited for the corridor.
4.8 How detailed is the AA?

The Alternatives Analysis is not as detailed as a Detailed Project Report-1 (DPR) which is about 40 percent design. Alternative Analysis is about 10 percent design. It is an analysis based on inputs from the CMP, then narrowing it to the identified corridor(s). At the corridor level, more detailed analysis is done and alternatives are detailed at about 10 percent design level. The figure below shows the level of detail the AA process entails.

![Figure 4-1: Analysis Detail](image)

4.9 Why has the Toolkit been prepared?

The Ministry of Urban Development (MoUD), with grant from Department of Foreign and International Development (DFID), has commissioned an urban transport study. The purpose of this study is to develop Toolkits and Guidelines based on world wide experience and practices which can be utilized to select the most appropriate transport interventions. In this regard, Wilbur Smith Associates, in association with CRISIL, has developed the Alternatives Analysis Toolkit.

4.10 What will the Toolkit achieve? What is it not meant to achieve?

Alternatives Analysis is about finding the best alternative to solve transport and related problems in a particular corridor or sub-area. The Alternatives Analysis Toolkit elaborates the different stages of the process. It provides a checklist for the different components of the analysis process. It provides an understanding of the process of AA, understanding of the terminology and options available.

It is not a design guideline. It is not a means to conduct detailed technical analysis.

4.11 Who are the users of the Toolkit?

The users of the Toolkit are the following:

- UMTA/Planning Body
- The City Corporation— planners, engineers.
• Stakeholders-STUs, Transit agencies, Metro agencies, PWD, NGOs
• Consultants

4.12 Conclusion

Transport Management consists of analyzing the needs and ensures that various Transportation Alternatives are considered. The impact of different alternatives on the community should be determined. The opinion of all the stakeholders are to be considered and the locally preferred alternative should be selected after consensus.

A Unified Transport Authority with a qualified Inter Disciplinary Team should follow a Comprehensive Planning Process with a horizon of 15 years or so and evaluate a number of feasible solutions for a given corridor/sub-corridor to identify the best solution.

A checklist for different components of the analyses process that provides an understanding of the process of Alternatives Analysis, different stages of the process etc is provided in the toolkit.
5.1 Introduction

In most developing countries including India, the experience has been that the government agencies are unable to provide adequate formal public transport systems; in such cases ‘informal public transport’ systems emerge to cater to the demand. While, provision of public transit and infrastructure is important, this alone will not help in increasing the attractiveness of public transport. It is also necessary that the system provided is accessible for its users, so that its full potential is realized.

This toolkit on public transport accessibility aims to fill this important gap and will act as a guide for urban practitioners in designing accessible public transport systems.

5.2 Subject Description

The focus of this toolkit will be on accessibility to public transport and not accessibility via public transport. Accessibility to Public Transport can be studied in terms of the following two levels –

- Accessibility to public transport at the stop level: Categories such as intermodal accessibility and safety and security provisions will look at infrastructural provisions and will be studied at the stop level.
- Accessibility at the network level: Categories such as spatial, temporal and economic accessibility will look at provision of services for users at the network level.

This toolkit will focus on accessibility to public transport at the stop level, and not the network level.

5.3 Intermodal Connectivity

A public transport system can only be efficient if the comfort and convenience of pedestrians, cyclists, rickshaw users and other feeder service users in accessing the public transport facility is considered while planning and designing the system. Intermodal accessibility based on its interaction with different types of feeder services can be classified into three levels –

- Level 1: Provision of adequate pathways for pedestrian and non-motorized vehicle movement up to the bus stop.
- Level 2: Provision of adequate loading and unloading space for passengers transferring from other modes at important public transit stops.
- Level 3: Provision of parking space for two-wheelers and bicycles at important terminals in addition to facilities of Level 1 and Level 2.
It is necessary to understand different access modes and plan for each and every one of these, and also for the potential access modes, to ensure accessibility to public transport. This further helps in identifying which are the access modes for which intermodal connectivity need to be provided in Indian cities. 5 types of modes have been identified:

a. Pedestrian  
b. Cyclists  
c. IPT users  
d. Bus Users  
e. Private Motor Vehicle Users

5.4 Social Accessibility

The use of public transport is also dependent on safety and security in using the system. Safety aspect will study the risks that the commuters are subject to in and around a particular station. Security is on the other hand a perception related issue. Areas or locations that have lesser activities or lesser number of people or poor lighting are perceived to be unsafe. “Access to public infrastructure and facilities is one of the greatest impediments to education and employment of persons with disabilities and the aged” (Samarthyam, 2012). It is hence necessary to build public transport systems which provide accessibility to the permanently and temporarily disabled.

5.5 Policy

Till date not much importance has been given to accessibility to public transport. Policies focused on public transport have sparingly mentioned certain aspects of public transport. There is a need to frame a policy at the national level to ensure that accessibility to public transport is given as much importance as provision of public transport facilities. Below given are the national level policies in India which focus on Public transport. Aspects of these policies which focus on various accessibility indicators are mentioned.

5.6 National Urban Transport Policy

Aspects associated with accessibility covered in this policy are –

Intermodal Accessibility:

- Addressing safety concerns of cyclists and pedestrians by encouraging the construction of segregated lanes for bicycles and pedestrians.
- Improving the traffic flow by Segregation of vehicles moving at different speeds.
- Providing Segregated NMV paths along arterials and access roads to public transport terminals. This will increase the use of the public transport system particularly when combined with the construction of NMV parking.
- Designing and constructing NMT facilities by consulting experts and community (i.e., potential users).
- Enabling the establishment of quality focused multi-modal public transport systems that are well integrated, providing seamless travel across modes.
Safety and Security:

- Controlling activities on footpaths such as street vendors to secure pedestrian safety.
- Establishing effective regulatory and enforcement mechanisms that allow a level playing field for all operators of transport services and enhanced safety for the transport system users.

Comfort:

- Introducing Intelligent Transport Systems for Public traffic management.

5.7 National Mission for Sustainable Habitats

This is a sub-component of the National Action Plan on Climate Change formulated by the Prime Ministers Council on Climate Change. Certain aspects of accessibility to public transport are covered under this –

- Facilitation of access to para-transit within 300m walking distance.
- High quality and high frequency rapid public transport within 800m (10-15 minute walking distance) of all residences in areas over 175 persons / ha of built area (* refer to service level benchmarks for urban transport).
- All public facilities (institutional/ educational/ cultural etc) should be accessible by public transport within 400m walking distance.
- One or more high capacity, high speed transit corridor with dedicated transit lines within walking distance for 80 per cent of the population.
- All public transport nodes (intersection of two public transit corridors/routes) should accommodate para-transit facilities. Inter modal integration of formal public transport, para transit and cycle sharing should be within 200m from each other.
- All public transport modes (including para transit and cycle sharing) to have integrated fare collection and passenger information.

5.8 Prerequisites for Designing Accessible Public Transport System

5.8.1 Institutional and Technical Prerequisites

- City authority should be in charge of undertaking public transport accessibility audit. Personnel, time and financial resources should be allocated.
- On ground audit can be conducted by user groups.
- User groups should be representative of various socio economic categories of public transport users.
- User groups/ auditors will be guided by technical experts in conducting the surveys.
- Technical experts are people with expertise in transport planning/engineering. Could either be employees of the city authority or external experts.

- City authorities responsible for formation of groups for audits and hiring the right technical experts.

**5.8.2 Sampling Methodology**

- Ideally, the entire city network should be studied. However, in certain cases due to lack of resources, audit can be done only in representative samples.

- Sampling can be done in different ways depending on the unit of measurement adopted for the study:
  
  - Corridor/Route based – In this method, a few mass-transit corridors or public transport routes in the city are selected out of the total public transport operations in the city. The routes are preferably selected such that they connect the sub-urban areas to the core-city areas. In such cases the route starts from the outskirts of the city which are generally sparsely populated residential areas and end at the core-city area, which are generally high density areas with high commercial activity and pass through different areas of the city at different points of the corridors. Generally a 1% sample of the total routes in the city is considered to be a good sample but it should be looked at in a case-specific manner.

  - Land-use based – In this method, the city is divided into various spatial units/zones based on factors like their predominant land-use, population density and development patterns. Among these zones a representative sample of zones comprising of different income groups and land-use patterns is selected and the indicators developed in the toolkit are applied to all the public transport routes and stops within the sample zones selected.

**5.8.3 Audit Area**

The area in which the audit has to be carried out is dependent on the type of road user. Access area to the public transport stop for different types of road users is calculated below:

<table>
<thead>
<tr>
<th>Type of Road User</th>
<th>City Bus System (in m)</th>
<th>Mass Transit System (Metro/BRT) (in m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian</td>
<td>300 - 500</td>
<td></td>
</tr>
<tr>
<td>Cyclist</td>
<td>1000- 1200</td>
<td>2000- 2500</td>
</tr>
<tr>
<td>Auto</td>
<td>1500- 1800</td>
<td>3000- 3500</td>
</tr>
<tr>
<td>Bus</td>
<td>≃ 2000</td>
<td>≃4000</td>
</tr>
</tbody>
</table>

*Source: vtpi.org*

**5.8.4 Data Required**

Auditor needs to have a database of PT services to be audited, including location of all bus stops/stations in the route/corridor. It is helpful to have a map of each bus stop (or pair of stops if they are located opposite each other) with circles drawn on to show what routes (footpaths, walkways, roads) should be assessed as part of the intermodal Accessibility and Spatial Accessibility surveys.
5.8.5 Other Requirements

- Conduct intermodal Accessibility audits on the relevant mode of travel. That is accessibility to pedestrian surveys are to be done after covering the service area on foot and similarly accessibility to cyclist survey should be done after covering the relevant service area on a cycle.

- It may be helpful to take photos of the deficient element to document your findings on the checklist.

- Maintain a log of all photographs taken by noting the photograph number on a sketch of the facility layout.

- Barriers on the accessibility routes can be marked directly on the map showing the stop/station and surrounding area. If you do not have a satellite map or other suitable diagram, you may want to sketch the facility, identifying the specific elements that do not meet the audit requirements.

5.8.6 Inventory and Present Status

Check Lists have been prepared for capturing the current state of accessibility in the city. There are 8 check lists in total. The first 5 checklists focus on infrastructural facilities and will help in rating the existing facilities through a scoring system. The final scores that are calculated with this check lists will help the city authorities in prioritizing the problem areas and devote funds accordingly. The next 3 checklists are used to study the environment in which the public transport stop or station is located. These checklists will study the behaviour of road users as well the traffic volumes on the roads. Studying environmental factors helps in understanding which areas require infrastructural intervention to improve accessibility.

Eight Checklists are:

- Check List 1: Accessibility to Pedestrians
- Check List 2: Accessibility to Cyclists
- Check List 3: Accessibility to IPT Users
- Check List 4: Accessibility to MV Users
- Check List 5: Accessibility to Bus Users
- Check List 6: Driver Behaviour
- Check List 7: Pedestrian Behaviour
- Check List 8: Traffic volume

The parameters in the checklists are dependent on the type of public transport being evaluated and the type of road on which the study is conducted. Keeping these differences in mind, separate sets of checklists have been provided depending on the public transport system (metro rail/mono rail/closed BRTS OR regular bus/open BRTS), and road type (arterial/sub-arterial OR collector/local roads).

5.8.7 Implementation and Procurement

When an existing road system is upgraded as a public transport access friendly design, it is rarely possible to include the required features without re-organizing other street elements such as carriageway, services, medians and edges, pedestrian paths, etc. The resultant cost of development of access infrastructure must account for funds required to rationalize other road elements. This would include the cost of dismantling
and re-constructing different road components, as required by the design. Components involved in costing for Public Transport access friendly infrastructure:

**Table 5-2: Cost of Various Components for Public Transport access friendly infrastructure**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Component</th>
<th>List of Items</th>
<th>Cost/ Km (in Rs. crores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Development of Footpath (2m Width)</td>
<td>Dismantling of existing surface and structures</td>
<td>0.0000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excavation</td>
<td>0.0078</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Base courses (GSB+DLC)</td>
<td>0.2503</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60mm thick CC paver blocks on sand bed</td>
<td>0.2970</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CC Kerb stone edges</td>
<td>0.0720</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Cycle Track Development (2m Width)</td>
<td>Dismantling of existing surface and structures</td>
<td>0.0000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excavation</td>
<td>0.0067</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Base courses (GSB+DLC)</td>
<td>0.5772</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M40 CC pavement + pavement marking</td>
<td>0.8155</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CC Kerb stone segregator</td>
<td>0.0000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Parking</td>
<td>Bus Shelters i.e. Parking space for Buses</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Parking for Cycles and Public Bicycle Sharing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Parking for Para-transit i.e. Auto-rickshaws and Cycle Rickshaws</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Provision of Functional Lighting</td>
<td>Foundations, including excavation</td>
<td>0.0426</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provision of new light poles with fittings, wires, etc.</td>
<td>0.2475</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dismantling of existing light poles</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>0.2901</td>
</tr>
</tbody>
</table>

*Source: Costing based on local schedule of rates in Delhi, 2006

**Schedule of rates can be obtained from the local PWD office**
5.8.8 Materials Selection Guidelines

Table 5-3: Guidelines for Selection of Material

<table>
<thead>
<tr>
<th>SN</th>
<th>Areas</th>
<th>Do’s</th>
<th>Don’ts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Footpath</td>
<td>Anti skid / matt finish tiles, interlocking paving tiles, sandblasted Stone, unpolished Stone, checkered tiles</td>
<td>Polished Stone finishes</td>
</tr>
<tr>
<td>2</td>
<td>Kerb ramps</td>
<td>Anti skid / matt finish tiles; Flared sides with tactile paving, exposed Cement Concrete</td>
<td>Polished Stone finishes</td>
</tr>
<tr>
<td>3</td>
<td>Tactile paving</td>
<td>Vitrified unglazed pavers in bright colour contrast to the flooring surface (preferably canary yellow)</td>
<td>Stainless steel or metal pavers in dull /slippery finish</td>
</tr>
<tr>
<td>4</td>
<td>Signage</td>
<td>Bright colour contrast big font signages on non-glare surface-acrylic, metal (fully painted) with retro reflective paints</td>
<td>Glass, stainless steel, aluminum</td>
</tr>
<tr>
<td>5</td>
<td>Bus Stops flooring</td>
<td>Anti skid / matt finish tiles with vitrified unglazed tactile pavers in bright colour contrast to the flooring surface</td>
<td>Glazed vitrified tiles, Granite, polished Kota stone</td>
</tr>
<tr>
<td>6</td>
<td>Streetlights</td>
<td>White color, mercury lights-full cutoff fixtures</td>
<td>Yellow lights</td>
</tr>
<tr>
<td>7</td>
<td>Handrails</td>
<td>Stainless steel 304/316, OD-40-45mm, scotch-brite or matt finish</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Light signals</td>
<td>Audio signals with time display</td>
<td>Normal light signals</td>
</tr>
<tr>
<td>9</td>
<td>Table top</td>
<td>Any load bearing anti-skid pavers, tiles</td>
<td>Cobble stone</td>
</tr>
<tr>
<td>10</td>
<td>Table top slopes</td>
<td>Cobble stone may be provided</td>
<td>Polished granite or any other Slippery Surface</td>
</tr>
<tr>
<td>11</td>
<td>Median refuges</td>
<td>Any load bearing anti-skid pavers, tiles</td>
<td>Cobble stone</td>
</tr>
<tr>
<td>12</td>
<td>Cycle tracks</td>
<td>Preferred Pavement Quality Cement Concrete</td>
<td>CC Paver Tiles and Polished Finishes</td>
</tr>
</tbody>
</table>

5.9 Conclusion

While Planning of an efficient public transport system is essential for citizen mobility, it is also imperative to make it attractive for them to use it. This can be done only by improving the accessibility to public transport in order to achieve its full potential.

This toolkit on public transport accessibility acts as a guide for urban practitioners in designing public transport facilities. Accessibility at the stop level and at network level is a different issue. Accessibility at the stop level consists of inter modal connectivity such as adequate pathways for pedestrians and non- motorized vehicle movements, provision of adequate loading and unloading space for passengers transferring from other modes at public transit stops, provision of parking space for two- wheelers, bicycles, autos and even four- wheelers if necessary.
Safety and Security in using the Public Transport System is also to be ensured and should include Persons with disabilities and the aged. The design of Stations and area around it has to be such that the traffic flow should be segregated for pedestrians, cyclists, non-motorized transports and motorized transports. Inter Modal Accessibility should be efficient such that a great percentage of population is within 400 meters walking distance of the public transit facility stop and other para-transit facility should be within 200 meters or so.

Integrated Fare collection systems and passenger information system for all public transport modes will encourage use of various public transport modes and enhance overall public transport efficiency.

Having Provided proper accessibility, it is important to continuously audit the efficiency of the same with the help of the User Groups from time to time. The toolkit also gives the procedures to conduct this audit, Guidelines for implementation and procurement, selections of proper materials for footpaths, street lights and other road furniture.
Chapter 6
Urban Road Traffic Systems

6.1 Introduction

Urban Road Traffic Systems (URTS) objectives include planning network of roads and other elements of the road network for evolving urban centres, designing new facilities, evaluating the existing road network and redesigning to meet the demand. This toolkit emphasises need for promoting public transport as well as non-motorized transport to achieve a sustainable urban transport system.

The various elements of urban road network are:

1. Carriageway
2. Cycle tracks
3. Footpaths
4. Service lanes
5. Pedestrian crossings
6. Bus Lanes
7. Bus stops
8. Medians
9. On-street parking
10. Street lighting
11. Intersections
12. Traffic calming elements

A typical cross section of an urban arterial road is shown below:

Figure 6-1: A typical Cross Section of Urban Arterial Road
The activities of road safety audit can be broadly classified into two major sections: Planning new network and Evaluating and redesigning existing as described in the following two flow charts.

**Figure 6-2: Planning for New Network**

**Planning for new network**

- Designing all 12
  - Check for satisfying as per standards
    - Yes
    - No
      - Check for adequacy for
        - Yes
        - No
          - Implement design elements

**Figure 6-3: Evaluating and redesigning existing network**

**Evaluating and redesigning existing network**

- Evaluating existing system for LOS, design
  - Identify gaps in various elements
  - Expand or redesign elements as per standards to meet current demand
  - Estimate sufficiency for design life
    - No
    - Yes
      - Implement design elements

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6.2 Steps for Implementing URTS

6.2.1 Step 1: Calculate total right of way

(a) For current demand

(b) Demand for next design life

Table 6-1: Right of way guidelines for different urban roads as per MOUD Guidelines

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Arterial Roads</th>
<th>Sub Arterial Roads</th>
<th>Distributory Roads</th>
<th>Access Roads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carriageway</td>
<td>50 km/h</td>
<td>50 km/h</td>
<td>&gt;30 km/h &amp; &lt;50 km/h</td>
<td>&gt;15 km/h &amp; &gt;30 km/h</td>
</tr>
<tr>
<td>ROW</td>
<td>50 m – 80 m</td>
<td>30 m – 50 m</td>
<td>12 m – 30 m</td>
<td>6 m – 15 m</td>
</tr>
<tr>
<td>Horizontal curve</td>
<td>30 m or more</td>
<td>30 m or more</td>
<td>10 m or more</td>
<td>5 m or more</td>
</tr>
<tr>
<td>Gradient</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Number of lanes</td>
<td>Minimum 6 lanes divided (using a raised median);</td>
<td>Minimum 4 lanes divided (using a raised median);</td>
<td>Maximum 4 lanes of 3.0m width each (excluding marking) or 2 lanes of 3.0 to 3.3m width each (excluding marking) with or without an intermittent median</td>
<td>1 to 2 lanes, (undivided); of 2.75 to 3.0m width each</td>
</tr>
</tbody>
</table>

| Minimum Width for car lane | 3.0 to 3.5m width each | 3.0 to 3.5m width each | 2 lanes of 3.0 to 3.5m width each | 2.75 to 3.0m width each |
| Minimum Width for bus lane | 3.5m -(segregated) or painted lane | 3.5m -(segregated) | Mixed traffic |

6.2.2 Step 2: Lanes for vehicular movement

(a) Minimum 2 lanes each

(b) Current demand for LOS C

(c) Future demand/ LOS C: Possible expansion for design life

(d) Follow LOS C as per IRC standards

6.2.3 Step 3: Cycle track

(a) Current usage through survey

(b) Minimum width as per standards

(c) If demand is more increase width as per need
### Table 6-2: Guidelines for planning cycle tracks

<table>
<thead>
<tr>
<th>Facility type</th>
<th>Dimension</th>
<th>Typical Application</th>
</tr>
</thead>
</table>
| **1. Buffered Bike Lane**     | 1.5m with the addition of a 0.6m to 0.9m painted buffer. Buffer is typically diagonally hatched to increase visibility | ✓ Any location where a bike lane may be considered and sufficient right-of-way exists  
✓ Streets with posted travel speeds $\geq 25$ mph  
✓ Where motor vehicle traffic volumes $\geq 10,000$ AADT |
| **2. Raised Cycle Track**     | ✓ 1.5m to 2.1m  
✓ Mountable curb should be 0.45m and have a 4:1 slope edge  
✓ Special attention needed for drainage to prevent pooling | ✓ Streets with multiple lanes and high traffic volumes ($\geq 10,000$ AADT)  
✓ Streets with high travel speeds ($\geq 40$ mph)  
✓ Streets with few intersections and driveway access points  
✓ One-way or two-way streets |
| **3. Two-Way Cycle Track**    | 3m min. and 3.6m preferred width. Can be combined with parking buffer, mountable curb, or physical barrier | ✓ Streets with multiple lanes and high traffic volumes ($\geq 10,000$ AADT)  
✓ Streets with high travel speeds ($\geq 40$ mph)  
✓ Streets with few intersections and driveway access points (requires innovative design treatment at intersections)  
✓ One-way or two-way streets  
✓ On streets where contraflow bike travel is desireable |
| **4. Multi-Use Off-Street Path** | 3m is the minimum allowed for a two-way shared-use path and is only recommended for low traffic situations. 3.6m or greater is recommended for high-use areas, or in situations with high concentrations of multiple users | ✓ Where there are few at-grade crossings such as driveways and alleyways  
✓ Where the existing roadway context makes a completely separated bikeway the preferred alternative (i.e. high traffic speeds and volumes in a constrained right-of-way). |
| **5. Bicycle Boulevard**      | _         | ✓ Streets with traffic volumes $\leq 3,000$ AADT  
✓ Streets with posted travel speeds $\leq 25$ mph  
✓ Along network identified in planning process |

### 6.2.4 Step 4: Footpath

(a) Minimum width as per standards  
(b) Increase the width to meet the demand if needed  
(c) Follow MOUD/IRC Guidelines
### Table 6-3: MOUD Guidelines for footpaths

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Dimension</th>
</tr>
</thead>
</table>
| Pedestrian Paths | **Arterial Roads**  
**Criteria**  
50 km/h  
50m – 80m  
1:20  
1.7 (including curbs) to 5.5m each. However where secondary footpaths are available along service lane, the minimum width of secondary paths can be 1.5m (including curbs)  
**Arterial Roads**  
50 km/h  
30m – 50m  
1:20  
1.7 (including curbs) to 5m each. (including curbs )  
**Distributor Roads**  
30 km/h  
12m – 30m  
1:20  
1.5 to 3.0m (including curbs) each  
**Access Roads**  
15 km/h  
6m – 15m  
1:20  
0-2.5m (including curbs) each |
| Paving        | The use of guiding and warning blocks should be used along the footpath.   |
| Road Markings | It is essential to designate areas in parking lots to make it comply with accessibility standards. |
| Road Signs    | All signs should be visible, clear and consistent. All accessible places should be clearly identified by the International Accessibility Symbol. They should be in contrasting colours. Also, for the visually impaired it is essential to use Braille. |
| Audible Signals | The use of audible signals or auditory signals is beneficial to the visually impaired to cross a road with minimum or no assistance. Also called a pedestrian access system, it is mountable onto signal poles at crossings and a push button system makes its use easier. It also gives an audible alert signal to Vehicle Users about Pedestrian Crossings. |

### Table 6-4: Components to be included for making accessible footpaths

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footpath</td>
<td>The minimum clear width should be 1.2m in order to accommodate wheelchair users. Comfortable minimum width is 1.8m. The footpath surface should be even and without any irregularities. The use of guiding and warning blocks should be used.</td>
</tr>
<tr>
<td>Paving</td>
<td>The use of guiding and warning blocks should be used along the footpath.</td>
</tr>
<tr>
<td>Road Markings</td>
<td>It is essential to designate areas in parking lots to make it comply with accessibility standards.</td>
</tr>
<tr>
<td>Road Signs</td>
<td>All signs should be visible, clear and consistent. All accessible places should be clearly identified by the International Accessibility Symbol. They should be in contrasting colours. Also, for the visually impaired it is essential to use Braille.</td>
</tr>
<tr>
<td>Audible Signals</td>
<td>The use of audible signals or auditory signals is beneficial to the visually impaired to cross a road with minimum or no assistance. Also called a pedestrian access system, it is mountable onto signal poles at crossings and a push button system makes its use easier. It also gives an audible alert signal to Vehicle Users about Pedestrian Crossings.</td>
</tr>
</tbody>
</table>

### 6.2.5 Step 5: Street vendors along footpath

(a) Minimum width as per IRC standards  
(b) Check for sufficiency at major urban corridors and increase if needed

### 6.2.6 Step 6: Bus lanes

Minimum 1 lane for buses as per IRC standards. The minimum bus lane width should be 3.2m where there are dividers or barriers and 3.0m lane width is required where there are no dividers or barriers.

### 6.2.7 Step 7: Calculate remaining width of right of way

\[ X = \text{Total right of way} - \text{cycle track} - \text{foot path} - \text{width for street vendors} - \text{Bus lane} - \text{Service lane} \]
6.2.8 Step 8: Calculate number of lanes for current traffic as per LOS C

\[ Y = \text{Remaining width after number of lanes for moving traffic} = X - \text{Number of lanes for both directional traffic} \]

6.2.9 Step 9: Check for median width

a) Minimum median width as per standards

b) \( Y > \text{Width as per standard} \)

c) Check for additional lanes needed for the design life, assuming the annual growth of vehicular flows@ 2%, 2.5%, and 3%.

d) If required increase the right of way accordingly

6.2.10 Step 10: Intersections

a) Determine the turning movements on all legs of intersection: Straight, Left, and Right

b) Select appropriate junction as per norms

**Table 6-5**: Criteria for selection of various intersections types and respective criteria

<table>
<thead>
<tr>
<th>Type of Intersection</th>
<th>Angle of intersection</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 leg Unsignalized intersection</td>
<td>60 to 120 degrees</td>
<td>Volumes are light</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt;500 veh/hr Channelize the traffic</td>
</tr>
<tr>
<td>4 leg Unsignalized intersection</td>
<td>60 to 120 degrees</td>
<td>Volumes are light on minor road</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Higher traffic volume on major road</td>
</tr>
<tr>
<td>Multileg Intersection</td>
<td>Multi-leg</td>
<td>Volumes are light and stop control is used for minor road</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Higher traffic volume on major road</td>
</tr>
<tr>
<td>Signalized intersection</td>
<td>any</td>
<td>Volumes are high and intersection is prone to accidents</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If required channelize the traffic</td>
</tr>
<tr>
<td>Roundabout</td>
<td>3 leg to multi leg</td>
<td>Where delays are more and traffic volume more than 1500 and less than 5000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Channelization on all approach roads</td>
</tr>
</tbody>
</table>

6.2.11 Step 11: Pedestrian Crossings

a) Provide at least 500m apart on stretches

b) Pelican signal where heavy pedestrian flow exists

c) Provide all red period to meet the pedestrian flow at signals
6.2.12 Step 12: On-street parking

a) Estimate current demand through surveys
b) Based on demand, decide about type of parking: Parallel, Angular etc.
c) Mark entry/exit points of parking lots
d) Calculate LOS for moving traffic during peak hour if parking is full on the road side.
e) If required ban parking only during peak hour or totally along the stretch
f) If not able to meet the demand, suggest off-street parking

6.2.13 Step 13: Signs and Markings

a) Identify all vulnerable areas along the network: Horizontal and Vertical curves, Narrow road sections if any, near bus stops, Pedestrian crossings, School zones etc.
b) Provide appropriate sign boards as per standards
c) Markings: Lane markings, Kerb markings, Zebra markings, Centre line marking etc.

6.2.14 Step 14: Street lighting

d) Calculate the “lux” needed.
a) Estimate the existing value of “lux” along the road
b) Change spacing of street light pole positions if needed
c) Check for sufficiency of lighting for pedestrians and cycle tracks
7.1 Aim of the Toolkit

‘Strategic Environmental Assessment and Environmental Impact Assessment’ aim to integrate environmental concerns in the process of planning, implementing and managing urban transport infrastructure and services.

At the strategic level, SEA needs to be conducted for city transport/mobility plans. EIA is project specific i.e. for transport projects like construction of urban roads/ expressways, public transit systems like bus rapid transit system (BRTS), metro rail, mono rail, light rail transit (LRT), construction of public transit terminals and parking complexes, etc.

7.2 Strategic Environmental Assessment of urban transport plans/ programs

Strategic Environmental Assessment (SEA) is an analytical approach for mainstreaming environmental and social considerations in policies, plans and programs. It introduces environmental considerations into decision making process at a fairly early stage and hence allows decision makers to focus on the environmental effects of strategic choices, before specific projects are considered.

7.3 How to conduct SEA of urban transport plans/ programs?

7.3.1 Step 1: Screening and scoping

In step 1, the plans or programs are assessed for their applicability/need for carrying out an environmental assessment exercise. If the plan or program calls for a need to conduct SEA exercise, the scope of the study is defined. Scoping helps in defining the boundaries of the SEA exercise, focussing the assessment to significant and relevant environmental impacts.
7.3.2 Step 2: Establishing the baseline

In step 2, the key environmental parameters that could be affected, directly or indirectly, by the proposed plan are to be identified and a description of their existing status is to be given in the SEA study report. Environmentally sensitive areas and issues that need special attention are to be highlighted.

Figure 7-1: Step 1: Screening & Scoping

The baseline data should be collected for the study area as delineated during the scoping exercise. A map of the delineated study area should also be shown in the SEA study report.
7.3.3 Step 3: Impact Assessment

In step 3, the proposed plan or program is to be examined for its environmental friendliness. For this, the vision, objectives and the strategic recommendations of the plan are to be assessed based on the parameters listed in Box 3 of the Toolkit. Secondly, alternatives to the Plan or the proposed strategies/alignments are identified and evaluated for their impact on the environment. The rapid assessment checklist (Table 2 a, b & c) presented in the Toolkit are to be used for this purpose. Any need for further detailed assessment studies (EIA of the proposed projects under the plan) is also identified in this step.

7.3.4 Step 4: Strategies to avoid/reduce impacts

Following the impact assessment of the proposed plan and alternative scenarios, various mitigation measures are to be identified at the planning as well as implementation stages so as to prevent or minimize the likely adverse environmental impacts.
7.3.5 Step 5: Monitoring and Evaluation

In step 5, a monitoring plan is to be developed for effective mitigation of the adverse impacts. This should include a program/schedule for carrying out regular monitoring and follow up assessment during the implementation and operation phases.

A performance checklist for SEA has been given at the end of the Part II in Volume I and may be referred by proponent to help assess the work of the consultant. It will help to evaluate if all the steps of SEA have been carried out as prescribed in this Toolkit.

7.4 Environmental Impact Assessment of urban transport projects

EIA is the process of identifying and evaluating the potential impacts of the proposed projects on the environment prior to implementation of the project. In India, it is mandatory to carry out an EIA study as an essential part of the “prior environmental clearance” process for scheduled development projects under Environmental Protection Act, 1986 as per the provisions of the EIA Notification of 2006 (last amended in 2009). The Notification at present does not bring urban transport projects within its purview. EIA however should be done as a best practice.
7.5 How to conduct EIA of urban transport projects?

7.5.1 Step 1: Screening and scoping

In step 1, all new as well as expansion projects are to be assessed to check if they qualify for a detailed Environmental Impact Assessment (EIA) exercise; the study boundaries/ terms of reference are to be defined at this stage. This is called Screening and Scoping for the EIA study and involves applying for prior environmental clearance with the State level Environmental Appraisal Committee (SEAC) along with Form 1/ 1A, a project brief and the proposed Terms of Reference. As per the EIA Notification, all category A and B1 projects require an EIA study.

Once the need for a detailed EIA is established, the broad scope of the study is determined by the concerned authorities in form of the ToR outlining the proposed study area, environmental parameters and range of alternatives to be considered, methods and techniques of modelling and assessment, and any additional studies to be conducted.

Figure 7-6: Screening & Scoping of Urban Transport projects

7.5.2 Step 2: Establishing the baseline

Step 2 entails identification of the study area and the key environmental parameters to be assessed. Typically, environmental components that can be considered in EIA of urban transport projects are: Land Environment, Water Environment, Air Environment (air quality, meteorology and noise), Biological Environment, Socio-economic, Cultural and Public health environment. At the same time, data needs
and sources are also identified for detailed analysis of the existing situation. Once information needs are identified, baseline environmental information may be assembled through the collection of existing data, by carrying out specific field studies, and/or input from consultations.

**Figure 7-7: Establishing the Baseline for Urban Transport projects**

### ESTABLISHING THE BASELINE: Identify and analyze present scenario

**Identification of Study Area**
- (including influence area)

- Transport Corridors – right of way as well as area falling within 500 metres on either side of ROW.
- Public transit terminals, parking complexes – guidelines similar to construction/townships projects have to be applied.

**Identify parameters to be assessed, data needs and possible sources**
- Environmental – Natural and Built
- Socio Economic
- Cultural
- Public Health

**Primary Sources**
- Field surveys etc.

**Secondary Sources**
- Pre feasibility studies
- Policy papers, studies/data compiled by other key organisations/Departments etc.

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### 7.5.3 Step 3: Impact Assessment

In step 3, the potential impacts of an urban transport project during construction and operation stages are assessed. This typically involves 1) identifying and assessing the potential impacts of the project on the environment, 2) an analysis of various alternative scenarios, and 3) any detailed additional studies that need to be carried out.

**Figure 7-8: Impact Assessment of Urban Transport Project**

#### IMPACT ASSESSMENT

- **Identification & description of potential impacts on the baseline conditions**
  - Assess impacts due to project location, design, construction, regular operations, possible accidents, or rehabilitation of a completed project, etc. (Modelling techniques enlisted in the Annexure VI to the toolkit)
  - Describe the anticipated changes – magnitude, time frame, nature of permanence, affected populations, etc.

- **Analysis of Alternatives**
  - Description of each alternative
  - Likely impacts
    - Spatial requirements of each alternative
    - Natural resources (including productive land) consumption
    - Human resource benefits and costs (resettlement versus better accessibility and mobility)
    - Waste production during the construction and operation/maintenance period.

- **Additional Studies**
  - Risk assessment exercises
  - Social impact assessment
  - Resettlement & Rehabilitation Action Plans
  - Environment Cost Benefit Analysis
  - Estimation of GHG emissions
7.5.4 Step 4: Strategies to avoid/reduce impacts

As per the EIA Notification, 2006 (as amended in 2009), any EIA exercise is to be followed by an Environmental Management Action Plan (EMAP) to mitigate the impacts of the project. The EMAP has to suggest an action plan which includes steps to be taken in the a) Pre-construction b) Construction and c) Operational stages of the project to prevent/minimize the adverse environmental impacts and also propose a mechanism for monitoring the significant environmental impacts. Some generic mitigation measures for typical environmental impacts of urban transport projects/activities have been presented in the Toolkit.

**Figure 7-9:** Strategies to Avoid Impact of Urban Transport project

Step 5: Monitoring and Evaluation

The project proponent has to prepare an environmental monitoring plan as part of the EMAP report. This involves identifying critical parameters to be monitored at different stages of project implementation and operation and also a program/schedule for monitoring and follow up assessment.

**Figure 7-10:** Monitoring & Evaluation of Urban Transport
7.6 Appraisal process

Once the Draft EIA report has been prepared by the project proponent, it is to be submitted to State Pollution Control Board (SPCB) or the Union Territory Pollution Control Committee (UTPCC) in case of Union Territories. SPCB or UTPCC will organize the public consultations for the EIA studies. The project proponent has to make necessary/required changes in the EIA report and also recommend appropriate changes in the project DPR, if any, as per the feedback received in the consultation. The Final EIA report is then submitted by the project proponent to the EAC/SEAC.

Figure 7-11: EIA Appraisal Process

A performance checklist for EIA has been given at the end of the Part III in Volume I and may be referred by proponent to help assess the work of the consultant. It will help to evaluate if all the steps of EIA have been carried out as prescribed in this Toolkit.
7.7 Conclusion

Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) aims to integrate environmental concerns in the process of planning, implementing and managing urban transport infrastructure and services.

At the Strategic level, SEA needs to be conducted for city transport/ mobility plans. EIA is project specific for transport projects like construction of urban road/ expressway, public transit system like bus rapid transit system (BRTS), metro rail, mono rail, light rail transit (LRT), construction of public transit terminals and parking complexes etc.

The toolkit provides the steps in making strategic environmental assessment like screening and scoping, establishing the base line, impact assessment, strategies to avoid or reduce the impacts, monitoring and evaluation etc.

It also provides the steps for the environment impact assessments in a similar way right up to the stage of monitoring and evaluation. A performance checklist for EIA has also been given for reference by the Authorities especially to assess the work of the consultants.
Chapter 8
Social Impact Assessment and Resettlement and Rehabilitation Plan

8.1 Aim of the Toolkit

‘Social Impact Assessment and Resettlement and Rehabilitation Plan’ aims to integrate social concerns in the process of planning, implementing and managing urban transport infrastructure and services.

The Social impact assessment includes the direct as well as the indirect impacts pertaining to land use changes, population increase and economic activities for various stages of the project. The toolkit pertains to the Resettlement and Rehabilitation Plan of the Project affected people including urban poor, vulnerable and other marginalized and excluded groups. All the above are done with a participatory framework including public/Stakeholder consultations in processes and decisions that affect them.

Figure 8-1: Toolkit on Social Impact Assessment and R&R Plan
The toolkit starts with Initial Social Impact Assessment.

### 8.2 Initial Social Impact Assessment (ISIA)

The Initial Social Impact Assessment (ISIA) should be conducted at the time of project planning. The ISIA starts by Project Initiators identifying the project and putting forth the Project details (i.e. defining nature of the project, with its location, type, scale, potentials, shortcomings and possible threats imposed) for which social impacts are to be anticipated and assessed. The Research Team formed by the Project Initiators visit the area to be affected by the project with the purpose of Scoping and Screening.

Scoping is done next, by the team in consultation with the stakeholders, in order to set the scale, scope or extent of interventions and types of action to be followed. Scoping would include:

a. Identifying and delineating the Impact Area (Refer Table 1)
b. Identifying the population affected, both directly and indirectly (Refer Box 2)
c. Setting the impact parameters (Refer Table 2)

The next step is Screening with a purpose to determine the TOR of detailed SIA study to be carried out later. Screening is a process undertaken in consultation with the stakeholders (Box1) to eliminate or screen out the ‘non-significant impacts’ of the proposed project. An appropriate assessment of cost involved not only towards resettlement (and towards rehabilitation) but also towards surveys, consultants, creation of rehabilitation and resettlement (R & R) cell etc. should be worked out.

#### Institutional Setup

Establishment of a Team (NODAL TEAM FOR EXECUTION-NTE) for SIA, which should involve participation of various experts from various fields, i.e. Social scientist, Anthropologists, Planner, SIA practitioners including project initiators, financers and consultants and other stakeholders. NTE shall also finalize the Impact Area.

### 8.3 Social Impact Assessment (SIA)

**Collection of Baseline data is the next step with a** purpose to develop a community profile in order to identify the nature of the groups and individuals likely to be affected. The Project Affected People (PAP) including those who would be displaced (if any) would also be identified.

Primary survey would include Questionnaire Survey, Focus group discussions, Semi—Structured interviews of directly or indirectly affected people and other stakeholders, Household Survey, Socio—Economic Survey, and Observation Survey, Participant observation, real time observations.

Secondary sources would include data and information from Research documents, Offices – e.g. District statistical office, Land and revenue office, Public health departments, and other district level offices, etc.), Census – e.g. District census handbook / Town Directory / Primary Census Abstracts, Statistical Office- e.g. District Statistical Abstracts, Maps – e.g. Land use Maps, Master Plans.
Institutional Setup
NTE would collect information/ Baseline Data by involving NGOs, Policy makers, Experts/Academicians, Regulatory agencies (Urban Local Bodies, State and Central level) to the project and other stakeholders through a process of consultation also.

8.4 Assessment of Impact
The next step is Assessment of potential / probable Social impacts and losses of Project affected people (including displaced people, if any). The social impacts have to be assessed as per the parameters indicated in Table no. 2. The impacts have to be qualified as follows for various stages of the project:

- Location of impacts,
- Scale of impact
- Spatial Extent of impact
- Direct/ indirect
- Magnitude (high/low)
- Positive / negative
- Significance
- Short Term (Construction)/ Long Term (Operational)
- Community level Impacts

The impacts and losses are to be assessed for all alternatives of project.

8.5 Mitigation Strategies (for non-displaced people)

The step involves Formulation of strategies for mitigation of losses for Project affected people (for non-displaced people) that would include Building of Capacity, Alternative Skill Building and Training and Coping Strategies.

Mitigation Strategies—can be divided into 4 distinct activities, namely:

8.5.1 Planning/ Formulation of mitigation strategies

The step involves formulating strategies and disclosure of information in order to ascertain the needs, aspirations, broad community acceptance of the project activities and mitigation measures by the stakeholders through a consultative process. Information disclosure or feed forward of information is essential to achieve a desired feedback from the concerned stakeholders.

Institutional Setup
A smaller unit called Project Management Unit (PMU) shall be formulated under the NTE for planning and managing the project. NTE and the PMU shall formulate the strategies. Under PMU, a Social Safeguard Officer shall be appointed to monitor the planning process and guide the NTE. Stakeholders may also be consulted at the planning stage. NTE, Regulatory Bodies and PMU shall coordinate with State Pollution Control Board to ensure that Information Disclosure of the mitigation measures is carried out within 15 days of finalizing of the Mitigation Strategies.
8.5.2 Clearance/Approvals

The step involves putting forth the projects to the Ministry of Environment and Forests and National Monitoring Committee (under the Ministry of Rural Development) for clearance and approval to begin implementation. The plan either would be approved or rejected or approved subject to modifications. All projects for further approval need to be sent to the State Pollution Control Board, which is also responsible for information disclosure. Project Initiators, Regulatory Bodies and PMU shall coordinate with State Pollution Control Board to ensure that Information Disclosure of the mitigation measures is carried out within 15 days of finalizing of the Mitigation Strategies.

8.5.3 Implementation of the strategies

Once the SIA is approved, the plan should be implemented. A specifically scheduled Time Frame for operations supported by budgeting and financing plans are to be prepared and must be developed in order to ensure effective implementation of plan.

Institutional Setup
NTE shall be responsible for implementation and shall appoint experts from different fields as and when required.

8.5.4 Grievance Redressal

All alternatives shall be put to public domain for invitation of objections and stakeholder suggestion to ensure that the mitigation strategies are aimed to solve most critical impacts of the project and the coverage of mitigation is maximum.

Institutional Setup
Grievance Redressal shall be carried out by the Ombudsman who is appointed by NTE in consultation with PMU. The process shall be completed within 45 days on objection being raised.

8.6 Resettlement & Rehabilitation Plan (R&R PLAN)

In case displacement of people takes place, then Resettlement and Rehabilitation plan has to be formulated and implemented and the plan has been detailed as under; This step can be divided into 4 distinct activities, namely:

8.6.1 Planning

Planning (including deciding the Compensation Plan): The R&R plan aims to ensure that the Resettlers have the right to participate in resettlement, planning and design; Resettlers agree on the resettlement house at their own will and income is not reduced as far as possible. To ensure this aim can be realized, it is important to compile a feasible ‘Resettlement Action Plan (RAP). The objectives (as per ADB) must be to avoid involuntary resettlement wherever possible, Minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to Improve the standards of living of the affected poor and other vulnerable groups. The prevalent laws and legislations should form the guidelines for decisions on compensation for displaced and resettled people (Refer Box 3). The legislations related to local property rights, expropriation procedures, compensation and resettlement requirements, public participation and appeal processes should be considered.
Compensation can be

- Financial Compensation for loss of economic activity or source of income is in the form of construction allowance, rehabilitation grants, cash equivalent of land cost, maintenance allowance, ex-gratia, house building assistance, subsistence allowances, grant-in-aid etc.

- Non-Financial Compensation is in the form of allotment of developed or fertile land according to valuation, assistance for entrepreneurship, vocational training, employment and provision of civic amenities. The step involves formulating a R&R Plan and disclosure of information in order to ascertain the needs, aspirations, broad community acceptance of the R&R Plan by the stakeholders through a consultative process. Information disclosure or feed forward of information is essential to achieve a desired feedback from the concerned stakeholders.

The project initiators must ensure disclosure of information in order to ascertain the community needs, aspirations, broad community acceptance of the project activities and resettlement plan. Participation of the affected people and should be ensured at all stages of impact assessment and resettlement planning for the success of the resettlement plan.

**Institutional Setup**

NTE shall prepare R&R Plan. Social Safeguard Officer appointed by the PMU shall play a special role of coordinating and Planning. Officials from Land revenue department and Land Record Office shall also be involved for formulating the R&R Plan and Compensation Plan. Project initiators, Regulatory Bodies and PMU shall coordinate with State Pollution Control Board to ensure that Information Disclosure of the Plan is carried out within 15 days of finalizing of the Mitigation Strategies.

### 8.6.2 Clearance/Approvals

The step involves putting forth the projects to the Ministry of Environment and Forests and National Monitoring Committee (under the Ministry of Rural Development) for clearance and approval to begin implementation. The plan either would be approved or rejected or approved subject to modifications.

### 8.6.3 Implementation of the Plan

The plan should be implemented once it is approved. A specifically scheduled Time Frame for operations supported by budgeting and financing plans are to be prepared and must be developed in order to ensure effective implementation of plan.

**Institutional Setup**

Rehabilitation and Resettlement (R&R) Committees shall be formed at District level or Local Level or both depending on the scale of project. They shall have representation from NTE, Regulatory Bodies and Project affected People. They shall be responsible for execution of the R&R Plan. Commissioner of R&R shall be administrative head at State level, who would also play an advisory role in the entire process. Administrator of R&R shall be administrative head at District level, who would also play an advisory role in the entire process. He would report to the Commissioner and head the R&R Committee at the local level.
8.6.4 Grievance Redressal

All alternatives shall be put to public domain for invitation of objections and stakeholder suggestion. This is an important activity to ensure that the mitigation strategies are aimed to solve most critical impacts of the project and the coverage of mitigation is maximum.

**Institutional Setup**
The Ombudsman who is appointed by NTE in consultation with PMU shall redress grievances, which may arise due to implementation of R & R Plan. The process shall be completed within 45 days on objection being raised.

8.7 Monitoring & Evaluation

The purpose of monitoring and evaluation is to ensure that mitigation schemes are communicated to the stakeholders, adhered to and implemented. Assessment of the number of people benefitted and the effectiveness of the Mitigation measures is also within the scope of monitoring and evaluation.

Monitoring should be conducted periodically (preferably biannually) and at different stages of the project which involves observing, assessing, and registering short and medium term social effects, comparing project objectives with actual outcomes, both negative and positive and incorporating improvements into project design to optimize beneficial impacts and reduce negative aspects.

**Institutional Setup**
All final projects reports shall be sent to the National Monitoring Committee under the Ministry of Rural Development, especially for R&R Plan, at the time when Clearances are taken to proceed with implementation and after that also for post project monitoring. Regional offices of Pollution Control Board shall also monitor different projects post completion depending on scale of projects. Regulatory bodies and Social Safeguard Officer shall be responsible for monitoring at all stages.

8.8 Stakeholder Consultations

A successful public participation programme requires the following three elements to be effectively executed:

a) Dissemination of information to the stakeholders;

b) Solicitation of information from affected parties and inhabitants; and

c) Consultation with interest groups and the public.

Public consultations will be there at each stage with the defined purpose strategies, involvement of stakeholders and the methods and techniques. Public involvement and public-private partnership help raise the awareness of the social implications of projects. They also provide the necessary input to minimize the negative impacts of the projects. Public consultations will be there at each stage with the defined purpose strategies, involvement of stakeholders and the methods and techniques.

The objectives of public participation are: Information, education and liaison; Identification of problems, needs and important values; Idea generation and problem solving; Reaction and feedback on proposals; Evaluation of alternatives and Conflict Resolution Consensus. The choice of the methods and techniques would depend upon the objectives.
1. **Information, education and liaison**: the first objective is directed toward education of the citizenry on SIA’s, its purpose and the process of citizen participation.

2. **Identification of problems, needs and important values**: focused on defining the social problems and needs and the relation of potential solutions being addressed in the project study.

3. **Idea generation and problem solving**: identification of alternatives that may not have been considered in normal planning processes, in addition to specific alternatives for identified needs, it is possible also to enumerate mitigating measures for various alternatives so as to minimize adverse social effects.

4. **Reaction and feedback on proposals**: the fourth stage attempts to probe public for evaluation of project alternative. The alternatives evaluation objective is closely related to reaction and feedback proposals.

5. **Evaluation of alternatives**: in this the process of evaluation of alternatives, valuable information can be received about the significance of unquantified and quantified impacts. Public reaction to value trade-offs in the process of selection can also be assessed.

6. **Conflict resolution techniques**: this involves resolving conflicts that exists over the proposed action. It involves mediation of differences among various interest groups, development of mechanisms for compensation and effort directed toward arriving at a consensus opinion on a preferred action. Conflict Resolution Techniques have to be applied in order to address the variability of the opinions and perceptions of different stakeholders.

### 8.9 Conclusion

The social impact assessment will involve resettlement and rehabilitation plans to take care of the concerns of the people. It includes direct as well as indirect impacts pertaining to land use changes, population increase and economic activities for various stages of the project.

The Initial Social Impact Assessment (ISIA) that should be conducted at the time of project planning, scoping and screening including establishment of a team (Nodal Team for Execution (NTE)) for social impact assessment involving participation of various experts like social scientist, anthropologist, planners, SIA practitioners etc. including project initiators, financiers consultants and other stakeholders have been discussed in detail in the toolkit. Further procedures to conduct the Social Impact Assessment (SIA) such as collection of baseline data, assessment of potential/probable social impacts and losses of project affected people, locations of impacts, scale of impact, magnitude, and community level impacts are all detailed out.

Mitigation Strategies for non-displaced people including planning and formulation, getting clearances from ministries of environment forest, national monitoring committee under ministry of rural development have all been detailed out in the toolkit. Formations of a Project Management Unit under the NTE including a Social Safeguard Officer have been recommended.

Resettlement & Rehabilitation Plan including the methods of Financial and Non Financial compensation and Co-ordination with various Government departments have been described with methodologies for Implementation of the plan, Stake holder consultation, Institutional set up, Monitoring and evaluation etc.
Chapter 9

Intelligent Transport System

The techniques of traffic management are the first line of action adopted in order to regulate and control the vehicular traffic flow for safety and efficiency of traffic operation in a city. The traffic management is generally carried out as per available ground situations without making any major interventions in the present infrastructure. The conventional techniques experience their own limitations as discussed in section II in this toolkit, but by adding the capability of “ITS”- Intelligent Transport System, the effectiveness of traffic management system increases manifold. This toolkit aims to provide a step by step approach to select and implement ITS tools for traffic management system of a city. The toolkit is meant for selecting and implementing ITS based Traffic Management System and can be used by city officials, administrators and network managers responsible for safe and efficient operation of vehicular traffic in the city without resorting to much application of transport planning. Further it may be said that application of traffic management measures is an important step to be undertaken before any city embarks upon adopting comprehensive transporting planning programme to be accompanied by a large scale capital investment for its implementation.

The first section of this toolkit covers the scope of toolkit. What one can achieve using this toolkit is a part of this section. The primary users for this toolkit are also explained with structure of this toolkit in this section. What are different types of conventional methods used for traffic management in a city are discussed in section II of this toolkit. The main concern of any traffic management system is further explained in this section. Although it is not expected to use any major infrastructural intervention as a part of traffic management system but some issues that are planning related need to be addressed while implementing any traffic management system in a city. This aspect has also been discussed in this section.

1. This toolkit first of all explains through section III," what is “ITS”, its definition, how it works and what are the tools used for traffic management in India and throughout the world”. The context of traffic management system is highlighted. What are the benefits of “ITS” based system for traffic management is described in this section. The other benefits like use in monitoring law and order issues in city which are an added advantage are also discussed. The ITS system also provides the on-line and in real time data continuously that is highly useful for future projects/ planning exercise in city. This section also explains the components of functioning of ITS system. The need of ITS policy and architecture at national level, state level and particularly city level is highlighted in this section.

2. Various case studies with comparisons are discussed in section IV, so that user can appreciate the various issues of traffic problems in that city where the ITS tools are implemented. The details case studies with benefits are shown in appendix.

3. The different types of tools used for traffic management system, their working and components are explained in details in section V. The traffic management system as alone is of limited use but if the safety concept is added then the traffic management shows much better results. In light of this, the
relevant ITS tools for safety are also shown in this section. The essential support system required for successful implementation of ITS based traffic management system is also discussed in this section. The workings of all these tools in details are discussed in this section V. The benefits of each individual tool are described along with system architecture (where ever possible) is included in this section. Where ever possible the examples are shown in diagram/ picture (of real installations) forms Some basic principles like writing/ developing messages for variable message signs (VMS) are also explained. The word of caution is provided for implementing these tools is highlighted in this section related to use of ITS based tools. The importance of data warehouse and very important role of control room is explained in this section along with how to use equipment to collect the traffic data. The features and performance of the equipments are included. Further the applications of uses of ITS tool for Traffic management system in public transport are also discussed.

4. The step wise approach for selecting the appropriate ITS tools is the main feature of this toolkit shown in section VI. This section helps the users to identify the problems of city in more technical manners well supported by facts and figures. How exactly one should start is shown in diagram form. On the basis of facts collected, one can easily choose the appropriate tools using the flow chart as shown in this section. How to delineate the area and where the project is to be implemented are discussed with help of diagrams for easy understanding. Finally what one should work out for finalizing the exact locations on ground to fix the ITS equipments that have also been explained.

5. The quick ready reckoning of the toolkit in form of matrix is also presented in these last pages of this section. These matrix forms help administrate to correlate the issues of city with appropriate ITS tool at a glance. The working with these steps as shown in this section does not require any help from any consultants or experts. Simply the working knowledge of traffic/ network management is sufficient to implement these tools. The functional specifications and scope of work of each individual tool are described in this section. This step helps the users to draw the scope of work, and functionality of work for tendering purposes also.

6. The detail performance, testing and evaluation parameters of individual tool are discussed in section VII, such that the user can choose appropriate equipments (produced or supplied by different vendors) and compare the various options of his own. Using these parameters the user can detail out the acceptance procedure/ parameters of any project before releasing the money to vendors. Actually it may also be used in describing the testing or evaluating parameters of the project for purpose of preparation of tender documents. Some parameters may be duplicated due their importance at some places.

The role and importance of maintenance of database is highlighted in this section because for any ITS based project, the role of database is of immense importance. What type of data, city should maintain for its development is underlined. The need of regular post evaluation is also emphasized.

7. What are the challenges in implementing the ITS tools are discussed in this section along with some hard fact that how and why the anticipated benefits could be washed out with in no time. So words of cautions are written specially to draw the attention for implementing/ approving agency for that project in this section.

8. One real life case study on ITS based transport project in section VIII is shown to demonstrate the benefits of ITS project. The steps as discussed in previous section related to data collection are used in this exercise. It consists of primary data along with secondary data collected from the different
sources. The data was analyzed to understand the different issues related to this study area. The problem area was delineated as per the guidelines of the toolkit.

9. On the basis of facts collected from ground conditions, the appropriate ITS tools are selected after defining the scope of work. The complete technical details, features/functional specifications of each related ITS equipments/products were collected and finalized. Where ever these equipments are to be installed and exact locations as per international guidelines are identified on ground. So administrators are advised to involve transport planners for finalizing the exact number of equipments required for their city as per application.

10. The detail costing is worked out for these equipments as per requirement calculated in above. These calculations can be workout by anybody with some knowledge of mathematics (accounts). At some instances, an approximate figure (on basis of previous project including the cost inflation) is taken due to non-responses from number of vendors. Due to same reasons, thumb rules are used for taking the maintenance cost.

11. The financial savings are calculated for further five years (assuming the life-cycle or technology of equipment is of five years) with assumption that maintenance cost will increase every year (due to cost inflation). The economic benefits are also analyzed using IRR and NPV. The results are highly encouraging. This exercise can be used by the administrators/implementers to demonstrate the worthiness of their projects.

12. The different types of funding options that can be used for ITS based projects are suggested in section IX. The role and importance of ITS infrastructure is highlighted in this section. The responsibility and importance of operations, maintenance management, maintenance strategy, inventory control and management are discussed in detail. The operation and management agency has to take care of the assets and its management in effective manner which is the key to success of ITS project. The administrator should also have to take care for replacement strategy and safety standards as highlighted in this section.

13. As ITS based projects are generally equipped with the applications of software, therefore the administrator has to consider this option and should finalize the system backup, system upgradation policy before awarding the work to vendors. At the time of finalizing the project, the administrator should also finalize the data sharing or data acquiring agreement with other related government departments for success of project. Thus these policy type matters are discussed for betterment of any ITS based project in last section IX. The word of caution is advocated at desired places in this toolkit in order to make it useful and successful project.

14. The appendix includes the survey formats for collection of data. The IRC standards and technical specifications of ITS tools are presented for reference purposes. The certificate for performance for automatic vehicle counter and classification (AVCC) equipment taken by vendor from IIT Madras is also shown such that user can demand the certificate for performance from suppliers/vendors for their supplied equipments.

15. It is suggested that the certificate from recognized government laboratory or government laboratory (like National Physical Laboratory, IITs, CRRI etc.) may be obtained where ever possible.
9.1 Conclusion

Traffic System Management consist of 3 components namely road, vehicle and road users which include pedestrian, cyclist and motorist. To efficiently manage the above components education, engineering, enforcement, energy and environment considerations should go into the planning and operation of all components.

The Traffic System Management is generally carried out as per available ground situation without making any major interventions in the present infrastructure. The conventional techniques have their own limitations but by adding the capability of Intelligent Transport System (ITS), the effectiveness of Traffic System Management increases manifold.

The toolkit aims to provide a step by step approach to select and implement ITS tools for Traffic Management System in the City. On the basis of facts collected from ground conditions, cost and functional specifications appropriate ITS tools can be selected after defining the scope of the work. A ready reckoned of the toolkit in the form of Matrix is presented to co-relate the issues of the cities with appropriate ITS tools at a glance.

Different types of funding options that can be used for ITS based projects are suggested. The responsibility, importance of operations, Maintenance Management, Maintenance Strategy, Inventory control and management are discussed in detail.
Chapter 10
Urban Road Safety Audit

10.1 Aim of the Toolkit

‘Urban Road Safety Audit’ is meant for accident prevention rather than accident reduction. It is a safety performance examination of an existing road or a future road by an independent audit team. The Audit can be conducted at any stage of a project, starting with the project planning stage to the Final design stage. It can even be conducted on roads that have already been completed and started operating.

10.2 Importance of Urban Road Safety Audit

Road safety audit (RSA) is important because it is a means of accident prevention rather than accident reduction. It is a formal safety performance examination of an existing road or a future road or an intersection by an independent audit team. RSA can be conducted at any stage of a project, starting with the project planning stage to the Final design stage. It can even be conducted on roads that have already been completed and started operating. The audit helps in identifying strategies to minimize risk and severity of road crashes; minimize the need for remedial works after construction; and reduce the life costs of the project.

Road Safety Audit (RSA) is dependent on the kind of activities and characteristics of a geographical area and can be classified into three types depending on its applicability; namely application to Highway, Rural areas and urban areas. In urban areas, safe people’s movement is at most important. As a result people who moves by different modes needs safe environment.

10.3 Development of Toolkit

URSA Toolkit attempts to integrate all issues concerned with transportation in order to promote safety, cleaner air, and energy conservation. The prime user for whom the tool kit is being prepared is city officials who are required to supervise and monitor consultant’s work. This tool kit will assist the user groups and civil society groups to monitor the improvement in urban road safety. It includes all municipal corporations and urban development authorities.

10.4 How to conduct URSA

10.4.1 Step 1: Scope of the Audit

This Audit shall only consider urban road safety matters and is not a fully technical checklist that the design conforms to Standards. So it does not consider structural safety.
10.4.2 Step 2: Urban Road Safety Audit Area Identification

In step 2, the purpose is determination of locations where “accident clusters” or specific accident types occur. (For Post-construction phase procedure in URSA, Hot-Spot identification using density clustering will be required).

Final Map from Hot spot analysis would provide the critical sections of the road based on clustering of accidents. Next, the key indicators that could affect the safety in urban areas are to be identified and a description of their existing status is to be given in the report.

Figure 10-1: Identification of location for road Safety Audit
**Figure 10-2: Indicators of Road Safety Audit**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>Exceeding speed limit results in unsafe conditions, speed limit signage and traffic calming measures are required to control speed.</td>
</tr>
<tr>
<td>Traffic volume</td>
<td>It is required to understand proportion of different users present on the road which has influence on specific infrastructure requirements.</td>
</tr>
<tr>
<td>Pedestrian Safety</td>
<td>Pedestrians are mostly concerned about the shortest path; they are not willing to wait beyond 60 seconds at signalized junctions.</td>
</tr>
<tr>
<td>Cyclist Safety</td>
<td>Cyclists mostly look for continuity and riding quality of road surface. Both for pedestrian and cyclist security (crime) is important. They avoid lonely and poorly lit places.</td>
</tr>
<tr>
<td>Motorist Safety</td>
<td>For motorized vehicles, any trees, side railing, raised median (more than 150 cm) or any vertical objects etc. is a hazard.</td>
</tr>
<tr>
<td>Road geometry</td>
<td>Minimum pedestrian and cyclists geometric design requirements should be met. For motorized vehicles, horizontal and vertical curves should be designed for safe driving.</td>
</tr>
<tr>
<td>Educational facilities</td>
<td>Educational facility or Hospitals is requiring because of presence of Old People, children and teenagers. Specific checklist is provided to look into safety of educational facilities.</td>
</tr>
<tr>
<td>Bus Stops or Metro Stations</td>
<td>Bus stops require because of large number of commuter’s boarding and alighting. Specific checklist is provided to look into safety of bus stops or metro stations.</td>
</tr>
</tbody>
</table>

**STEP 2.1. Understand importance of each URSA Indicators**

**10.4.3 Step 3: Checklist preparation and assessment procedure**

After identifying project or existing urban road for URSA (Problem Area or Hotspot), and collecting information on indicators which data needs to be collected, conduct URSA analysis and report the results.
Figure 10-3: background Information

STEP 3. Providing Background information

- Statement of expected outcome of audit (Aim and objective of URSA for particular area)
- Specify required site data based on different stages

Table 10-1: Information required at different stages

<table>
<thead>
<tr>
<th>Different Stages</th>
<th>Information required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feasibility Stage</td>
<td>Road design standards and layout visualization</td>
</tr>
<tr>
<td>Preliminary Design Stage</td>
<td>Local Knowledge</td>
</tr>
<tr>
<td>Detailed Design Stage</td>
<td>Critically examine the details</td>
</tr>
<tr>
<td>Pre-opening Stage and Construction Time</td>
<td>Police officer and maintenance engineer</td>
</tr>
<tr>
<td></td>
<td>Familiar with traffic control devices</td>
</tr>
<tr>
<td></td>
<td>Familiar behavioural side of road safety</td>
</tr>
<tr>
<td>Monitoring and Existing stage (Post-Construction)</td>
<td></td>
</tr>
</tbody>
</table>

The checklist is categorized into three types of roads including Arterial or sub-arterial, Collector and Local Road. Each type of road has to have a separate checklist for different hotspots. URSA Toolkit has identified three different problem areas to be audited; midblock or intersection, bus stops or metro stations and educational facilities like schools or hospitals.

Figure 10-4: Checklist preparation & Assessment Procedure

STEP 3.1. Checklist Preparation

- Specify important issues relating to road type
- Specify a road type: Arterial, Collector and Local
- Specify Audit area on map

- Running the checklist for each specific hot spot
- Score the checklist for final evaluation

Evaluation & Recommendation based on Scored checklist for each specific problem area
10.5 Conclusion

The toolkit attempts to identify the safety indicators for urban roads. It also further addresses the problems related to urban road safety and provides a comprehensive audit methodology to assess the roads during designs or post construction phase.

Site based or city level safety audit would help the authorities to develop safety plans for all motorized, non-motorized and vulnerable road users like pedestrians, disabled citizens and the aged. Method to conduct road safety audit step by step has been given in detail. This includes understanding the importance of various Urban Road Safety Audit (URSA) indicators such as speed, traffic volume, pedestrian safety, cyclist safety, motorist safety, road geometry, educational facilities, and bus stops for metro stations etc.

Checklist preparation and assessment procedures have been detailed out categorized into different types of road namely arterial, sub arterial, collector and local streets. Information required at different stages such as feasibility stage, preliminary design, detailed design, pre opening and monitoring and existing stage have been Provided in detail.
Chapter 11

Transport Demand Management

Transport Demand Management (TDM), is a practice wherein various strategies (policies, programs, services and products) are used to change travel behaviour (how, when and where people travel) in order to increase the efficiency of transport systems and achieve sustainability of mobility systems.

The toolkit on Transport Demand Management (TDM) presented in this report is aimed at helping the city officials involved in planning, implementing and managing transport infrastructure and services in identifying appropriate TDM measures for their cities. The toolkit will provide guidance to the city officials on:

- How to select an appropriate package of TDM measures for their city?
- How to implement the selected TDM measures?
- How to monitor and evaluate the impacts of the TDM measures being implemented?

The toolkit will guide the city officials through each of the processes involved in identifying, planning, implementing and evaluating TDM strategy/ies for your city.

Figure 11-1: Structure of the toolkit

The steps to be followed to select and effectively implement TDM strategy/ies are discussed in this toolkit; the brief outline of the process suggested in the toolkit is given in figure 11-2.
Figure 11-2: Identifying and implementing TDM strategies for your city: process suggested in the toolkit

1. Problem identification

2. Framing goals & objectives

3a. Identifying potential TDM strategies

3b. Screening of potential TDM strategies

3c. Assessment of shortlisted TDM strategies

3d. Identifying complementary TDM measures and developing alternate packages of TDM strategies

2a. Establishing indicators & targets

5. Implementation and evaluation of selected TDM measures

11.1 Steps to Implement TDM Strategy

11.1.1 Step 1- Problem Identification

Step 1 will aid you in identifying the traffic & transport related issues in your city by using available resources and consulting with key stakeholders. Step 1 also suggests detailed surveys for understanding the nature and intensity of the key problems identified. This step adopts two approaches to identify traffic related problems, depending on whether your city already has any transport related study/ document available.
11.1.2 Step 2 – Framing Goals & objectives

Step 2 will guide you on how to frame goals and objectives and how to establish performance indicators, so that you can evaluate the effectiveness of strategies selected for implementation.

11.1.3 Step 3 – Identifying potential TDM Strategies

Step 3 will help you in selecting the most appropriate set of TDM strategies to solve the traffic and transport related problems identified in Step 1. Step 3 has four sub-steps, as described below.

Step 3a will help you in selecting the potential TDM strategies applicable to your city-specific problem/s. This selection process is based on a three-tier process, which involves identification of problem for which TDM solution is being explored as the first step, identifying the spatial context of the problem as the second step, and assessing the desired impact from TDM strategy as the third step. Some of the most common traffic problems, which the urban centres in India face, have been included in this step. These problems are congestion, parking issues, emissions and safety. The spatial levels that have been incorporated in this step are city, area and corridor levels. The potential of different types of TDM strategies in terms of yielding short or long term benefits/impacts is also listed to help you identify the most appropriate potential TDM strategies for the problem/s that your city faces.

**Step 3a**

Identify the potential TDM strategies

Spatial context of the problem

1. City level
2. Area level
3. Corridor level

Desired impact from the strategy

1. Long term
2. Short term

Select potential strategies

**Step 3b** will help you to categorise the potential TDM strategies selected in step 3a into low, medium and high potential TDM strategies based on three criteria, namely, benefits offered by the strategy, ease of implementing the strategy & perception about public acceptance of the strategy. The benefits that the strategy/ies offer may be assessed in terms of improved mobility, improved air quality, energy conservation, safety, etc. Ease of implementation may be evaluated in terms of capital cost, resource requirements, maintenance requirements, availability of institutional capacity, etc. It is also advisable to keep in consideration public acceptance, which at times can play a pivotal role in deciding the implementation of the strategy.

**Steps 3b & 3c**

Screening and assessment

**3b Screening**

- Benefits of the strategy
- Ease of implementation
- Public acceptance

Identification of high, medium and low potential strategies

**3c Assessment**

- Positive Impacts
- Issues/challenges

Ranking of strategies
Sustainable Urban Transport Project

Step 3c is a quantitative process and it will help you in ranking the high and medium potential strategies identified in Step 3b so that you can further narrow down on most appropriate strategies. Each high and medium potential TDM strategy is assigned a positive score between 1 to 3 for each of the positive impact the strategy has and negative score between -1 to -3 for each of the issues or challenges involved in the implementation of the strategy. Scores for each of the benefits and challenges for every TDM strategy are then added up to obtain the final scores. Higher the score, better is the strategy; the top two or three highest scoring strategies are to be considered for step 3d.

Step 3d - The world experience shows that a TDM measure yields best results when implemented along with its complementary/supporting TDM measures. This step will guide you in identifying complementary TDM strategy/ies so as to enhance the impacts of the selected TDM measure/s. The toolkit provides a list of complementary TDM strategies for some of the principal TDM strategies. It is further recommended that alternate packages of TDM strategies be developed; you can develop alternate package of TDM strategies for your city by pairing the highest scoring principal TDM strategies with their complementary strategies.

11.4 Step 4 - Evaluating Alternate TDM Strategies

Step 4 will inform you on the principles of evaluating the alternative TDM packages developed in Step 3d. You will be able to finalize an appropriate package of TDM strategies for your city in this step. In this process, you will have to evaluate the alternatives with respect to the same criteria/ performance indicators, which you have decided upon in Step 2. The alternate package, which has the highest potential to achieve the objectives, should be selected for implementation.

11.5 Step 5 – Implementation of TDM Strategies

Step 5 will guide you on how to implement the TDM package that you have identified for your city. Guidance is provided in this step on how to integrate TDM strategies with other city-level plans, using existing/proposed transport plans to implement TDM strategies and on preparing Terms of References for hiring consultants.

11.6 Step 6 – Assessment of Performance

Step 6 will guide you on the process of assessing the performance of the TDM measures by providing a list of criteria, which should be considered while undertaking the review and evaluation. It is important to
monitor, review and evaluate the effectiveness of TDM measures in the post-implementation stage. The criteria that have been discussed are related to the performance and economic evaluation of the TDM strategies like revenue generation, travel time savings, level of service, modal split, ridership, number of accidents, etc.

11.2 Conclusion

Transportation of people and goods is an essential feature in Urban Planning as the efficiency of Urban Management is fully dependant on its Transportation facilities between the various land uses in the urban area.

Management of this demand is to be made efficient by various Strategies i.e. policies, programmes, services and products. Travel Behaviour of the people also depends on the Efficiency and Sustainability of various Transport Systems.

The toolkit is aimed at helping the City officials in planning, implementing and managing transport infrastructure and Services in identifying appropriate transport demand management measures for their cities.

The efficient transport demand management will enable the citizens to decide how/when and where they can travel efficiently with safety, comfort and conveniently resulting in least travel time.
Chapter 12
Financing & Financial Analysis

The fast pace of urbanization has fuelled the demand for urban mobility and hence triggering large number of planning and implementation projects in urban transport at city level in India. However, given their capital intensive nature, financing of such projects becomes a key challenge. This toolkit attempts to provide steps for choosing and developing appropriate financing options through assessment of financial viability of the project including, inter alia capturing the socio economic benefits that arise from the same.

12.1 Objective of the toolkit

The objective of this toolkit is to provide a systematic guide covering the aspects/steps of economic and financial/commercial viability analysis of the project which in turn assists the decision makers;

i. In deciding whether project accrues required socio economic benefits and thereafter;

ii. In choosing appropriate project financing option.

Attempts have been made to achieve objectives of toolkit through developing a framework for Project Economic and Financial Analysis. Generally Financial and Economic Analysis of the project are undertaken with different perspectives and hence key differences have been have been conceptualised. Economic Analysis measures the benefits to the society against the social cost of the project while Financial Analysis estimates the financial return/profit accruing to the project entity/ its owners. It is possible that Project which is financially attractive may be economically unviable and vice versa.

Table 12-1: Point of Comparison Economic Analysis Financial Analysis

<table>
<thead>
<tr>
<th>Point of Comparison</th>
<th>Economic Analysis</th>
<th>Financial Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point of View</td>
<td>Public, Society</td>
<td>Private, Project sponsoring Entity</td>
</tr>
<tr>
<td>Objective</td>
<td>Maximising Public Benefits</td>
<td>Maximising Benefits to Private / Project Sponsoring Entity</td>
</tr>
<tr>
<td>Types of Effect</td>
<td>All benefits and costs to society (including external costs)</td>
<td>All receipts and outlays that affects the financial return from the project.</td>
</tr>
<tr>
<td>Taxes, Subsidies and Interest payment</td>
<td>Excluded</td>
<td>Included</td>
</tr>
<tr>
<td>Prices used in valuation</td>
<td>Real Prices</td>
<td>Actual domestic market prices/current prices</td>
</tr>
</tbody>
</table>
12.2 Project Economic and Financial Analysis Framework

In order to achieve toolkit objectives, this toolkit puts forward a framework for analysis of urban transportation projects covering aspects and steps involved in economic and financial/commercial viability assessment, evaluation of financing options and nature of the implementation arrangement suitable to project. The framework steps for Project Economic and Financial analysis are provided below.

Figure 12-1: Framework for Financial & Economic Analysis

Each of the steps of Project Economic and Financial Analysis framework are summarised below.
12.2.1 Step -1: Defining project boundaries

The economic or financial returns are measured based on the quantum of investment involved in the project components. Toolkit elaborates the steps involved in estimating the project investment requirements and also discusses the steps for estimating the operation and maintenance cost. Summary is presented in figure below.

Figure 12-2: Steps in Defining project Boundaries

As specified in figure above, the components of an Urban Transport project can be categorised broadly into three categories (1) Infrastructure (2) Rolling stocks (2) Information Technology. It can be populated based on Urban Transport project chosen and Project Cost is estimated based on the chosen urban transport project and project components thereof. Project cost can be categorised in to capital cost of project components, Land Acquisition and R&R costs, taxes and duties, contingencies and financing costs.

12.2.2 Step -2: Economic analysis

Economic analysis of the urban transport project is undertaken with an objective to evaluate the contribution of the proposed Urban Transport Project to social objectives and to the region’s economy. It captures all the project related expenditure flow (i.e life cycle cost); and all benefits likely to accrue to the society (irrespective of the investor) during a pre-defined analysis period. The framework for Project Economic Analysis is presented in figure below.
The outcome of economic returns, sensitivity tests and switching value analysis could be interpreted as follows.

**Table 12-2: Interpretation of Financial Evaluation Outcomes**

<table>
<thead>
<tr>
<th>No.</th>
<th>Parameters</th>
<th>Interpretation / Decision Criteria</th>
</tr>
</thead>
</table>
| 1   | Outcome of project analysis and sensitivity analysis in terms of EIRR, ENPV and Benefit to Cost Ratio. | • Outcome of EIRR is compared with social opportunity cost of capital. Generally in developing countries Social Cost of Capital is considered as 12%.  
  • If EIRR is above this 12%, ENPV is a positive value and Benefit to Cost ratio is more than 1 then **the project is considered economically viable.** |
| 2   | Outcome of Switching value analysis                                        | Quantum of change in parameters determines the economic viability of a project. If such changes are considerably higher, then the project is economically robust. |

Upon arriving at outcome and deciding the interpretation of Economic Analysis for Urban Transport Project, the following further actions could be undertaken.

(1) Financial Analysis of the Project should be undertaken if;  
  - Project is evaluated to be economically viable.  
  - Even if Project is not evaluated to be economically viable but in case of strategic important cases in which the qualitative (Unquantifiable) social benefits are very high, it can be considered for recommendation.
(2) Alternative Projects should be considered or modification in proposed project should be considered if project is evaluated for economic viability.

12.2.3 Step -3: Financial Viability Assessment

The Financial analysis of Urban Transport projects is generally carried out to assess (i) financial viability and (ii) operational sustainability of the project. The outcome of financial analysis forms the basis for undertaking an appropriate financing method through either project recourse financing or Public Finance through balance sheet based financing.

Steps involved in financial viability assessment are summarised in table below. Detailed calculation steps are presented in toolkit.

Table 12-3: Steps involved in financial viability assessment

<table>
<thead>
<tr>
<th>No</th>
<th>Steps</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Determination of Project Horizon</td>
<td>Project Horizon comprising of Construction Period and Operation Period of the Project. The costs and income/revenue associated with the sub projects should be estimated during the project Horizon period.</td>
</tr>
<tr>
<td>2</td>
<td>Determination of Project Cost including financing cost</td>
<td>The key components of project are decided based on the transport Mode chosen and based on which project cost is estimated. It includes capital costs, Land acquisition, R&amp;R, Financing costs (i.e IDC) and asset replacement cost. Details summarised in step 1 of Economic AND Financial Framework.</td>
</tr>
<tr>
<td>3</td>
<td>Phasing of Investment</td>
<td>Phasing of investment/capital cost is to be done based on project implementation plan.</td>
</tr>
<tr>
<td>4</td>
<td>Determination of O&amp;M Cost</td>
<td>As per details summarised in step 1 of Economic and Financial Analysis framework.</td>
</tr>
<tr>
<td>5</td>
<td>Determination of Income/Revenue</td>
<td>Demand is highly price elastic as observed world over in urban transport systems. Therefore, tariffs are an important determinant of demand. Due to social/political considerations, tariffs that are set are usually insufficient for meeting the operation cost thus revenue framework should capture the value from the benefits that accrue to different users.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nature of the Benefits</th>
<th>Value Capture/Revenue generating sources (Summary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>• Fare Box/Toll • Advertising • License Fees from station assets</td>
</tr>
<tr>
<td>Proximate Mode and Indirect modes</td>
<td>• Transit Oriented Development (TOD)/Real Estate Development. • Premium from Higher Floor Space Index (FSI) • Betterment Charges/ levy. • Additional Property tax • Carbon Credit • Congestion Charges</td>
</tr>
</tbody>
</table>

Of above betterment levy, additional property tax and congestion pricing could be used as corpus to the revolving Mass Rapid Transit Fund (MRTF) which could be used to fund project development and O&M.

Toolkit also provides various case studies of revenue generation through direct/indirect value capture.
<table>
<thead>
<tr>
<th>No</th>
<th>Steps</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Deciding Quantum of Debt</td>
<td>Equity contribution and quantum of debt is decided based on estimation of Financial Operation Plan and balance sheet analysis as specified in Attachment 4 of toolkit</td>
</tr>
<tr>
<td>7</td>
<td>Estimation of cash flow</td>
<td>The costs and revenue streams associated with the project for Project Horizon period is estimated based on steps above. Based on this, the project free cash flow is estimated.</td>
</tr>
<tr>
<td>8</td>
<td>Determining Outcome</td>
<td><strong>Steps for arriving at outcome are summarised below.</strong></td>
</tr>
<tr>
<td></td>
<td>Parameters</td>
<td><strong>Steps for calculation</strong></td>
</tr>
</tbody>
</table>
|    | Calculation of weighted average cost of capital as a benchmark to assess return | • WACC is expressed as the weighted average for required rate of return for equity and debt.  
• For Government Agency the social cost of its own fund or grant is considered as 12% whereas actual cost of debt is considered for calculation of WACC.  
• The cost of Debt is perceived to be higher for private sector as compared to Government agency. |
|    | Calculation of Financial IRR and NPV      | Overall financial viability of the project is measured through Financial IRR and NPV.  
**i. Financial IRR:** Financial IRR is calculated based on free cash flow stream. Financial IRR indicates the return on investment.  
**ii. Net Present Value (NPV):** Discounted Cash Flow technique is used to estimate the NPV. As per Govt. agencies point of view, Discount rate used for above calculation should be social discount rate (i.e. 12% social cost of capital or (G-sec) rate). However, WACC can be adopted as discount rate as per private sector point of view. |
|    | Calculation of Debt Service Coverage Ratio (DSCR) | • The Debt Service Coverage Ratio (DSCR) gives an indication of the capacity to repay the debt incurred for the project from operating surpluses.  
• It is calculated as ratio of net cash flow to Principal and interest payment of debt. This ratio should be above 1.15, although lenders may insist on much higher DSCR for additional comfort.  
• Cash reserves and other separate provisions may have to be made to ensure that the DSCR does not fall below the minimum. |
|    | Sensitivity Analysis                      | The range of sensitivity can be in the range of 10 to 15% of the critical factors such as (a) Cost overruns due to delay or other factors (b) Increase in Maintenance Cost (c) Reduction in traffic in case of toll road (c) Reduction in overall revenue from the project (d) Combination of reduction in revenue and increase in cost. Outcome in terms of parameters as specified above should be calculated under each of sensitivity test. |
### Table: Steps and Details

<table>
<thead>
<tr>
<th>No</th>
<th>Steps</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Interpretation of Outcome</td>
<td>The subproject is evaluated to be financially viable if (1) FIRR is higher than WACC (2) NPV is positive and (3) DSCR is higher than 1.15. Even if a project is not commercially viable but operating ratio is higher than 1.0 then project is considered to be sustainable.</td>
</tr>
<tr>
<td>10</td>
<td>Way Forward/Decision criteria</td>
<td>• If sub project is evaluated to be financially viable then Private finance option could (PPP Option) be explored.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Even if project is evaluated commercially unviable then Viability Gap Funding Scheme (VGF) of Central Government is examined. The commercial viability of the project is assessed further under this scheme(^1). If Project is evaluated to be commercially viable then Private Finance Option shall be undertaken/explored.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Project is evaluated to be commercially unviable in standalone as well as under VGF scheme then public finance option could be explored.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If project is evaluated to be financially unviable under standalone basis and under VGF scheme but it is found sufficiently operationally sustainable and viable then mix of Private and Public Finance option could be explored.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Project is evaluated to be commercially unviable in standalone as well as under VGF scheme and also sufficiently operationally unviable as well as unsustainable then Public finance option could be explored.</td>
</tr>
</tbody>
</table>

#### 12.2.4 Step – 4 & 5: Examining Financing Options

The financing decision depends on nature of the returns on the Investment and its attractiveness to PPP option, resources available from the ULB, State and Central Government and other sources.  

\(^1\) The overall share of the VGF is capped at 40% of the project cost as per Government policy in this regard which stipulates 20% funding by Government of India and 20% from State Government/Sponsoring Govt. Agency.
Exising Private finance option

Private Sector Finance can be obtained by selecting the project implementation model on Public Private Partnership (PPP) basis. The selection of an appropriate project implementation model depends on commercial viability/return on investment.

Private Sector Models imply that PPP models where full projects are implemented by the private sector and the capital and operation expenditure is recovered either through right to revenue streams or through annuity payments by the Government.

Possibilities of Private Sector Participation in the project would be evaluated taking the following PPP formats into account

Table 12-4: Possibilities of Private Sector Participation

<table>
<thead>
<tr>
<th>No.</th>
<th>Outcome of the Financial Viability</th>
<th>Suitable PPP Model</th>
<th>Roles and Responsibilities</th>
</tr>
</thead>
</table>
| 1   | Project is evaluated commercially viable based on project revenue stream and cash flow. (Strong Revenue Model with Possibility of Investment recovery) | Built Operate and Transfer (BOT)       | • Entire project cost and O&M Costs as against the right of revenue during the concession period.  
• ULB/State/Central Govt. assumes project monitoring and supervision responsibility. |
<table>
<thead>
<tr>
<th>No.</th>
<th>Outcome of the Financial Viability</th>
<th>Suitable PPP Model</th>
<th>Roles and Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Project is commercially unviable on standalone basis but Viable considering VGF. (Investment recovery is possible to a large extent but not fully)</td>
<td>Viability Gap Funding (VGF) Model (The overall share of VGF in the Project cost would be capped at 40% as per Govt. Policy in this regard which stipulates 20% funding by the central Govt. and remaining 20% from State Govt. /ULB / Sponsoring agency.)</td>
<td>• Entire project cost and O&amp;M Costs as against the right of revenue during the concession period and capital grants in terms of VGF during Project construction. • The concessionaire would ask for VGF in this case which would be the bidding variable.</td>
</tr>
</tbody>
</table>

Following PPP Models could be explored if project is evaluated to be unviable for both options of BOT and VGF.

| 3   | Project is evaluated to be commercially unviable for both options of BOT and VGF and project Investment is higher and budgetary allocation is limited | Grant During Operation | The private player would bear 100% of project cost and collect the revenue as well. The ULB/State Govt. /Central Govt. would provide an equal amount of revenue shortfall grant every year for the entire concession period to maintain adequate returns of the concessionaire. The grant quoted per year would be the bidding variable. |
| 4   | Annuity Model | The private player would bear the entire project cost and implement the project. The revenue would be collected by the Public Sector. The concessionaire would ask for fixed annuity amount to be paid in equal annual instalments over the entire concession period. The annuity amount would be the bidding variable. |

Urban Transport project being capital intensive in nature requires long term finance. There are various means of long term funding available to private sector for infrastructure projects in India. The prime sources of long term funds are described in the toolkit and summarized below.

1. **Capital Grants** in terms of Viability Gap Funding (VGF) from Government.
2. **Subsidies** in terms of grant during operation or annuity.
3. **Equity from own source:** This constitutes the risk capital for the project. Depending upon the project structure, equity could be contributed by the private party player. Normally equity contribution from Private players varies from 20% to 30% in infrastructure projects based on its balance sheet based analysis.
4. Debt: Debt has to be repaid from project revenues or other sources and also carries an interest payment obligation. Lenders may typically require escrowing of revenues from income sources to ensure periodic payment. There are various options for raising debt for a project. These include loans from:

- Development Financial Institute such as IIFCL, IDFC, IFCI etc.
- Commercial Banks and NBFC in India
- External Commercial Borrowings
- Long Term Infrastructure Bonds.
- Private equity
- Long term Infrastructure Bond to be issued by Private Player.
- Urban Transport Fund

**Examining Mix of Public and Private Finance option**

This model implies a mix of public and private sector model where project is partially implemented by the Public sector and the private sector. This model can be explored when a Project is evaluated to be financially unviable for both options of BOT and VGF, however limited investment recovery is possible. The capital expenditure with respect to civil construction is incurred by the Public sector while investment with respect to rolling stocks and operation expenditure is made by the private sector. Under this model private sector is provided with right to revenue or availing regular annuity payment by the public sector through which private sector recovered its investment and O&M cost.

**Table 12-5: Possibilities of Mix of Public & Private Sector Participation**

<table>
<thead>
<tr>
<th>No.</th>
<th>Outcome of the Financial Viability</th>
<th>Variants of Mix of Public and Private Sector Model</th>
<th>Roles and Responsibilities</th>
</tr>
</thead>
</table>
| 1   | Project is evaluated to be financially unviable for both options of BOT and VGF however limited investment recovery is possible. | Revenue Share Model | - In this Model Public sector would bear the cost of civil infrastructure where as private sector would invest in rolling stocks, ITS and O&M as against the rights of revenue.  
- The Private sector would share fix amount of revenue every year with public sector and thus proportion of revenue share would be bidding variable. |
| 2   | Project is evaluated to be financially unviable for both options of BOT and VGF however limited investment recovery is also not possible through project revenue stream. | Annuity for investment recovery for rolling stocks /ITS investments | - In this Model Public sector would bear the cost of civil infrastructure where as private sector would invest in rolling stocks, ITS and O&M against the regular annuity income. The Public sector would retain the rights of project revenue.  
- Bidding variables could be lowest annuity amount quoted. |
Examing Public Finance Option

Public finance options should be explored if projects bring higher socio economic benefits but are commercially evaluated to be unviable and do not fit into Private Financing through PPP option or mix of Public and Private finance Option. Under this model ULB/State/Central Government could form an SPV to develop, operate and maintain the Urban Transport project. Funding under this model is availed through own sources, state and central Government funding, loans on concessional rates from multilateral agencies such as ADB, World Bank, JICA etc. and through the municipal bonds. All funding sources available to public sector are elaborated in toolkit and summarised as follows.

1. Equity/ own source: Depending upon the availability of fund from own sources based on a balance sheet analysis, the quantum of equity contribution from own sources should be decided. The balance sheet based analysis comprises the preparation of Financial Operating Plan and the Capital Investment Plan and could help in determining the following:
   a) Quantum of equity contribution from own sources for the project;
   b) Determination of whether ULB/Project Authority could meet project maintenance expense through its own fund; and
   c) Determining the Quantum of Debt servicing capability.
      
Steps for preparation of FOP are also summarized in this toolkit and placed as ATTACHMENT 4 for ready reference.

2. Capital Grants / Equity from State / Central Government: Grants from central and state governments (including JNNURM) are also important sources of funds. DPR needs to be prepared for availing such grant.

3. Debt: The Quantum of debt could be decided based on debt servicing capacity. The balance sheet based analysis as specified in ATTACHMENT 4 of toolkit could be undertaken to determine the quantum of debt. The various options for raising debt for the project include followings.

   a) Loans from Multilateral Financial Institutions such as ADB, World Bank, JICA etc.
   b) Issuance of Bonds.
   c) Interest free loans from State/Central Government.

4. Mass Rapid Transit Fund: A dedicated Mass Rapid Transit Fund (MRTF) could be created to fund development and operation of the Urban Transport project. The corpus of fund can be collected from following sources.

   a) Sale of Extra FSI
   b) Betterment Charges
   c) Cess on Property Tax
   d) Cess on Building Use Permission
   e) Cess on vehicle registration:
   f) Cess on VAT
12.3 Risk Analysis Framework for Urban Transport Project

Given the Capital Intensive nature of an Urban Transport Project, risks associated with the project and its subsequent mitigation assumes importance as it impacts the outcome of Economic and Financial Viability of the Urban Transport Project. It also affects the sustainability of the project. Thus a Risk analysis framework comprising identification of risks, likely impact and its mitigation measures are summarized in figure below.

Figure 12-5: Risk analysis framework

12.4 Conclusion

The toolkit provides a Systematic guide covering the aspects/ steps of economic and financial/ commercial viability analysis of the project to assist the decision makers. The Financial viability assessment including the determination of the project horizon, phasing of investment, determination of operation maintenance cost, income/ revenue, deciding quantum of debt, estimation of cash flow etc have been discussed in detail. Steps at arriving at the outcome on the basis of parameters such as average cost of capital, financial internal rate of return, net present value, and debt service coverage Ratio have been given to evaluate the viability and interpret the outcome.

Examining the finance Options including private finance in case of public – private participation either on BOT basis or viability gap funding models have also been discussed. The possibility of other PPP models with grants during operation, annuity models, equity from own source, debts/loans from financial institutions, bonds, urban transport funds have been discussed in detail. Examining a mix of public and private options for financing and creating of mass transit funds through sale of extra FSI, betterment charges, Cess on Property Tax, Cess on Building Use Permission have been described in detail.
Chapter 13

Public Private Partnership (PPP) in Urban Transport

All estimations of investment in urban transport are unanimous in pointing out that implementing the strategies for meeting the future demands of urban transport will require large capital investments.

The purpose of this toolkit is to assist the relevant public entities in conceptualising, assessing and developing projects involving private capital. The toolkit aims at providing a holistic view of the project development cycle to facilitate the planning process of projects involving private sector participation for the urban transport sector. The purpose of this toolkit is to lay down the guidelines for developing projects in the domain of urban infrastructure through the route of the public private partnerships. The guidelines have been prepared to assist PPP practitioners and public entities planning project development through PPP.

The toolkit has been divided into modules to facilitate its understanding. The modules have been sequenced in the order of the various stages of project development; specifically directed towards project development through the PPP route.

13.1 Context of the Toolkit

As mentioned above, the purpose of the toolkit is to assist the relevant public entities in developing projects in urban transport. The project development process in urban transport involves multiple stages to arrive at the implementation stage. These multiple stages in successive order are:

Table 13-1: Stages in development of urban transport projects

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Stage</th>
<th>Description</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Comprehensive mobility plan</td>
<td>Comprehensive mobility plan (CMP) is an integrated planning process for city-level urban transport combining strategic planning for the city’s transportation, city transportation and land use planning, demand management, identification and evaluation of project in the sector, prioritisation of the projects and coordination among nodes.</td>
<td>City level</td>
</tr>
<tr>
<td>2.</td>
<td>Alternative analysis</td>
<td>Alternative analysis is the process of identifying possible alternatives for satisfying corridor-level service needs, evaluating identified alternatives and selecting the optimum alternatives based on multiple parameters. The output of the alternative analysis process is a set of defined projects for every corridor.</td>
<td>Corridor level</td>
</tr>
<tr>
<td>S. No.</td>
<td>Stage</td>
<td>Description</td>
<td>Level</td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td>3</td>
<td>Techno-economic feasibility for project approval</td>
<td>Techno-economic feasibility is the process of assessing whether the identified project is technically and financially implementable. As per the guidelines for the preparation of Detailed Project Report for Integrated Mass Transit System development plans issued by the Urban Transport Division, Ministry of Urban Development, the feasibility assessment should be a part of the DPR-I</td>
<td>Project level</td>
</tr>
<tr>
<td>4</td>
<td>Detailed project report for project implementation</td>
<td>DPR is the specific project blueprint based on which the project is implemented includes detailed technical designs of the project and the detailed costing. As per the guidelines mentioned above this is termed as the DPR-II.</td>
<td>Project level</td>
</tr>
</tbody>
</table>

As it is apparent from the description of the stages, the present toolkit covers parts of the technical economic feasibility or in other words the DPR-I in the project development process. DPR-I incorporates the project implementation route, whether public-funded or through PPP, as a part of the financial feasibility process. Thus to summarise, this toolkit will help the project team in preparation of DPR-I.

The project team will draw most of the inputs for the process defined in this toolkit from the comprehensive mobility plan (CMP) and the Alternatives Analysis process as these are the preceding stages of the project development project.

### 13.2 Users of the manual

As explained above, this manual covers a part of the project development process. Therefore, the manual may be used by any entity which is developing urban transport projects and wishes to explore the possibility of implementing the project through the PPP route. In India, the likely organisations involved in project development process can be

- A Urban Local body (ULB)
- State Transport Department
- State Public Works Department (PWD)

Therefore individuals who will be most likely users of this manual would be the departmental staff of the above entities with project development responsibilities. Additionally the manual will help in deciding whether a particular project might be suitable for the PPP route or not. The manual can therefore be the basis of approving a project implementation structure as part of the overall project approval. Usually the project approval responsibility is vested in the top decision making authority of the entity, which has the primary responsibility for implementing and/ or financing the project. Thus it can be useful for the Municipal Commissioner and the Standing Committee (being the top decision-making authorities in an ULB) in urban local bodies and the State Government (in case of State Transport Department or the State PWD).

The National Urban Transport Policy mandates the formation of Unified Metropolitan Transport Authorities (UMTA) for million plus Indian cities. The intention is that UMTA will be the single planning entity for urban transport in a city, coordinating with the state transport department and other agencies. All funds intended for the urban transport sector of a city will be routed through its UMTA. Thus in cities where it is formed or will be formed, the manual will be used by UMTA for
• Approval of project implementation structure
• Overall project approval
• Consideration of viability gap funding for individual projects

13.3 General definition and overview of PPP

To define the nature of a PPP transaction we have adopted the definition given by Department of Economic Affairs (Infrastructure section), Ministry of Finance in the guideline document for ‘Scheme for Support to Public Private Partnerships in Infrastructure. This definition is based on three essential elements- a contractual arrangement, between a government or statutory entity and a private sector company, and for the purpose of providing an infrastructure service.

A Public Private Partnership (PPP) project means a project based on a contract or concession agreement, between a Government or statutory entity on the one side and a private sector company on the other side, for delivering an infrastructure service on payment of user charges;

While service delivery through a PPP changes the means of delivering services, it does not change a department’s accountability with regard to ensuring that the services are delivered. The department’s focus shifts from managing the inputs to managing the outcomes, i.e. becoming a contract manager rather than a resource manager.

Example: A road concession to the private sector to design, construct, finance, operate and maintain a road for a given period of time. At the end of the concession period, the road project is transferred back to the government agency. During the concession period, the private sector is allowed to collect tolls from users (vehicles plying on the road), so that the private sector can recover its costs, and the private sector is responsible for road construction, road maintenance and operation of the toll stations.

PPP is different from public procurement and privatisation.

PPP is not to be confused with privatisation and public procurement as indicated in the following exhibit:

Table 13-2: Difference between PPP, Privatisation and Public Procurement

<table>
<thead>
<tr>
<th></th>
<th>PPP</th>
<th>Public procurement</th>
<th>Privatisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td>PPPs introduce private sector efficiencies into public service by means of long-term contractual arrangement. It secures all or part of the public service, so delegated by private funding and calls upon private sector know-how</td>
<td>Supply by the private sector of works, goods or service as defined by the public authority.</td>
<td>Privatisation means transferring a public service or facility to the private sector, usually with ownership, for it to be managed in accordance with market forces and within a defined framework.</td>
</tr>
</tbody>
</table>
### Main Features

<table>
<thead>
<tr>
<th>Contracting Authority</th>
<th>Privatisation Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishes the specifications of a project and leaves the private sector the responsibility of proposing the best solution, subject to certain requirement.</td>
<td>Prepares the divestment plan.</td>
</tr>
<tr>
<td>Price is one of the many criteria in the evaluation of bids. A lot of emphasis is laid on the technical and financial capability of the bidder, financial arrangements proposed, and the reliability of technical solutions used.</td>
<td>Involves transfer of ownership to the private sector.</td>
</tr>
<tr>
<td>Given the long duration of the concession period, emphasis is on the arrangements proposed for the operational phase.</td>
<td>Generally, the public sector withdraws from management of the entity on privatisation.</td>
</tr>
</tbody>
</table>

### 13.4 Rationale for PPPs

PPP offers a win-win solution for all stakeholders, as is explained below.

#### 13.4.1 For the Public Sector

PPPs allow the public sector to derive benefits from the efficiency and effectiveness of the private sector. This is possible because of the following impacts;

**Innovation**

PPP allows the government to tap the private sector’s capacity to innovate. This is achieved by the government not specifying how a service should be delivered or how an asset has to be designed and built. Instead, the government will spell out the services it needs, and the desired outcomes/outputs. The private sector can then introduce innovative solutions to meet the government’s objectives.

**Sharing of responsibilities**

In a PPP project, the government and the private sector share the responsibilities of delivering a service. The responsibilities are allocated according to each party’s expertise in managing and adding value to a specific part in the service delivery process.
Finance

In a PPP project, the government can tap private capital for achieving public policy objectives. In case of
government investments, demand for the investment is always more than the availability of funding. Access
to private capital frees government capital to be used in projects with higher public policy objectives.

13.4.2 For the Private Sector

Through PPP the private sector can have access to business opportunities which were traditionally
accessible only to the public sector.

Designing and delivering innovative solutions

PPP also allows the private sector to move from just constructing assets according to clearly specified
designs, to designing and delivering innovative solutions. The private sector has more room to innovate
and offer efficient solutions for public services.

13.4.3 For the Public

Combining expertise of public and private entities

PPPs bring together the expertise of the government and the private sector to meet the needs of the
public effectively and efficiently. When structured appropriately, PPPs will deliver public services that can
better meet the needs of the public without compromising public policy goals and needs.

Protection of public interest

The government will also ensure that public interest is protected in all PPP projects and that service
delivery will meet public needs at the best value for money when the private sector is brought in to
provide government services.

13.5 Typical Contractual Structures in PPP

Various contractual structures of PPPs exist and the choice of contract depends on the objective of the
government such as improving service efficiency, transferring investment risk, maintaining service control
or improving the quality of service. The exhibit below presents the typical contractual forms of PPP and
their unique characteristics;
### Table 13-3: Nature of PPP Contracts

<table>
<thead>
<tr>
<th>Nature of Characteristics</th>
<th>Nature of service &amp; Payment to contract</th>
<th>Asset O&amp;M</th>
<th>Capital Commercial contractor</th>
<th>Duration ownership</th>
<th>Investment Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Contract (1-3 years)</td>
<td>Public &amp; Private</td>
<td>Public</td>
<td>Public &amp; Private</td>
<td>Public</td>
<td>A definitive, often technical type of service. Fee paid by government service.</td>
</tr>
<tr>
<td>Management Contract (3-8 years)</td>
<td>Public</td>
<td>Private</td>
<td>Public</td>
<td>Public</td>
<td>Manage the operation of a government service. Fee paid by government for service and a performance-based incentive</td>
</tr>
<tr>
<td>Lease (8-15 years)</td>
<td>Public</td>
<td>Private</td>
<td>Public</td>
<td>Shared</td>
<td>Manage, operate, repair and maintain a municipal service to specified standards and outputs. All revenues, fees or charges from consumers for provision of service; the service provider pays the government rent for the facility.</td>
</tr>
<tr>
<td>Concession (15-30 years)</td>
<td>Public</td>
<td>Private</td>
<td>Private</td>
<td>Private</td>
<td>Manage, operate, repair, maintain and invest in public service infrastructure to specified standards and outputs. All revenues from consumers for the provision of the service; the service provider pays a concession fee to the government and may assume existing debt</td>
</tr>
<tr>
<td>BOT/BOO (15-25 years)</td>
<td>Private &amp; Public</td>
<td>Private</td>
<td>Private</td>
<td>Private</td>
<td>Construct &amp; operate, to specified standards &amp; outputs, the facilities necessary to provide the service. The Government mostly pays the service provider on a unit basis.</td>
</tr>
</tbody>
</table>

Source: The World Bank Toolkit, Guidelines for PPP, South Africa

While service delivery through a PPP changes the means of delivering services, it does not change the government’s accountability for ensuring that the services are delivered. The department’s focus shifts from providing the service to managing the service provider.
13.6 Conclusion

Having done the Financial Analysis, in case a decision is taken to go for a Public – Private Partnership a separate toolkit is in the Compendium. To secure the Capital Investments in the sector, public entities would need to attract private capital for the development. The purpose of the toolkit is to assists the public entities in developing the urban transport projects in stages to arrive at the Implementation Stage.

A general definition and overview of PPP means a project based on a contract or a concession agreement between a government or statutory entity on the one side and a private sector company on the other side for delivering an infrastructure service. The rationale for PPP’s innovation, sharing of responsibilities and tapping for private capital for financing has been discussed.

The combination of the expertise of the Government and the private sector to meet the needs of the public is achieved in Public- Private Partnership. The protection of public interest and typical contractual structures in PPP such as service contract, management contract, lease, concession, built operate transfer (bot) build own and operate (boo) etc. have also been discussed in detailed in the toolkit.
## Terminologies

1. **Access:** It is the ability to reach, visit or use a transport service.

2. **Accessibility:** The concept of accessibility is generally interpreted as a measure of the effort of overcoming spatial separation. It denotes the importance of a place and, more particularly, the ease with which one can travel from one place to another.

3. **Activity Based Model:** Activity-based models are another class of models that predict for individuals where and when specific activities (e.g. work, leisure, shopping, ...) are conducted.

4. **Alighting:** Descend from a train, bus, or other form of transportation.

5. **Alignment:** It is the horizontal and vertical ground plan of a road, rail, transit route or other facility as it would appear in plan and profile.

6. **Arterial Road:** A general term denoting a road primarily for through traffic, usually on a continuous route.

7. **Average Daily Traffic (ADT):** Average number of vehicles that pass a specified point during a 24-hour period.

8. **Average Travel Cost:** Average cost of travel taking all trips (including or excluding walk) into account.

9. **Average Travel Time:** Average time of travel taking all trips (including or excluding walk) into account.

10. **Average Trip Length:** Average distance of travel taking all trips (including or excluding walk) into account.

11. **Average Trip Rate:** A weighted average of the number of trips made by an individual.

12. **Balanced Transportation System:** A system in which the facilities and services of different transportation modes are treated as parts of a single system, and each mode is planned in a manner that most effectively uses its special elements in combination with other elements to provide mobility for people in the most effective manner.

13. **Boarding:** Enter, climb onto a train, bus or other form of transportation.

14. **Bypass:** A road meant to enable through traffic by avoiding congested areas or other obstructions to passage.
15. **CBD**: Central Business District

16. **Centroid connectors**: Are hypothetical links that connect the centroids to the network. Centroid connectors represent local streets within the zone.

17. **Collector Street**: A street or road for collecting and distributing the traffic to and from local streets and also for providing access to arterial streets.

18. **Crowding**: The act of filling up a vehicle completely with passengers leaving almost no room for movement.

19. **Destination**: It is the farthest point of travel from the point of origin or it is the point of travel at which the trip ends.

20. **Diverted Traffic**: A component of traffic that has changed from its previous path of travel to another route without a change in origin, destination, or mode of travel.

21. **Door-to-Door Service**: A service that picks up passenger from the door of their place or origin and delivers them at the door of their place of destination.

22. **Expressway**: A divided arterial highway for motor traffic, with full or partial control of access and generally provided with grade separations at intersections.

23. **Feeder Service**: Local transportation service that provides passengers connections with major transportation service.

24. **Forecasting**: The process of estimating the number of commuters which will use a specific mode of transportation by a given time period in the future.

25. **Generated Traffic**: A general term that can be applied to any part of traffic created by one or more land users.

26. **Growth factor**: It is the rate at which traffic grows.

27. **Headway**: The average interval of time between two vehicles (for examples buses) moving in the same direction on the same route.

28. **Highway**: (i) A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way; (ii) An important road connecting two cities.

29. **Home Based Trips**: Trips that have one end (origin or destination) at the home of the person making trip.

30. **Home Interview Survey/ Household Surveys**: A survey in which data is collected at home through face-to-face interviews. Such interviews usually include information on household characteristics and travel patterns.
31. **Impact Analysis (impact Evaluation):** It is that part of transportation planning process in which there is an evaluation of the effects of an existing or proposed transportation project on social, economic, and environment factors or variables.

32. **Impedance:** Any condition that restricts or discourages travel, or a measure of that condition. Time and costs are the factors usually considered, but others could also be taken into account.

33. **Induced Traffic:** The added component of traffic volume that did not exist previously in any form but emerges when new or improved transport facilities are provided.

34. **Inter zonal traffic:** Traffic generated between various zones of a geographical area.

35. **Intermediate Public Transport (IPT):** Modes of transport that are neither public nor private. They can be hired for point-to-point travel. Examples are taxis, tempos, auto rickshaws and cycle rickshaws.

36. **Intersection:** The general area where two or more streets join or cross, and which includes the carriageway and the roadside facilities for traffic movement in that area.

37. **Inter-Zonal Travel Time:** The travel time between any two zones, including the terminal time at each end of the trip.

38. **Intra-Zonal Travel Time:** The travel time (including waiting time) for trips that begin and end in the same zone, including the terminal time at each end of the trip.

39. **Jaywalking:** The activity of crossing the road either from an undesignated location or at an undesignated time.

40. **Land use:** It is a description of the use of land. Land-use may be categorised as residential, commercial, institutional, transportation etc.

41. **Lane:** A portion of a street usually indicated by pavement marking that is intended for one line of vehicles.

42. **Large Urban Area:** An urban statistical region with population of ten lakh or more.

43. **Level of service:** It is a measure of effectiveness of the various constituents of transportation infrastructure such as roadway facilities, pedestrian facilities etc.

44. **Link Road:** The assigned volume of traffic on a link.

45. **Link:** A section of transportation network/road defined by intersection points (nodes) at each end. It connects two nodes. It could be one-way or two-way.

46. **Local Street:** A street or road primarily for access to residence, business premises, or some other abutting property.

47. **Market Research:** The process of gathering and analysing information about the movement of goods or services from producer to consumer.
48. Mass Transportation: Transportation by bus, rail or some other conveyance, either publicly or privately owned, that provides general or special service to the public on a regular and continuing basis (not including school buses, chartered or sightseeing services)

49. Median Opening: A gap in a median provided for crossing and right-turning traffic (turning against oncoming traffic)

50. Median: The central physical divider separating the traffic in opposite directions

51. Mid-block: Mid-block is a location on a road away from road intersections.

52. Mixed Traffic: Traffic that encompasses different vehicle categories or different modes.

53. Mobility: It reflects the ease or difficulty in travelling to a service or facility

54. Modal Split: The proportion of total person trips that use various modes of transportation including walk

55. Mode share: The percentage of total traffic moved by a particular mode of transportation.

56. Mode: A particular form of travel

57. Model validation: Process of determining the accuracy of a transportation model

58. Model: A mathematical or conceptual presentation of relationships and actions within a system. It is a mathematical description of a real-life situation that uses data on past and present conditions to make a projection about the future.

59. Multi-modal: A combination of two or more modes of transportation to complete a trip is known as multi-modal

60. Municipal Committee: A Municipal Committee is constituted for an area which is undergoing changes (becoming urban in nature) and which has a population of minimum 50,000 people. Also known as town committee, the committee consists of members who are directly elected by citizens of the area concerned.

61. Municipal Corporations: The 74th amendment of the Indian Constitution stipulates that a municipal corporation should be constituted for a ‘large urban area’.

62. Municipal Council: The 74th amendment of the Indian Constitutions stipulates the setting up of Municipal Councils for smaller urban areas.

63. National Highways: Main highways running through the length and breadth of the country, connecting major ports, highways of neighbouring countries, state capitals, large industrial complexes, important tourist centres, etc.

64. Network: A system of links and nodes that describe a transportation system

65. Node: A point that represents an intersection of two or more transport links
66. **Non Home-Based Trips**: Trips which have neither ends at the home of the person making the trip.

67. **Off-peak**: It is the period of time when the infrastructure is not at its heaviest use.

68. **Operating Costs**: The sum of all recurring costs that can be associated with the operation and maintenance of the transport system during the period under consideration.

69. **Operations plan**: A plan which contains complete information about the operation of a particular transportation mode/infrastructure.

70. **Origin**: It is the point or location from where a trip starts.

71. **Origin-destination Trip Matrix**: A trip matrix is a table which depicts the origins and destinations in a zone-wise manner. In other words, it shows how many trips are generated and attracted to every zone in a geographic area.

72. **Para-statals**: An agency or organization which is completely owned, controlled and operated by the state (the central government or state government).

73. **Para-transit**: Same as Intermediate Public Transport.

74. **Passenger-Car Unit**: These are equivalency factors that convert the traffic volumes of the road comprising different modes into equivalent passenger car units (PCU).

75. **Path**: Any series of links where each succeeding link has the ending node of a previous link as its beginning node.

76. **Peak**: It is the period of time when the infrastructure is at its heaviest use.

77. **Per Capita Trip Rate (PCTR)**: Average number of trips per person. It is expressed as a ratio of total trips to total population in an area. PCTR is usually expressed either in terms of mechanized mode trips, which excludes walking, or for all trips including walking. It could also be expressed for various trip purposes or various modes of travel.

78. **Productivity**: The ratio of output to input (consumed resource).

79. **Public transport**: It is a transportation service which can be used by the general public by payment. Modes such as buses, metro, monorail and trams can be considered as public transportation modes.

80. **Ridership**: The number of passengers using a particular mode of transportation.

81. **Right-of-Way (ROW)**: A general term denoting land, property or interest therein, usually in a strip acquired for or devoted to transportation purposes.

82. **Road**: A wide way leading from one place to another, especially one with a specially prepared surface which vehicles can use.

83. **Rolling stock**: Rolling stock is the vehicle for the use of commuters.
84. **Route**: The geographical path of a given trip from start to finish

85. **Sensitivity Analysis**: Sensitivity analysis is a systematic method for examining how the outcome of cost benefit analysis changes with variations in inputs or assumptions

86. **Service Attributes**: Those aspects of a transportation system that affect travel such as travel time reliability, comfort, cost, ease of use, and safety

87. **Service Frequency**: The number of transit units on a given route moving in the same direction that pass a given point within a specified interval of time

88. **Small Urban Area**: An urban area with a population below 200,000 people;

89. **Special Purpose Vehicles**: Special Purpose vehicles are companies created under the Companies Act to perform a specific function

90. **Stakeholder**: A stakeholder is a person who has a vested interest in the success of a transportation project

91. **Street**: A road within a town or some other centre of habitation that has become partly or wholly defined by buildings established along one or both frontages, and which may or may not be a highway.

92. **Sub-Arterial Street**: A highway or a street primarily for through traffic, but a lower level of mobility than the arterial streets. It forms the link between arterial streets and collector streets

93. **System Planning**: A procedure for developing an integrated means of providing adequate facilities for movement of people and goods, involving regional analysis of transportation needs and identification of transportation corridors involved

94. **Terminal**: The end station or stop on a transit line or route, regardless of whether special facilities exist for reversing the vehicle or handling the passengers

95. **Throughput**: Volume of vehicles passing or people transported past a point or series of points during a given period of time

96. **Traffic Count**: A record of the number of vehicles, people aboard vehicles, or both that pass a given checkpoint during a given time period. This may be classified by the types of vehicles.

97. **Traffic**: The vehicles, people, or both that pass a specified point during a given period

98. **Transfer Time**: The time required to effect a change of mode or to transfer between routes or lines of the same mode

99. **Transfer**: A passenger’s change from one transit unit or mode to another transit unit or mode.

100. **Transit System**: The facilities, equipment, personnel and procedures needed to provide and maintain public transit service.
101. **Transportation of Disadvantaged:** People whose range or transportation options is limited, especially with regard to the availability of relatively easy-to-use and inexpensive modes for trip making. Examples include the young, elderly, poor, handicapped, and those who do not have automobiles.

102. **Transportation Interface:** The point or facility at which two or more modes of transportation meet or at which two or more transit system routes or lines meet.

103. **Transportation System:** A system that provides for the movement of people, goods, or both. It is also defined as a coordinated system made up of one or several modes serving a common purpose, i.e. the movement of people, goods or both.

104. **Travel Survey:** Collection of data that describe the social, economic, and travel characteristics of people who make trips by various modes of transportation.

105. **Trip Attraction:** It is defined as a trip end connected to a non-residential land-use in a zone.

106. **Trip Cost:** It is the cost incurred to complete one-way person movement by a mechanized mode between origin and destination.

107. **Trip Distance:** It is the distance of one-way person movement between origin and destination.

108. **Trip Generation:** It is the home-end of any trip that has one end at the home (of home-based trip) and is origin of trip with neither end home-based (i.e. of non-home based trip).

109. **Trip Production:** It is defined as a trip end connected with a residential land-use in a zone.

110. **Trip Time:** It is the time taken to complete one-way person movement between origin and destination.

111. **Trip:** A one-way person movement by any mode of transport having two trip ends: an origin, or start, of a trip and a destination, or end, of a trip for a specific purpose.

112. **Urban Area:** A geographical area constituting a city or town.

113. **Urban Development Authorities:** Urban Development Authorities usually have larger jurisdictions than individual municipalities and are constituted through special acts passed by the state legislature. They were created to achieve a planned development for rapidly growing cities and emerging towns.

114. **Urban Local Bodies (ULB):** There are different kinds of ULBs that are constituted for different urban areas. The nature of what ULB is constituted largely depends on the total population, population density and occupation.

115. **V/C Ratio:** Ratio of actual hourly traffic volume (V) on a road section to its traffic carrying capacity (C).

116. **Zones:** A contiguous area that is distinguished on the basis of a particular characteristic, use, restriction, etc.
Sustainable Urban Transport Project