

# Development of Toolkit under “Sustainable Urban Transport Project”



सत्यमेव जयते

MINISTRY OF URBAN DEVELOPMENT  
GOVERNMENT OF INDIA



*Empowered lives.  
Resilient nations.*



# Land Use Transport Integration and Density of Urban Growth”

[www.moud.gov.in](http://www.moud.gov.in)

December 2013





[www.iutindia.org](http://www.iutindia.org)

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.



The Centre of Excellence in Urban Transport, CEPT University (CoE-UT, CEPT), established in 2009 is an initiative of the Ministry of Urban Development (MoUD), Government of India and is supported by the Ahmedabad Municipal Corporation. CoE-UT, CEPT has been envisaged as a resource centre for dealing with issues in urban transport planning and management. It has a mandate to cover three aspects of capacity building in urban transport - human resource development, knowledge management and technical assistance & advisory.

The Centre has been providing technical assistance to the MoUD on urban bus specifications and has been contributing to numerous national committees, working groups and government led missions / projects related to urban development and urban transport in varying capacities

# Acknowledgement

---

The Centre of Excellence Urban Transport CEPT University expresses its sincere thanks to the Ministry of Urban Development (MoUD), Government of India, for awarding the work of preparation of toolkit on “Land Use Transport Integration and Density of Urban Growth” which is prepared under Sustainable Urban Transport Project (SUTP) jointly initiated with the support of Global Environment Facility (GEF), United Nations Development Programme (UNDP) and World Bank.

Sincere thanks to Dr Sudhir Krishna, Secretary, MoUD, for his guidance to the study team. The invaluable direction and advice provided to the study team by Shri. S.K. Lohia, Officer on Special Duty (Urban Transport) & Ex-Officio Joint Secretary, MoUD is appreciated and acknowledged.

Special thanks are due to Mr. B I Singal, Director General, Institute of Urban Transport (IUT), India and Ms. Kanika Kalra, Urban Transport Expert, IUT, for their continued advice and support throughout this endeavour.

The Centre of Excellence in Urban Transport, CEPT University wish to express their sincere thanks to Dr. Sandeep Garg, Program Specialist, UNDP, for his valuable suggestions and support during the course of the preparation of this toolkit.

We also would like to thank Mr. I C Sharma, National Project Manager, GEF-SUTP; the PMC members and all the members of the Technical Monitoring and Advisory Committee (TMAC) for their suggestions and advice.

We also acknowledge the inputs provided by the international reviewers of the toolkit - John McNulty, Director London & Continental Railways and Mr. Mohinder Singh, Dean, LTA Acedemy, LTA, Singapore who advised us in the process of making this toolkit.

Finally, we would like to thank the authors for their contributions and making this document a valuable resource:

**Authors:**

Prof. H.M.Shivanand Swamy, Executive Director CoE-UT, CEPT University

Ms Nitika Bhakuni, Associate Professor, CoE-UT, CEPT University

Ms. Shalini Sinha, Associate Professor, CoE-UT, CEPT University

Ms. Swapna Wilson, Researcher, CoE-UT, CEPT University



# Preface

---

Government of India has initiated the Sustainable Urban Transport Project (SUTP) with support from Global Environment Facility (GEF), World Bank and UNDP. The primary objective of SUTP is to facilitate urban transport infrastructure in a sustainable environment and under the ambit of National Urban Transport Policy (NUTP).

Component 1A of GEF-SUTP project aims at capacity building amongst practitioners in the field of sustainable urban transport. The objective of the initiative is to create an enabling institutional framework for sustainable urban transport in India. This is to be accomplished by enhancing the capacity of policymakers, planners, researchers, executive agencies, service providers, managers and other professionals involved in urban transport to plan, implement, operate and manage sustainable urban transport.

**To achieve the objectives of component 1A, as part of the program 5 sub-components have been identified which include the following:**

- Sub-Component 1 – Institutional capacity development, focusing on strengthening of Institute of Urban transport (IUT)
- Sub-Component 2 – Individual capacity development
- Sub-Component 3 – Preparation of manuals and toolkits
- Sub-Component 4 – Promotion, awareness and dissemination of information to expand and enhance the impact of GEF-SUTP
- Sub-Component 5 – Technical assistance to cities to address emerging issues encountered during project implementation.

Sub-Component 3 aims at providing step by step guidance to cities and other concerned authorities to enable them to plan and implement projects related to urban transport and also facilitate public decision makers and transport planners/ engineers in overseeing urban transport projects. It will include briefly the concept behind the subject of the tool kit, applicable planning standards and norms (most up to-date version to be used) and reference to a code of practice where necessary. The toolkits are as follows:

1. Land Use Transport Integration and Density of Urban Growth
2. Urban Travel Demand Modelling
3. Transport Demand Management
4. ITS for Traffic Management System
5. Public Transport Accessibility



6. Urban Road Safety & Safety Audits
7. Planning, Design and Evaluation of Urban Traffic systems
8. Finance and Financial Analysis
9. Environmental Analysis/SEA & SIA
10. Social Impact Assessment and R & R plan

The present toolkit would deal with the subject of “**Land Use Transport Integration and Density of Urban Growth**”. The aim of this toolkit is to provide an efficient tool to promote sustainable development, with specific objectives as follows:

- To provide an efficient tool kit to assessed and evaluate the progress of existing condition.
- To assist in planning towards optimizing transport demand by using various integration techniques like TOD, redevelopment of areas, zoning of activities, intensified development, etc.
- To deal with the institutional framework and appropriate tools for implementation to ensure successful implementation of above mentioned integration techniques.

# Table of Contents

---

<b>Acknowledgement</b> .....	<b>i</b>
<b>Preface</b> .....	<b>III</b>
<b>Abbreviations</b> .....	<b>xiii</b>
<b>Executive summary</b> .....	<b>xv</b>

## **Chapter 1 - Overview**

1.1 Background .....	1
1.2 Objectives of the Toolkit .....	3
1.3 Users of the Toolkit .....	4
1.4 Scope of the Toolkit.....	4
1.5 Structure of the Toolkit .....	5

## **Chapter 2 - Land Use Transport Integration- Concept and its Elements**

2.1 What is land use transport integration? .....	7
2.2 What are the benefits of land use transport integration .....	9
2.3 How integrated are the land use and transport decisions that the cities take?.....	9
2.4 What tools are available for city planners to undertake integrated planning? .....	10
2.5 What are the key elements of integration? .....	11
2.5.1 Enabling Urban Structure.....	12
2.5.2 What are the infrastructure challenges in densification? .....	15
2.5.3 What the implication on infrastructure maintenance .....	15
2.5.4 Complete Network and Complete Streets .....	16
2.5.5 Strategic Alignments .....	19
2.5.6 Transit Oriented Development and Value Capture .....	20
2.5.7 Integrated Multimodal Transit Interchange Facilities.....	21



2.5.8	Accessibility Improvements in terms of Local Area Plans .....	22
2.5.9	Redevelopment and Re-vitalization (Inner city, dilapidated areas, slums) .....	23
2.6	Planning process in India .....	25
2.6.1	Master Plan (or Development plan).....	26
2.6.2	City Development Plan.....	26
2.6.3	Transport Plans .....	27
2.6.4	Present Institutional Framework for LUTP in India .....	27
2.7	Integrating Land use and Transport: A Cyclic Process .....	29
2.8	Way Forward .....	30

**Chapter 3 - Main Toolkit**

3.1	What are the enabling mechanisms for land use transport integration? .....	31
3.1.1	Integrating land use and transport in the planning process .....	31
3.1.2	Institutional integration and legal mechanism.....	32
3.1.3	Financial requirements .....	33
3.1.4	Capacity building.....	33
3.1.5	Stakeholder identification .....	33
3.2	What should be the decision making process?.....	35
3.2.1	How big will the city grow in future? .....	44
3.2.2	Where and how do we organise forecasted growth? .....	47
3.2.3	What are the decisions to be taken at the city level? .....	51
3.2.4	What are the decisions to be taken at the local level? .....	59
3.3	What are the factors that facilitate the implementation of such strategies? .....	63
3.4	How do you evaluate Land use Transport Strategies? .....	65
3.5	How do we monitor the progress/ success of land use transport strategy?.....	65

**Chapter 4 - Supporting Case Studies**

4.1	Introduction to International and National case studies.....	67
4.2	London .....	67
4.2.1	Introduction .....	67
4.2.2	Land-use Transport integration in London .....	68
4.3	Singapore .....	76
4.3.1	Introduction .....	76





4.3.2	Land-Use Transport Integration .....	76
4.4	Hong Kong .....	82
4.4.1	Introduction .....	82
4.4.2	Land-use Transport Integration.....	83
4.5	Curitiba.....	89
4.5.1	Introduction .....	89
4.5.2	Land-Use Transport Integration .....	89
4.6	Stockholm .....	93
4.6.1	Introduction .....	93
4.6.2	Land-Use Transport Integration .....	94
4.7	Ahmedabad.....	97
4.7.1	Introduction .....	97
4.7.2	Land-Use Transport Integration .....	98
4.8	Bangalore .....	104
4.8.1	Introduction .....	104
4.8.2	Land-Use Transport Integration .....	104
 <b>Annexure - Working paper on Land use Transport Integration.....</b>		<b>107</b>
 <b>Bibliography .....</b>		<b>133</b>





# List of Figures

---

Figure 1.1 Typical development approach – A vicious cycle of demand and supply ..... 1

Figure 1.2 Impacts of Sprawl ..... 2

Figure 1.3 Characteristics of a compact city ..... 3

Figure 2.1 Interrelation between land use and transport ..... 7

Figure 2.2 High density, Mixed land use and Transport strategies to help reduce trip lengths and travel demand ..... 8

Figure 2.3 Land use Transport Integration cycle ..... 10

Figure 2.4 Aspect of Enabling Urban Structure ..... 12

Figure 2.5 City Structure Options for Urban Growth ..... 12

Figure 2.6 Settlement Scenarios ..... 13

Figure 2.7 Population density versus distance from city centre ..... 14

Figure 2.8 Completing networks ..... 17

Figure 2.9 Strategic Alignment along Development Zones/Centres ..... 19

Figure 2.10 Transit Oriented Development ..... 20

Figure 2.11 Inner city development ..... 23

Figure 2.12 Town Planning Scheme ..... 25

Figure 2.13 Planning in India ..... 26

Figure 2.14 Issues with Land Use Transport Integration in India ..... 29

Figure 3.1 Enabling Mechanism for Land Use Transport Integration ..... 31

Figure 3.2 Consultation Decisions ..... 34

Figure 3.3 Vision led approach for land use transport planning ..... 35

Figure 3.4 Planning Information System ..... 40

Figure 3.5 Problem Identification Cycle ..... 41

Figure 3.6 Problem Identification ..... 42

Figure 3.7 Key decisions in planning process ..... 42

Figure 3.8 Scales of implementation of Strategies ..... 43

Figure 4.1 Planning Process London ..... 68

Figure 4.2 Concept Plan London ..... 69

Figure 4.3 Road network London ..... 70



Figure 4.4 Activity Zones of London .....	72
Figure 4.5 London Docklands and Canary Warf .....	73
Figure 4.6 Accessibility Improvements London .....	74
Figure 4.7 Long Range Comprehensive Concept Plan .....	77
Figure 4.8 Strategic Alignments and Completing the Network .....	78
Figure 4.9 Integrated Transit and Housing.....	79
Figure 4.10 Integrated Transit Facilities Singapore .....	81
Figure 4.11 Planning Framework Singapore .....	82
Figure 4.12 Rail Network Hong Kong .....	83
Figure 4.13 Transit Map Hong Kong .....	84
Figure 4.14 Integrating Transit with Housing.....	85
Figure 4.15 Development Axis in Hong Kong .....	86
Figure 4.16 Pedestrian network providing accessibility to PT network.....	86
Figure 4.17 Integrated Transit Facilities Hong Kong .....	88
Figure 4.18 Planning Process in Curitiba .....	89
Figure 4.19 Complete Street Network.....	90
Figure 4.20 Trinary System Curitiba.....	90
Figure 4.21 Varying FSI .....	91
Figure 4.22 Strategic Alignment and TOD in Curitiba .....	92
Figure 4.23 Polycentric Structure with 8 Sub Centres .....	94
Figure 4.24 Road network Stockholm .....	95
Figure 4.25 Stockholm Structuring the Region with Strategic Alignments.....	96
Figure 4.26 Cluster Development Approach Ahmedabad .....	98
Figure 4.27 Road Network Ahmedabad .....	100
Figure 4.28 BRT Alignment .....	101
Figure 4.29 Multimodal Transit System with TOD Ahmedabad.....	102
Figure 4.30 Mass Transit Network Bangalore .....	105



## List of Tables

---

Table 2.1 Density Ranges.....	12
Table 2.2 Infrastructure cost.....	16
Table 2.3 Road Functional Classification.....	18
Table 2.4 Agencies Involved in Urban Transport in India.....	28
Table 3.1 Classification of Cities on Population Size .....	36
Table 4.1 Case Study Cities .....	67

## List of Box

---

Box 3.1 Policies at National level.....	32
Box 3.2 Land use Transport Integration Evaluation Criteria .....	37
Box 3.3 Study Area Delineation.....	45
Box 3.4 Scenario Building .....	47
Box 3.5 Identifying existing and potential activity nodes .....	48
Box 3.6 Regional Development Scenarios and Structuring growth.....	49
Box 3.7 Refining Scenarios.....	51
Box 3.8 Complete Network and Hierarchy .....	52
Box 3.9 Transit Ready Street to accommodate any Mass Transit in future .....	54
Box 3.10 Multimodal Transit System and Last mile connectivity.....	55
Box 3.11 Multimodal Transit Interchanges and Activity nodes .....	57
Box 3.12 TOD Concept depicting proposed FSI along a Mass Transit Corridor and Transit Interchange Facilities .....	58
Box 3.13 Street Planning and Design Principles .....	60
Box 3.14 Local Area Access Network plans .....	61
Box 3.15 Regeneration Areas .....	62



# Abbreviations

---

AMTS	Ahmedabad Municipal Transport Services
AUDA	Ahmedabad Urban Development Authority
BMLTA	Bangalore Metropolitan Land Transport Authority
BMRC	Bangalore Metro Rail Corporation
BMTC	Bangalore Metropolitan Transport Corporation
BRT	Bus Rapid Transit
CAZ	Central Activity Zone
CBD	Central Business District
CDP	City Development Plan
CEPT	Center for Environmental planning and technology
CMP	Comprehensive Mobility Plan
CoE	Centre of Excellence in Urban Transport
CRS	Commuter Rail System CTTT
DCR	Development Control Regulations
DP	Development Plan
FORS	Freight Operator Recognition Scheme
FSI	Floor Space Index
GLA	Greater London Authority
GLS	Government Land Sales
GTPUDA	Gujarat Town Planning and Urban Development Act
HDB	Housing Development Board
IPPUC	Instituto de Pesquisa e Planejamento Urbano de Curitiba (Research and Urban Planning Institute of Curitiba)

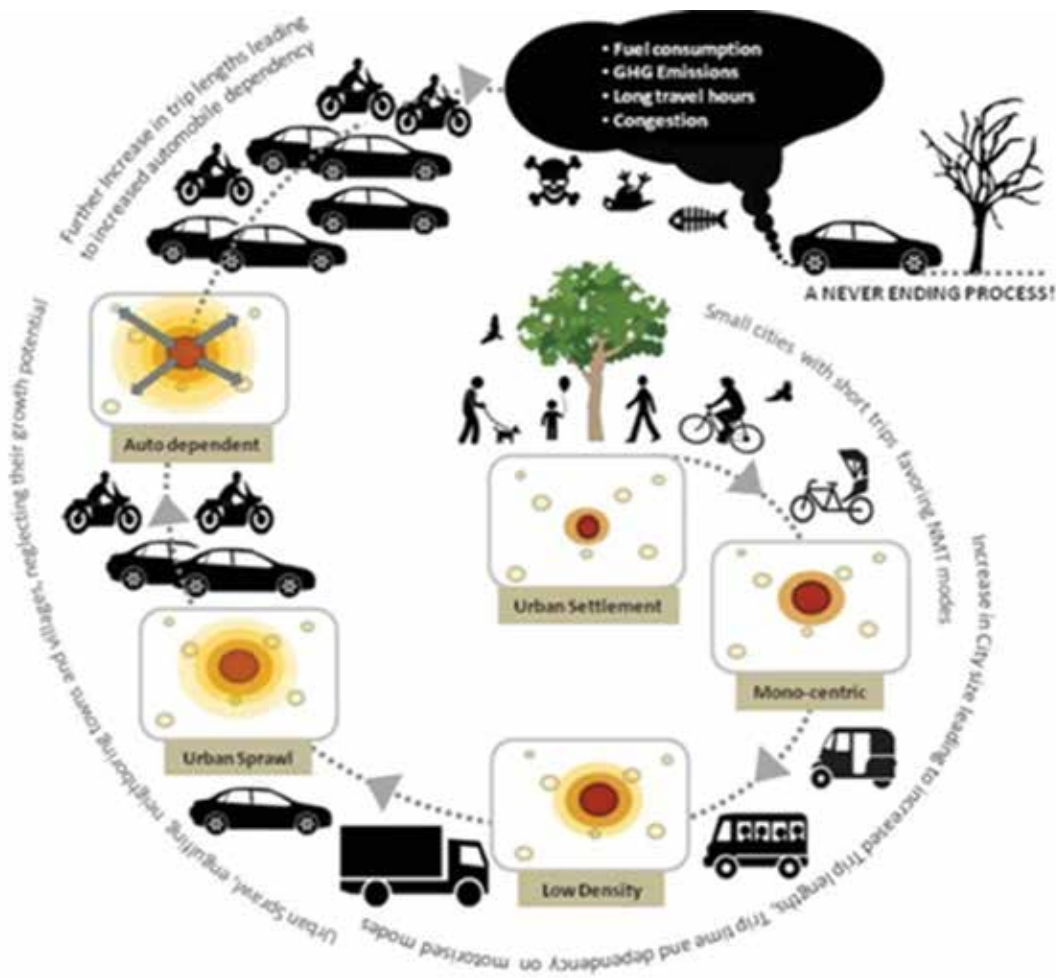


JnNURM	Jawaharlal Nehru Urban renewal mission
KUIDFC	Karnataka Urban Infrastructure Development and Finance Corporation
LIP	Local Implementation Plans
LRT	Light Transit System
LTA	Land Transport Authority
MoUD	Ministry of Urban Development
MRT	Mass Rapid Transit
MTRC	Mass Transit Railway Corporation
NUTP	National Urban Transport Policy
PTAL	Public transport accessibility level
RTS	Rapid Transit System
TDR	Transfer of Development Rights
TERI	The Energy and Resources Institute
TOD	Transit Oriented Development
TPS	Town Planning Schemes
TTMC	Traffic and Transit Management Centre
UMTA	Urban Metropolitan Transport Authority
URA	Urban Redevelopment Authority



# Executive Summary

Land use and transport are intricately related. While urban structure determines travel demand and transport supply influences urban structure. The location and design of 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 from both macro and site plan perspectives.



Typical development approach – A vicious cycle of demand and supply



Integrating urban development with transport has been considered key for moving towards compact and sustainable development of cities. The National Urban Transport Policy, 2006 in India also recognises “integrated land use and transportation planning” as one of the efficient tools for sustainable development.

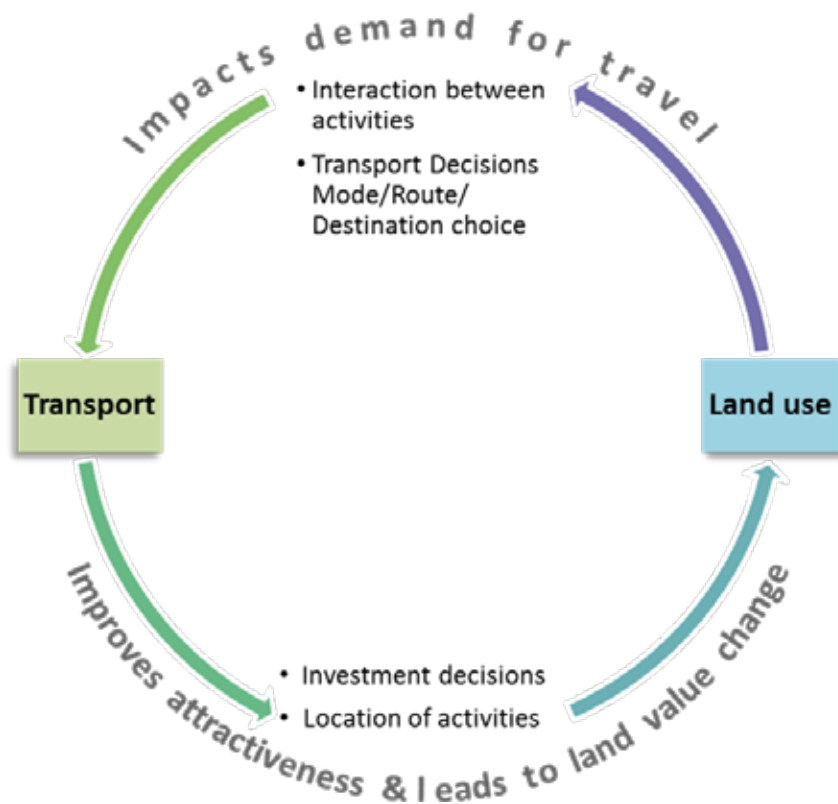
## Objectives of the Toolkit

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.

## 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.



## 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)

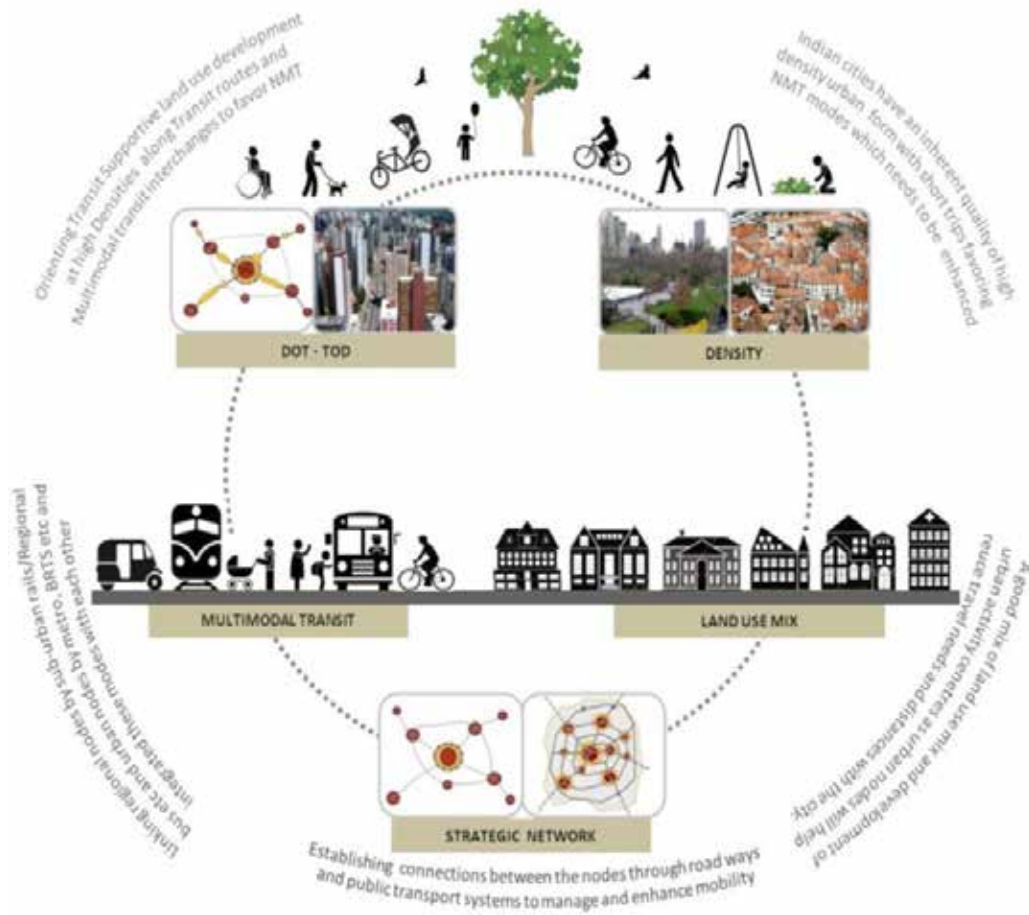


- Reduced vehicle emissions and higher quality of living environment
- Less time spent in travel and therefore higher productivity as well as quality of life
- Greater access to public transport and thus to jobs; additional health and quality of life benefits by enabling and encouraging more walking and cycling.

## How integrated 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.

Land use Transport Integration cycle



Source: Working paper on 'Concepts of Land use Transport Integration', CoE-UT, CEPT



## What are the key elements of integration?

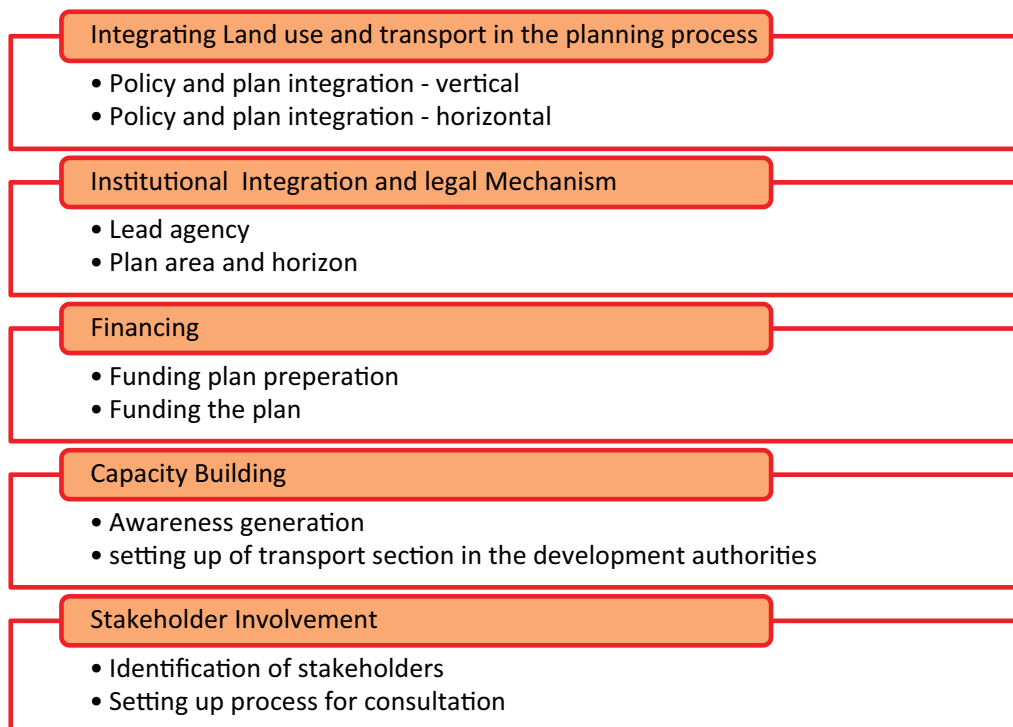
The integration of land use with transportation systems has to happen at all scale/ levels of planning and through multiple intervention mechanisms. The most important elements of land use transport integration are listed below:

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.

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

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

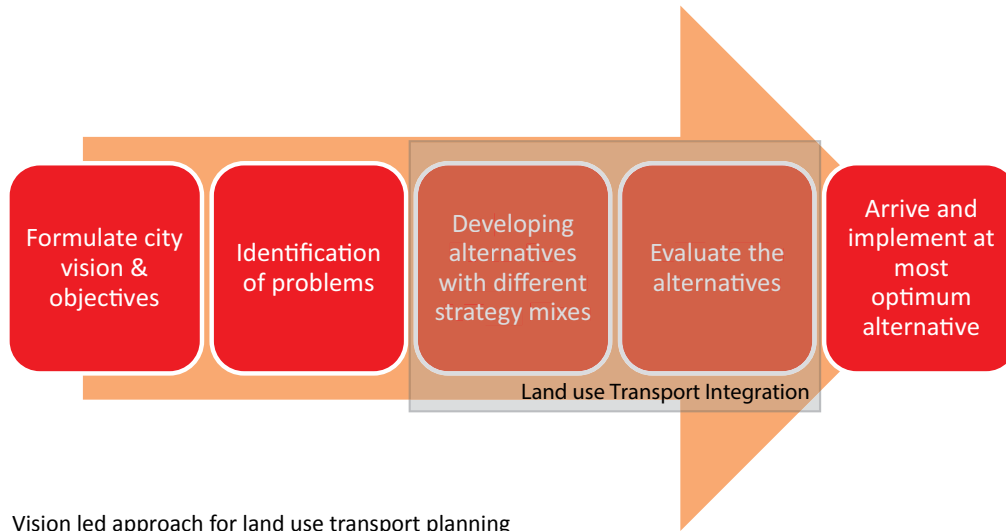


Enabling Mechanism for Land Use Transport Integration



## 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.

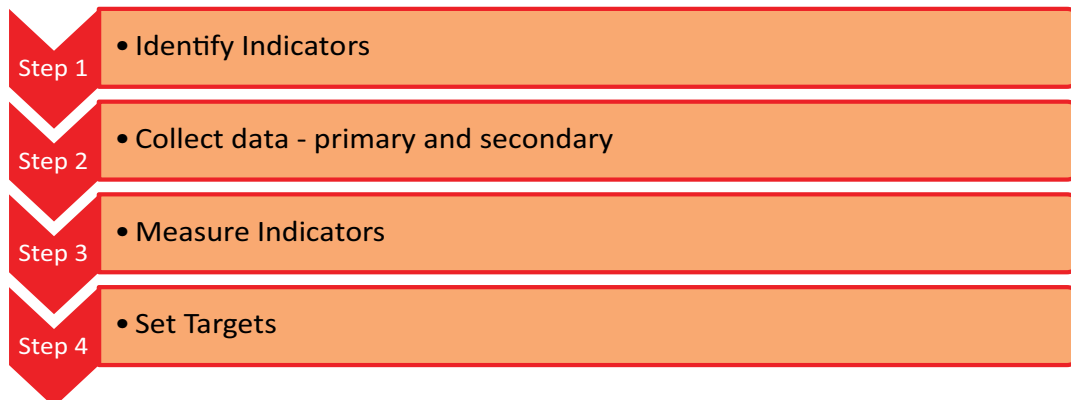


### Step 1 - Setting Vision and Objectives

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 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.

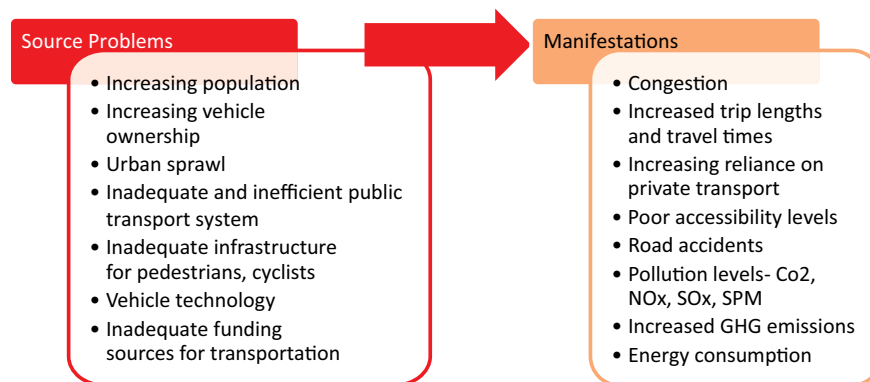


Problem Identification Cycle

### 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 23: Problem Identification

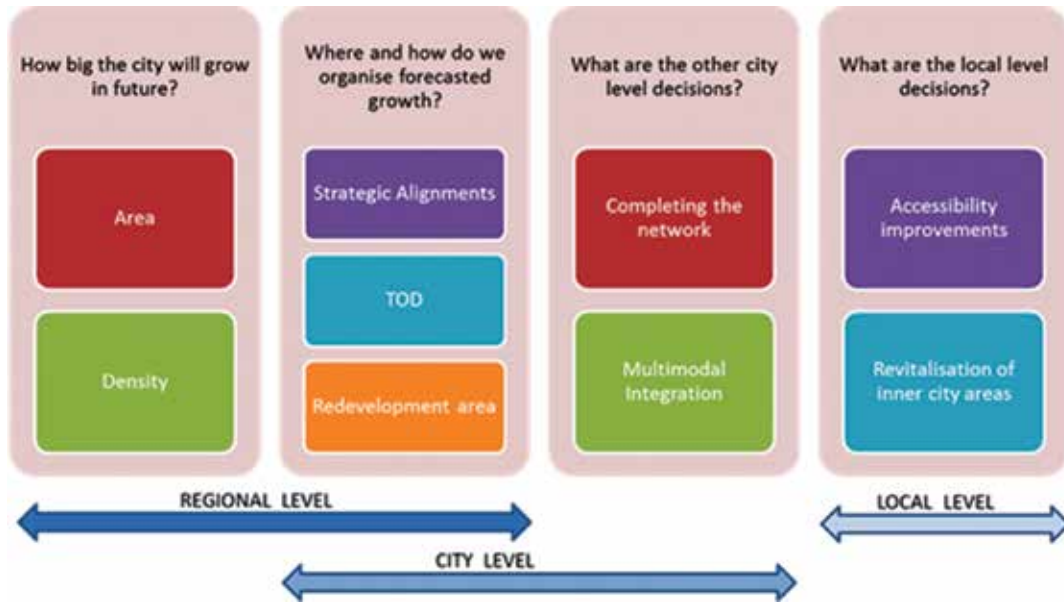


Source: Toolkit on Strategic Integrated Mobility Plan, Draft Report The World Bank 2012

## 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.

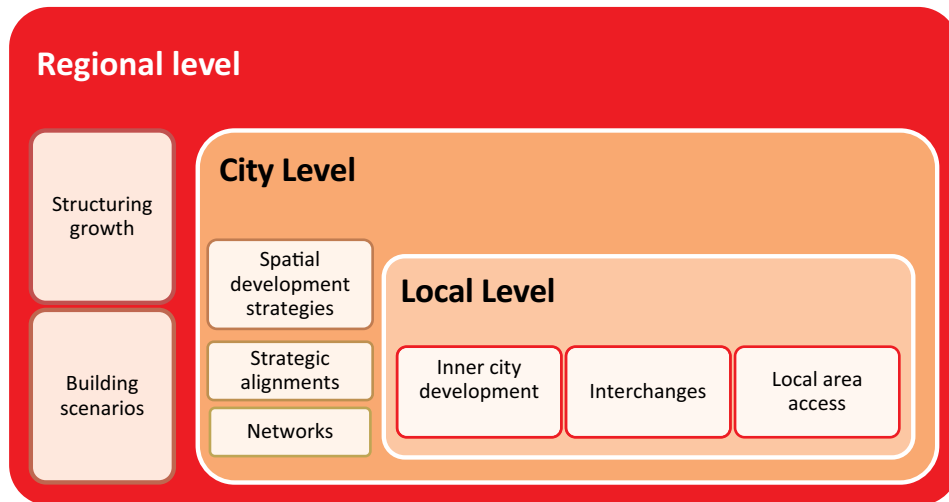




Key decisions in planning process

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.



Scales of implementation of Strategies



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

How big will the city grow in future?

### 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

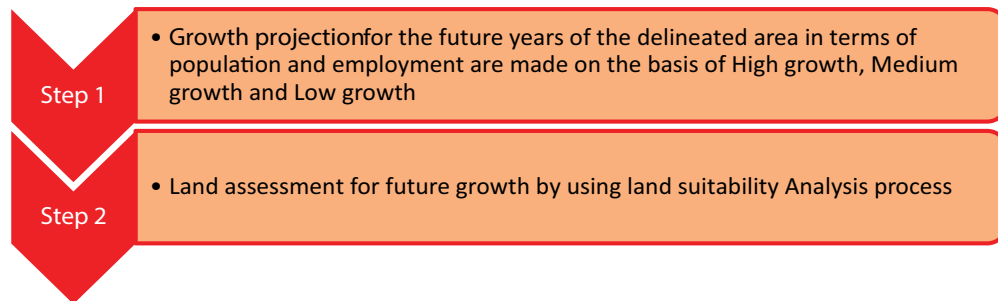
- in this case the same area can be adopted to decide on structuring growth

#### City does not have a metropolitan area

- The city will need to delineate a larger hinterland which has direct influence on the city

### Step 2: Forecasting Growth

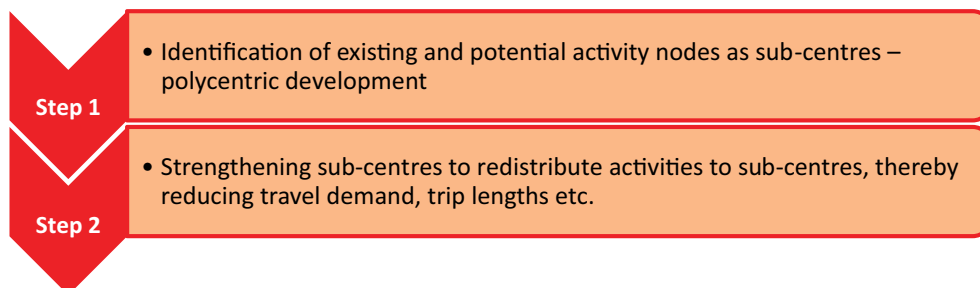
Growth scenarios for structuring the city will be developed at this stage.



## Where and how do we organise forecasted growth?

### 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.

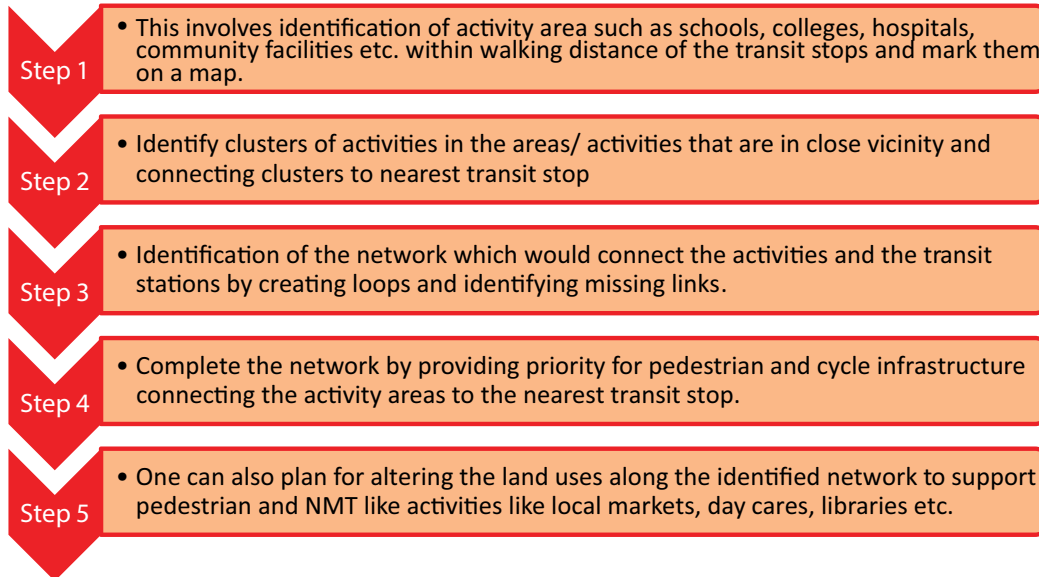






## Developing Scenarios

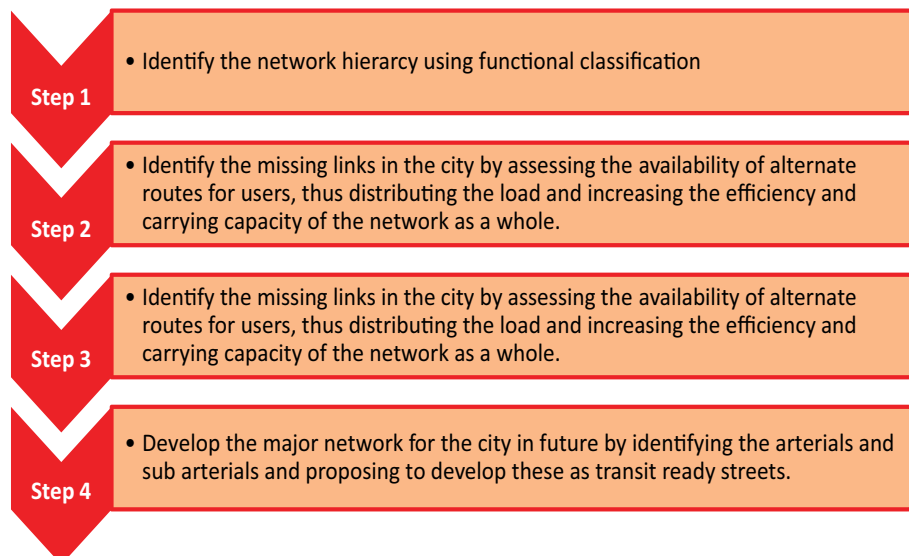
Using density as a tool, different growth scenarios for the projected population and employment are built to determine the future extent of the city.



## What are the land use decisions, transport decisions and the resultant land use-transport decisions at the city level?

### Decision on Network Development

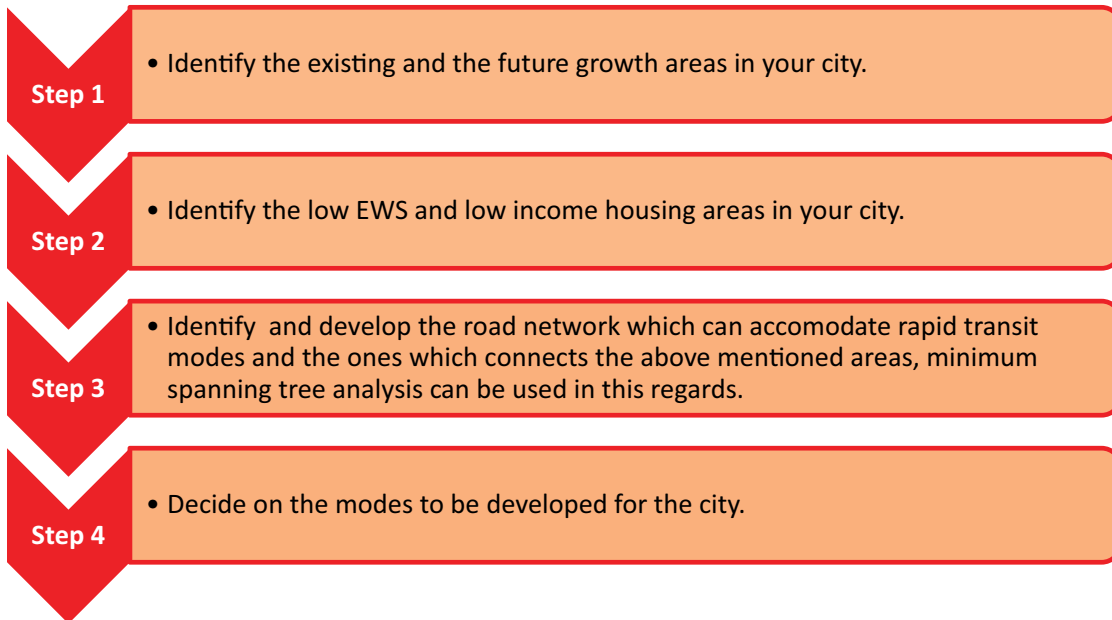
This involves the developmet of network pattern for the city depending on the existing pattern the city can choose ring radial, grid or linear pattern.





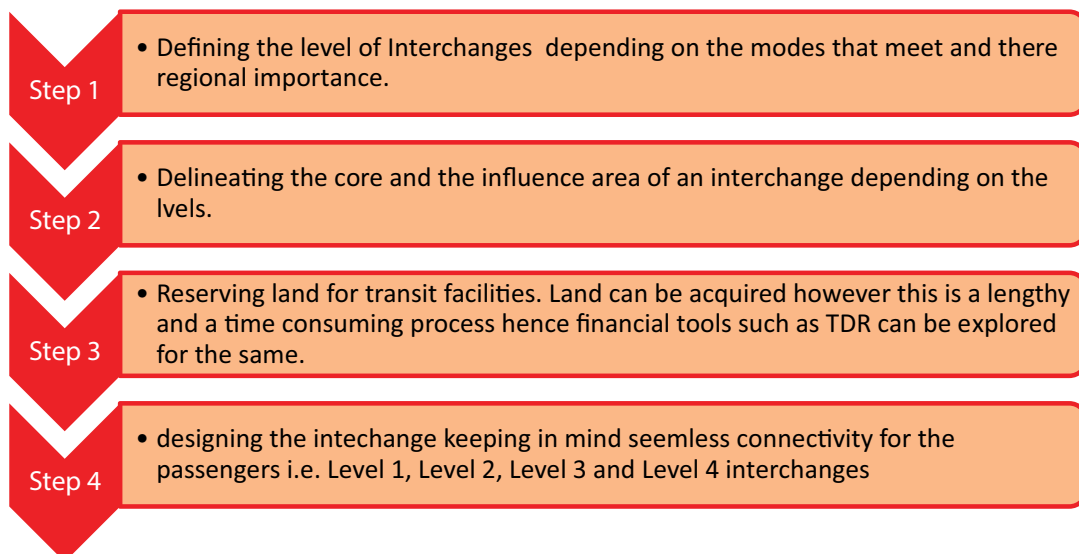
## Decision on Strategic Alignment of Multimodal Transit Network

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.



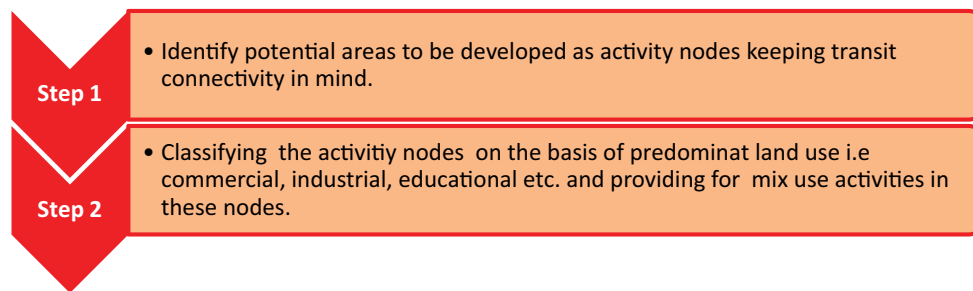
## Identification of Transit Interchanges and Activity Nodes

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

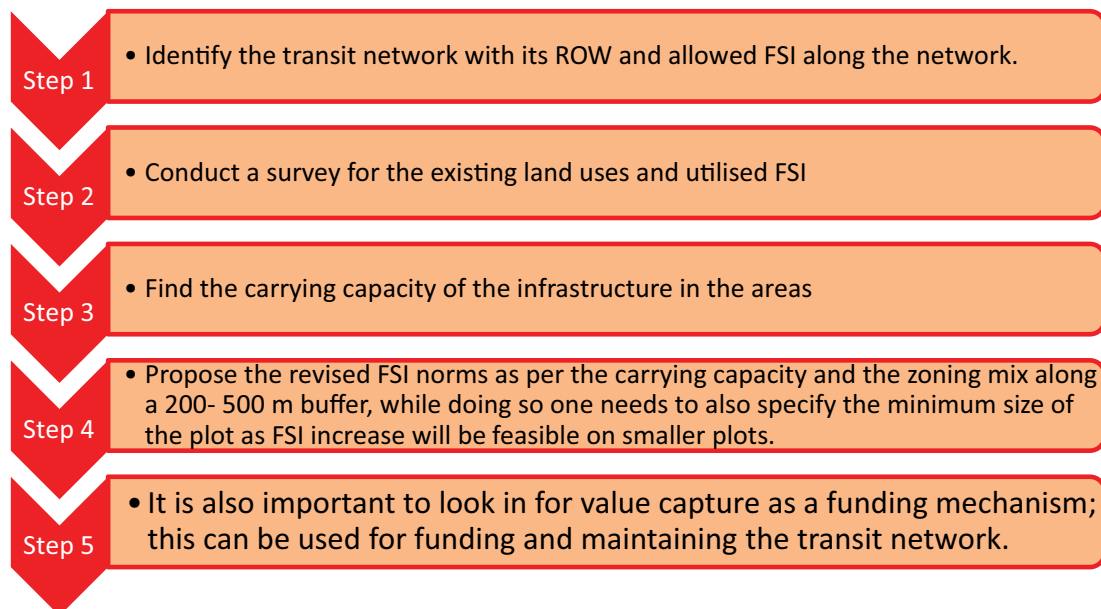




**b. Identifying activity nodes that are connected by transit system.**



## Transit Oriented Development



## 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-



- Step 1**
  - Decide on block size at which the strategy will be implemented as it has an implication on travel. Small block sizes should be adopted in such a way that walking distances to the public transport stops is not more than 500- 750m.
- Step 2**
  - Assess the urban fabric which is made of buildings, streets and open spaces as it help in providing the identity. Organized land use activity to encourage the use of NMV and pedestrian modes.

## Developing Local Area Access Plans

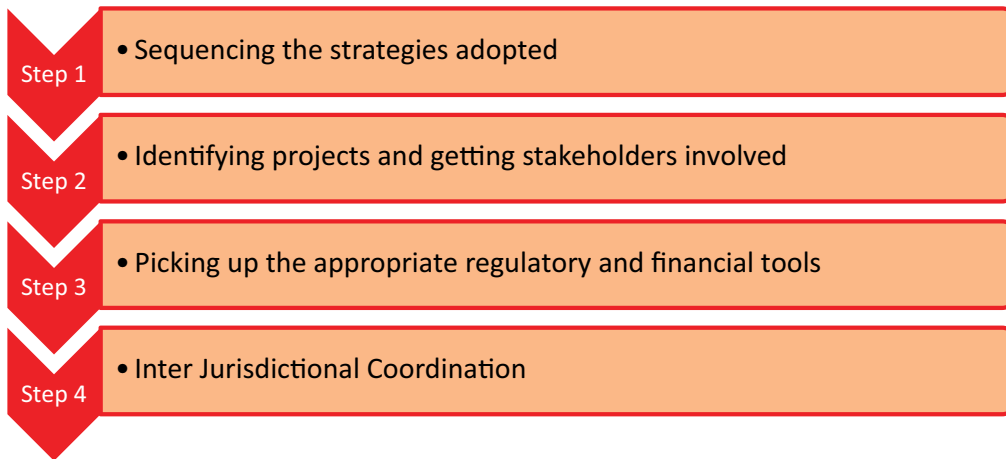
- Step 1**
  - This involves identification of activity area such as schools, colleges, hospitals, community facilities etc. within walking distance of the transit stops and mark them on a map.
- Step 2**
  - Identify clusters of activities in the areas/ activities that are in close vicinity and connecting clusters to nearest transit stop
- Step 3**
  - Identification of the network which would connect the activities and the transit stations by creating loops and identifying missing links.
- Step 4**
  - Complete the network by providing priority for pedestrian and cycle infrastructure connecting the activity areas to the nearest transit stop.
- Step 5**
  - 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.

## Developing Plans for Regeneration Areas

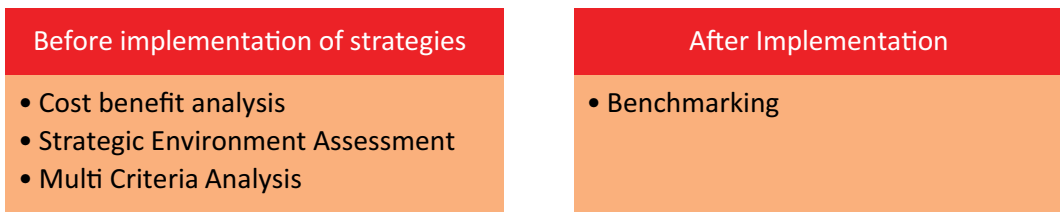
- Step 1**
  - Identify the different kinds of vacant or underutilized land in the core city area- Industrial derelict land/ mill lands, land under urban land ceiling, vacant public purpose land and public purpose reservation lands.
- Step 2**
  - Increasing the density in these areas by mix land use 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.



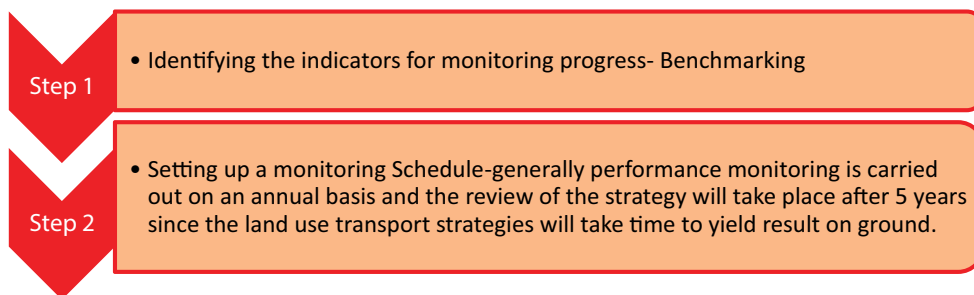
## What are the factors that facilitate the implementation of such strategies?



## How do you evaluate Land use Transport Strategies?



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





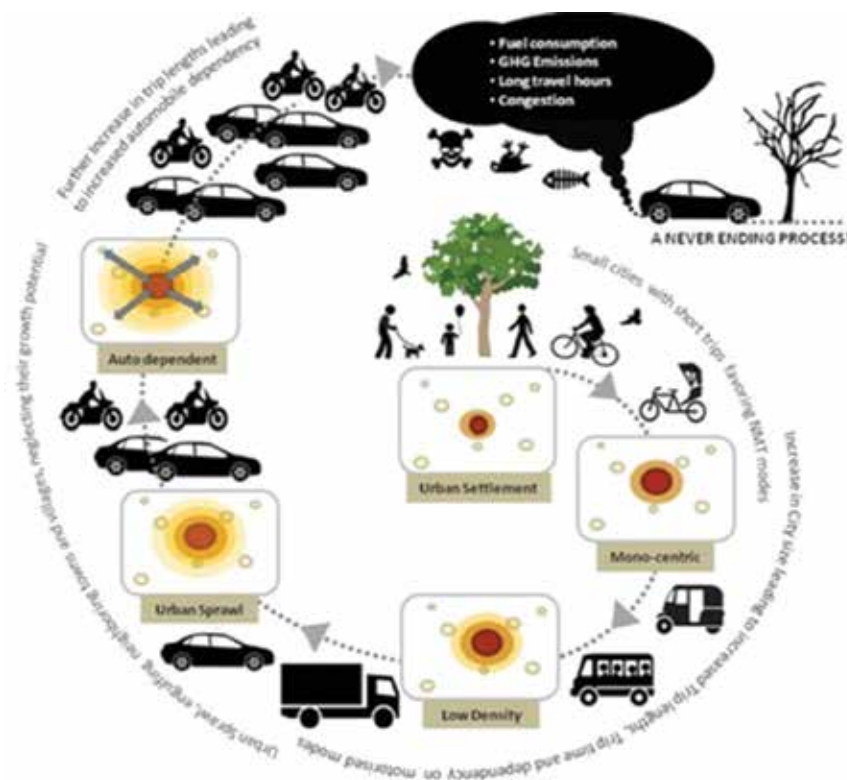
# Chapter 1

# Overview

## 1.1 Background

Land use and transport are intricately related. While urban structure determines travel demand and transport supply influences urban structure. The location and design of 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 from both macro and site plan perspectives.

**Figure 1.1:** Typical development approach – A vicious cycle of demand and supply



City structure and transport have influenced each other with the city shape and size being determined by the transport modes/technology. Traditionally, cities across the world grew organically and were centred around work centres. The cities were compact with the central market square and institutional buildings, distribution of commercial activities located along major streets. For cities to be accessible by walk or cycle, all destinations had to be within easy reach, thus leading to small and dense development of cities.

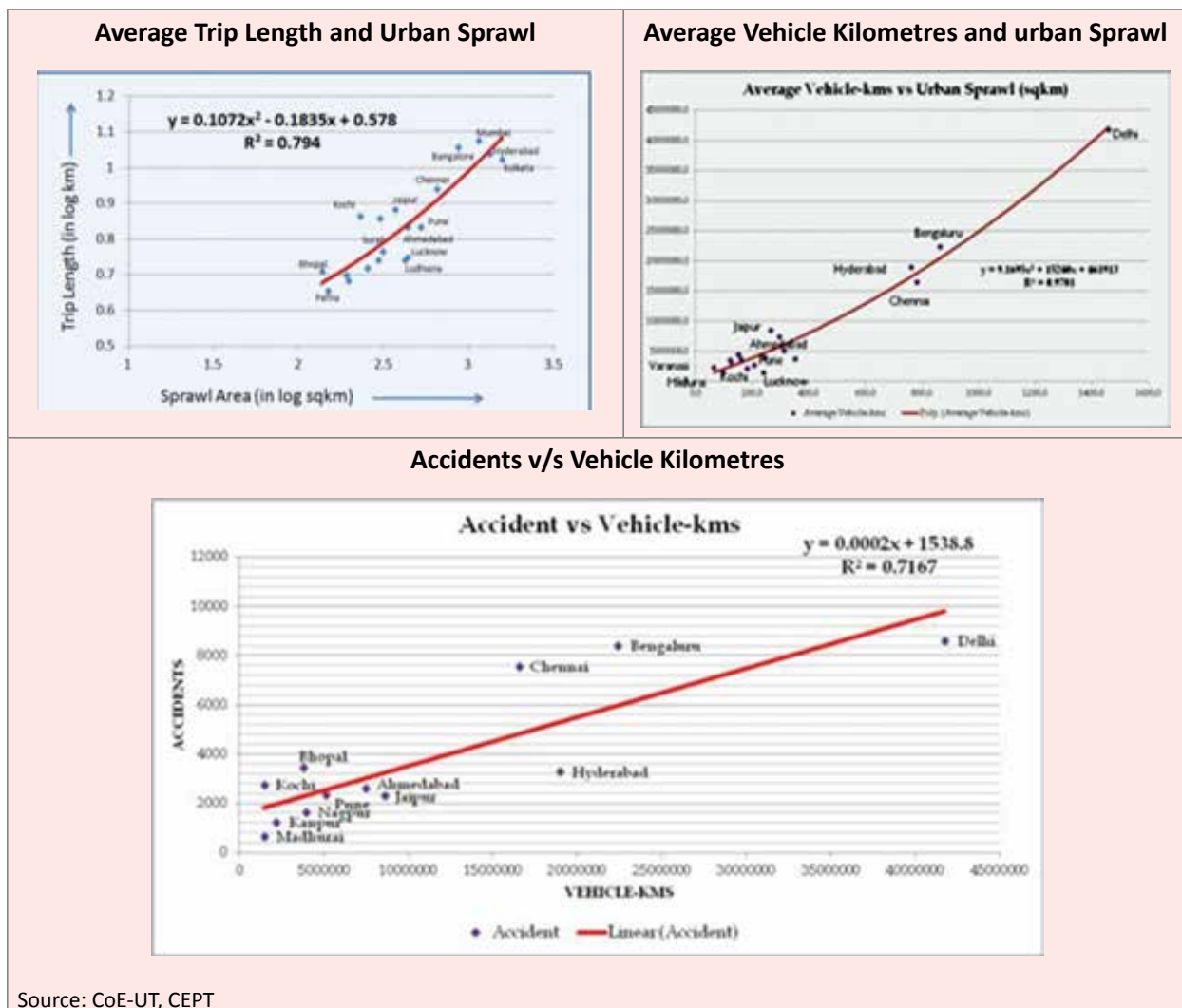


With the coming up of public transport modes like buses, trams, etc, cities grew bigger in size. However, all the urban development still had to be close to the tram/bus stops. These cities were thus larger but had concentrated developments around PT nodes.

With the advent of automobiles, the mobility of people increased and it provided them with the flexibility to stay in a better living environment, farther away from the city centre. As the private vehicle ownership grew, it led to the outward expansion of the city. The city sizes grew and with the increase in vehicular volumes, new wider roads were developed providing better mobility to access different places to fulfil daily needs.

Thus, this trend of increasing motorisation is leading to sprawling cities characterised by low density, longer travel distances due to increasing city sizes and dispersed development patterns, and resulted in road congestion and green house gas emissions, deterioration of environment, increased accidents and diminution of urban life standards. As per Alonso's theory, land values and population densities decline as one move away from the city centre. As the city grows larger because of urban sprawl, density decay curves become flatter. (Alonso & Sinclair)

Figure 1.2: Impacts of Sprawl



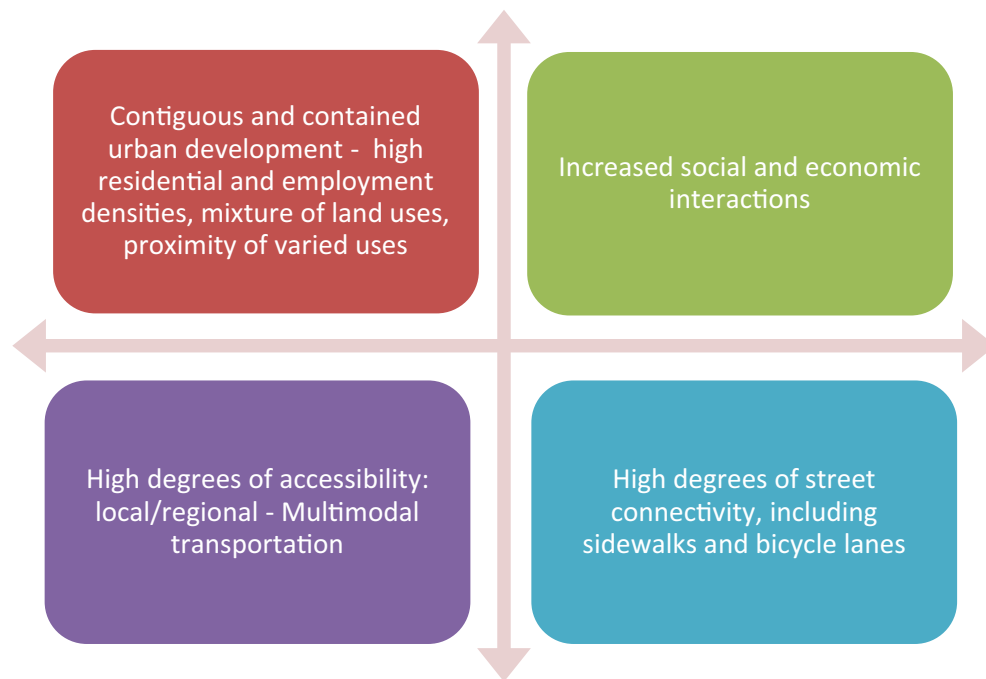




This present development trend and its impacts have caused worldwide concern on sustainability and sustainable development models to conserve the environment and its resources. It is argued by most researchers that the solutions to sustainable development lie in the very historic model of compact city development. (Jenks, Burton, & Williams, 1996)

Compacting the city is argued to be a manner in which travel distances within it could be reduced, thereby reducing emissions and greenhouse gases. (Mayer, 1996) Compact city is defined as an urban containment which provides a concentration of socially sustainable mixed uses that will concentrate development and reduce the need to travel. Compact city characteristics is defined as: (Neuman, 1994)

**Figure 1.3:** Characteristics of a compact city



Integrating urban development with transport has been considered key for moving towards compact and sustainable development of cities. The National Urban Transport Policy, 2006 in India also recognises “integrated land use and transportation planning” as one of the efficient tools for sustainable development. The current planning practice in Indian cities entails undertaking land use planning as a separate exercise without considering its effect on transport. Transport planning on the other hand is mainly focused on providing solutions to the resultant problems and largely focuses on road improvement measures. It is therefore important that the cities undertake an integrated approach towards spatial and transport planning in order to ensure integrated land use transport decisions.

## 1.2 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.



## 1.3 Users of the Toolkit

This toolkit would provide guidance to city officials involved in the preparation of strategic land use and transportation plans.

## 1.4 Scope of the Toolkit

This toolkit would provide guidance to city officials and consultants involved in the preparation of strategic land use and transportation plans. It would also facilitate the decision makers in assessing and understanding the impacts of different urban transport projects. It should however be noted that this is a generic document on the tools and processes which may be adopted, and would need to be tailored by cities taking into account the local context.

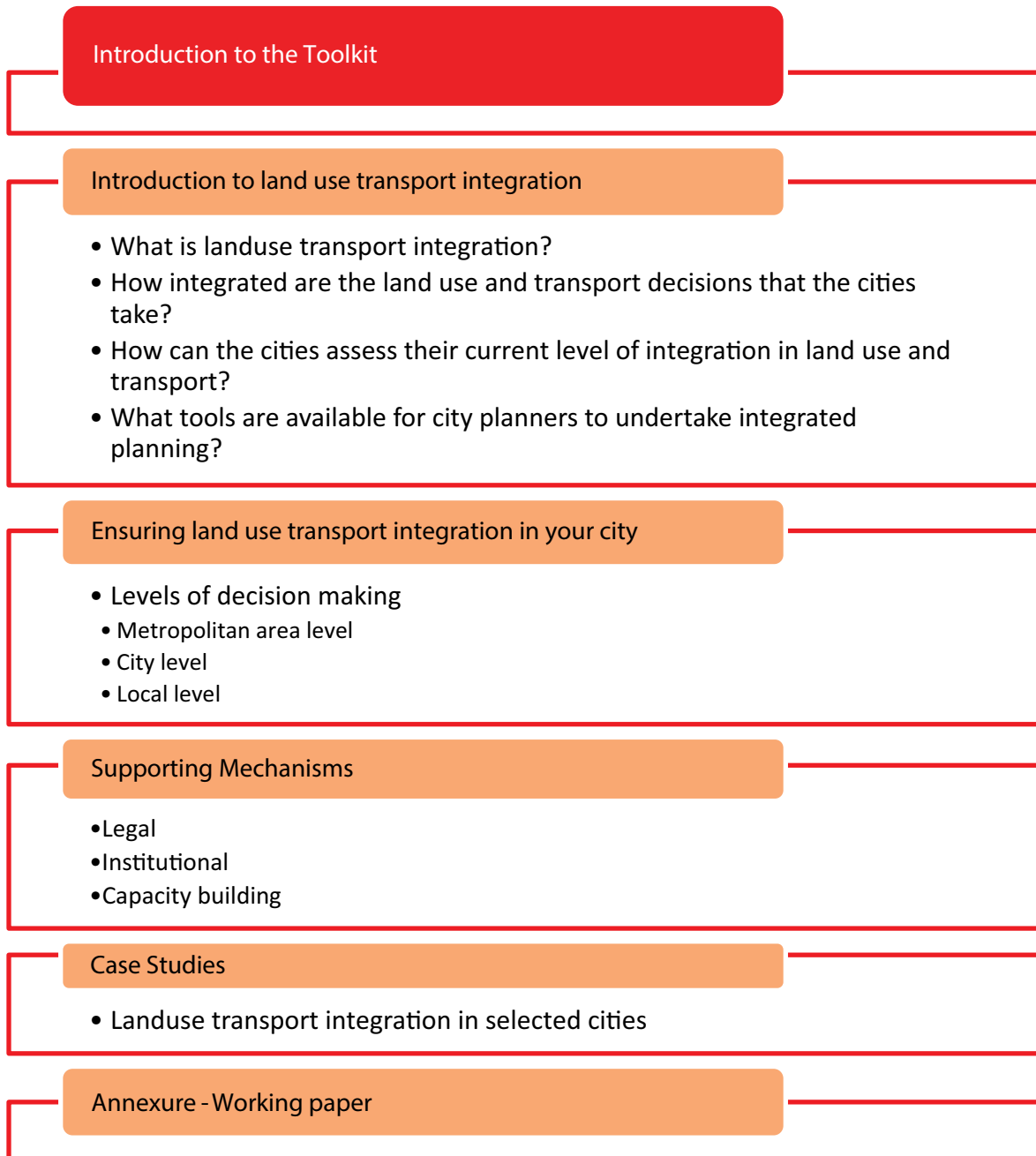
- Guidance to decision makers at city level
- Provide understanding of:
  - the concept of land use transport integration
  - benefits of land use transport integration
  - ill effects of lack of integration in land use transport decision making
- Provide a framework for:
  - Assessing as to how far, in their city, land use transport planning decision making is made in an integrated manner?
  - A framework for identifying aspects of LUT integrated decisions needing attention/ have potential for improvements
- Provide a step by step procedure for:
  - Comprehensive City level integrated LUT planning
  - Partial interventions
- Present good practices

Several best practice cities across the world have been studied for their integrated spatial and transport planning approach and these are also presented as a part of this report.



## 1.5 Structure of the Toolkit

The toolkit is developed in three parts as given below-





## Chapter 2

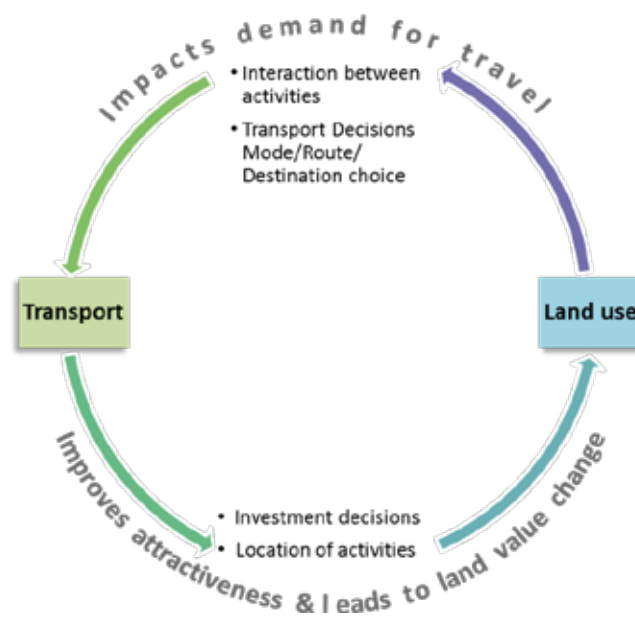
# Land Use Transport Integration- Concept and its Elements

This chapter aims to provide an understanding of land use transport integration.

## 2.1 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. While allocation of land uses impact demand for travel as people need to access different activities, transport infrastructure adds to the attractiveness of a location by improving accessibility and leads to change in land values. With improved accessibility, the locations become attractive for investments and it results in further development of these locations.

**Figure 2.1:** Interrelation between land use and transport



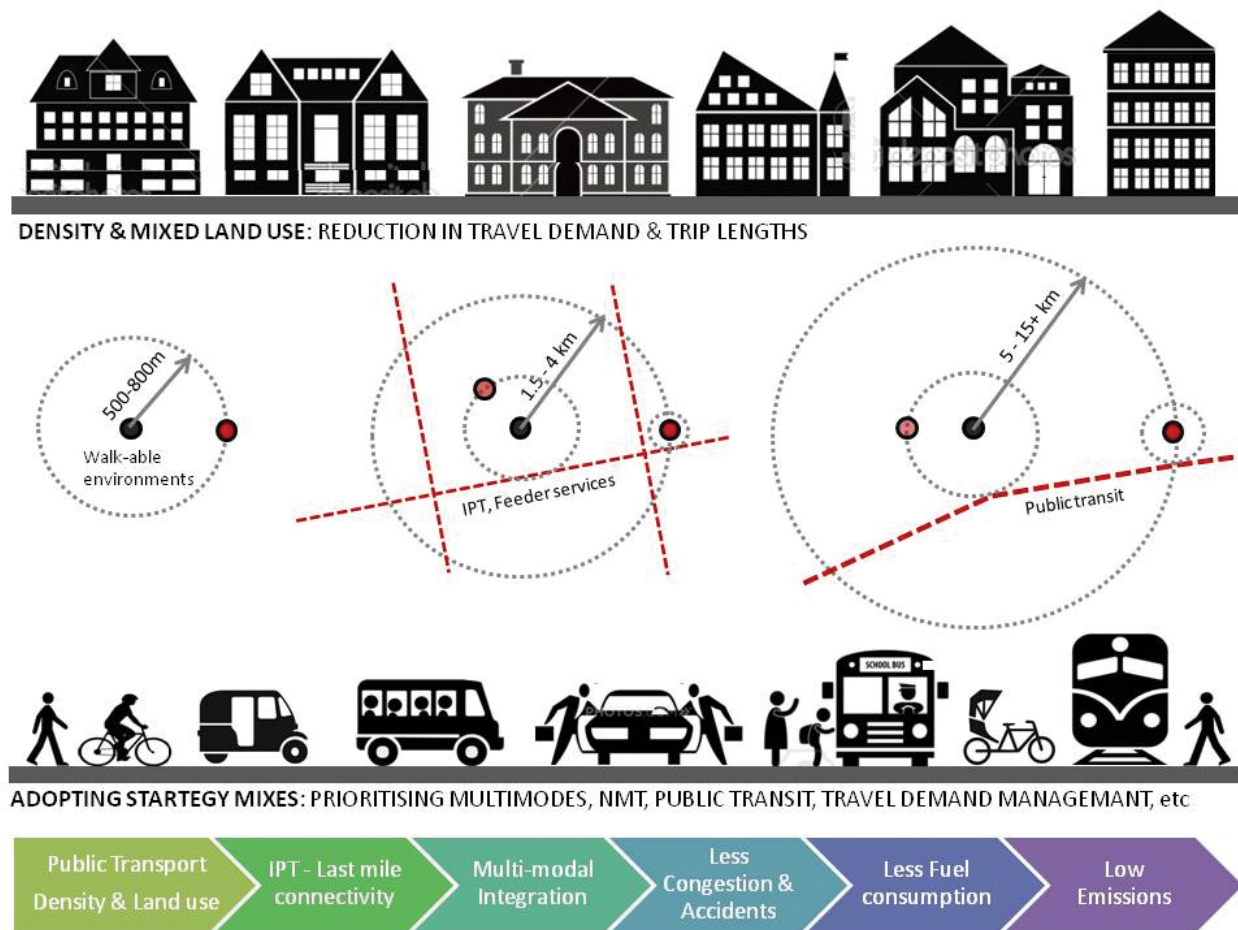
**Integrating land use and transport thus involves two simultaneous mutually supportive processes:**

- Organizing the physical form and land use pattern of a city such that travel demand, trip lengths and travel times are minimized, while accessibility, comfort and efficiency are maximized.
- Organizing all systems of transportation from pedestrian pathways to mass transit systems such that they integrate well with each other and enable the harmonious establishment of land uses around them, in the process generating a city form that is sustainable.



The figure below depicts the type of transport and spatial development as a city grows. While the city is small and compact, its activity nodes like the business district, markets, educational and other institutional centres are closely located and hence it becomes accessible through NMV modes. As the city grows, strategic linkage of these activity nodes with public transport systems makes these compact cities to grow in a more sustainable fashion. Moreover, distribution of mixed land uses at neighbourhood levels also, further facilitates shorter trip lengths and mobility through NMV modes.

**Figure 2.2:** High density, mixed land use and Transport strategies to help reduce trip lengths and travel demand



Hence there exist a relation between high density and mixed land use to trip lengths. The transport and land use strategy mixes along with a supportive urban form of the city further helps reduce the travel demand and automobile dependency. This shift to sustainable modes of travel helps reduce fuel consumption and resultant GHG emissions.

It is observed that in urban areas, land use distribution across a city determines the nature of mobility within and from neighbouring towns and villages. Similarly presence of a transit facility alters the land use of an area. This interrelation and interdependency between land use, transport and environment is as shown in Figure 2.1. This interaction of urban spatial patterns, its land use and transport, and its resultant impact on environment is vital to be understood and explored for efficient planning and development of cities.



Spatial Development of the city – impacts – social, environment, economic

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.

## **2.2 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.

## **2.3 How integrated are the land use and transport decisions that the cities take?**

The Indian cities undertake preparation of both spatial as well as transport plans. While, the preparation of spatial plans which are more commonly known as ‘Development Plans/ Master Plans’ statutory in nature, transport plan preparation is undertaken by cities when they perceive their need. Therefore, while spatial plans are prepared every ten years, transport plan preparation is ad-hoc and not regular.

The spatial plans are statutory plans prepared by the Urban Development Authority for the city area and developable area in the plan horizon (15-25 years). They consist of two parts:

- A. Land use plan, and
- B. Development control regulations to implement the land use plan

The primary objective of such spatial plans is to provide a framework for accommodating anticipated growth including basic infrastructure while protecting/ preserving natural resources. The output also defines, though in a limited way, the future transport network and nodes (and other facilities) without explicit regard for interactions between various land uses/ activity sub systems.

The transportation plans or transportation studies are generally undertaken by cities when transportation problems become a politically-driven priority rather than a continuous process as in land use planning. Thus, transport plans and spatial plans are taken up as exercises independent of each other. Transport



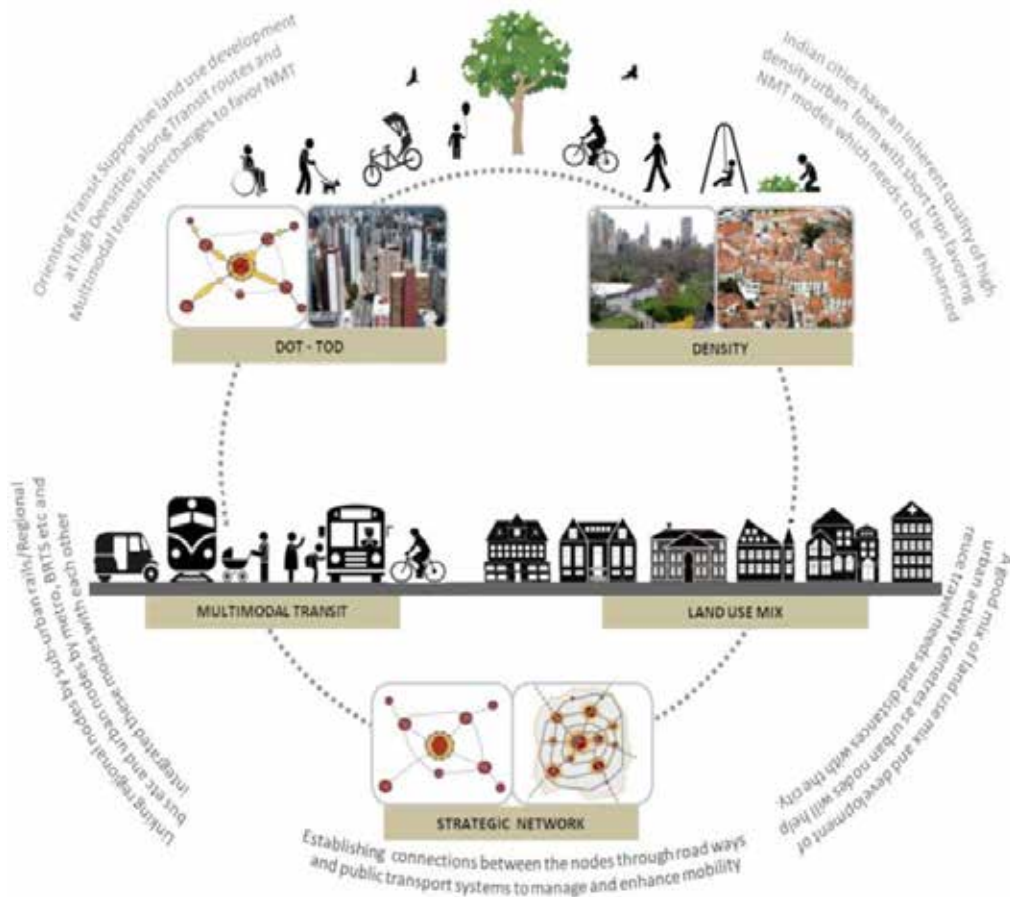


plans are usually based more on modelling results (often with a preordained outcome, e.g., plan to build more elevated highway flyovers and ring roads and a metro) than on achieving a vision that includes land use and transport. Thus, planning becomes an engineering exercise, identifying spot solutions with a demand follow approach. In the master plans, the road network and hierarchy gets defined at a broad level. However, at micro level there are problems of missing links, inconsistent hierarchy and little attention is given to the relationship of roadways, public and non-motorized transport.

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.

## 2.4 What tools are available for city planners to undertake integrated planning?

Figure 2.3: Land use Transport Integration cycle



Source: Working paper on 'Concepts of Land use Transport Integration', CoE-UT, CEPT





The following concepts of urban development and transport planning, when planned in an integrated fashion, will enable efficient land use transport integration. For further details on the concepts, refer Annexure 1 (working paper on 'Concepts of Land use Transport Integration', CoE-UT, CEPT) of the toolkit.

**Density:** Intensity of development – concentration of activities and people. Higher densities enable more people to reside in a smaller area. This thereby reduces the demand and utilization of resources for infrastructure development for the same. Dense urban fabric allows cities to remain smaller in size, thereby reducing the travel distances within the urban settlement.

**Land use Mix:** A good mix of land use within an urban fabric will ensure self contained neighbourhoods and a city. Land use mix will ensure that a variety of facilities like jobs, education, entertainment etc are available within walking distances or accessible by other non-motorised modes, from the place of residence. This thereby will reduce the need for travel through motorised modes. Major city level activities and land uses need to be clubbed at certain nodal points within a city. This will ensure that one can engage in multiple activities at a single urban node.

**Strategic Network:** The various activity nodes when linked with a good network of roads and an efficient mass transit system will enhance accessibility within the city. Linking all major activity nodes with mass transit will ensure more public transit patronage, a more sustainable mode of travel.

**Multimodal Transit:** The various modes of transport when linked with each other in an efficient manner will enhance mobility of a city. This will include physical integration of the various modes in a manner that there is minimum distance to walk and minimum time taken to transfer from one mode to the other.

**TOD and DOT:** While transit systems are strategically aligned to connect major development/activity nodes of a city, there exists a reverse reaction of; development following mass transit systems. This principle/ concept of Development Oriented Transit and Transit Oriented Development ensures land use transport integration in cities.

## 2.5 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

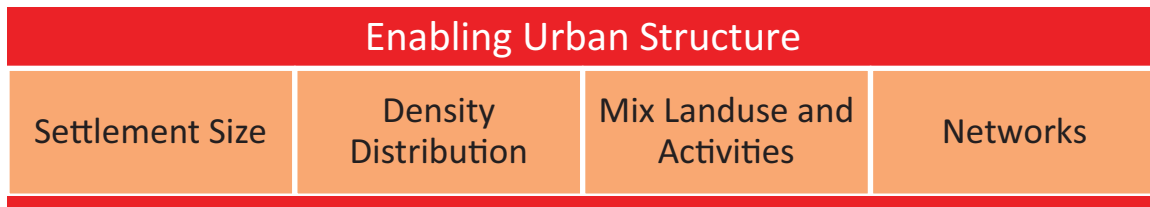
Apart from the above mentioned elements Inter jurisdictional coordination is also important overarching aspect.



### 2.5.1 Enabling Urban Structure

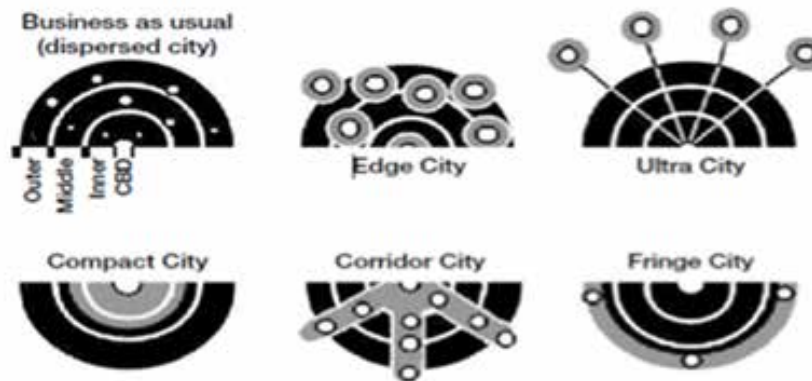
While there are many elements that constitute the physical form of the city, the below are critical to land use transport integration. These characteristics have a direct impact on travel patterns and are in turn impacted by the characteristics of the city's transportation system.

**Figure 2.4:** Aspect of Enabling Urban Structure



**1. Settlement pattern and Size:** It refers to the number of houses within a contiguous built-up area. It is important to note that cities need to keep a small settlement size in order to reduce the trip lengths. Hence infill areas and regeneration areas need to be identified and used for future growth before identifying new growth areas.

**Figure 2.5:** City Structure Options for Urban Growth



**2. Distribution of population density:** Cities will need to adopt density as a tool to keep the settlement size small. Density is viewed in the form of gross densities and the current density should be used as a reference point to plan for future densities. In order to achieve a compact city form a high density scenario is desirable. However the cities should also understand that one cannot just increase the density considerable since most of the city will already be built up and the scope for increasing the density is hence limited to regeneration and vacant land development. The following density ranges can be used as a guideline to understand the concept of high and low

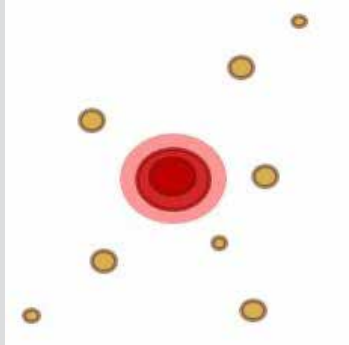
**Table 2.1:** Density Ranges

Size of the city	High Density (PPH)	Reasonable Density (PPH)	Low Density (PPH)
Large cities / Metros	Above 125	Above 100	Below 100
Medium and Small size cities	Above 75	Above 60	Below 60

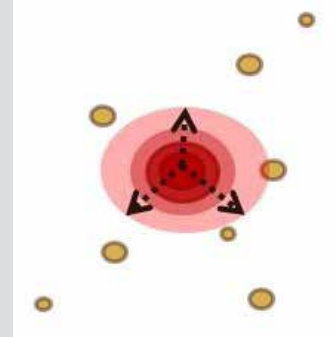


**Figure 2.5:** Settlement Scenarios

**Sprawl Scenario**

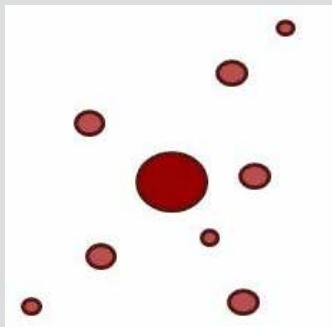


The urban sprawl as city grows in size without recognising the growth trends, travel patterns and demand with the neighbouring centres.

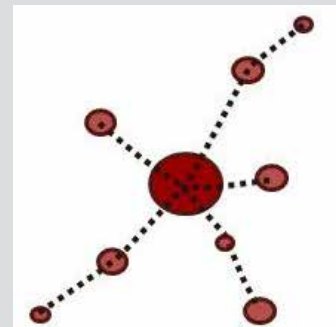


The city would extend engulfing neighbouring towns and villages, thus resulting in increased trip lengths, travel time, CO2 emissions etc

**Growth Management Scenario**



Identifying growth centres and distributing growth in the neighbouring growth centres



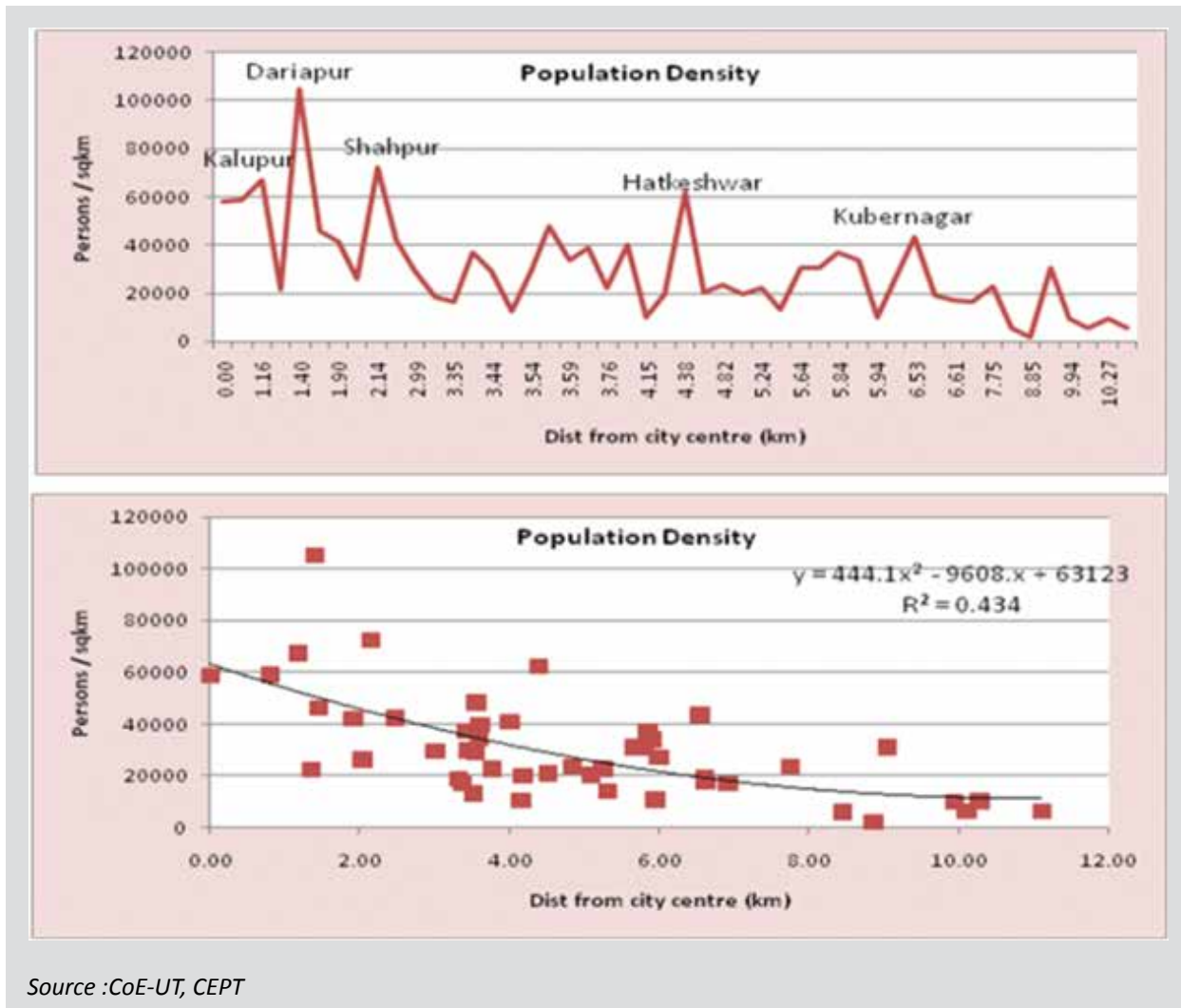
Linking the growth centres with the parent city with regional connectors (highways/rail etc.)

Source: CoE-UT, CEPT

It is also observed that in case many Indian cities a polycentric structure already exists and it is also observed that as we move away from the city centre the density tend to decrease as shown in the figure below-



Figure 2.7: Population density versus distance from city centre



Source :CoE-UT, CEPT

Urban Spatial structure refers to the inter relations between urban form and its underlying interaction of people, freight and their movement. Studies have explored the manner in which one can assess the basic concept of structuring urban form. A set of indices developed like <sup>1</sup>Centrality index, <sup>2</sup>Size index, <sup>3</sup>Coverage index and <sup>4</sup>Attractiveness index help in determining the urban structure. These qualitative measurement tools of spatial structure using movement data can be used to help develop insights into urban dynamics and its planning. (Zhong, Huang, Arisona, & Schmitt)

- 1 Centrality index measures how central an area is in terms of attracting people to do various activities and it is a combination of diversity and density functions.
- 2 Size index measures how large the centers are geographically
- 3 Coverage index measure the spatial influence of the centre, defined by the average distance people are willing to travel to the centre.
- 4 The attractiveness index measures the intensity of the force that attracts people to one centre, and it is based on size and coverage



The strategy to intensify population densities in urban areas, more specifically along transit lines is gaining in popularity among cities. This is expected to contribute towards urban development in three different ways:

- i. Higher densities means increased use of public and non-motorised transport
- ii. Higher densities would also reduction in the area to be developed per unit population and the consequent reduction in the capital cost of building water, drainage, sewerage, sewerage and other networks, and
- iii. In the process capture a portion of certain value created through improved accessibility.

While benefits of high densities appear attractive, there are still puzzles in the minds of policy makers about the viability of this proposition. The questions are:

- i. Is it viable to increase population density in our cities which traditionally have had higher densities?
- ii. How does the relationship between the cost of infrastructure development and densities vary with sectors?
- iii. Is available infrastructure adequate? If not is it possible to augment?

Higher Population Density generally results in lower per capita infrastructure costs. Due to lower capital costs and lesser pipe lengths, the operation and maintenance costs are also lesser.

### **2.5.2 What are the infrastructure challenges in densification?**

The decision to densify existing urban area has the following challenges:

- a. Adequacy of Infrastructure such as Water and Sewerage.
- b. Condition of the existing infrastructure.

Generally the decision to densify by allowing higher FAR is along wider roads with the facility of public transport. Most case studies also indicate that the larger trunk lines are laid along this route due to wider road widths available unless specific dedicated utility corridors are provided which are not generally provided

### **2.5.3 What are the implications on infrastructure maintenance?**

In the process of urbanization, provision of the infrastructure is a major challenge within cost constraints and time for infrastructure implementations. The present trend is to provide infrastructure in the initial stages of development. The following infrastructure is mainly provided in any existing or upcoming urban area:

**Table 2.2:** Infrastructure cost

Utility Infrastructure	Factors Affecting Design/Cost	Factors Affecting operation or maintenance/Cost
Roads	Road length and width	Surfacing
Water Supply	Source, network length, population density along roads, topography	Treatment, pumping, network maintenance
Sewerage	Network length, population density along the roads, topography, treatment and disposal location.	Treatment, pumping and network maintenance
Storm Water	Network length, built up area along each road (imperviousness), topography, disposal point	Network maintenance
Electricity	Network length, population density along the roads	Network maintenance

However the maintenance of the same should also be considered as it would impact on the overall budget of the municipal authorities in maintenance. Hence it is seen that the compact development leads to lower network requirement and the densities favour it in terms of economics of scale by reducing the per capita cost.

**1. Distribution of “centres” (concentrations of activity) Mix of land uses:** As the city population and size increases the trip lengths also tend to increase in order to make the transport system efficient it is important to start creating more activity centers and mix use development. The number of centers would vary from city to city however one thing should be kept in mind that few centres would lead to concentration of trips leading to congestion however too many would lead to very dispersed trips and would lead to difficulty in planning for rapid transit systems in the city.

**2. Transport network:** well defined transport networks will lead to efficiency of movement within the city. This may be characterized by complete networks with proper hierarchy as they would result in the reduction in the travel time of the people.

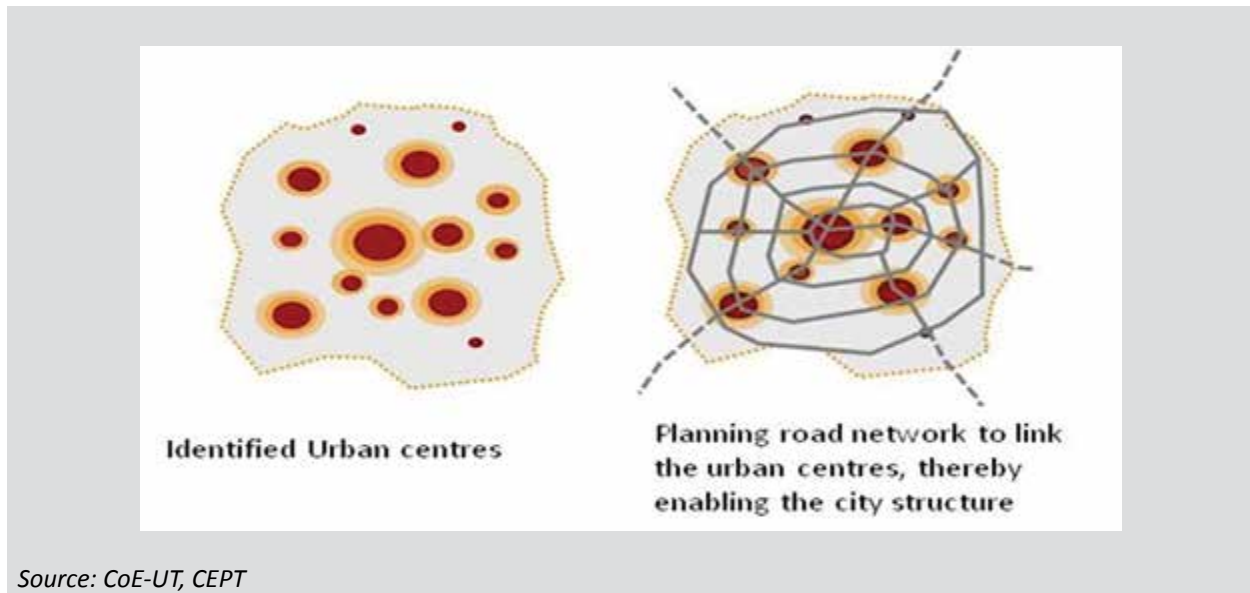
#### 2.5.4 Complete Network and Complete Streets

When cities are made more compact in terms of physical form and in terms of functional interrelationships (mix of uses), it is expected that trip lengths will reduce and the modal choice will shift only towards public transport, but also towards pedestrian movement and non-motorized traffic. In that situation, the efficiency of the road network at macro and micro levels becomes very important. So does the usability of the street for all modes of movement (and not just motor vehicles).





**Figure 2.8:** Completing networks



Source: CoE-UT, CEPT

Efficiency of the network is defined by-

- a. **Pattern:** The road network forms the backbone of the city structure. It is observed ring radial pattern at the city level is the most efficient especially in case of large size cities, as one zooms down at the zonal level grid iron would also prove efficient. However in case of small size cities one may find the grid iron pattern or the radial, star or linear pattern to work as efficiently at the city level. In most Indian cities, partly due to organic growth and partly due to sluggish implementation of plans; the road network is incomplete and lacks an effective pattern.
- b. **Completeness:** Along with a clear pattern for the network to be efficient it needs to be complete so that there are no missing links. Completeness of the network is required for achieving the following:
  - Availability of alternate routes for users, thus distributing the load and increasing the efficiency and carrying capacity of the network as a whole
  - Shorter trip lengths
  - Higher accessibility of public transport, thus encouraging public transport use
  - Safety and comfort of pedestrians and NMV users, thus enabling walking and cycling as significant modes of movement

Similar to complete network, “Complete Streets” also play a very important role in achieving an efficient road transport system. Following are the principles of complete streets:

- **Safety:** Ensure safety of users of all modes provide separate lanes for different modes, speed limits, dedicated signal phases for pedestrians and cyclists, pedestrian crossings at regular intervals, subways or bridges for crossing roads, where required etc. One must realize that this may not be feasible everywhere, hence a judgment needs to be taken on the basis of space availability and need.



- **Vending activity:** Streets vendors are one of the regular users of streets. If they are not considered while designing a road, they encroach pedestrian pathways, parking areas etc. Hence designated street vending areas are provided on complete streets. Availability of vending areas also keeps the roads active and provides sense of safety.
  - **Accessibility:** Complete Streets are designed in a way that they avoid traffic congestion and provide easy access to all the users with reduced time delay.
  - **Equity:** They provide universal access by designing all road elements for convenience of disabled people.
  - **Sensitivity to local context:** Complete streets are designed considering, local street activities, movement pattern and adjacent land uses.
  - **Interactive spaces:** In India roads are constantly treated as public interactive spaces. Old age people enjoy sitting on street benches and chatting for long. Thus street furniture is smartly designed to provide soothing atmosphere to cater the need of people and keep streets lively all the time.
- c. **Hierarchy:** The hierarchy of the network is also important to improve the efficiency. The following can be used as a guideline to define the hierarchy of the network:

**Table 2.3:** Road Functional Classification

Road Classification	Definition
Level 1 "ARTERIAL" – Formulates the pattern or form of the city"	<ul style="list-style-type: none"> <li>▪ All radials and rings that are 80% completeness</li> <li>▪ National Highway and State Highway</li> <li>▪ Orbitals roads that are long and that cut across the city.</li> <li>▪ Roads, which are helping in forming the shape of the city i.e. ring / radials / Grid form</li> </ul> <p style="text-align: center;"><b>OR</b></p> <ul style="list-style-type: none"> <li>• Roads that have right of way</li> <li>• Category I cities or Mega Cities (4 Million+ People): &gt;36m – 60m</li> <li>• Category II cities or Metro Cities (1-4 Million): &gt;24m - 60m</li> <li>• Category III cities or Others (&lt;1 Million People): &gt;7m</li> </ul>
Level 2 "SUBARTERIAL" - Formulates patterns by further dissecting level 1 roads / Forms grids – patterns	<ul style="list-style-type: none"> <li>• All radials and rings that are 50% complete</li> <li>• Radials which are having length less than half of the city</li> <li>• Long roads (roads having lengths of approximately half or three quarter length to the city size)</li> <li>• Major district roads &amp; Other district roads</li> <li>• Roads, which are further dissecting level 1 roads and form grids or pattern</li> </ul> <p style="text-align: center;"><b>OR</b></p> <ul style="list-style-type: none"> <li>• Roads that have right of way</li> <li>• Category I cities or Mega Cities (4 Million+ People): &gt;24m - 36m</li> <li>• Category II cities or Metro Cities (1-4 Million): &gt;15m-18m</li> <li>• Category III cities or Others (&lt;1 Million People) :&gt;5.5.</li> </ul>





Road Classification	Definition
Level 3 "Collector" – creates blocks	<ul style="list-style-type: none"> <li>Roads that connect level 1 and level 2 roads</li> <li>Roads, that further create smaller grids</li> </ul> <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> <li>Roads that have right of way</li> <li>Category II cities or Metro Cities (1-4 Million): &gt; 9m</li> <li>Category III cities or Others (&lt;1 Million People): &lt;5.5</li> </ul>
Level 4 "Local roads" – Access to the residents	<ul style="list-style-type: none"> <li>Roads that connects to residential units.</li> <li>Roads that have right of way &lt; 9m</li> <li>In case of hill cities, as noted there are footsteps that connect to another level of road which can be of any levels of road as mentioned above. Such roads are taken as level 4 roads.</li> </ul>

Source: CoE-UT, CEPT

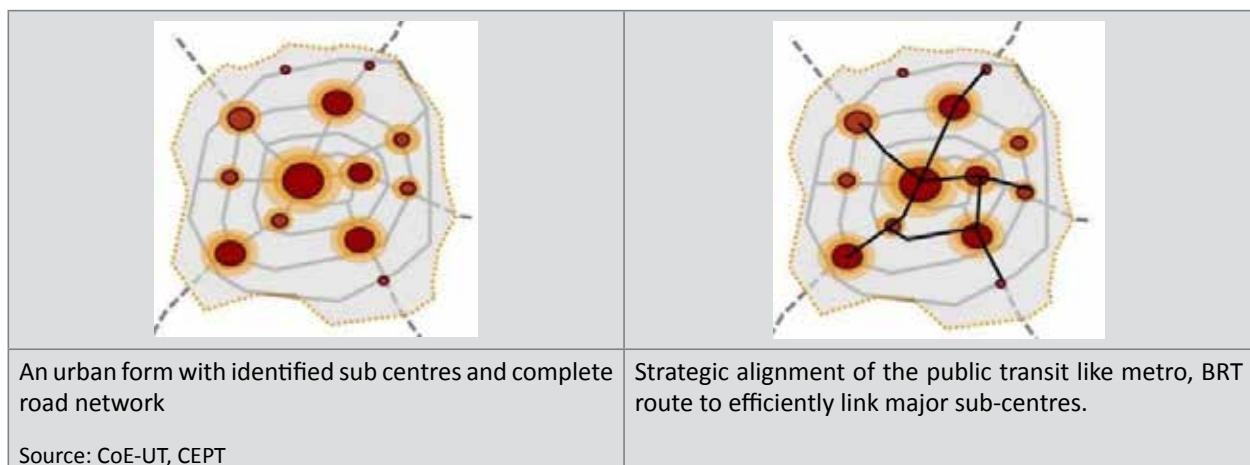
In Indian cities it is observed that large arterial roads are fed by smaller roadways that rarely connect with each other. Moreover the network design is focused on motorized vehicles, ignoring pedestrians and bicycle trips. Hence there is a need to balance the requirements of various road users – the need to set a hierarchy of streets, enhance cycling and walking facilities and including more and better street crossings, and to give priority to buses, while maintaining smooth vehicular traffic flow.

### 2.5.5 Strategic Alignments

In most Indian cities, the provision of public transport is a post facto intervention once new growth areas have developed. Growth happening in areas where public transport has not been planned results in an increase in the number of trips made by private vehicles as well as an increase in trip lengths, eventually leading to greater traffic congestion, trip delays, higher travel costs and pollution.

In this regards it is important to have a strategic spatial plan for the sustainable growth of a city, this plan will sets out the spatial development priorities, both geographically and thematically, and which permits the production of a complementary strategic transport plan for the enhancement of the transport network, in a way that ensures transport capacity with the right accessibility and quality is provided just in time to support the various land-use developments. This alignment will also allow the timely extraction of value from respective developments to help fund the transport improvements.

**Figure 2.9:** Strategic Alignment along Development Zones/Centres



Source: CoE-UT, CEPT



Existing low density developments along public transport corridors should first be densified before opening up new land for development. This would ensure efficient utilization of available public transport service, at the same time it would control unnecessary city sprawl. The new developments should be proposed along the existing public transport corridor to promote use of public transport service and to avoid scattered development.

The alignment of the public transit system is hence an important component to ensure efficient movement in the city. The idea is to provide for a network of transit in the city rather than just corridors with flexible route operations. The transit should be aligned so as to connect the major activity centers in the city. Importance needs to be given to existing bus patronage and pattern of movement along with using transit as a catalyst for area development e.g. in areas with low income housing and poor accessibility. Right of way availability should also be considered while choosing the alignments.

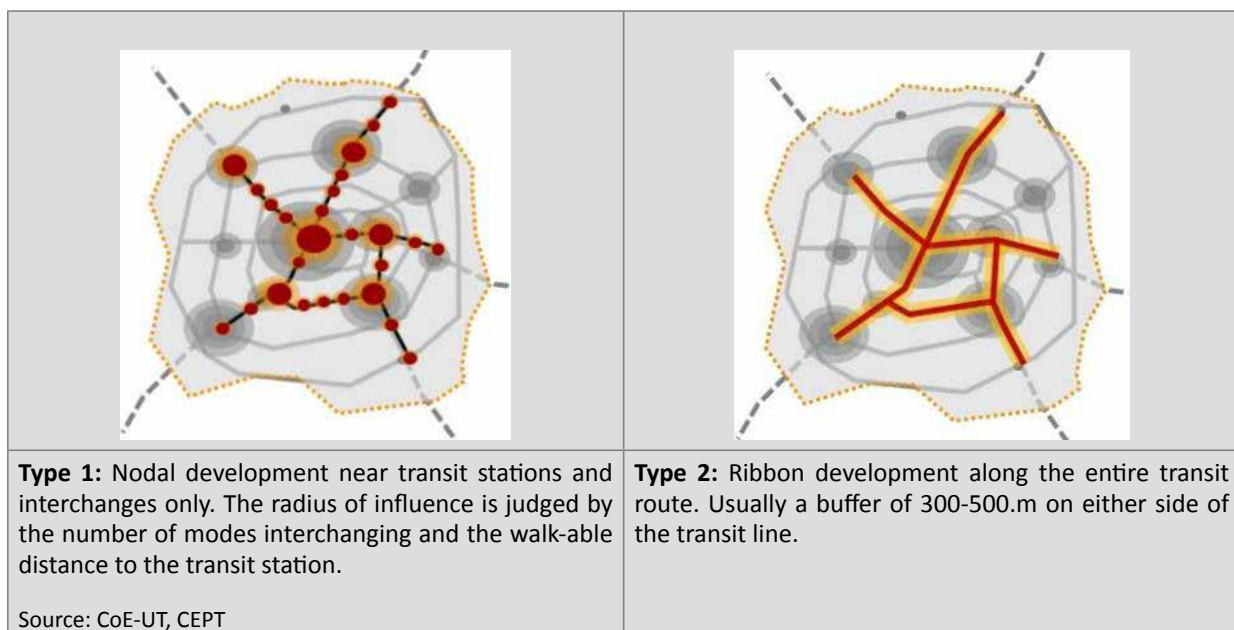
### 2.5.6 Transit Oriented Development and Value Capture

Transit-oriented development (TOD) is a key element of “smart growth” which emerged in the mid-1980s. The concept is based on the principle of maximization of access to public transport through mixed use and compact neighbourhoods.

The main elements of this concept include:

- High densities around transit stations
- Mixed land use
- Pedestrian friendly and walk-able neighbourhoods
- Provides multiple transportation choices by multimodal integration

**Figure 2.10:** Transit Oriented Development





In the process this concept itself works against urban sprawl by keeping the city compact. The process also assists in the mobilization of resources by capturing a part of the increased land values due to improved accessibility. Commercial developments along the transit network will have value added and be made more commercially viable by the provision of enhanced transport infrastructure and services. It is therefore appropriate for these developments to contribute to the cost of transport infrastructure enhancements, commensurate with the mitigation of the development impacts on the transport network.

### 2.5.7 Integrated Multimodal Transit Interchange Facilities

A single mode of transport cannot cater to the transport needs of a city. For an efficient transportation system, various modes need to be introduced and developed in an integrated fashion. These modes need to be further integrated to enable easy transfer of passengers from one mode to another with minimum time loss. Integration of transit facilities is a must for the success of public transport systems in the city.

An integrated multimodal system that makes the best use of each mode needs to be developed, to serve the present and future travel demand. Adequate provisions need to be made for movement between each mode of transport at different times of day. The aim of integrated multimodal system is to provide a viable and low cost solution of transport that minimizes the need to change modes in a trip and where changes are necessary they should be convenient, comfortable and with minimum time loss. The idea is to provide for seamless movement of people. This would also provide enhanced network resilience and customer choice, especially when the service on one transport corridor or mode has degraded or failed.

The design and the operational management of these multi-modal interchange facilities are critically important to maximize customer benefits. The key considerations are:

- Efficiency allow for efficient movement of people and the public transport services they use, through the interchange facility, as well as being simple to manage and maintain.
- Accessibility for all potential users and an environment which is safe, secure and comfortable. Not only are accidents and crime removed, but the fear of these unpleasant experiences is also removed, thereby increasing the usability of the interchange zone.
- Understanding of an interchange zone covers more than information. Adopting principles of legible design and interchange zone management from the outset will result in places that are easy to use, require minimal signage and are well integrated with their surroundings.
- Providing a high quality interchange facility and interchange zone environment will improve all aspects of a users' experience. A high quality interchange facility and zone design will influence how it is perceived by its users, operators and providers; whether it has characteristics which give it a significant identity; whether its quality of design, configuration and facilities make it feel safe, give it a sense of place or make it a destination in its own right creating social, economic and environmental value and instilling a sense of civic pride in those who use it.

Properly designed integrated Interchange facilities will make a major contribution to 'place-making', by making these hubs and their environs better places to live and work as well as travel through, by good integration of multi-modal transport facilities, public realm and commercial development

There are three aspects to the multimodal transit integration.

**a) Physical integration**– This includes integration in terms of network (MRT/BRT/suburban rail/ public transport) hence the networks are planned in such a way that it is convenient to change from one



mode to another. The hierarchy of modes and the location of these interchange points will determine the size of the interchange. One of the key objectives is the integration of public transport interchanges with activity centers in the city. Integration also allows decisions about local land use to lend support to and gain benefit from increased accessibility provided by improvements to public transport. The location of interchanges / hubs / nodes on the network is an important consideration from a network efficiency and effectiveness perspective.

**b) Fare integration-** Fare integration will ensure that people get onto public transport as this will ensure that the cost of transportation reasonable. Fare integration can further be of the following types

- Transit Route Integration- Single mode
- Transit modes integration- multimodal
- Transit modes + Intermediate Public Transport System
- Transit modes + Intermediate Public Transport System + Parking

Hence this would include the provision for integrated fare with zero transfer penalties and use of smart card. Smart cards reduce journey time by reducing / avoiding queues for 'pay as you go' tickets, at the start of a journey. It avoids much of the cost and time required for an intermediate ticket purchase on a multi-modal trip. They also reduce operational staff resource costs and simplify ticketing for customers and staff, and reduce fare evasion costs.

Fares integration will also offer better customer choice, especially when there is a service problem on a route or part of the network, and enhance network resilience.

**c) Information Integration-** Integration can also be achieved if information is easily and freely available to all users. The emphasis needs to be on journey planning where a person is able to make an informed decision on the mode and route one takes.

### 2.5.8 Accessibility Improvements in terms of Local Area Plans

Local area plans provide immense opportunities to focus on smaller areas and involve the in-depth study of these selected areas. Accessibility plays an important role at a local level in getting people to use sustainable modes. Walking, cycling and public transport services are the most sustainable modes for travel. Also walking and cycling improve health, reduce emission and save money on fuel and maintenance. A pedestrian and cyclist friendly environment should therefore be created to promote use of these modes for all short trips and to access public transport. One way of encouraging this concept is developing new areas as self-sufficient neighbourhoods with a complete street network for easy access of all modes of transport, and local facilities like schools, hospitals, shops, play grounds etc., within walking distance from most of the houses in that neighbourhood.

To promote walking and cycling and to improve accessibility to mass rapid transit system by NMV modes, pedestrian-friendly and cyclist-friendly road should be designed. Our first transport policy namely National Urban Transport Policy (NUTP) also recommends equitable distribution of street space between different modes of transport. It also gives priority to public transport service and NMV modes for travelling.

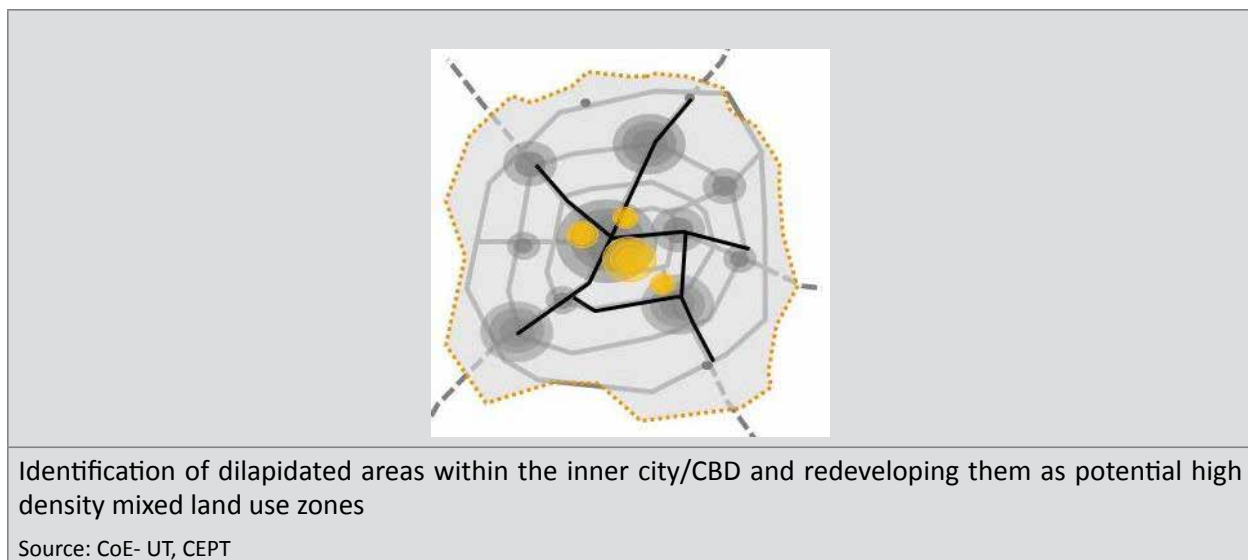


### 2.5.9 Redevelopment and Re-vitalization (Inner city, dilapidated areas, slums)

The redevelopment and regeneration of vacant lands and low density developments in core areas of cities and along public transport corridors may prove useful in maintaining the city's compactness. Providing high density mixed use development in these areas should be considered as the major element of the city's development plan. For efficient and optimum utilization of existing urban land, a strategy should be developed to accommodate additional population in these areas depending on their carrying capacities (based on the carrying capacities of infrastructure facilities like water supply, sewage, road network etc including what is existing and the potential for supplementing).

In case of big cities in India, a hierarchical approach to spatial planning will be beneficial, starting with the city-wide identification of priority areas, which then allows a more focused approach to sub-regions in the city, working in collaboration with the public sector agencies relevant to each sub-region, and in turn, an even greater focus on the discrete priority areas within each sub-region, where more specific local development planning frameworks can be produced. When the public authorities have agreed a local development planning framework, this will provide the planning certainty that will attract credible property developers who can then engage with the public sector in the production of commercially viable, deliverable master plans.

**Figure 2.11:** Inner city development



For each level of strategic/city wide, sub-regional and local development planning, the transport authorities must work with the spatial planners, to help them identify the spatial priorities and to produce viable transport plans to support the spatial plans in an integrated manner. The transport authorities will need the input of the spatial planners to ensure that planned growth in city-wide, sub-regional and local demand is input to the strategic city-wide and sub-regional modelling, and local operational modelling. This all requires a high degree of co-ordination between the various spatial and transport planning authorities.

The following measures may be considered:

#### 1. Re-densification of low density areas

The historic, core city development pattern of Indian cities consist of low density developments with mixed type of land use. Also some empty pockets of land belonging to Government and encroached by





slum dwellers can be seen in core city, hampering the city character. This also results in underutilization of high value core city land. Such areas should primarily be taken for re-densification and providing high density mixed use developments.

## 2. Redevelopment of brown field areas and areas with other types of dereliction

In many Indian cities large chunks of land are lying vacant or unutilized due to closing down of industrial units, as seen in case of cities like Mumbai, Ahmedabad, Kolkata etc. Strategic redevelopment of such lands can add great value, not just to the local economy and employment scenario, but also to sustainable transport and sustainable urban development in general.

In most of the traditional Indian cities, some old developments can be found where the building are in poor structural condition, areas are compact with low rise high density developments and infrastructure facilities are insufficient. Such areas should also be redeveloped with high density mixed use type of development and high quality infrastructure facilities should be provided in these areas.

The above processes can be facilitated using various legal instruments like raising the permitted FSI over time, provision of Transferable Development Rights and spot level zoning to accommodate urban growth. Incentives required for redevelopment and regeneration of inner city areas include Legal instruments like:

**1. Increasing the Floor space index (FSI)** FSI is one of the most misused terms in the Indian urban planning system. Restricted FSI and density norms have led to sprawling cities with increasing costs of infrastructure development. Slight modifications in FSI in different cities; at different zones will help in maintaining their compactness and controlling overall city forms. This would require spatial planning that supports (and is not inimical to) economic efficiency and market responsiveness.

**2. Spot zoning** is a provision that can be made in zoning plan which benefits a single parcel of land by creating an allowed use for that parcel that is not allowed for the surrounding properties in the area. Because of implications of favouritism, spot zoning is not favoured practice.

**3. Transfer of Development Rights (TDR)** means making available certain amount of additional built up area in lieu of the area relinquished or surrendered by the owner of the land, so that he can use extra built up area either himself or transfer it to another in need of the extra built up area for an agreed sum of money. It is a market-based mechanism that promotes responsible growth, while conserving areas such as forests, prime agricultural areas and environmentally sensitive lands. Landowners benefit by being compensated for placing land use restrictions on their land, keeping farmland prices affordable for agricultural uses, and removing land uses that impede farming. Local Governments can use TDR to direct development in specific zones. They can use this tool to preserve farming areas, forested areas, heritage areas etc. by allowing its owners to give up their rights to develop these spaces commercially in lieu of TDR. The public benefits as private sector funds are used to purchase the development rights, thus avoiding large public expenditures, farmland and environmentally sensitive areas are protected, and development occurs in suitable areas, resulting in more efficient public services.

**4. Land Pooling / T.P. Scheme** is an innovative mechanism for land sharing through collaborative efforts of public authorities and private land owners. It is a self-financing mechanism since all the developmental costs are recoverable from enhanced land value in form of betterment charges. In this process the land required for public purpose is made available without resorting to the Land Acquisition Act.



**Figure 2.12:** Town Planning Scheme

<p><b>TOWN PLANNING SCHEME</b>  <b>A LAND READJUSTMENT TOOL</b></p> <ul style="list-style-type: none"> <li>▪ Reconstitution of land holdings</li> <li>▪ Appropriation of land for public uses without acquisition (up to 50%)</li> <li>▪ Local level road network (upto20%)</li> <li>▪ Local level social and physical infrastructure (5%)</li> <li>▪ Land Bank for Urban Poor (up to 10%)</li> <li>▪ Land appropriation compensation adjusted against land value increments due to infra. provision</li> <li>▪ Land Bank for Financing of infrastructure (15%)</li> </ul> <p>Town Planning Scheme regulations for implementing proposals.</p> <p>Source: AUDA</p>	
--	--

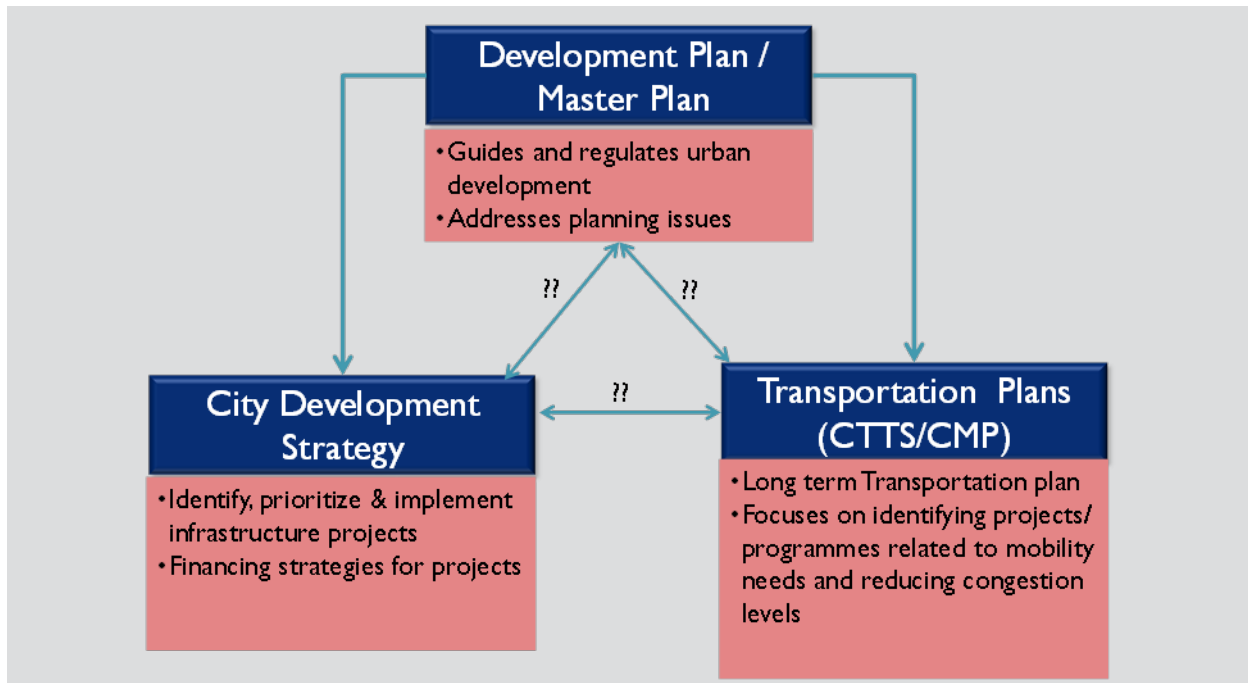
It also has provisions to make land available for low income housing. The working of the Town Planning schemes including preparation of a broad layout of the entire area including road network and reservation for public utilities (Water supply) and public facilities like park, school, markets, playground etc. the remaining 50 to 60 percent of the land area is reconstituted in regular sized plots and reallocated to the owner with an access the additional/incremental value of the final plot is charged in the form of betterment levies.

## 2.6 Planning process in India

In India, as per the 74<sup>th</sup> Constitutional Amendment Act passed in 1993, it is mandatory for local planning bodies to prepare and implement Master Plans or Development Plans for their jurisdiction. Under the JnNURM program, the preparation of “City Development Plans” has also been initiated, which are essentially business plans for the urban local body.



**Figure 2.13:** Planning in India



### 2.6.1 Master Plan (or Development plan)

A Master Plan (or Development plan) is a statutory document for guiding and regulating urban development. It is prepared by urban development authorities in each metropolitan area, defines future for urbanization, and addresses planning issues for various sectors. The transport sector plan, however, is one of the most important sector, and contains development measures such as road network, parking facilities and MRT system (MoUD). It is a long range, comprehensive document, which is intended to guide growth and development in a community or region for the next 10 to 20 years. It is revised every 10 years. Though processes vary in different states, typically these plans are based on studies of existing development patterns, socio-economic characteristics, environmental considerations and demographic analyses. Usually the planning process involves some efforts for public consultation, thus factoring in citizens' aspirations and concerns.

These Development Plans / Master Plans are usually prepared under the state's town planning/ urban development legislation. The jurisdiction for the plan typically covers an area delineated under the provisions of law and includes the municipal area of the main city as well as some surrounding area. While some states have legal and institutional frameworks for regional and metropolitan area planning, most do not.

### 2.6.2 City Development Plan

"A City Development Plan (CDP) is prepared by each city in advance of requesting JnNURM funds from MoUD. It is not a statutory document. The CDP addresses various urban development sectors, including urban transport. Usually, the CDP includes project proposals for both infrastructure and regulatory measures, but the development of urban transport is not comprehensively addressed. It rarely adopts





a transport modelling approach and do not include clear strategies regarding long-term urban transport development and ‘mobility’. However, a CDP does provide valuable information regarding the existing and future development of the urban area” (MoUD) .

### **2.6.3 Transport Plans**

One of the main planning issues for transport system is that there is no statutory status to any transport plan. Most of the Indian cities do not have a long term comprehensive urban transport plan. Some of the cities have prepared urban transport master plans by conducting Comprehensive Traffic and Transport Studies (CTTS). However, these studies mainly focused on vehicle movement and do not pay adequate attention to the mobility of people and goods.

Many proposals have been submitted by cities to obtain financial support from JNNURM for different urban transport projects like roads, flyovers, Mass Transit System, BRT etc. However, due to unavailability of a long term transport strategy in the cities, these proposals contained inadequate information and incomplete analysis resulting in non-acceptance of these projects. In 2006 Government announced the first ever urban transport policy in India called as National Urban Transport Policy (NUTP) which focused on movement of people not vehicles. Its objective is to ensure easy accessibility, safety, affordability, comfort, quick service, reliability and sustainable mobility for all.

The NUTP advocates the preparation of Comprehensive Mobility Plans (CMP), which include land use transport integration proposals. The CMP is a prerequisite for urban transport funding under JnNURM scheme launched by Government of India. The overall objective of CMP is to provide a long term strategy for the desirable mobility pattern of a city’s populace. To achieve this, the following are the main objectives:

1. To provide a long-term vision(s) and goals for desirable urban development in each city;
2. To illustrate a basic plan for urban development and include a list of proposed urban land use and transport measures to be implemented within a time span of 20 years or more; and
3. To ensure that the most appropriate, sustainable and cost-effective implementation program is undertaken in the urban transport sector.

Other than CTTP and CMP, Integrated Mobility Plan and Strategic Transport Plans are also prepared in some of the Indian cities.

### **2.6.4 Present Institutional Framework for LUTP in India**

The responsibility of land use planning of cities in India falls under the purview of the municipal body or development authority of that city. Whereas, different aspects of transportation planning are controlled by different agencies at local, state as well as national level. Agencies involved in urban transport planning in India and their roles are stated below. (Please note that there is considerable variation from state to state. The table below is a generalization)

**Table 2.4:** Agencies Involved in Urban Transport in India

Levels of Government	Agencies	Functions
Central	Ministry of Urban Development	National urban and transport policy and investment programs
	Town and Country Planning Organisation	Technical Wing of the Ministry of Urban Development, Government of India. It is an apex technical advisory and consultancy organization on matters concerning urban and regional planning strategies, research, monitoring and evaluation of Central Government schemes and development policies.
	National Highway Authority of India	NHAI responsible for the development, maintenance and management of National Highways passing through the city
	Railways	Creation and management of railways or other forms of rail systems such as metro, etc.
State	Infrastructure Development Boards	Developing infrastructure projects, mobilising finances, coordination between different agencies for the infrastructure projects
	Town Planning Department	Technical support to State for approval of plans
	Public Works Department/ Roads & Buildings Department	Creation and maintenance of Regional/rural Roads
	Regional Transport Office	Licensing and permits for road based transport modes
	State Road Transport Corporation	Operation and maintenance of regional bus services
	Traffic Police	Regulation of traffic
Local	Development Authority	Preparation of Master Plan /Development Plan
		Infrastructure development
	Municipal authorities	Preparation of Master Plan /Development Plan
		Management of infrastructure within city limits
Private bus operators	City public transport service operations	

Source: Adopted from SIMP (CoE-UT, CEPT, 2013)

Urban Transport in India as evident from the above table is mostly handled by multiple agencies at different levels of Government. Problems include a lack of clear definition of responsibilities amongst different tiers of government which leads to institutional conflicts in areas including enforcement, infrastructure provision and use, policy formulation and coordination.

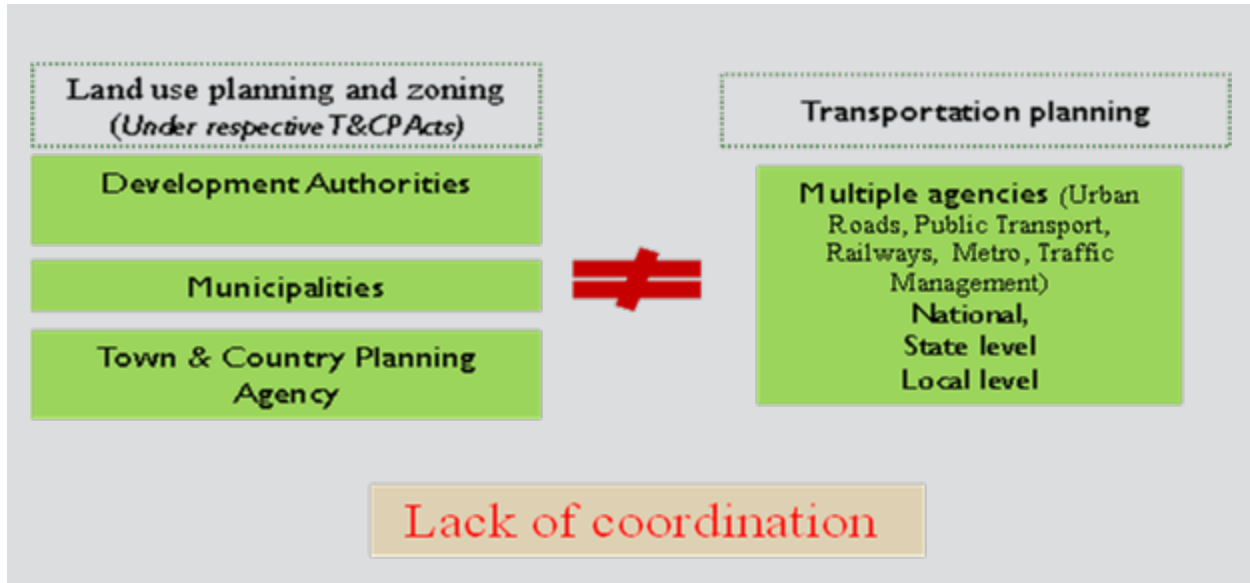
In case of India currently there is no apex body to ensure coordinated planning system. A recent initiative for coordinated planning has been taken under Nation Urban and Transport Policy (NUTP) by recommending formation of Urban Metropolitan Transport Authorities (UMTAs) in all million plus cities.

In the last 10–15 years, the concepts of land use transport integration as well as sustainable transportation in general have been gaining ground. The JnNURM provided a much needed boost to urban public transport with widespread improvement in bus based transportation in all JnNURM cities. The National Urban Transport Policy, 2006 has provided the unequivocal policy support needed to promote sustainable transport. The policy states that “attention should be paid to channel the future growth of a city around a preplanned transport network rather than develop a transport system after uncontrolled sprawl has taken



place” and promises to “promote the development of such integrated land use and transport plans for all cities.” Practical examples of such integration are however still in the making.

**Figure 2.14:** Issues with Land Use Transport Integration in India



## 2.7 Integrating Land use and Transport: A Cyclic Process

It is vital to understand, that there exists no ‘single step by step’ process to achieve land use-transport integration. Also, not all the above mentioned elements may be applicable concurrently in a city. The manner in which each of the elements is to be applied is determined by the nature of existing settlement pattern, strategies, socio-economic and political background, etc of a city. Some cities may have explored some of these concepts and hence would require only strengthening and addition of supplementary elements. Others may need strategic introduction of some of these elements. Hence the planning process of integrating land use and transport is never a predetermined process. It can be defined as a cyclic process where one element influences the other in a manner that the socio-economic and environment impacts of urban development be minimized, as rendered in figure below.

Indian cities vary in size, density, settlement pattern, soci-economic systems and hence, varying mobility patterns. Hence it is important to consider this phenomenon while planning for city development. Some mega cities may require interventions at a regional level to influence land use and transport integration, while smaller cities may require only interventions at city level. A region may not be dominated by a single city, but shared by regional clusters. Growth potential of the various growth centers are to be explored and growth distributed across the region. Growing cities are to be regarded as ‘Cities within a City’ by identifying and redistributing activity and land use to develop multiple centers within it. In order to achieve land use transport integration it is important to work on all these elements simultaneously.

## 2.8 Way Forward

Indian cities are growing at a very fast pace and hence the need for integrated land use and transport planning is becoming imperative. The cities need to recognise that development plans and transport plans have a complementary role to play in promoting greater integration of transportation and land use planning and they should reinforce each other. This will help to ensure that the land use allocations, key site requirements and policies of a development plan are closely linked with the policies, proposals and investment priorities for transportation identified in the transport plan.

The above problems are coupled with the fact that urban transportation is handled by multiple agencies at different levels of Government. The lack of clear definition of responsibilities among different tiers of government leads to institutional conflicts, including enforcement, infrastructure provision and use, policy formulation and coordination. The problems on the whole have led to an ad-hoc decision making process for the cities.

The International and national case study cities provided in this toolkit have clearly indicated that for an efficient city movement one measure alone will not solve the problem. The cities will have to pick and choose the measures depending on the local context. Invariably, trade-offs would be required in deciding on the measures to be used. Even in the case study cities it is evident that not all the measures were applicable in any city. These cities are also managing growth however they do provide insights and directions that could be explored by Indian cities.

The basic success of strategies adopted by these case studies depend on the fact how they started off their development. Long term vision for strategic planning along with the concurrency in the development plans/ Master Plans with transportation plans would yield positive results. Implementation of the plan and overcoming obstacles along the way would also need to be addressed. Lack of high density development is not really an issue in most of the Indian cities. However, management of future growth in our cities will be critical planning for desirables need to be thought about as evident in case of London and Singapore.

It is also important to consider mechanisms to manage demand for public and private transport such as-

- Flexible working hours, to reduce peak hours demand
- Fare pricing with cheaper off-peak fares, to reduce peak hours demand
- Working remote from the city centres e.g. home; suburban office hubs
- Tolling private & commercial vehicles or single occupancy vehicles, on (inner) urban streets (e.g. London's congestion charging)

## Chapter 3

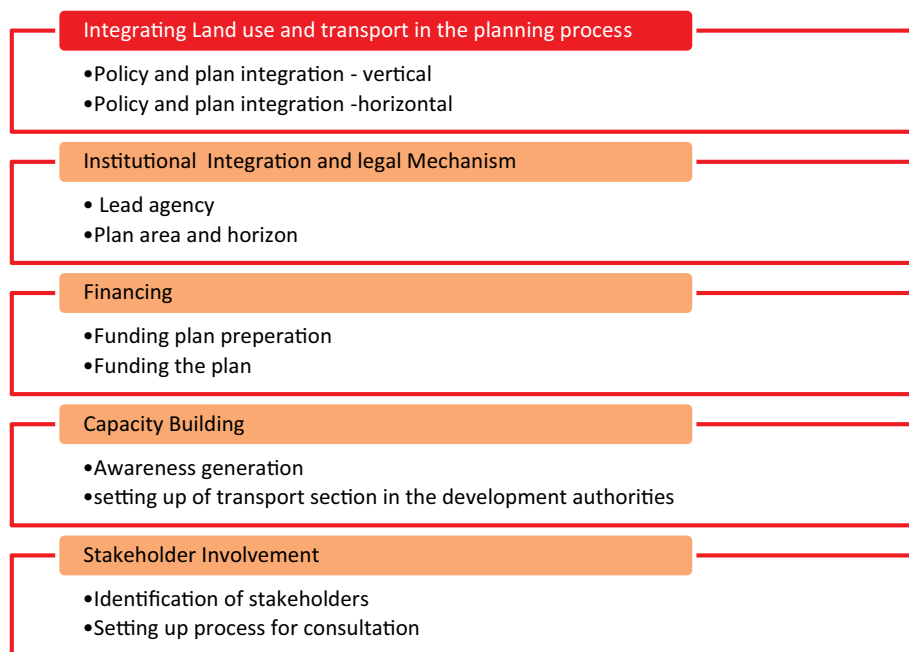
# Main Toolkit

In order for land use transport integration to happen it is important to understand the context in which the process will work, while land use plan is statutory in nature whether in the form of a Development Plan or Master Plan, it often deals with transport decisions at a physical level only. On the other hand transport plans are non-statutory and hence are done in a piecemeal way whenever the need arises.

### 3.1 What are the enabling mechanisms for land use transport integration?

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

**Figure 3.1:** Enabling Mechanism for Land Use Transport Integration



#### 3.1.1 Integrating land use and transport in the planning process

##### 1 Vertical integration of plans and policies

A review of the national and state level policies dealing with urban and transportation development would help provide a context for planning.



Some of the policies and initiatives with specific relevance to transport are discussed in the following box-

**Box 3.1:** Policies at National level

**National Urban Transport Policy (2006)**

In 2006, National Urban Transport Policy (NUTP) was announced by Government of India which outlined the issues in the urban transportation and discussed a set of policy guidelines for better urban transport management. It focuses on building people centric urban transport solutions instead of merely improving the conditions for private vehicles. This is significantly different from traditional urban transport practices in Indian cities, as it emphasizes now on public transport and non-motorized modes.

**Jawaharlal Nehru National Urban Renewal Mission (JnNURM)**

A central government assistance fund (JnNURM) was launched for providing financial support for investments in urban infrastructure. For the urban transport projects, for cities to receive financial assistance from JnNURM, the cities had to prepare transportation plans based on NUTP recommendations. Around 29 medium size cities prepared Comprehensive Mobility Plans as recommended by NUTP and received funding for plan preparation (up to 80%).

**National Mission to Sustainable Habitat**

This mission aims at making cities sustainable through urban and transport planning indicators. It emphasizes on better urban planning and renewal practices so as to ensure modal shift to public transport. It suggests preparation of long term transport plans to facilitate the growth of medium and small cities in such a way that ensures efficient and convenient public transport.

**Auto Fuel Policy**

The Auto Fuel Policy (2002) specifies emission standards and fuel quality

**2. Horizontal integration of plans and policies:**

It is also important to consider the other sectoral plans that are made for the cities while planning for land use transport integration. These may be in the form economic development, housing or environmental plans for the city.

**3.1.2 Institutional integration and legal mechanism**

To insure land use transport integration the development agencies/ local authorities will need to adopt a proactive role and look into their respective legislations to ensure that processes are setup to enable integration. It is important to note that the development plans/ Master Plans have provision to ensure that transportation is taken care of in the planning process; hence the problem is with the application rather than the Act itself.



- **Lead agency:** for the success of any plan ownership is very important hence it is important to decide on who would take the ownership. There are few aspects that play a key role in the coordination-
  - Strong political leadership
  - Inter-Agency Collaboration- Collaboration between agencies is critically important, and requires careful management of requirements, expectations and relationships.
  - An integrated, hierarchical approach to spatial and transport planning, this is only realistically achievable if there is good collaboration with strong leadership.

Hence the development of a separate agency can be looked into similarly one can also explore decentralized process with a provision in the mandate of the various agencies to abide with the strategic plan. The agency which takes ownership of the plan will act as a watchdog to streamline the implementation process. It is recommended that the Development Authority or Municipal Authority will need to take a pivotal role in the process and ensure that integration of plans made by various organizations while planning for future.

- **Plan area and horizon:** Plan period is often defined in terms of long term, medium term and short term plans. Spatial plan decisions and transport decisions have long gestation periods involving city-level and longer-term measures. Hence the planning horizon for such plans needs to be longer around 20-30 years. Land use and transportation plans need to be prepared concurrently.

It is also important to align plan period with national/state level plans so that their funding becomes predictable. While plan horizon has to be long, they should not remain rigid. For cities witnessing rapid and dynamic growth a review and revision of strategic plans after 5 years may be done.

### 3.1.3 Financial requirements

- **Funding the plan preparation:** this kind of funding is required for large scale base map and information base development both for land use and transport aspects. This aspect can be taken care of by the GOI schemes which provide grants on 80-20 sharing basis for integrated land use and transport plan preparation studies.
- **Funding the plan:** the various proposals from the above can be converted into detailed project reports and can be funded by either internal funds or grants that are got by the state and central government. Apart from this the scope of PPP also needs to be explored while funding the proposals of the Plan. In some cases like TP scheme mechanism adopted by the authorities like in Gujarat the plan has a self-funding mechanism as discussed in the case studies.

### 3.1.4 Capacity building

- **Awareness on Land use Transport Integration:** Since most of the people involved in the land use planning process are not exposed to the intricacy of transport issues it is suggested that authorities should encourage them to go for professional development courses so as to refresh their knowledge and also give an outlook to newer concepts and techniques. Four Centers of Excellence in urban transport have been setup by GOI who offer such courses apart from organizations like TERI, UNDP, GIZ and The World Bank.
- **Setting up of transport section in the development authorities:** The development authority/ Municipal authorities should also look into the provision of having a transport planning wing in its institutional setup to help in the integration process.



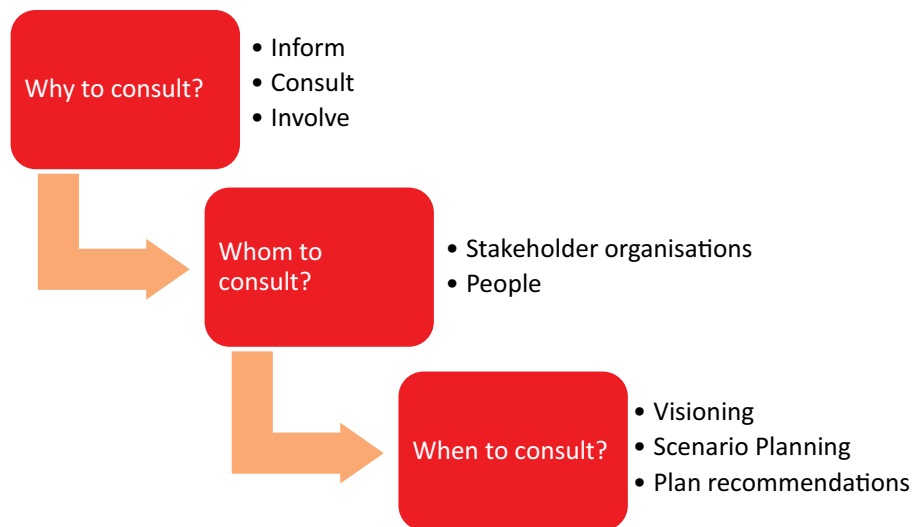


### 3.1.5 Stakeholder identification

The main objective of consultations is to have people on board from inception so as to resolve conflicts at every stage of the plan preparation and ensure that the plan are better received from the community point of view.

At the planning stage three critical decisions would affect the type, time and level of consultation.

**Figure 3.2:** Consultation Decisions



The level of involvement of stakeholders would depend on the level of participation:

- a) Inform:** This is the simplest way of providing appropriate information about services, policies and decisions. This type of communication strategy has the sole purpose of keeping people informed about the plan and its strategies.
- b) Consult:** This would be typically carried out to seek people’s opinion and views when certain decisions or policies are being considered. A consultation process is expected to provide people an opportunity to express their thoughts and opinion which can be considered while making the final decision.
- c) Involve:** this is a more participatory type of process involving stakeholders by giving them an opportunity to actively participate in developing strategies and proposals. This might involve including them at every stage resulting in a more intense participation than the normal consultation process.

**Who to consult:** An integral part of any planning process is the identification of the key stakeholders and taking them on board in the planning process. The stakeholders include representatives from organisation dealing with operation of public transport, traffic police, and municipal authorities, other state government authorities that are responsible for delivering infrastructure for the city.

**Setting up process for consultation:** Two types of committees can be setup for the consultation process involving stakeholder organisations:

- d) Steering committee:** This committee includes the representatives from all main stake holder agencies and is mainly responsible for the coordination of the plan.



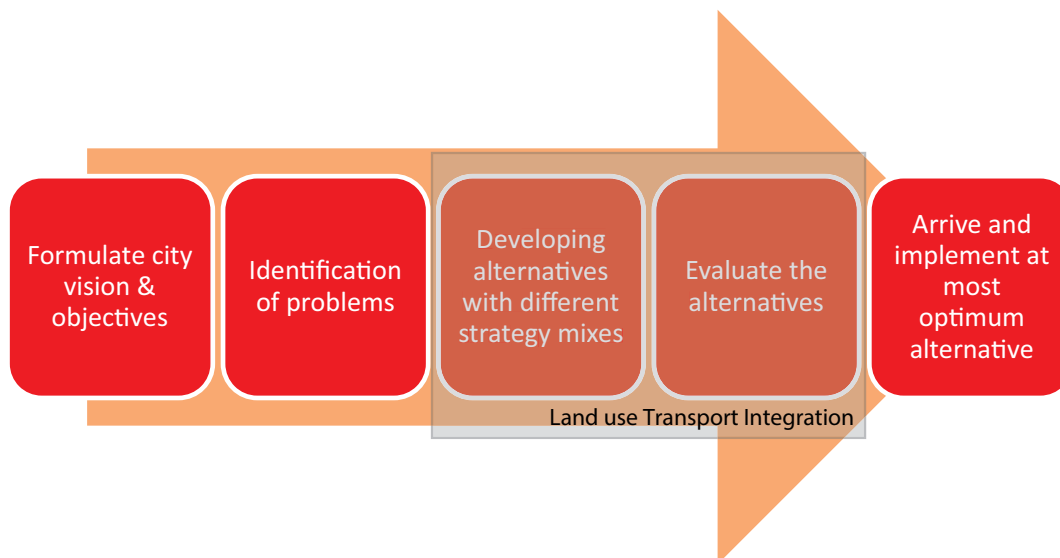


e) **Working committee:** The working committee is responsible for providing technical assistance comprising of the main stake holders and technical experts.

## 3.2 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 below shows the decision making process for a vision led approach. The process starts with the formulation of a long term vision for the city. The vision statement is a guiding principle which helps define priorities for developing the transport objectives and the transport plan. The transportation vision should be based on ideals and aspirations for the future of transport development for the city.

**Figure 3.3:** Vision led approach for land use transport planning



### Step 1 - Setting Vision and Objectives

The first step deals with identifying problems in the existing situation as well as in the future with respect to the set vision and the objectives. Subsequently, alternative scenarios with different land use transport strategy mixes for the future are developed, which may help city move closer to its set vision. The alternative scenarios are evaluated against the objectives to assess which scenario performs better.

Targets need to be set in line with the vision and objectives of the plan. 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.

Objectives are statements that tell us about the desired end state. These are generally broad statements like provision of "efficient transport system", "sustainability of transportation", "safety to its citizens", etc.

The vision and objectives will also help in setting targets for the city which could be quantitative or qualitative in nature e.g. reduction in the Co<sub>2</sub> emissions by 25% or improving cycling infrastructure to increase the use of NMV modes.



Vision and objectives are fulfilled by strategy tools selected by the city. Mix of strategies in terms of extent and type would vary from city to city. As a result outcomes would also vary. No doubt socio-economic context would also influence the outcome. An understanding of this linkage between strategy-mix and outcomes is necessary. The decision on strategies mix adopted by the cities will depend on two basic factors –

**1. Size** – On the basis of the size the cities can be classified as -

**Table 3.1** Classification of Cities on Population Size

Classification	Population Size
Metro City (A)	Million Plus
Medium Size City (B)	5 -10 Lakh
Small Size City (C)	1 – 5 Lakh
Town (E)	Below 1 Lakh

**2. Location/ Physical setting of the city-** On the basis of the physical setting the cities can be of two types

- a) Constrained physical setting– As the name suggest these are cities that have some physical barrier to growth in term of physiography ( Hill, coastal areas, sensitive areas etc)
- b) Unconstrained Physical setting– cities relatively flat with no major physical constraint to growth.

## 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’.

The basic indicators that can be used to do a quick assessment of the city are:

1. Density- measuring the gross density and the developed area density.
2. Trip length/ travel times
3. Network pattern and completeness

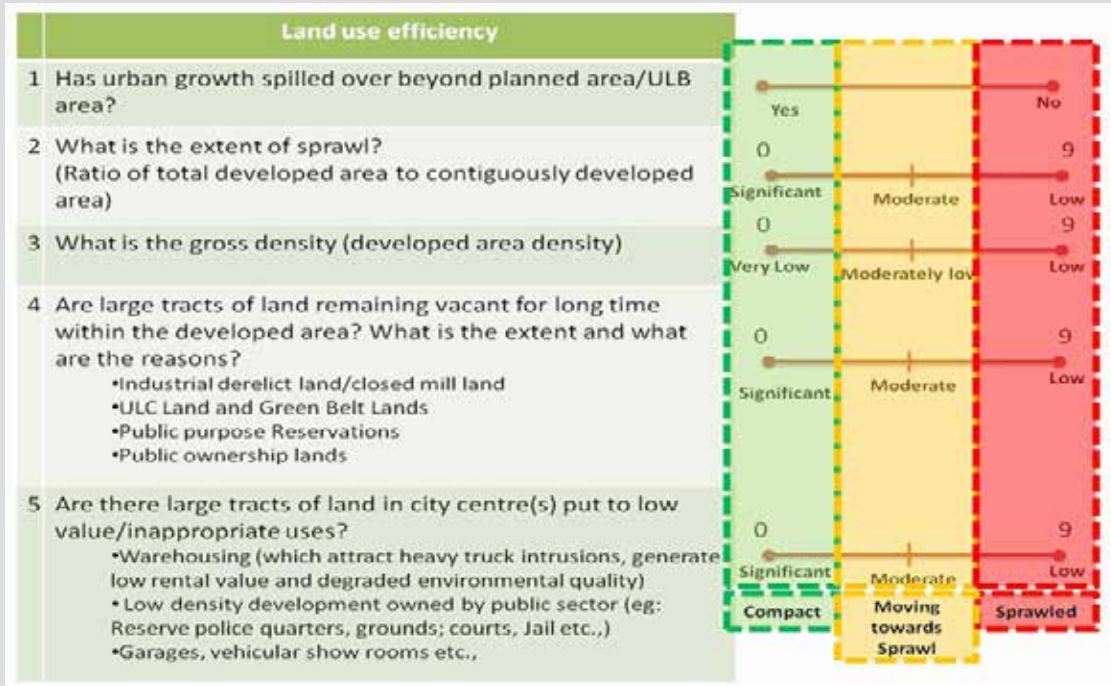
Each city can measure the current performance and compare this with previous years to know the situation. If the density is decreasing and the trip lengths are increasing at a rapid pace it indicates that the city is moving towards sprawl.

Cities can also adopt the criteria and device city specific ranges and go in for more elaborate measurement criteria. The measures can range from simple yes know answers to more complex weighing and scaling method where the cities will have to measure the performance on a 0 to 9 scale where zero represents a more proactive approach of the city where as 9 indicates that the city is far from integration and will need to adopt land use transport strategies as a priority. A general evaluation criterion is presented below:

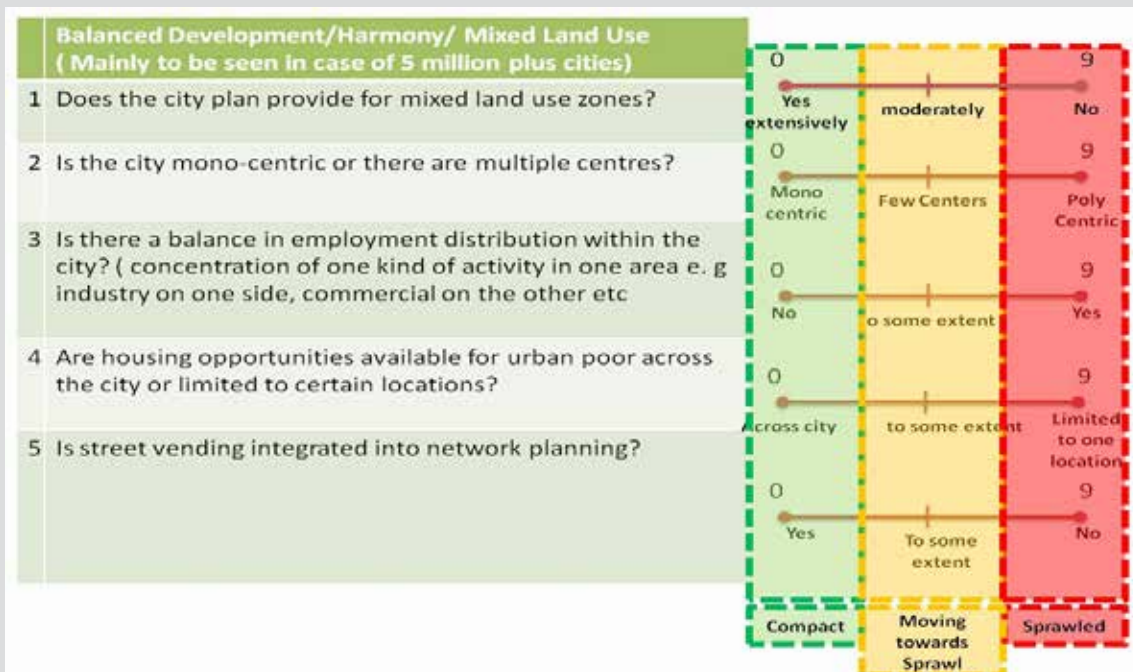


**Box 3.2:** Land use Transport Integration Evaluation Criteria

**1. Land use Efficiency-** these indicate the efficiency of the land use in the city and how well it responds to a compact urban form.

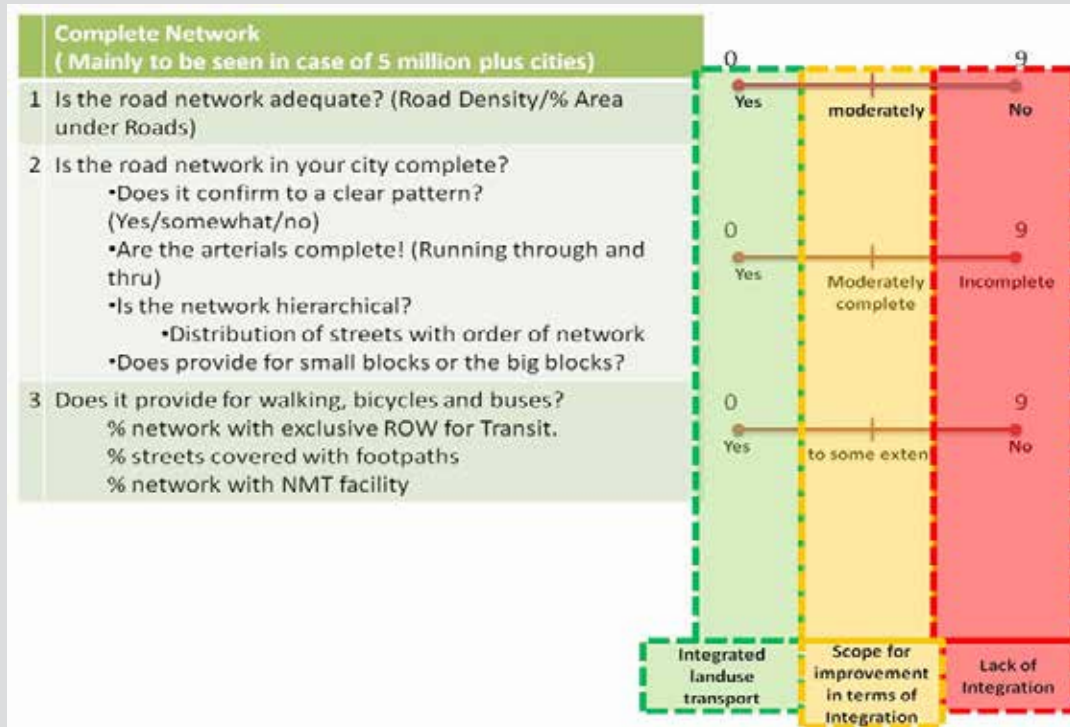


**2. Balanced Development/Harmony/ Mixed Land Use-** This indicate how well mix use zoning and equity is integrated in the city.

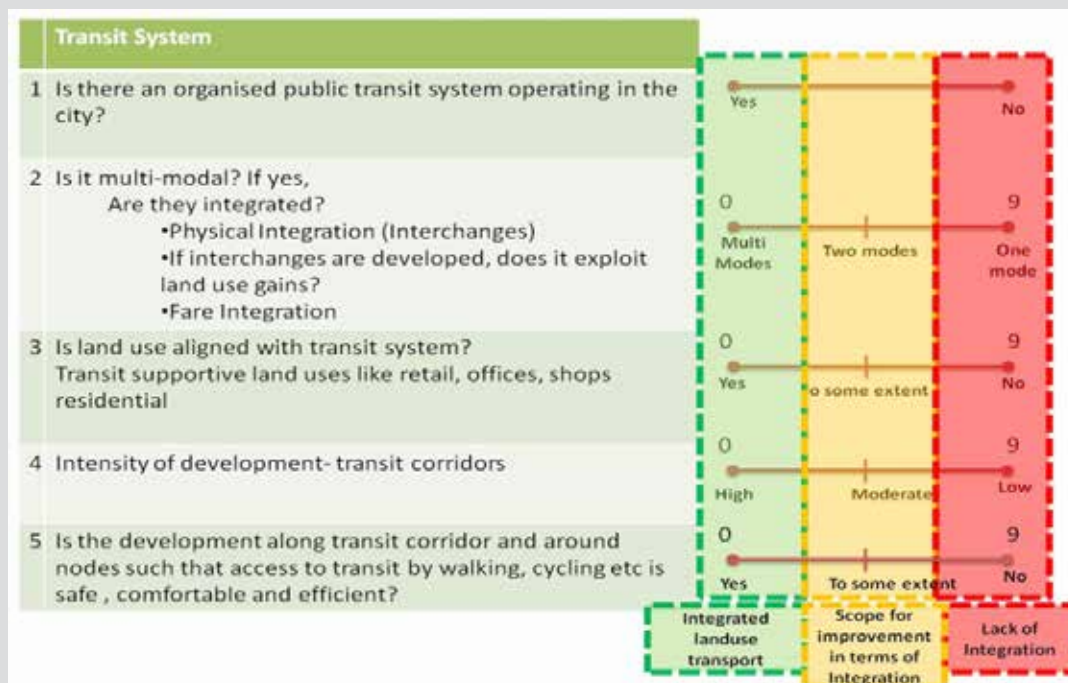




**3. Network efficiency-** Suggest how well network hierarchy and completeness compliments land use transport integration



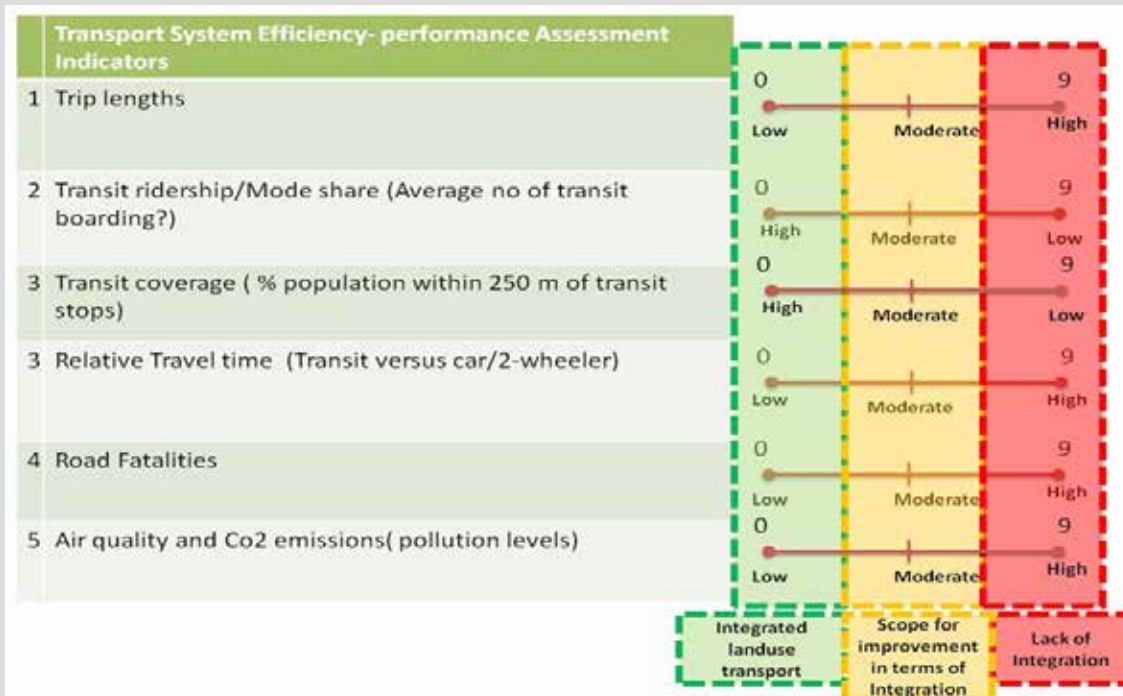
**4. Transit System efficiency-** indicates integration within the different transit modes and how well the city has utilised the density as a tool for structuring growth.







**5. Transportation System efficiency** – indicates the efficiency in the transportation that have been leveraged by the land use transport integration strategies.



Source- CoE-UT,CEPT

MoUD, has already prepared Service level benchmarks in urban transport which lays down the indicators and the methods of data collection apart from this National Mission for Sustainable Habitat has also identified indicators for Urban Planning and transport planning which look into the aspect of measuring land use transport integration . Data is to be collected and transferred spatially on maps using GIS and a data collection system put in place. It is important to understand the outputs that are desired before we start collecting information. Data collection should focus on data that will be used to measure indicators. Depending on the indicator measured the data collected needs to be representative both spatially and temporally. Following are the land use transport integration indicators suggested by MoUD-

- Population Density (Gross persons /Developed area in hectare)
- Mixed land use on major transit corridors /Network
- Intensity of development -Citywide (FSI)
- Intensity of Development along Transit Corridors
- Clear pattern and completeness of network
- % age network having exclusive ROW for Transit network
- Trip length/ travel times



Following is the list of data that can be collected to measure the indicators-

- i. Base map containing administrative boundaries, Municipal and Urban authorities (includes zones, wards, urban areas, villages)
- ii. Built up area ( digitized from Google/ Satellite Imagery)
- iii. Road network- ( based on IRC/ master plan / functional classification)
- iv. Land resource mapping –Cadastral mapping with identification of physical barriers.
- v. Activity mapping- Land Use, employment generating activity mapping via property tax information , data from registrar of establishments and industries department.
- vi. Traffic related information- location of signalised intersections, road under bridges, and road over bridges and river bridges, in order to understand the traffic flow information on origin destination, classified volume counts, speed and delay is required.
- vii. Public transport and rapid transit network including location of stops, frequency of services along with their schedules.
- viii. Demographic – population of 2011 (In case the new census figures are not available collect information on the last three to four decades and estimate the base year population. It is also important to take into consideration the area changes that have taken place which has an implication of the growth rates used for base year estimation.
- ix. Origin destination information using household surveys.

The Development Agency / Municipal Authority depending on the size of the city will need to take a lead in the process of data collection and management. In this regard a Planning information Management system is to be developed and standardized processes be established for data collection and processes to be put in place to update it from time to time.

**Figure 3.4:** Planning Information System





## Step 3 - Problem Identification

As we know that land use transport integration propagates a planning for desirable approach rather than a problem based approach as discussed above, however in the process of problem identification both today's and the future's problems need to be assessed.

### 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 3.5: Problem Identification Cycle



For example if the objective is to reduce congestion in the city it indirectly implies that the public transport system in the city is unreliable or if safety is one of our objectives that means that the accidents are a concern either today or in the future. Hence we can say that both objectives and problems are two sides of the same coin, meaning that we can start either with objective or problem and still come to the same conclusion.

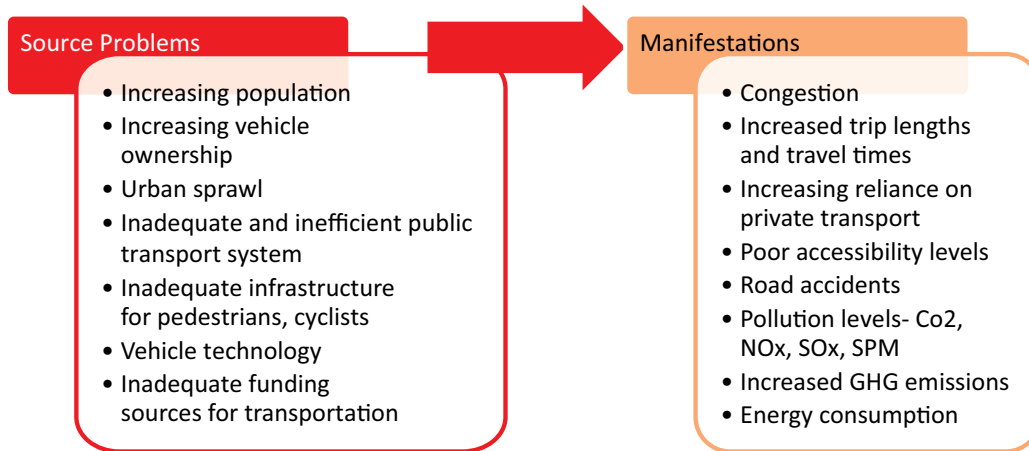
### Step 2: Identifying the problem and seriousness:

Problems can be identified in different ways

1. **Consultation:** Stakeholder consultations can be carried out with the people travelling by different modes along with the agencies that are responsible for transportation be it the traffic police or the transport operator to understand the problems.
2. **Objective analysis-** In this technique an objective set of indicators and targets are adopted and threshold limits are set by grading the problem as- severe, moderate and slight. The problem is said to exist if the measured or predicted value is different from the threshold.
3. **Problem tree analysis-** is another way of identifying the problem by understanding the root cause. Problems can be categorized as source problems and manifestation problems as given in the figure below-



**Figure 3.6:** Problem Identification



Source: Toolkit on Strategic Integrated Mobility Plan, Draft Report The World Bank 2012

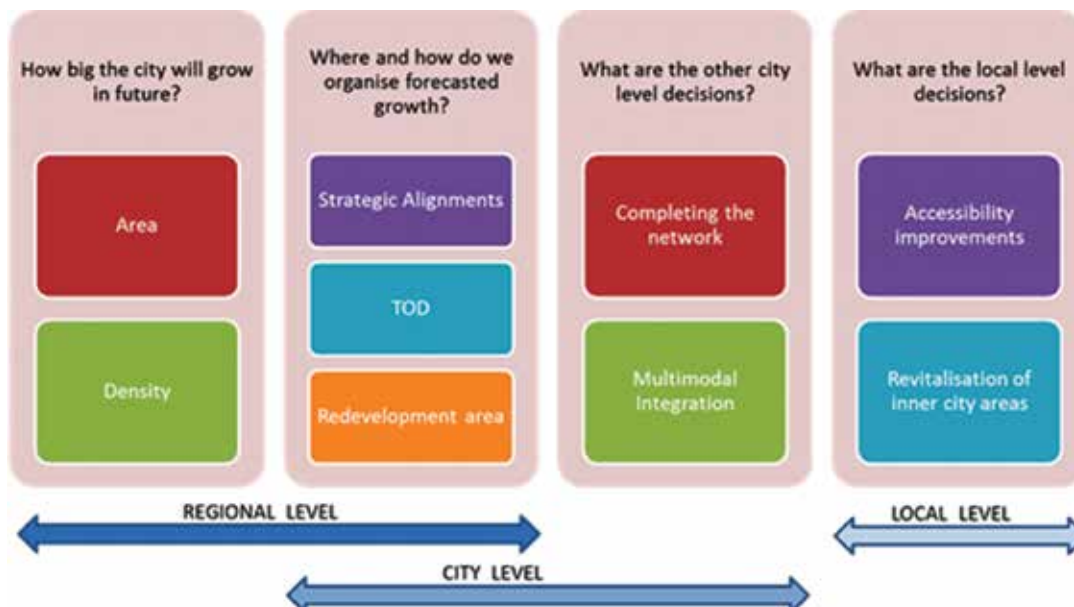
For example, increased trip length and travel times, pollution levels are manifestation problems while increased urban sprawl is the source problems.

It is important to distinguish between the two in order as it will have an impact on our choice of strategy to resolve the problem. If we only concentrate on the manifestation problems like accidents, the strategies adopted may be limited to improvement in the geometric design of the junction which will result in short term relief and due to increase in trip lengths and car ownership the problem will spring back. Hence it is important to tackle the problems at the source to yield long lasting results.

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-

**Figure 3.7:** Key decisions in planning process



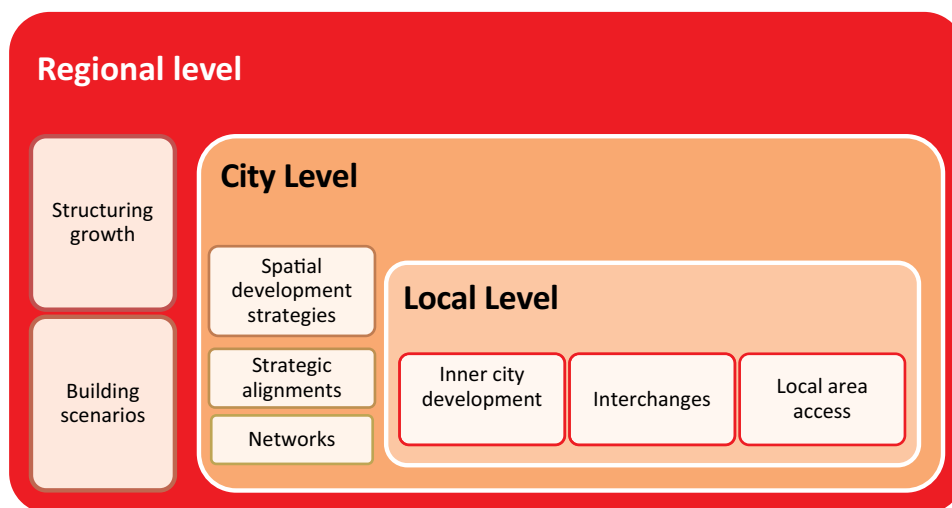




The strategy mix to be adopted for a city will depend on the size and the location of the cities. In case of metro and medium size cities the strategies need to be adopted at all three levels regional, city and local since they have a greater impact on the surrounding areas as they act as growth magnets for the region and have to deal with more complex problems which have a bearing not just for the city but also at the regional level.

However in case of the small size cities and towns the strategies adopted are mainly at the city and local level. It is important to note that the impact of strategies for land use transport integration is at long and medium term. The figure below lists the various strategic tools for land use transport integration and the level at which they are generally used.

**Figure 3.8:** Scales of implementation of Strategies



The various land use decisions, transport decisions and the resultant land use-transport decisions at the regional level are:



### 3.2.1 How big will the city grow in future?

Land use Decisions →	Land use Transport Decisions	← Transport Decisions
<b>REGIONAL ACTIVITY &amp; DENSITY</b>	<b>Cyclic Process: Linking activity nodes and high density nodes with Road Network and vice versa</b>	<b>REGIONAL ROAD NETWORK &amp; MULTI MODAL TRANSIT</b>
<p>Identify the major towns/villages, SEZs, SIRs, etc (further referred to as ‘regional nodes’) which have interdependent land use/activities with the parent city and distribute growth at a regional level.</p> <p>Encourage growth and develop CDPs for these identified regional nodes to reduce the demand on parent city/cities.</p> <p>Special nodes which has stronger relations (ex: industrial node – a major employment generator) with the parent city are to be prioritized for development.</p>	<p>Effectively link the regional nodes with each other and with the parent city with a good network of Regional roads</p> <p>To allocate future development of towns, employment centers etc only along the existing infrastructure (roads/railways) in a manner that growth can be directed and controlled at a regional level.</p> <p>Establish strong linkages with special nodes with rail based mass transit system to encourage more PT usage.</p>	<p>Develop a regional road network which helps establish a good regional connectivity.</p> <p>Develop a good hierarchy of regional roads that deviate regional traffic from entering the urban roads of the regional nodes/growth centers.</p> <p>Plan and encourage multi-modes of transport to help establish links at a regional level.</p>

The decision on the size of the city is very crucial in adopting the strategy mix; this will depend on the current and the future size of the city. The first step in the process is to identify the influence area of the city as this will help in deciding the growth strategy for the city and delineate the study area.

#### Study Area Delineation

Study areas delineation becomes a very important step in the planning process while integrating land use and transport. As we are aware that land use and transport decisions have a symbiotic relationship, hence delineating the influence area for the city is critical. This process is required for all cities irrespective of their size, however proper delineation for rapidly growing cities and large metropolitan cities is even more critical as we all know that ‘when city grows it become city regions’ and the transportation movements are not confined to the city limits alone.

There are two ways in which one could decide on the study area-

1. **City already has a metropolitan area defined**- in this case the same area can be adopted to decide on structuring growth
2. **City does not have a metropolitan area**- The city will need to delineate a larger hinterland which has direct influence on the city the box given below depicts the method of delineation.

The process of Study Area Delineation for a city/region which does not have a defined metropolitan area is explained and illustrated with a hypothetical example.

The example below shows the scenario of a typical metro city surrounded by satellite towns, smaller towns, villages, special investment zones etc. It is important as it helps identify the travel demand from these centres to the city and between each other, an indicator of its growth potential in the future. It helps



define the resultant influence area of travel in the region. There exist potential growth centres beyond the urban development boundaries like the proposed SIRs of the region, towns within its vicinity which will have immense growth potential due to the anticipated growth of the SIRs etc. Hence, in this example, the study area is chosen in a manner that these potential growth centres are included for the regional transport and spatial planning

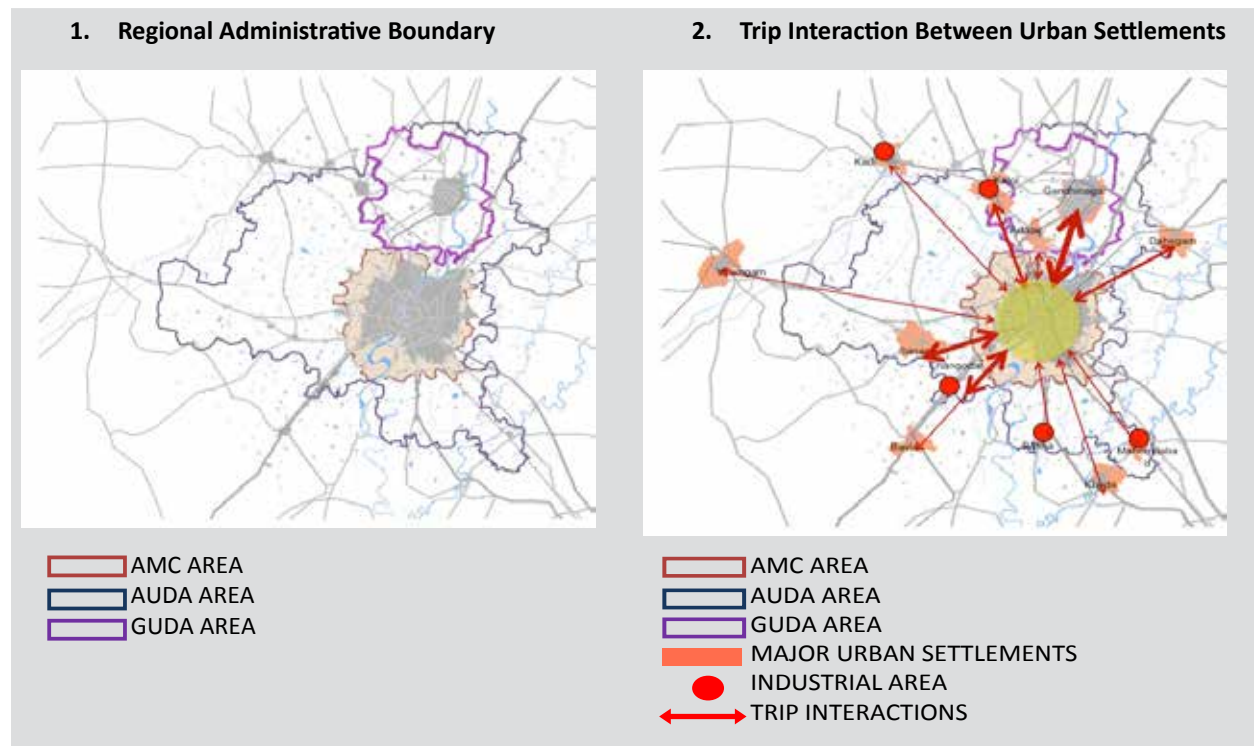
Step 1- Define the administrative boundaries

Step 2- Assess the trip interactions between urban settlements

Step 3- Identify the Major future proposals

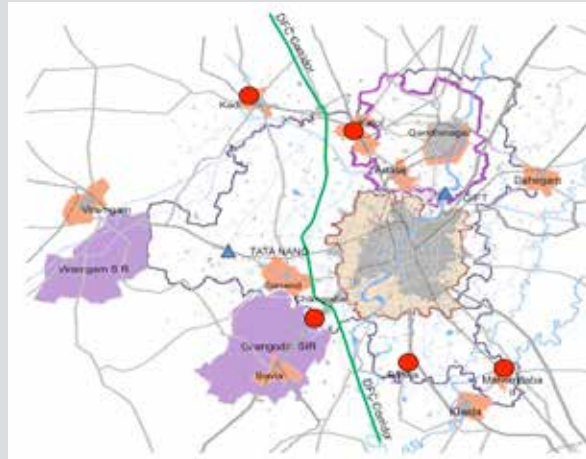
Step 4- Keeping all the above in mind delineate the study area

**Box 3.3: Study Area Delineation**



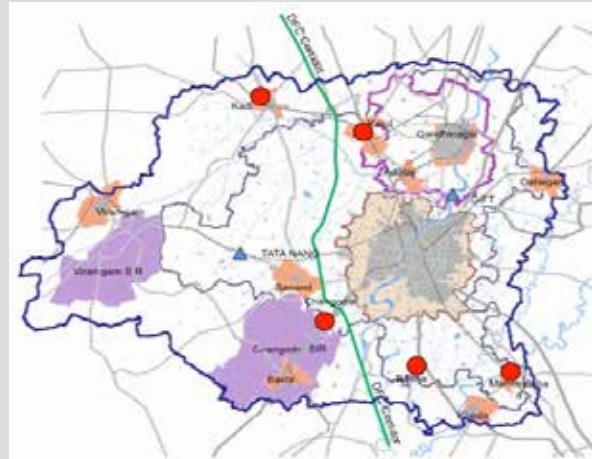


### 3 Major Future Proposals



- AMC AREA
- AUDA AREA
- GUDA AREA
- MAJOR URBAN SETTLEMENTS
- INDUSTRIAL AREA
- SPECIAL INVESTMENT REGION
- DEDICATED FREIGHT CORRIDOR

### 4. Delineated Study Area



- AMC AREA
- AUDA AREA
- GUDA AREA
- MAJOR URBAN SETTLEMENTS
- INDUSTRIAL AREA
- SPECIAL INVESTMENT REGION
- DEDICATED FREIGHT CORRIDOR
- STUDY AREA

Source: CoE-UT, CEPT

## Structuring Regional Growth and Scenario Building

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

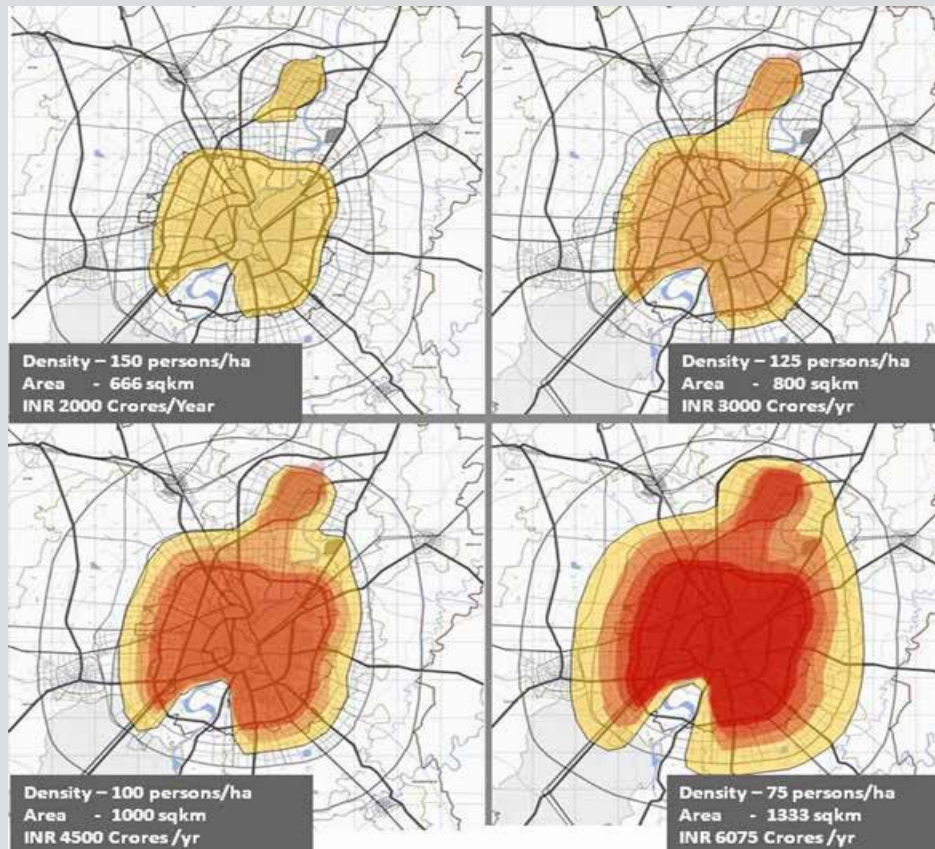
Looking at the existing trends and the future opportunities that the city has to offer one of the three projections is selected for further detailing.





**Box 3.4:** Scenario Building

The example depicts the various density scenarios that can be derived for the development of a city. Denser the city, the length of roads, transit systems, its related infrastructure like transit stations, parking lots etc reduces in length and number respectively. The varying cost for infrastructure development for each of the scenarios is as provided. Looking at the existing trends and the future opportunities that the city has to offer, the density scenario of 125 persons/ha which confines the city area to 800 sqkm is chosen for further detailing.



Source: CoE-UT, CEPT University

**Step 2- Land assessment for future growth:** As an integral part of land use planning land suitability assessment is carried out to determine spatially the total available land for urban use. At this stage one should also identify the area that will be available for regeneration and infilling inside the city. Hence this should also be added to the total area that is available for future growth especially in and around the city.

**3.2.2 Where and how do we organise forecasted growth?**

**Structuring at Regional Level**

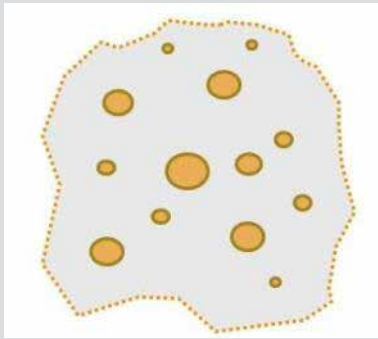
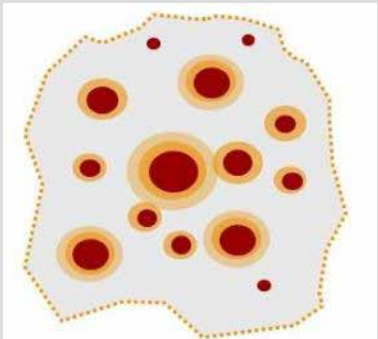
In case of metro and medium size cities owing to their growth trends and influence in the region it is important to structure growth at regional level. The strategy for integrated land use and transport at a regional scale is to distribute growth and activity in a manner that it helps structure cities or city regions.



The size of the city in terms of the area will have to be determined as a part of this process. Urban Structure is generally defined by size, spread and intensity of development:

- Intensity of development/ density defines the size and spread of the city
- Compact cities are high density cities
- High density means distance between various function is shorter i.e. separation between home and work is lesser
- This also implies that shorter trips and more trips on NMT

**Box 3.5:** Identifying existing and potential activity nodes

	
<p><b>Step 1:</b> Identification of existing and potential activity nodes as sub-centres – polycentric development</p> <p>Source: CoE-UT, CEPT</p>	<p><b>Step 2:</b> Strengthening sub-centres to redistribute activities to sub-centres, thereby reducing travel demand, trip lengths etc.</p>

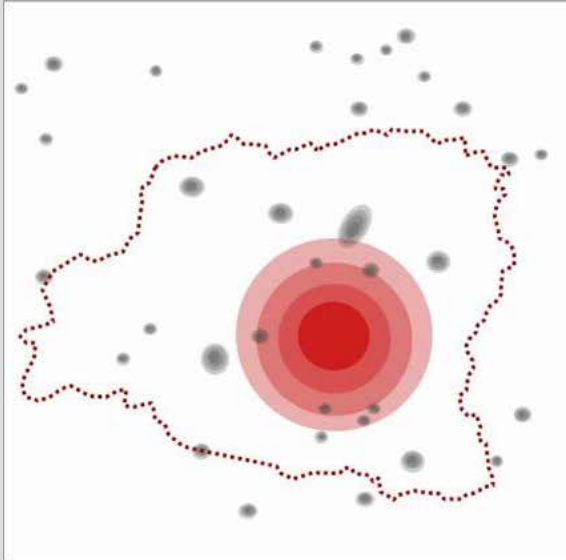
City and city regions have a tendency towards sprawl; managing sprawl is critical so as to keep the trip lengths short. City will need to decide on what kind of structure they are looking for, however land use transport integration promotes a compact city structure. Depending on the physical setting and availability of space the city can choose the growth option i.e. compact v/s sprawl, mono-centric v/s poly-centric, grid iron v/s ring radial etc.

In case of larger city areas, a number of centres can be developed, reflecting the concepts of ‘polycentric city’ or ‘decentralised concentration’, where smaller towns and industrial areas are developed as nodes, complementing the ‘compact’ high order main city.



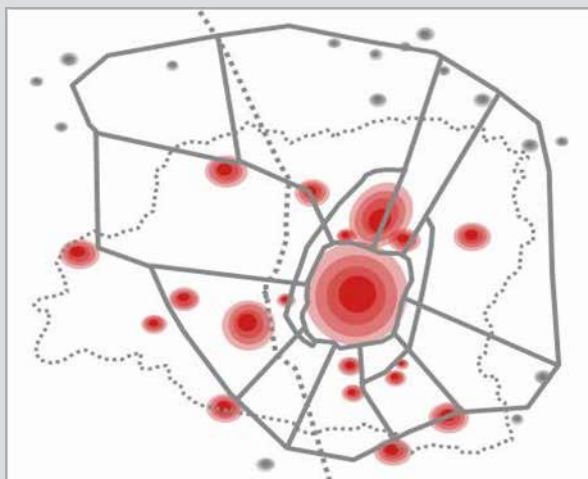
**Box 3.6: Regional Development Scenarios and Structuring growth**

A hypothetical case of a city region is used to explain the process of structuring growth. Two scenarios of urban growth of this region are derived as illustrated in Figure below.

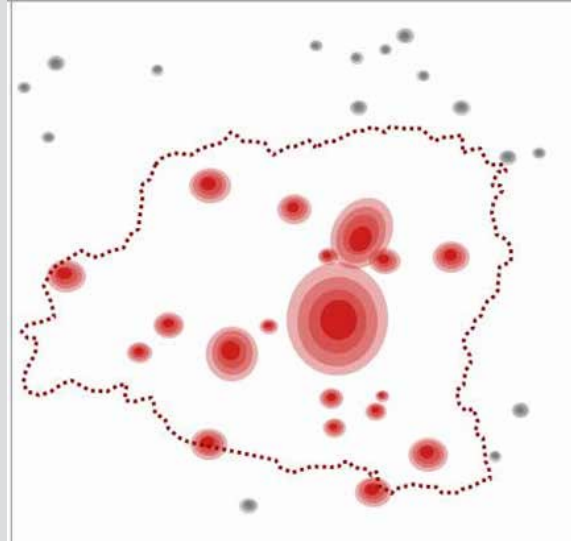


**Scenario 1** depicts the growth of the central city with low density sprawl, engulfing neighbouring towns and villages. This leads to longer trip lengths, increasing dependency on motorised modes of travel and resultant congestion, accidents and pollution.

**Connecting the centres with strategic alignments**



Source: CoE-UT, CEPT University



**Scenario 2** shows the strategic distribution of growth amongst the growth centres. Adoption of this strategy helps retain the size of the parent city and the neighbouring centres to grow. It is important to note that not all urban nodes (towns/villages) within the study area/metropolitan area need to be selected for development.

It is important to identify the centres which hold potential for growth like industrial towns/areas, SIRs, SEZ and villages/towns nearer to them etc. The example above shows the manner in which the growth centres are to be linked by roadways and railways in-order to function as an inter-related system. This network may also act as the strategic alignments having MRT modes on them. In this manner, the central city retains its compact size and density. It can be achieved by developing each cluster node to be self-sufficient, with a mix of land uses like housing, employment, education, entertainment, institutional etc.

The various land use decisions, transport decisions and the resultant land use-transport decisions at the city level are:





Land use Decisions →	Land use Transport Decisions	← Transport Decisions
<b>Urban activity &amp; density</b>	<b>Cyclic Process: Linking activity nodes and high density nodes with Road Network and vice versa</b>	<b>Urban road network</b>
<p>Define the maximum developable area boundary to accommodate the projected population, for the parent city and for each of the nodes.</p> <p>To adopt recommended Gross densities of an average 125 persons per hectare (UDPFI guidelines) to be adopted for development of each node.</p>	<p>To plan a Complete urban road network for the city that effectively links major activity nodes and existing high density zones of the city, enhancing accessibility within the city.</p> <p>The Complete Network should establish new links in a manner that it establishes connectivity and hence encourage growth and development at locations which were formerly derelict.</p>	<p>To plan a Complete network that strengthen existing roads by building new roads, flyovers, rail under/over bridges, foot over bridges etc.</p> <p>It should establish new links within the city and to the proposed peripheral areas of development in a manner that it complements the existing road structure/pattern.</p> <p>To design roads with a clear hierarchy of use.</p>

### 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.

The following spatial strategies can be used for densification-

- Increasing FSI using TOD- Identification of Transit corridors where FSI can be increased keeping in view the carrying capacity of infrastructure.
- Identification of underutilised areas- These can be in the form of infilling areas or regeneration areas, incentives of FIS increase can be provided and areas such as dilapidated/ unused mill areas (typically lying vacant in the core city areas) need to be identified and used for intensification.

### Structuring and refining at city level

The further refinement of the scenarios can be done at the city level depending on the strategies adopted.

Since land use transport strategies have to be developed concurrently decision on the important activity nodes (land use related decisions), strategic alignments (transportation related decision) that connect these nodes and the intensification strategies (land use related decisions) go hand in hand. Since demand on the transit network is dependent on the population density and population density is dependent on the connectivity hence these aspects are difficult to separate out.

On the basis of above three kinds of intensification strategies can be explored as given in the box below.



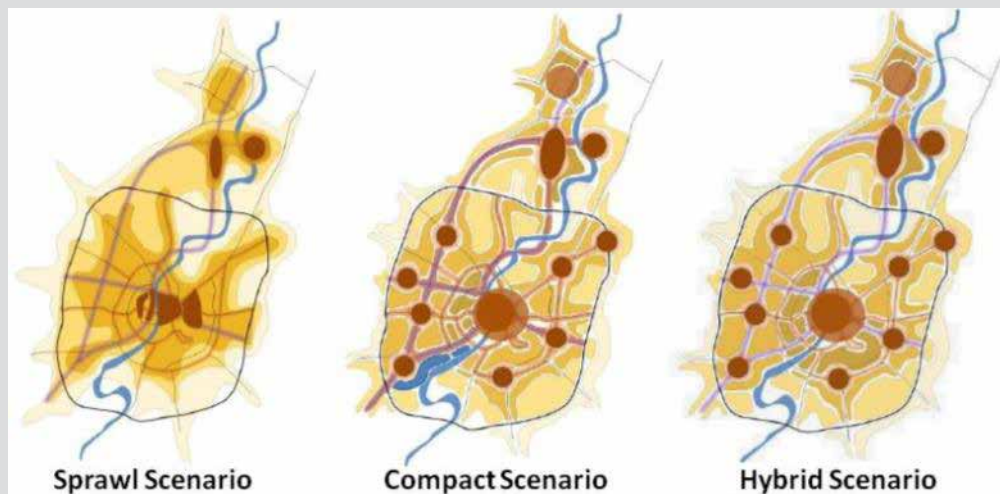
### Box 3.7: Refining Scenarios

The example below shows the manner in which the selected density scenario is further detailed out in terms of mass transit alignment, road network development etc. The base density of 125 persons/ha is further distributed within the city in the following ways:

One can use different spatial strategies to further refine scenarios using FSI increase and TOD-

- **Sprawl Scenario:** This scenario distributes density evenly all across the city. This does not consider principles of land use transport integration and leads to sprawl.
- **Compact Scenario:** This scenario distributes high density along all mass transit corridors and at multimodal transit interchanges and activity nodes of the city. It proposes to concentrate major activities/transit supportive land uses in these high density zones.
- **Hybrid Scenario:** This scenario distributes high density along only selected mass transit corridors (ex: metro) and selected nodes (ex: major railway station area, metro to rail and BRT interchanges, major markets, employment nodes etc.) of the city.

It is observed that it is often not easy to change the density along all mass transit corridors due to limitations such as already existing developments, presence of historical monuments etc. Hence it is important that scenarios be selected realistically and hence in most of the cases a hybrid scenario is selected.



Source: CoE-UT, CEPT University

### 3.2.3 What are the decisions to be taken at the city level?

The issues faced by metro and medium size cities are more complex than those of small cities and towns, hence the selection of the tools from the above list will also vary. On one side where the transport needs of the large city are complex and high the adoption of multimodal rapid transit system on a priority basis along with other strategies would be required on the other side in case of small cities where the city size is still small and manageable with greater share on NMV and pedestrian modes the tools like mix use development, improvement in public transportation may be sufficient.



At the city level tools that are available for ensuring land use transport integration are density, strategic alignments, network development, transit oriented development / density oriented transportation, integrated transit facilities, legal and financial tools. It is important to review the vision and objectives set by the land use plan to choose the appropriate strategy mix for your city.

If the vision for the city is “Integrate city structure and transport system towards greater accessibility, efficient mobility and lower carbon future” the focus of the strategies adopted are on density, transit development, multimodal integration, adopting strategic alignments and planning for sustainable modes along with adopting TDM measures.

### 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. It is however important to ensure that there are no missing links in the existing network and a proper hierarchy is maintained. At the development plan level network upto the third level should be developed having provision for transit ready streets.

**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-** Develop network concept for the area identified for future growth of the city in line with the existing pattern.

**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.

#### Box 3.8: Complete Network and Hierarchy

A ring radial city is chosen to illustrate network development and its completion. It can be observed that the major roads form a ring radial pattern, structures the city and its travel patterns. It is seen that this pattern is broken at various locations in the city which are identified as missing links. Completion of this network includes connecting these missing links through:

- New road alignments through vacant plots, waste land, illegal settlements etc
- River bridges, RoBs, RuBs, Flyovers etc

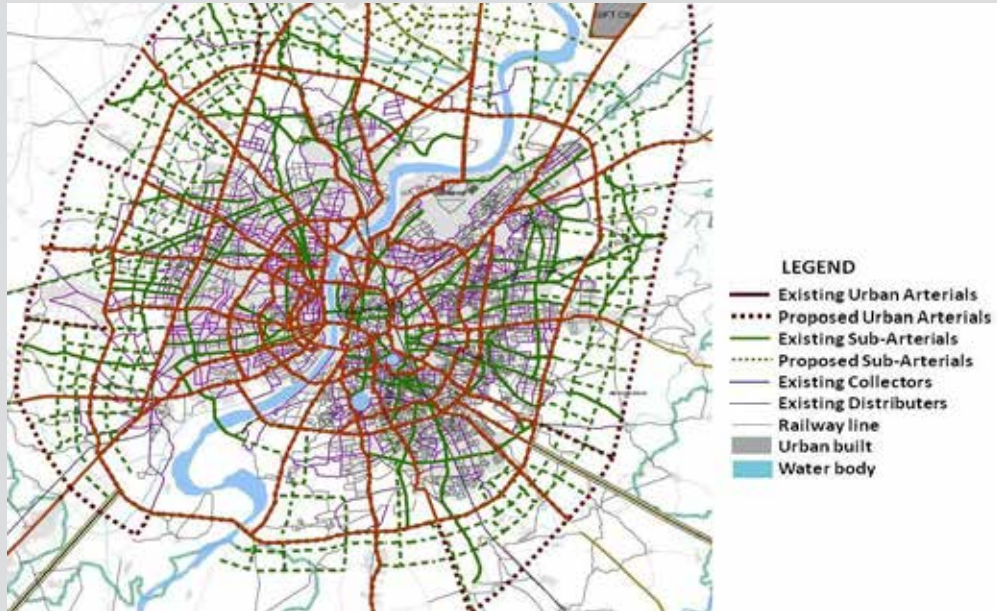
It can be observed that the existing alignment is considered which proposing new roads or extension of the old to the city periphery. This approach helps retain the existing road pattern which has formed the structuring element of the city, over years.

It is important to have a clear hierarchy of roads, which facilitates various road uses as:

- The highest level of roads in the example is the arterials, consisting of major rings and radials, designed for mass transit, high speed and heavy traffic flow or even regional traffic at times.
- Sub-arterial roads connect arterial roads and lead to formation of ‘blocks’, classified as sub-arterial roads of level 2 hierarchy.
- All roads that provide connection between blocks/ neighbourhoods are classified as level 3 collector roads. These roads are meant to collect traffic from neighbourhoods and feed them to level 2 and level 1 roads.



- Level 4 local streets are internal roads within neighbourhoods. They are the last link to residential destinations and join level 3 collector roads only. On no account would they directly connect with level 1 and 2 roads.



Source: CoE-UT, CEPT University

Land use Decisions →	Land use Transport Decisions	← Transport Decisions
<b>Land use decisions: Urban Activity and Density</b>	<b>LUTI decisions: Cyclic Process of Linking activity nodes and high density nodes with Road Network and vice versa</b>	<b>Transport Decisions: Urban Mass Transit</b>
<p>Identification of existing major activity centers and new centers as to be developed as urban nodes.</p> <p>Redistributing the gross density by allocating high densities in existing activity centers of the city and also identifying potential new high density nodes. The new nodes are to be developed within the developed area and also in the proposed developable areas of the city.</p> <p>Urban Renewal of derelict areas by altering existing land use and activities.</p> <p>Local Area Plans to be prepared for detailing the Infill, Consolidation, Re-densification, Compaction projects to densifying the built and intensifying activities of a node.</p>	<p>Plan Transit Ready Streets – design arterial streets of the city in a manner that it prioritize transit, NMT and supportive activities and land use</p> <p>Route Selection- To strategically align public transport systems like metro, BRTS, tram, city bus services etc, complimented by feeder buses &amp; para-transit systems to connect all activity centers.</p> <p>To encourage T.O.D</p> <p><b>Multimodal interchanges:</b> To design multimodal interchanges that facilitate physical integration of multi-modes in a city.</p> <p>TDM measures:</p> <ul style="list-style-type: none"> <li>• Design of interchange zones which are pedestrian prioritized</li> </ul>	<p>To plan for a multimodal transport system for the city and to efficiently integrate the various modes by:</p> <ul style="list-style-type: none"> <li>o Institutional Integration</li> <li>o Fare integration</li> <li>o Physical integration</li> </ul> <p>Public transit modes like metro, BRTS, city bus services, etc are to be prioritized among the multi-modes of a city</p> <p>Formalizing para-transit modes like auto-rickshaws, taxi, cycle- rickshaw etc and their integration with mass transit systems in the city. Para-transit systems should be prioritized to serve as last mile connectivity</p> <p>NMT networks to be developed to help shortest possible access to major activity centers and to multimodal interchanges.</p>





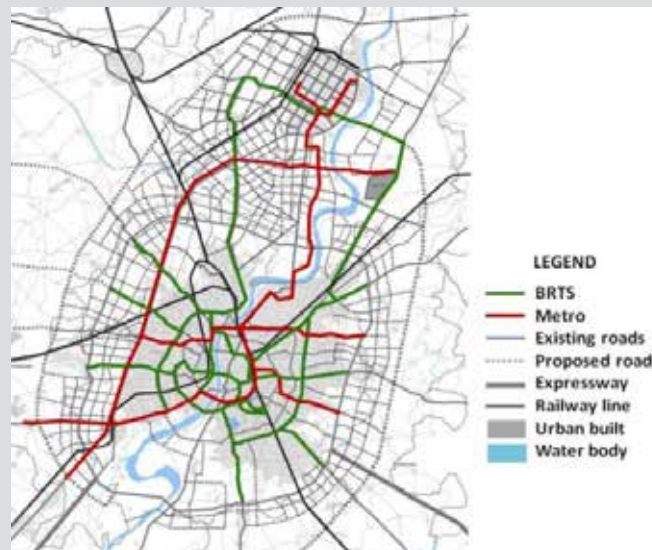


- The transit grids should be smaller in size in the city centre, thereby assuring more transit options in the denser (population and employment) areas of the city.
- The 'transit grid' can be larger blocks towards the periphery of the city.
- There should be other public transit systems like the city bus services, para transit systems, etc which complement this mass transit systems and network.

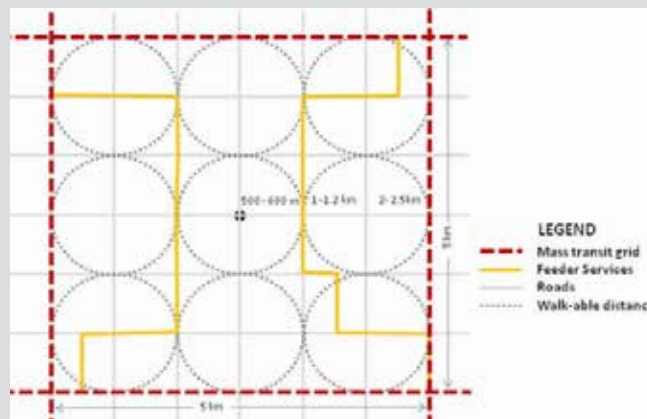
**Box 3.10: Multimodal Transit System and Last mile connectivity**

The example illustrates the mass transit system for a city. The transit routes are proposed along the major rings and radials of the city, forming an average grid of 5km x 5km. The mass transit system, once implemented, insures access to mass transit within an average distance of 2.5 km from any point in the city, through feeder services like city buses, auto-rickshaws, bicycle etc. The figure below shows the basic principle of a mass transit grid size for a city, which explains the feeder service grids and walk-able distances/grids.

**Multimodal System for a city**



**Relation between mass transit grids and other modes for last mile connectivity**



Source: CoE-UT, CEPT University





## 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 their 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.

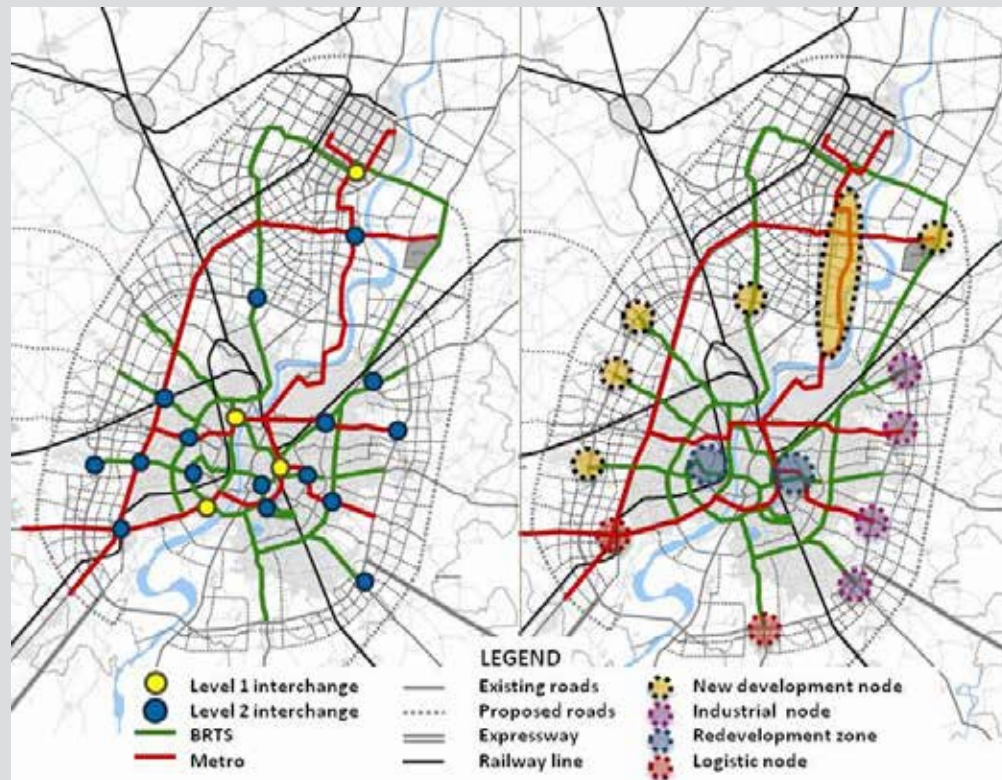
**Step 4-** designing the interchange keeping in mind seamless connectivity for the passengers.

- **Level 1 interchange-** are defined as area where the city and the regional and urban transport modes meet e.g. railway station the influence area of this kind of interchange is about 400 m whereas the area requirement for the core station can range between 4 to 16 ha. In most of the Indian cities it is observed that the level 1 and two interchanges are located in the heart of city and hence in this case land availability for interchange development can be an issue. In such cases transfer of development right can be adopted to make the area available.
- **Level 2 Interchange-** are defined as area where the high order of transit modes meet e.g. Metro and BRT the influence area of such an interchange is between 250 - 450 m and the core station area requirement is about 3-7 ha.
- **Level 3 interchange-** where public transport meets the transit mode. The influence area and core station requirement are similar to that of level two interchange however the lesser facilities are provided as compared to level two.
- **Level 4 interchange-** refer to the area where the public transport routes meet, provision of interchange facility may not be required.



**Box 3.11: Multimodal Transit Interchanges and Activity nodes**

The example below shows the various transit interchanges, their hierarchy and activity nodes of a city, selected for development.



Source: CoE-UT, CEPT University

**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. These activity nodes can be in the form of new development, infilling development or regeneration areas to encourage the economic development of the cities. Generally the size of such nodes is around 1 to 1.5 sq km. The land can be made available by two means – TP scheme mechanism especially in case of greenfield areas to be developed or TDR mostly in case of infilling and regeneration areas.

**Step 2-** Classifying the activity nodes on the basis of predominant land use i.e commercial, industrial, educational etc. and providing for mix use activities in these nodes.

**Transit Oriented Development**

As discussed earlier in box 4(refining scenarios) the city will have to decide on how much area do they want to intensify this can range from a full TOD scenario where the FSI for all the transit routes along with the interchange nodes is increased, to select TOD option where depending on the ROW available one can opt to intensify selected areas only. In most of the cities it is observed station spacing acts as a major factor in this regards. In most of the cases it is also seen that it is more feasible to go in for a corridor intensification in case of BRT where the station are closely spaced and a node/ station TOD in case of a metro system.



**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

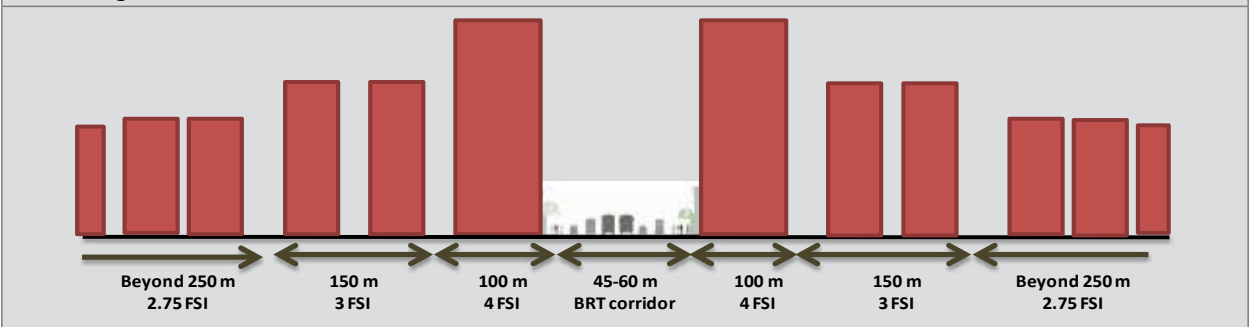
**Step 3-** Find the carrying capacity of the infrastructure in the areas

**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.

**Box 3.12:** TOD Concept depicting proposed FSI along a Mass Transit Corridor and Transit Interchange Facilities

The Figure below illustrates the manner in which the FSI in a city can be varied to concentrate high density development along a mass transit corridor and development decreasing in density as moving away from transit. A buffer of 200-500m is adopted as TOD zones in most cases. The density is highest around the station areas/ interchanges within walk-able distance.



It is also important to define specific land use along TOD zones, which is supportive of mass transit. The land use is to be so chosen that it offers transit passengers to engage in multi-functions at interchanges like-

- Shopping: Super markets, book stores, garments etc.
- Entertainment: Public open spaces/parks, movie theatres, sports centres/stadiums etc.
- Employment: offices at multi-levels of the interchange or within walk-able distance
- Education: Schools, Colleges, Tuition and training centres etc.
- Social amenities: Heath facilities, ATMS, banks, public toilets, rest areas, hotels/ lodges
- Residential: Apartment type housing of high density

The basic facilities provided and the concentration of land use mix at an interchange will vary with the level of interchange as shown above.

	Influence zone	FSI	Access Areas	Parking	Public Amenities	Other facilities
<b>Level 1</b> Metro, Railway, BRT, AMTS	4 SqKm	4		Short term Long term Full day		<b>Transit supportive land use</b> Local street markets Commercial complexes High density office towers Mid density residential Hospital Restaurants Child day care center
<b>Level 2</b> Metro, Railway, BRT, AMTS	2.25 SqKm	4		Short term Long term		<b>Public Spaces</b> City plaza Entertainment spaces <b>Para transport Facilities</b> Taxi stands Auto stands Bicycle rentals

Source: CoE-UT, CEPT University



### 3.2.4 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. Apart from this the emphasis of the strategies at this level is on infrastructure development for pedestrian and bicycle facility. The strategies like activity area and interchange area development that are adopted at the city level are actually implemented at the local level. Apart from this the emphasis of the strategies at this level is on infrastructure development for pedestrian and bicycle facility.

Land use Decisions →	Land use Transport Decisions	← Transport Decisions
<b>Urban activity &amp; density</b>	<b>Cyclic Process: Linking activity nodes and high density nodes with Road Network and vice versa</b>	<b>Road network and connectivity</b>
<p>At a neighborhood level, a good mix of land use is to be encouraged to ensure formation of neighborhood center with:</p> <ul style="list-style-type: none"> <li>○ Commercial and entertainment facilities</li> <li>○ Educational centers like day-cares and schools</li> <li>○ Social amenities like libraries, community centers etc</li> <li>○ Small scale industries and employment centers</li> <li>○ Parks, playgrounds etc</li> </ul> <p>To Concentrate/Distribute the above mentioned activities/land use in neighborhood centers or form smaller sub-centers within a neighborhood</p>	<p>At a neighborhood level, a good mix of land use is to be encouraged to ensure formation of neighborhood center with:</p> <ul style="list-style-type: none"> <li>○ Commercial and entertainment facilities</li> <li>○ Educational centers like day-cares and schools</li> <li>○ Social amenities like libraries, community centers etc</li> <li>○ Small scale industries and employment centers</li> <li>○ Parks, playgrounds etc</li> </ul> <p>To Concentrate/Distribute the above mentioned activities/land use in neighborhood centers or form smaller sub-centers within a neighborhood</p>	<p>To design for neighborhood level roads/road pattern that ensure:</p> <ul style="list-style-type: none"> <li>○ Deviation of city level traffic from entering neighborhoods</li> <li>○ Design of Collectors and Distributors in a manner that they encourage safe NMT mode usage within neighborhoods</li> <li>○ Complete Streets that facilitate slow traffic movement, NMT prioritized streets through roadway designing and adopting traffic management measures</li> <li>○ Multimodal Interchanges: To enhance last-mile connectivity through Local Area plans for good pedestrian linkages to station areas and land use development along these routes.</li> </ul>

### 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-

**Step1-** Decide on block size at which the strategy will be implemented as it has an implication on travel. The block at local level should be planned in such a way that they encourage walking, cycling and public transport use; hence small block sizes should be adopted in such a way that walking distances to the public transport stops is not more than 500- 750m.





**Steps 2-** Assess the urban fabric which is made of buildings, streets and open spaces as it help in providing the identity. Along with this the land use activities should also be organized in such a way that it encourages the use of NMV and pedestrian modes. One way of achieving this could be by providing through pedestrian/ NMV network instead of through streets.

The function of the local level streets is to provide higher level of accessibility and hence this should reflect in the design of such streets by incorporating features such as wide footpaths, pedestrian crossing priority at intersections etc.

**Box 3.13:** Street Planning and Design Principles

The street hierarchy pattern as illustrated in the example in Figure below shows:

- Urban sub-arterials forming urban blocks of average size 1.5 km x 1.5 km.
- The collector roads to define the structuring of urban blocks and connect existing public spaces/ parks/play grounds etc.
- Distributers to define the access to each plot in the neighbourhoods.
- The collectors and distributers to have speed limitations, parking specifications and well defined NMT facilities to enable safer environments within urban blocks of activity that facilitate more NMT share.

Source: CoE-UT, CEPT University

There exist planning tools in various states across the country to facilitate the planning of cities to this level of detail. In cities of Gujarat, the practice of Town Planning Schemes over the years has facilitated the government bodies to develop road network and structuring cities.

**Developing Local Area Access Plans**

Local area access plans can be prepared for the transit network. The following steps can be adopted to identify the network for improvement-

**Step 1-** 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.

**Step 2-** Identify clusters of activities in the areas/ activities that are in close vicinity and connecting clusters to nearest transit stop



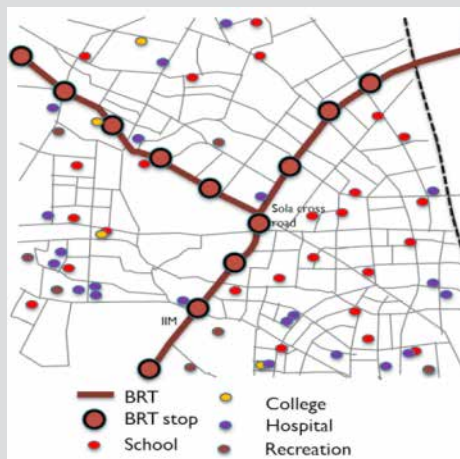
**Step 3-** Identification of the network which would connect the activities and the transit stations by creating loops and identifying missing links.

**Step 4-** Complete the network by providing priority for pedestrian and cycle infrastructure connecting the activity areas to the nearest transit stop. Identified routes/streets are designed and developed for pedestrian and bicycle use on priority. Motorised vehicle speed regulations and restrictions along these streets are other measures adopted to ensure safer environments and access to public transit.

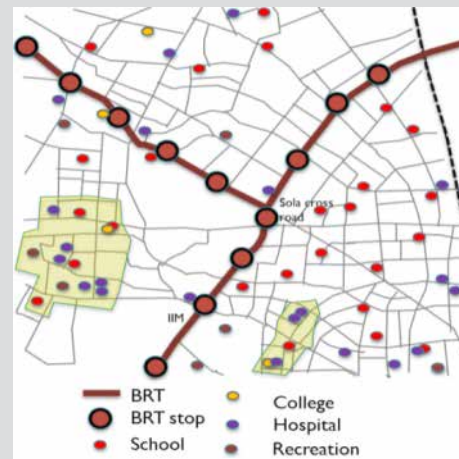
**Step 5-** One can also plan for altering the land uses along the identified network to support pedestrian and NMT like activities like local markets, day cares, libraries etc.

**Box 3.14:** Local Area Access Network plans

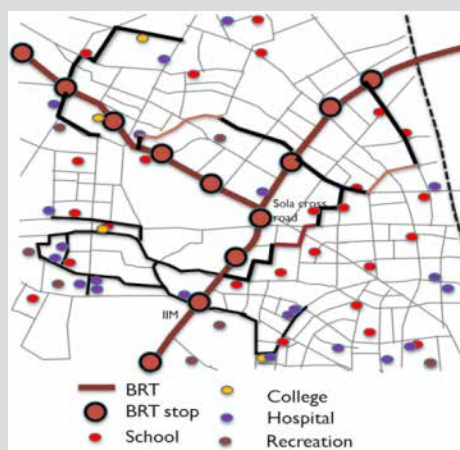
The example illustrated Local Area Access Plan (LAAP) developed to enhance the last mile connectivity to public transit, mostly by NMT modes.



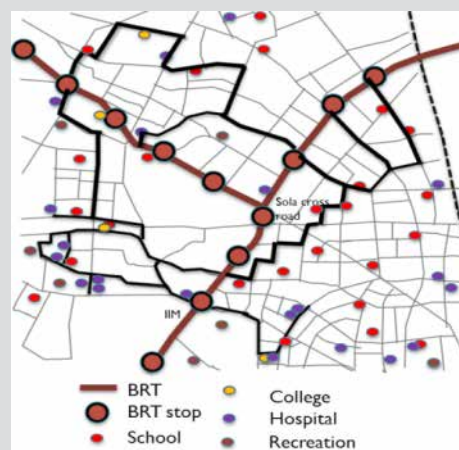
Step 1



Step 2



Step 3



Step 4

Source: CoE-UT, CEPT University





### Developing Plans for Regeneration Areas

In most of the Indian cities it is observed that large chunks of land are underutilised in core city area. It is important to ascertain ownership of these lands and develop strategies to bring these areas into the development realm. One could look into the financial tools like increasing FSI or go in for land pooling to develop the area as a mix use zone. It is also important to provide transit connectivity to these areas and one can also look into TOD options for such areas.

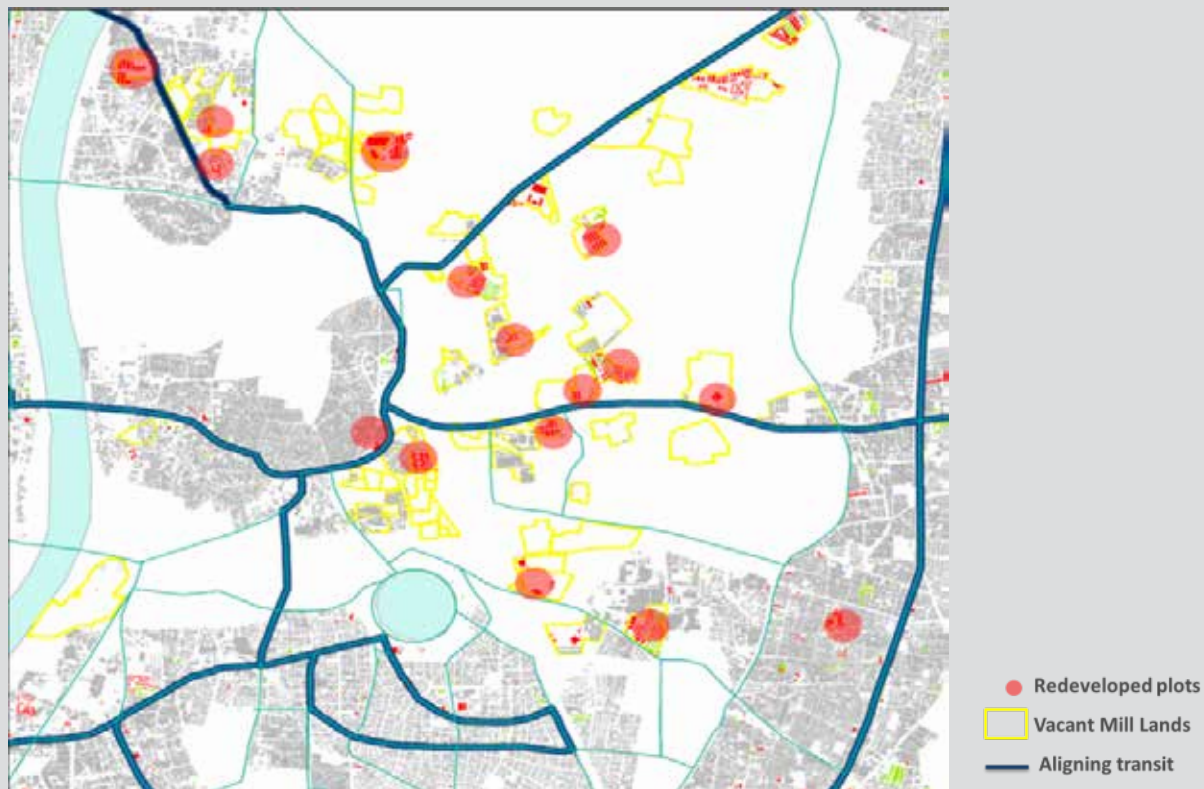
**Step 1-** Identify the different kinds of vacant or underutilized land in the core city area- Industrial derelict land/ mill lands, land under urban land ceiling, vacant public purpose land and public purpose reservation land.

**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.

#### Box 3.15: Regeneration Areas

An example to regenerate such areas is given below where the transit network has been aligned along the derelict mill lands and proposed for regeneration.



Source: CoE-UT, CEPT University



## 3.3 What are the factors that facilitate the implementation of such strategies?

### Step 1 - Sequencing the strategies adopted

Sequencing of strategies is as important as identifying the strategy mix for the city for the successful implementation e.g. if we are looking to increase the transit ridership one has to first look into improvement in the access and egress infrastructure in terms of improving the pedestrian facilities around the transit stations. Similarly if measures to restrict car use are adopted through zoning it will be important to provide for alternative mode of transport first.

### Step 2 - Identifying projects and getting stakeholders involved

Depending on the strategy mix adopted the implementation of the same will take place by identification of projects. e.g. If we are looking to complete the network in the city then identification bridges, underpasses or flyovers will happen at the strategic level however more detailed projects will be developed for the implementation of the same at a local level.

Typical projects range for network completion projects as mentioned earlier to development of an integrated multi modal system for the city. At this stage stakeholder involvement becomes very important as these projects can be discussed across the table and different organisations can opt in to take a proactive role for the detailed feasibility.

### Step 3 - Picking up the appropriate regulatory and financial tools

This will depend on the strategy mix that the city has decided to go ahead with. The important thing to note here is that most of the cities have the development control regulations and building bylaws to facilitate the implementation of the above strategies. However the success of implementation of these will depend on application by demonstration and action than by law itself.

Implementation of land use transport strategies can broadly be put under two heads-

A. Strategies that are addressed by the regulatory frameworks which in turn governing the use and development intensity of urban land.

**These mainly include-**

- Compact development
- Mix use
- Strategic alignment
- Network accessibility improvement
- Local area planning
- Inner city development
- TOD ( Transit oriented development)



The tools that are used to implement the above strategies broadly use zoning and development control regulations to achieve results. It includes regulations for land pooling/ subdivision of land in terms of plot sizes, margins, building by laws, norms and standards for facility and amenities provision.

Type of Strategy	Impact of Travel Behaviour				
	Reduction in Trip length	Reduction in VMT	Decrease in private mode trips	Increase in transit and PT use	Increase in NMV and pedestrian share
Regulatory Strategies					
Compact development	1	2	2	1	1
Mix use	1	1	2	2	1
Strategic alignment	-	2	2	1	1
Network accessibility improvement	1	2	2	1	1
Local area planning	1	-	1	-	1
Inner city development	-	-	1	1	1
Transit oriented development	-	1	1	1	1

1. Primary effect of regulatory strategy      2. Secondary effect of regulatory strategy

B. Strategies that use financial aspects of land development to influence the types of land uses and development patterns.

These include financial incentives for the implementation of the strategies-

- Public Incentives: Include land pooling, TDR (Transfer of development rights), FSI to increase density.
- Tax based Public financing: include Land value taxation, Tax abatement programs, Revenue sharing, Tax increment financing, Impact fee
- Public Private partnership
- Private sector support: Location-efficient mortgage programs, Financing for mixed-use development, Community land trusts

Type of Strategy	Impact on tools of Land use Transport Integration						
	Compact development	Mix use	Strategic alignment	Network improvement	Local area planning	Inner city development	TOD
Financial Strategies							
Public Incentives	✓✓	✓	✓✓	-	-	✓✓	✓✓
Tax based public financing	✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓
Public Private partnership	✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
Private sector support	✓	✓✓	-	-	-	-	✓

✓✓ Direct impact

✓ indirect impact

#### Step 4 - Inter Jurisdictional Coordination

In order to achieve integration it is important that the various stakeholder agencies come together and work towards this in a coordinated way. There are number of aspects involved in transport planning,



including planning for various modes of transportation, provision of infrastructure such as road network, street furniture, bridges, bypasses, parking facilities, pedestrian and bicycle facilities, waterways, rail transit, etc. All these aspects are managed by different agencies. This multiplicity of agencies results in inconsistent and fragmented data, lack or improper distribution of funds for various transport projects, lack of clarity in the roles and responsibilities of different agencies. It results in low decision making power with local authorities. The role of one agency conflicts with role of other, resulting in development of inferior quality of public transport system. Low standard public transit services fail to fulfil the demand and also to impose itself as a choice of majority of population over private vehicles.

**Ownership** plays a key role in the success of any plan. The clarity on ownership insures that the plan is prepared and implemented properly. There are few aspects that play a key role in the coordination-

1. **Strong political leadership** : An integrated, hierarchical approach to spatial and transport planning, this is only realistically achievable if there is good collaboration with strong leadership
2. **Inter-Agency Collaboration**- Collaboration between agencies is critically important, and requires careful management of requirements, expectations and relationships.

Hence the development of a separate agency can be looked into similarly one can also explore decentralized process with a provision in the mandate of the various agencies to abide with the strategic plan.

### 3.4 How do you evaluate Land use Transport Strategies?

Success of the strategy mix can be evaluated in two stages-

1. **Before implementation of strategies**- this normally refers to the use of tools like cost benefit analysis and multi criteria analysis to be used to test the strategies adopted.
  - a. Cost benefit analysis: In case of cost benefit analysis land use transport model created for the city could be used where the results for future years in terms of trip length, vehicle miles travelled, area and population coverage by public transport, accidents, GHG emissions etc. can be measured used further for evaluating the results on cost benefit analysis terms.
  - b. Strategic Environment Assessment- SEA framework can also be used to evaluate strategies also being done as a separate toolkit.
  - c. Multi Criteria Analysis: One can also use multi criteria analysis on the strategies adopted and by using weighing and scaling methods one can evaluate the specific strategies. Many countries have adopted this methodology to evaluate the land use plans.
2. **After Implementation**- In this case benchmarking can be used and criteria's that were discussed in the above section can be used to evaluate the actual success of the strategy.

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

Regular monitoring is important to assess if the strategies adopted are delivering the required results, along with any kind of side effects in the form of newly emerged problems. Hence it provides a context for the review of the strategy.



### **Step 1 - Identifying the indicators for monitoring progress**

Monitoring is generally based on the indicators that are set for performance measurement at the time of benchmarking (refer to section 3.2, Stage 2) and hence it is also important to keep these indicators easy to measure and interpret.

### **Step 2 - Setting up a monitoring Schedule**

The cities will also need to devise a schedule of monitoring, 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.

## Chapter 4

# Supporting Case Studies

### 4.1 Introduction to International and National case studies

This section presents a variety of good practices for coordinated planning can be adopted from the cases selected from around the world to demonstrate the various aspects of land use transport integration as mentioned in the previous section. The selection of the case studies is based on the literature review. The table below presents the case study cities based on the aspects of land use transport integration.

**Table 4.1 Case Study Cities**

City	Aspect of Land use Transport Integration								
	Enabling Urban structure	Network and streets	Transit Oriented development	Strategic alignment	Integrating Transit Facilities	Inner city and transit	Accessibility Improvements	Legal Instruments	Inter jurisdictional Coordination
London	•	•			•	•	•		•
Singapore	•		•	•	•			•	
Hong Kong	•	•	•		•		•	•	
Curitiba	•	•	•	•				•	
Stockholm		•	•						•
Ahmedabad	•	•		•				•	
Bangalore									

## 4.2 London

### 4.2.1 Introduction

London holds a distinctive position in the global economy that very few cities can claim. It attracts migrants from not just the Great Britain and Europe, but all over the world. It is the capital and the most important city of the United Kingdom, the seat of the Queen of Great Britain and has historical importance as the capital of the British Empire. Greater London is spread over 1569 sq km and has a population of 7.75 million people in 2009 with projections of 8.57 million by 2026 (Greater London Authority, 2011). The city is has been changing and growing throughout its 2000 year long history (Greater London Authority, 2011). Although policies have been formulated in order to decentralize population from London, new towns will have to be built in close proximity to the economic hub of London and this does not look likely in the near future.





With the upcoming London Olympics 2012 and the 2012 Paralympic Games, robust infrastructure for transport, public spaces, housing and employment was deemed necessary in order to create and retain the “World Class City” image. Hence, the planning authorities of the city, including the Mayor, who holds the overall strategic responsibility for the planning in London, have drafted “The London Plan 2011” with spatial strategies for London’s spaces, transport, economy and housing.

“The London Plan 2011” aims at integrating transport and land use through planning for a compact urban form, well-defined road network, regeneration of the inner city along with an accessible and integrated multi-modal transport network.

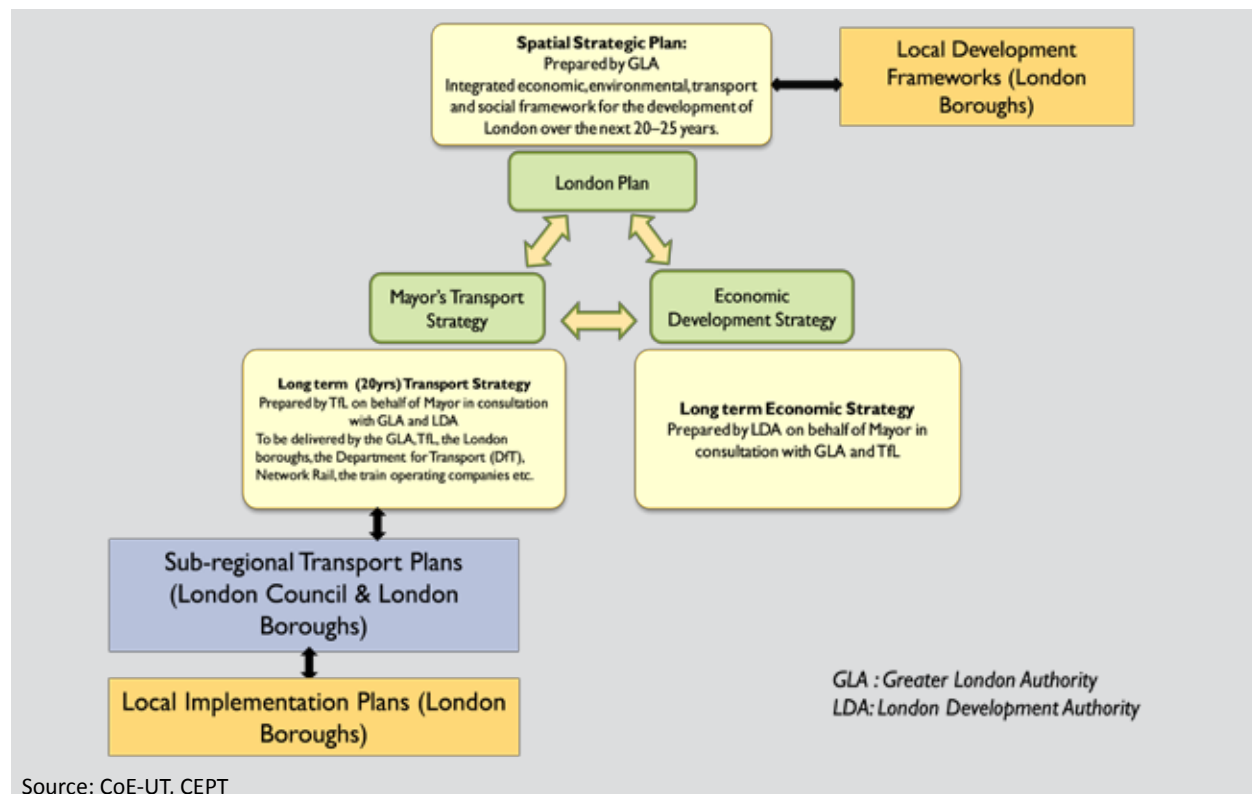
#### 4.2.2 Land-use Transport integration in London

##### Institutional framework and coordination

The Mayor of London holds strategic responsibility for the formulation and implementation of the London Plan. A Mayor’s Transport Strategy has been prepared in order to further the policy direction of connecting the city of London and integrating land-use and transportation.

The Mayor works in coordination with the boroughs, Transport for London, the London Assembly, the Government and a range of other stakeholders with a part to play in ‘delivering safe, efficient and environmentally-friendly transportation for London’ (Greater London Authority, 2010). The objectives and policies formulated are used as a framework by the London boroughs in drafting sub-regional transport plans and Local Implementation Plans (LIPs), local development frameworks and other local transport policies and strategies. The functions of the Local Development plans are now incorporated in the Greater London plan since April, 2012

Figure 4.1: Planning Process London



Source: CoE-UT, CEPT



The role of the London Assembly is to provide political scrutiny of the Mayor’s activities, including the activities of the GLA group – it has no executive role in spatial or transport planning for London.

The national rail agencies are important stakeholders for the Mayor, alongside the 33 boroughs and their various representative partnerships. These national rail agencies include:

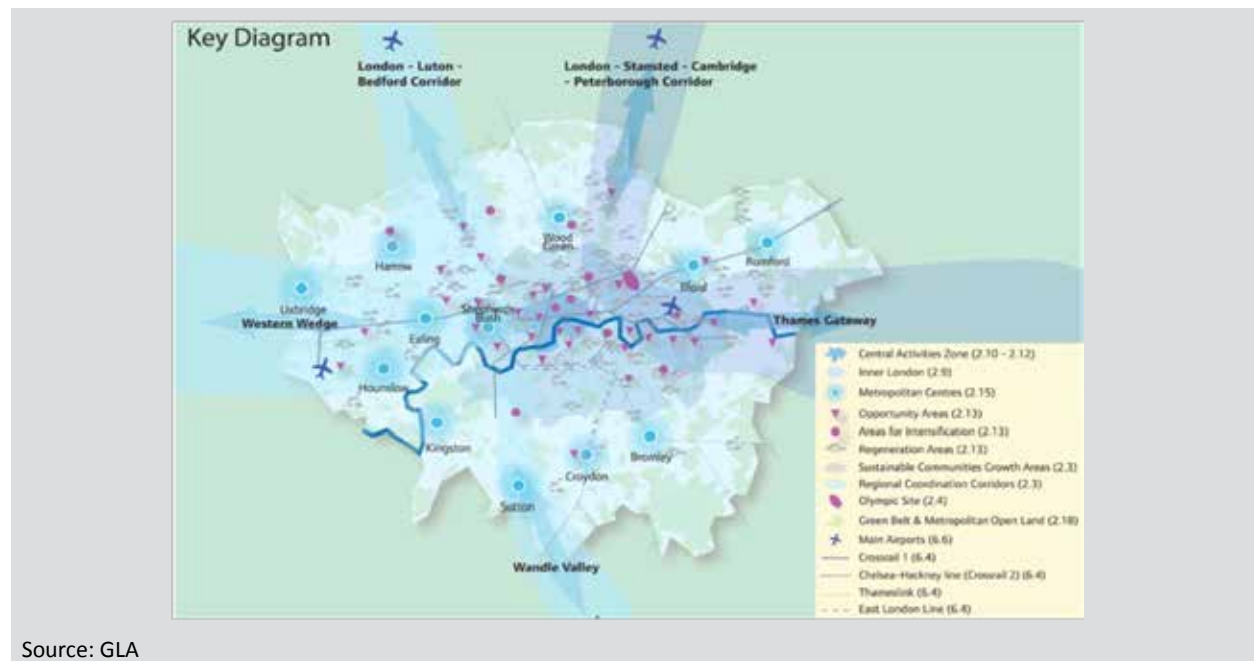
- the central government Department for Transport (DfT) whose rail division effectively sponsor major rail investment projects, and who franchise railway service operations to private sector Train Operating Companies (TOCs)
- Network Rail, the not-for-profit private company who manage, maintain and improve the national rail infrastructure, charging TOCs for access to the railway, in accordance with terms set by DfT.
- TOCs that lease/own trains and operate the train services on Network Rail’s infrastructure within the terms of the franchise granted by DfT through competitive tender. The new franchises are being let for longer periods of 15 years or more to help incentivise the TOCs to invest more in the railway.
- The Office of the Rail Regulation, which is the economic and safety regulator of the railway.

### Urban form

The urban form of a city influences its travel demand and thus can greatly contribute to sustainable urban mobility. Greater London is polycentric in nature. It is characterised by the urban sprawl of the dominant core of the London city and the integration of smaller boroughs in the metropolitan areas (Lemoine & Predali, 2009).

The pattern of development of the city has been largely dictated by the development of its transport network. It has developed in a ‘radial-centric’ with employment concentrated in the centre and housing in Outer London, linked by high capacity rail-link. A radial-centric transport network has been instrumental in high-density and highly-productive service industries in Central London.

Figure 4.2: Concept Plan London



Source: GLA



The London Plan defines the urban form of London in terms of its national context and boundaries, its 5 sub-regions, outer and inner London and the Central Activities Zone (CAZ), opportunity areas, areas of intensification and regeneration areas, town centres outside the CAZ, and strategic industrial locations, all with different mixes of residential, industrial, town centres, local neighbourhoods, commercial and cultural activity. Spatial strategies like-

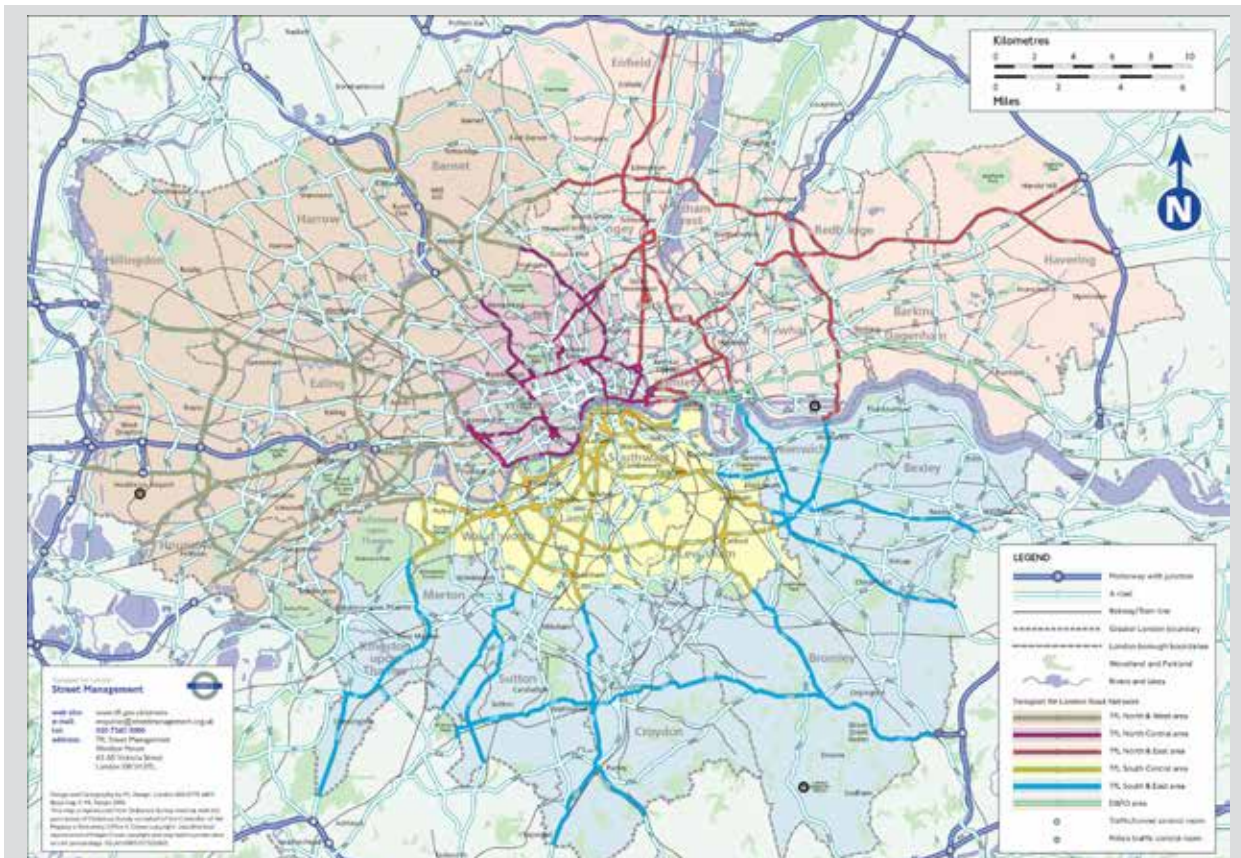
- Strengthening existing work centres
- Infilling areas – developed areas with good accessibility which can accommodate higher densities
- Area within the city which can be redeveloped-vacant land, brown field
- Socially excluded areas which need to be regenerated

The main challenges for integration of Land-use and transport in Greater London include interconnection of Metropolitan town centres through various modes of transport.

### Network and streets

The city of London has a radial-centric network of roads as shown below in Figure below.

**Figure 4.3:** Road network London



Source: [http://www.anglonauts.com/voyager\\_map\\_uk/ill\\_map\\_uk\\_london\\_roads.htm](http://www.anglonauts.com/voyager_map_uk/ill_map_uk_london_roads.htm)





With diverse and competing road demands, the effective management of scarce road capacity is a key challenge for the city of London. In order to meet this challenge, a Central London Congestion Charging Scheme was introduced in February 2003, which was then extended up to February 2007 (Greater London Authority, 2010). However, in order to be beneficial to businesses the Mayor proposed the removal of the West Extension Zone, to the west of the original Central London form the Concession Charging scheme.

The Transport Strategy of London includes improvement of road safety and transport safety through improving street lighting, promoting ‘balanced streets and an improved urban realm to make roads safer, particularly for vulnerable users such as pedestrians and cyclists’ (Greater London Authority, 2010). Cycling and walking have been promoted keeping in mind their positive health impact on Londoners as well as their serving to reduce Carbon emissions in the city. Cycle superhighways, cycle parking provisions, key walkway routes and consistent way finding have been implemented in London. In addition, new developments like attractive public spaces and more attractive streets have been planned in order to influence a modal shift to walking and cycling in London.

Congestion on London’s roads costs the economy about £2 billion each year (Greater London Authority, 2010). The city transport authorities have planned to promote fair approach to traffic enforcement on streets. A package of measures has been proposed in the Transport strategy to ensure smoother flow of traffic and reliable journey times that include improved traffic control, minimising the impact of planned and unplanned events (such as road works and collisions), maintaining road network assets in a state of good repair, and – where there is a net benefit – developing the road network. Tackling congestion is especially important for the freight industry and the efficiency of freight distribution will be further improved through a number of measures, such as the Freight Operator Recognition Scheme (FORS) (Greater London Authority, 2011).

There have been significant benefits from the reduction in inner London road congestion realised from the Congestion Charging initiative, notwithstanding the removal of the Western Extension from the scheme by the current Mayor. However, these have largely offset the negative impacts on road congestion brought about by an extensive programme of overdue upgrades to fragile utility infrastructure (gas, water and electricity) in the streets. This work has been outwith the control of the Mayor and has been historically difficult to regulate or co-ordinate.

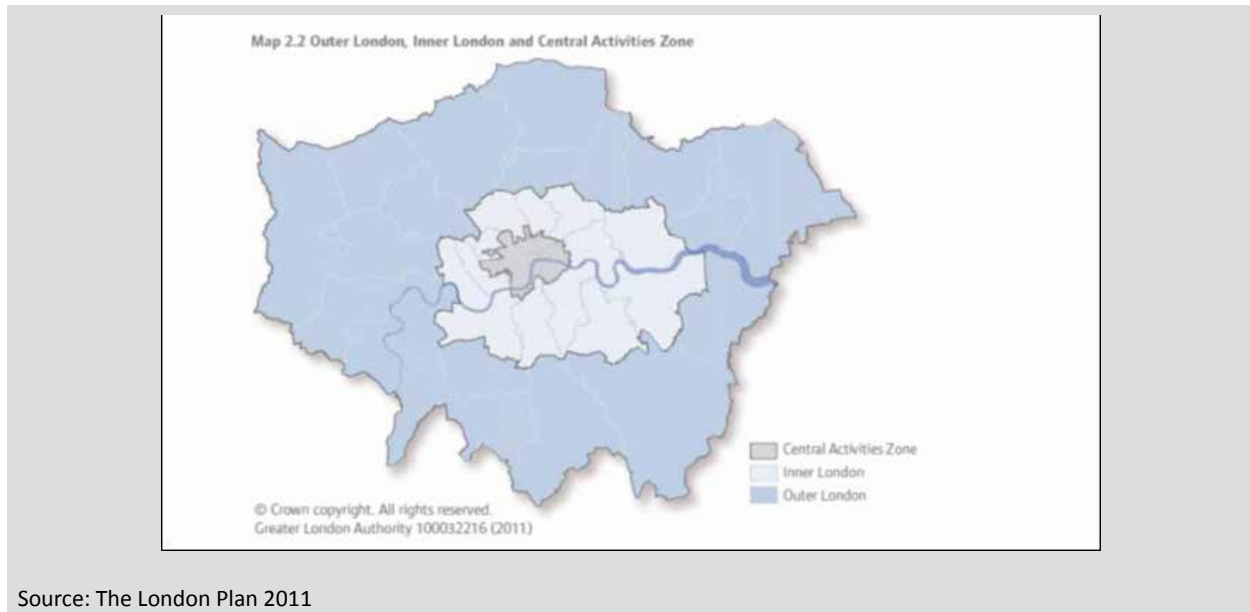
It has proven to be a difficult challenge to achieve the optimum balance between the Mayor’s policies to provide more, better, safer facilities for cyclists and pedestrians, and at the same time to smooth traffic flows. A number of cyclist fatalities has increased the public focus on this issue. The Mayor’s programme of ‘Super Cycle Highways’ is well under way. A pilot ‘shared spaces’ scheme has been implemented at Exhibition Road in the Royal Borough of Kensington and Chelsea, and is being monitored. The Mayor has recently made a statement of intent to renew investment in London’s roads, following a period of focus on rail investment, which continues.

### **Inner city and transit**

The inner city of London covers 321 sq km with 3 million people inhabiting it and a far higher density of 9346 inhabitants/ sq km as compared to the rest of the metropolis (Lemoine & Predali, 2009). The part of Inner London outside the central area of CAZ and Canary Wharf contains both what is probably the largest concentration of deprived communities and places that have experienced remarkable growth and development (Greater London Authority, 2011). Employment has grown in both absolute (92000 jobs) and relative (20%) terms since the 1990s (Greater London Authority, 2011).



**Figure 4.4:** Activity Zones of London



The Planning Authorities of London have recognised the need for continued development and growth in ways that deprived communities are able to access jobs and social infrastructure, and the proximity to CAZ, the inner business core of London, will provide opportunities for development and regeneration through provision of transport infrastructure.

The regeneration of London Docklands presents a unique case where London Docklands Development Corporation (LDDC) was set up to renew the obsolete docklands and derelict area. This initiative was supported by transit-Docklands Light Railway and Jubilee Line extension have increased access to the docklands area, whilst the City Airport has allowed quick transfers to places throughout Europe. Low tax rates and rents have been used to attract large businesses to relocate to the area. (eg. Daily Telegraph and many financial institutions). Canary Wharf Tower has been the centre point of this business influx. This is supported by a good housing mix wherein high end typologies, for young workers, low-cost housing for under-privileged groups who were living in the docklands area previously.



**Figure 4.5:** London Docklands and Canary Warf



Higher levels of public transport accessibility increase scope for high density development in Inner London which has widely varying existing density of housing. The existing land use character is mixed-use in Inner London, which when coupled with improvement in public transport network like usage of the River Thames through the Blue Ribbon Network and the Crossrail (Greater London Authority, 2011), can enhance the quality of life of the people in Inner London.

The London Underground network is extensive which connects the boroughs to Inner London. The boroughs of Inner London with high levels of deprivation are connected through the Underground to other parts of London. The boroughs which are inferior in terms of infrastructure and redevelopment have been regenerated with refurbishment of schools, housing and healthcare infrastructure, as well as mix-use development of residences, offices and factories (Construction News, 1998).



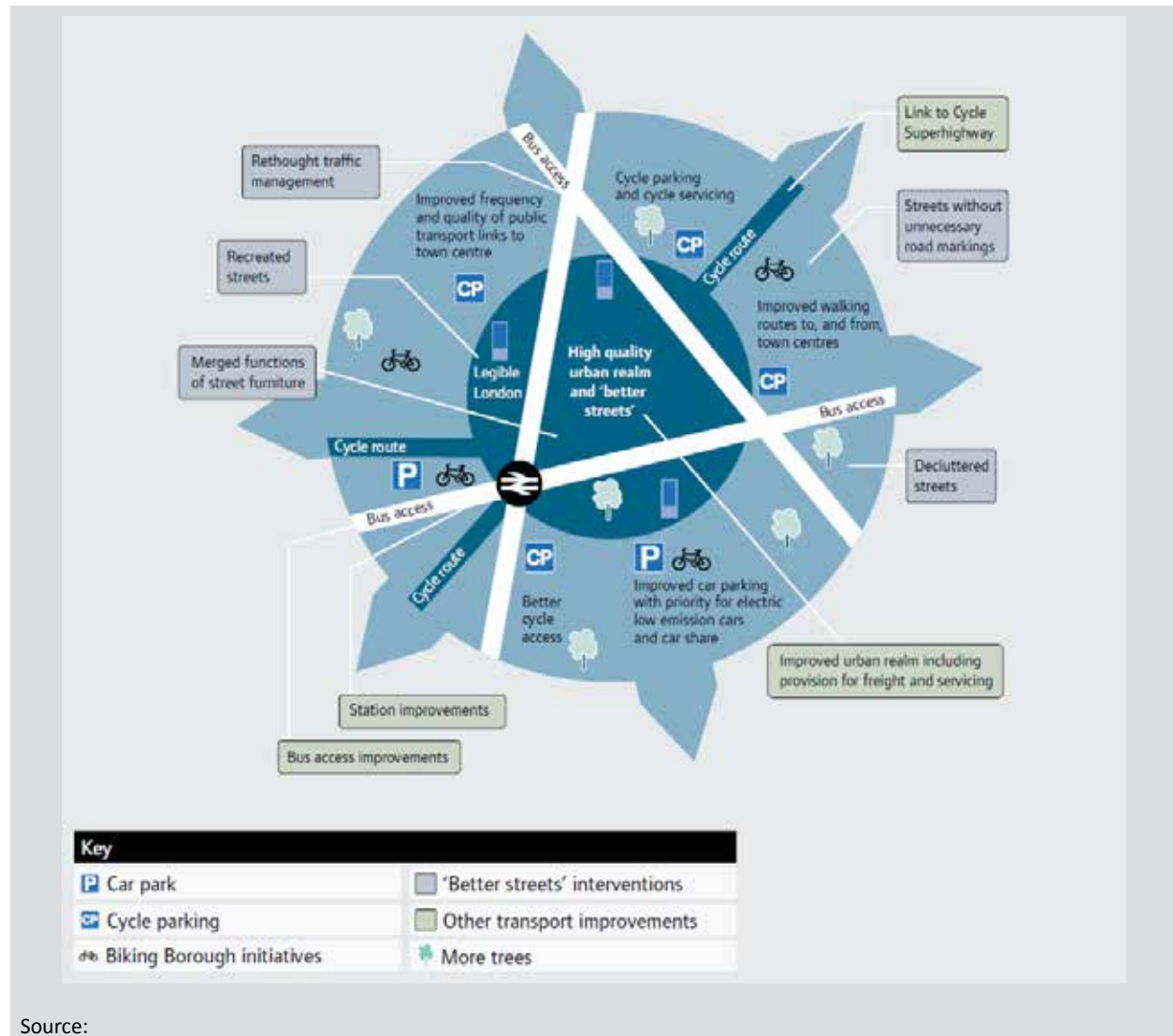


### Accessibility and Improvements

Physical accessibility to public transport has been improved in the recent years with the use of low floor busses, step-free access from street to platform at stations. However, recognising that more needs to be done in this regard, the “whole journey approach” is used to increase physical accessibility of the transport system (streets, bus stops, stations and vehicles) for all Londoners (Greater London Authority, 2011). Information provision is enhanced, staff is more visible and better-trained, and better interchange at various nodes is provided. Fares are also kept under review and concessions are provided to those who need them, in order to make public transport affordable and hence, accessible.

Also, currently, more than 90% of Londoners live within 400 m of a bus stop or a station (Greater London Authority, 2010). A standard measure of accessibility in London is the public transport accessibility level (PTAL) which uses the range, proximity and frequency of public transport services for any given location to score accessibility to the transport system at peak times.

Figure 4.6: Accessibility Improvements London



Source:



## Transit facilities and integration

The transportation network is enhanced, improved and maintained in order to cater to the growing needs of the city. In London, improved public transport integration occurs between rail, Underground, Dockland Light Railway, Croydon Tramlink, bus, taxi, coach, air and River Bus services (Transport for London). Ticket fares between different modes are integrated through the availability of system-wide tickets, such as the Travel cards or the Oyster Smartcards, as a result of which only 3% of London bus users pay cash (Preston, Marshall, & Tochtermann, 2008). The Transport for London is an umbrella transport authority that co-ordinates between the Mayor of London, the Government, the boroughs and the delivery operators. Finally, there has been an integration of policies and strategies of public transport. The Mayor's Transport Strategy integrates the health impacts of walking and cycling, the reduction in emissions through transport policies and spatial strategies to reduce the need to travel.

Integration of improved walking and cycling facilities at interchanges is a priority for the Mayor, as well as rail, underground, bus, streets and public realm. This includes improved wayfinding (Legible London), public realm, street crossings, cycle lanes, cycle parking and cycle hire facilities. This encourages and enables a greater shift to sustainable modes, with environmental and health benefits for the city and those who visit it, as well as those who work and live in it.

The Oyster card has been extended to cover national rail services in London, offering much greater convenience, flexibility, journey time savings and value for money.

TfL passenger service operations include rail (one strategic railway line in London has been transferred to the control of the Mayor and TfL (London Overground), with more possibly to follow), metro (Underground), tram, bus, bus transit, coaches, streets, walking and cycling, including cycle hire. It does not include national rail (apart from the London Overground).

The lessons learned from London highlight the following:

**Strong political leadership:** London has had the benefit of a strong Mayor since 2000, when GLA was formed. There have been two Mayors in that period, from different political parties, but they have had quite similar policies and approach to spatial and transport planning in London. Both have understood the importance of coherently integrated transport and land use planning, and have been very strong champions of this cause, and of the inter-agency collaboration that is necessary. They have both made a very strong and consistent case to central government for capital funding for strategic transport infrastructure, with great success. As a result, there has been a coherent spatial strategy (the London Plan) and Mayoral transport strategy for much of this period, informing the growth of London in an integrated manner.

**Inter-Agency Collaboration:** while London has had the benefit of an integrated transport authority (TfL) since 2000, co-ordination between the operational businesses within TfL has remained a challenge, as each business has rightfully focused on managing and improving its own infrastructure and operations. Furthermore, national rail services, which are so important to London, are not under the control of TfL or the Mayor. (The Mayor has successfully secured the right to take over and manage one strategically important part of the national railway in London, and this is providing better services to customers). The 33 boroughs own, manage and maintain the local streets within their respective boroughs. There are obligations on them, TfL, GLA and the Mayor to work together on transport and land-use planning matters. Collaboration between these agencies is critically important, and requires careful management of requirements, expectations and relationships.

An integrated, hierarchical approach to spatial and transport planning funding and implementation, as outlined above. This is only realistically achievable if there is good collaboration with strong leadership.



A coherent national context for transport and land-use planning: The UK government's planning for Growth initiative, including in particular the National Planning Policy Framework provides a robust and definitive context for planning, funding and implementation of sustainable integrated transport and land-use developments in London.

## 4.3 Singapore

### 4.3.1 Introduction

Singapore is a city state and an island nation situated in South East Asia. It covers an area of just 700 sq km with 5.2 million people inhabiting it (Urban Redevelopment Authority, 2012). It has enjoyed robust socio-economic development due to prudent economic policies, land use planning and infrastructure development, including the safeguarding of land for future development. Public transport is recognised as the backbone of the transport system due to the land, and an integrated approach has been adopted for land-use and transportation.

Planning in Singapore is done at a long term level with a Concept Plan and at a medium term level for 10-15 years with a Master Plan. The Concept Plan 2011 is under review and the Master Plan 2008 is the current Master Plan. Both these plans are drafted with the vision of 'meeting immediate economic and social needs while maintaining a good quality living environment' (Urban Redevelopment Authority, 2012).

Urban Planning in Singapore has been a matter of great pride for the city and its citizens. It is geographically constrained as it is an island. It can reclaim land only till a certain limit within its own boundaries, after which it would encroach up on its neighbours' boundaries. Hence, it has planned for compact development of its cityscape through Transit Oriented Development and spot zoning in the city, in coordination with an integrated and strategically aligned multi-modal transport network.

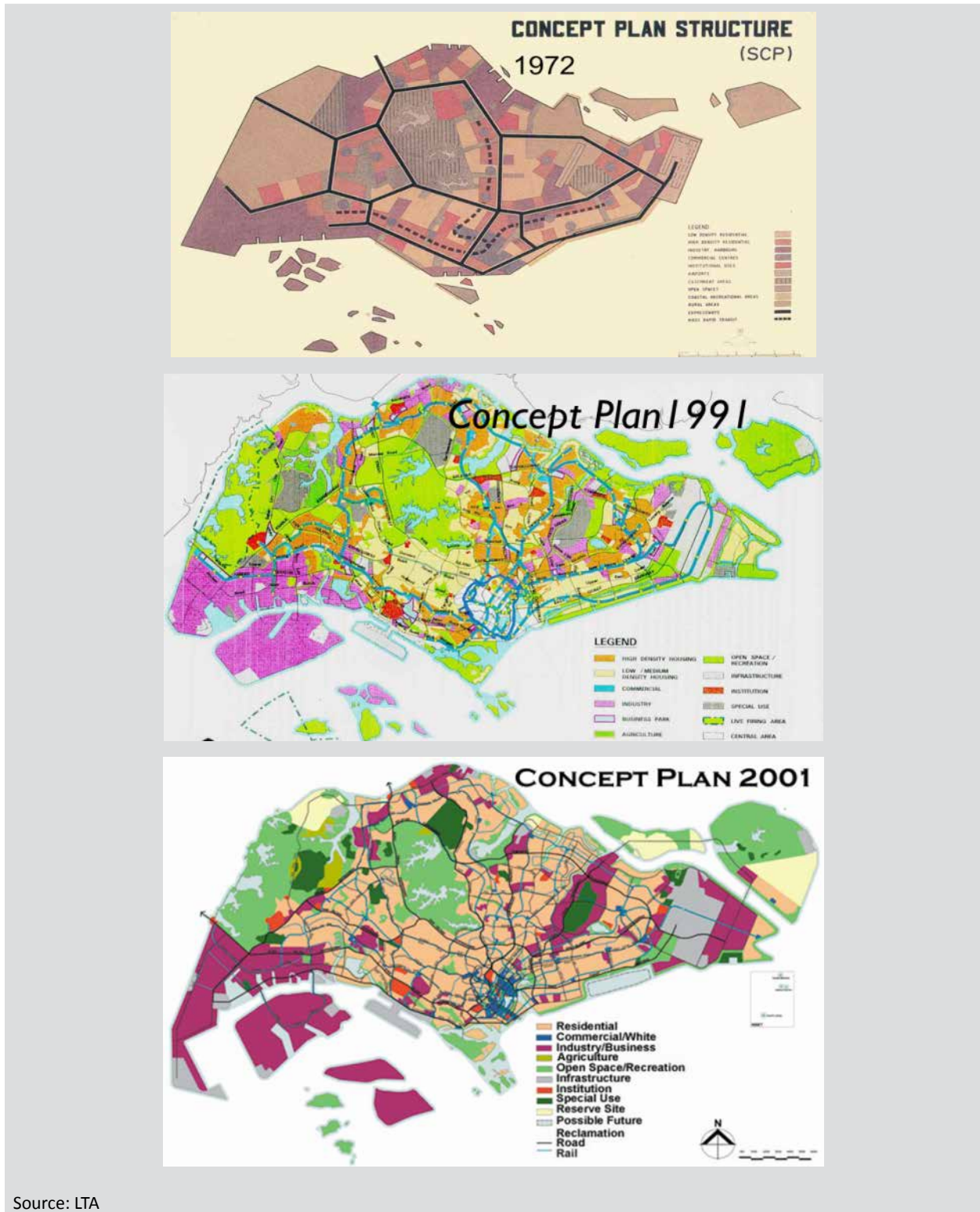
### 4.3.2 Land-Use Transport Integration

#### Urban Structure

Singapore has a ring-radial urban structure lined with expressways and circumferential MRT Rail Networks (Roychoudhury, 2000). The city has been planned in a ring formation around the central catchment area. The urban centre of Singapore is densely built. The urban structure of Singapore has a series of radial and circumferential lines of the Mass Rapid Transit (MRT) System and Light Rapid Transit (LRT) feeder networks with major and minor sub-centre nodes at the intersection of the MRT lines. Each of these nodes is developed at high densities (Kenworthy, 2008). This public transport network is essential to the spatial planning of the city, and expansion of the public transport network is done in tandem with the future growth of the city, guided by the Concept Plan.



Figure 4.7: Long Range Comprehensive Concept Plan





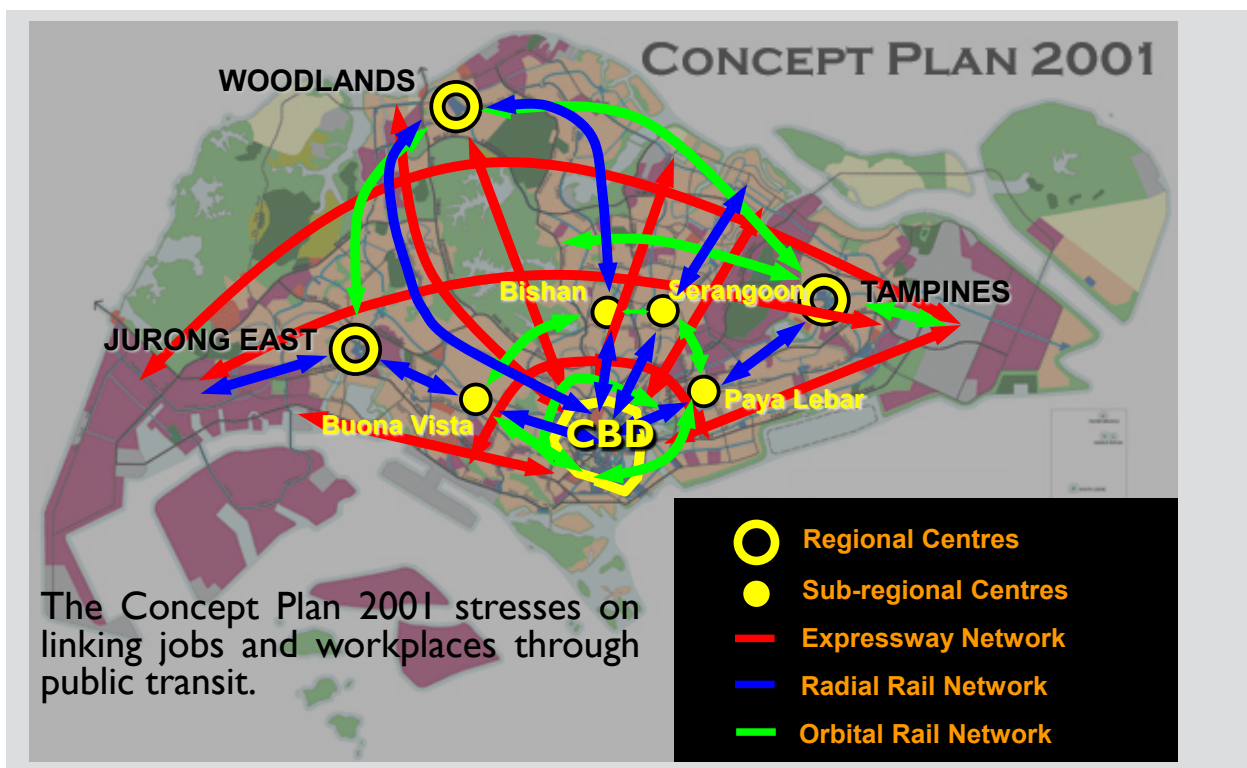


## Strategic Alignment

Travel demand in Singapore has been rising and is expected to continue as the population grows. About 12% of the land in Singapore has been used by road infrastructure, and there is limited scope to use more land for road networks due to competing demands for land development. Moreover, the Land Transport Authority of Singapore recognises that increasing road space will not tackle problems like congestion sustainably. Hence, the LTA has planned for improving the modal share of public transport to 70% through various means. In order to attain the target, the LTA will expand the MRT network substantially, expand and improve bus services, while managing private transport demand through policies to control the growth of the vehicle population and usage of roads through Electronic Road Pricing (ERP)

The routes of the road and the rail infrastructures are aligned strategically in order to serve maximum population. As Singapore's economy has developed in the last few decades, many global firms have set up their offices in the Central Business District, to serve which a dense rail network has been envisaged. The Concept Plan 2001 stresses on linking jobs and workplaces through public transit. Most housing developments have come up within 500 m walking distance of the LRT and MRT networks, and there is a co-dependence between the new housing construction and the new expansion in the LRT and MRT network (Cervero & Murakami, Rail+Property Development: A Model of sustainable transit finance and urbanism, 2008).

**Figure 4.8:** Strategic Alignments and Completing the Network



The Rapid Transit System (RTS) network will be increased to 278 km by 2020, and to 360 km by 2030 in order to enhance its spatial coverage and improve connectivity. Average journey times by public transport are estimated to be reduced to 1.5 times of that by car from 1.7 times in 2008. The RTS operates on heavy demand corridors for long trip lengths, while the trunk buses complement the RTS routes in order to ensure accessibility to maximum population and avoid duplication of routes. Also, greater priority is given



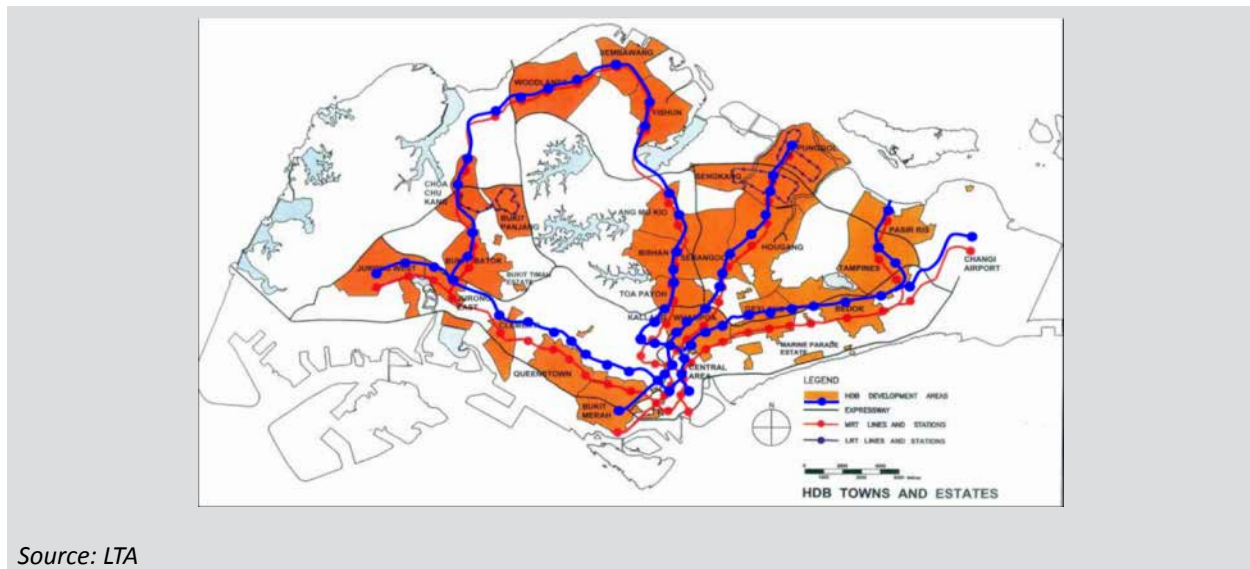
to buses in order to reduce journey times and improve the reliability of buses in Singapore and average speeds of buses have improved due to measures like signal priority to buses at junctions, easy exit from bus-bays and full-day bus lanes in the city.

The LTA has also planned innovative measures to improve route alignment of buses in the city. Segregated bus ways with a dedicated right of way have been planned in some corridors of the city. Overall, the LTA has planned a hub and spoke network of bus routes in order to optimise the efficiency with a commuter-centric approach towards planning in order to reduce journey times and improve transfers.

### Transit Oriented Development and Value Capture

Travel demand in Singapore has been increasing and is expected to grow to over 14 million journeys per day from 8.9 million journeys in 2008 (Land Transport Authority, 2008). The Singapore Urban Redevelopment Authority (URA), working in close consultation with the Land Transport Authority (LTA), has done the land-use planning of the city in such a manner that the distance to travel has been reduced, leading to ‘a reduction of the workers’ need to commute, easing traffic congestion, and providing businesses with a nearby pool of workers’ (Urban Redevelopment Authority, 2012).

**Figure 4.9:** Integrated Transit and Housing



Source: LTA

Land-use and planning in Singapore have been integrated by adopting Transit Oriented Development for the city. Singapore has a balanced distribution of jobs and homes, high density construction around the transit nodes and newly developed areas are well-served by buses and an extensive rail network. The road as well as the rail network has been systematically expanded as land use developments have taken place over the years, and is being expanded to serve new areas of development and link them to the city centre and regional centres. .

A 20 year strategy was adopted in 1971 for the spatial development of the city called the Ring Plan. High density housing, commercial areas and industrial estates were planned in a ring formation around the urban centre, connected by a mass transit network, according to the Ring Plan. This plan directed the development of new towns, road-ways and the Mass Transit Railways system. With the increase in development as well as demands of a growing population a Constellation Plan was proposed, which is now





guiding the development of Singapore. This Plan has now changed the emphasis from a ring structure to a hierarchical constellation structure of satellite towns linked by a mass transit network.

In Singapore, 86% of the housing is public housing, constructed by the Public Entity Housing Development Board (HDB) and the land is owned by the Singapore Land Authority (SLA), an arm of the Government. The HDB has also helped in the development of 20 satellite towns, as per the last Concept Plan in the vicinity of the Central City in order to decentralize the population. In each of these towns as well, Transit Oriented Development has been practiced, with a public transport terminus in the centre of the town, and the residential construction within walking distance of the neighbourhood centre.

### Legal Instruments

Spot zoning is used as an instrument for Transit Oriented Development in Singapore. Plot Ratios in the Master Plan 2008 are increased by 5% to 10% within a demarcated boundary around the MRT nodes.

MRT Radius	Increase above Base Plot Ratio
Less than 50% of the site is within the demarcated boundary	5%
50% or more of the site is within the demarcated boundary	10%

Source: (Urban Redevelopment Authority, 2008)

As mentioned earlier, Singapore has 86% public housing and the land is owned by the Government, and therefore any increase in Plot Ratio also benefits the Government financially. Spot Zoning is a tool to intensify the density and retain a compact city structure in Singapore. It also ensures that most of the city's residents live within walking distances of the Transit nodes, hence minimizing the need for private transport and improving accessibility of the MTR.

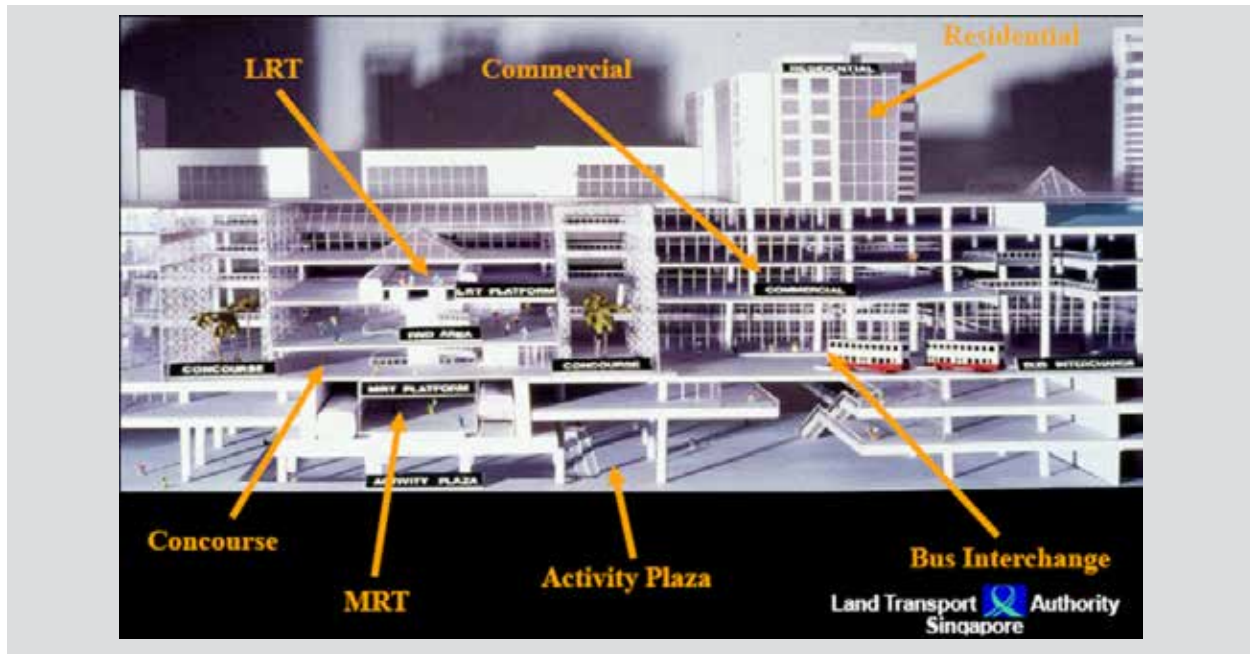
### Integrated Transit Facilities

The public transport system in Singapore is critical to its sustainable development and future growth. The Land Transport Authority (LTA) focuses on the "total journey approach" from the commuters' perspective while planning for its hub and spoke public transit system. The feeder service has been enhanced so that commuters can reach transfer hubs quickly. In the Central Area (consisting of the CBD and the fringe employment centres around it), an RTS station can be accessed within 400 m distance.

The overall journey experience has been enhanced in Singapore through the provision of 'covered linkways, pedestrian overhead bridges, underpasses integrated transport hubs, real time information systems for public transport, and greater security measures' (Land Transport Authority, 2008). Also, the LTA has taken over as the central bus network planner from 2009 onwards in order to provide institutional level integration and avoid conflicts that cause inconvenience to the commuters. A single ticketing system and distanced based fare structure have been adopted for the bus, MRT and LRT networks and an integrated seasonal pass has also been introduced with appropriate concessions to target groups.



**Figure 4.10:** Integrated Transit Facilities Singapore



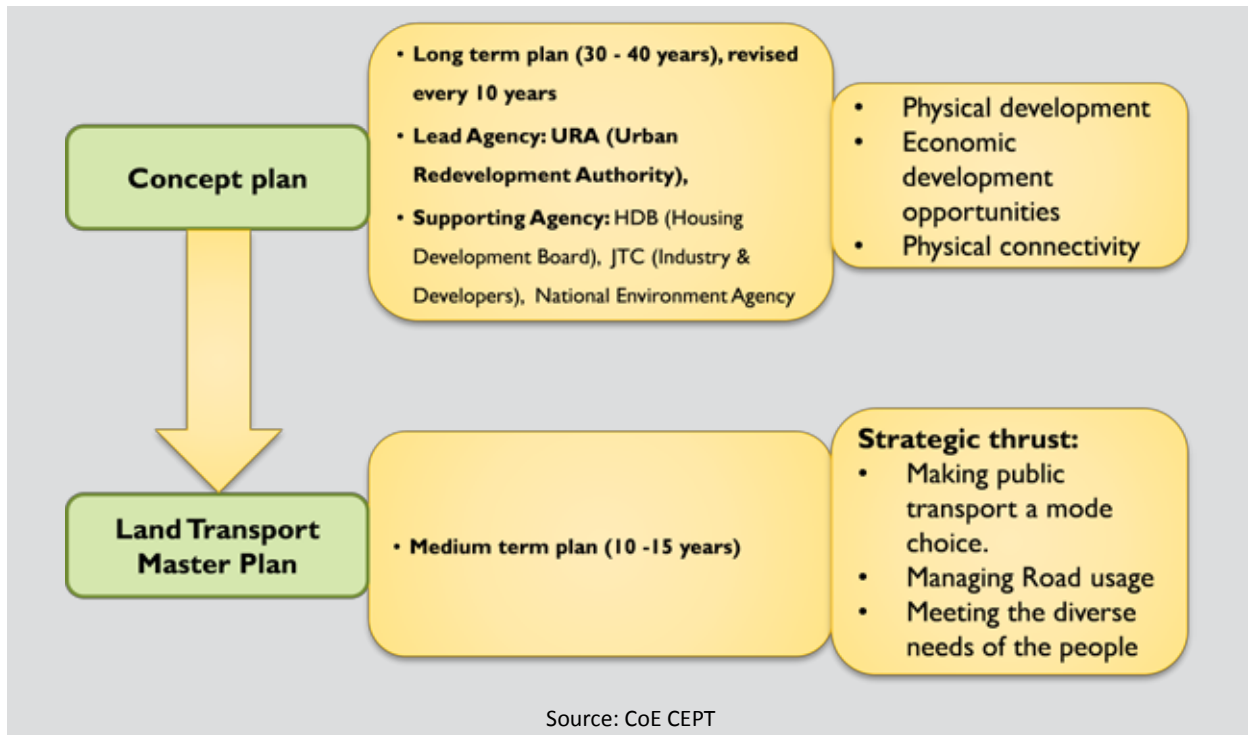
An innovative facility of ‘park and ride’ has been introduced by the LTA wherein car-owners are encouraged to switch to public transport by parking their cars at an MRT or bus interchange facility at attractive seasonal parking rates (Land Transport Authority, 2012). Also, cycle parking lots have been provided at interchange facilities, foldable cycles are allowed on buses and trains and the gaps between park connectors and transport nodes are closed (Land Transport Authority, 2008).

### **Institutional framework and coordination**

The Singapore Urban Redevelopment Authority (URA) prepares the Concept Plans which is similar to a master plan. This plan preparation also involves other agencies which work concurrently to prepare the sectoral plans; Land Transport Authority (LTA) is one such agency in Singapore. The LTA ensures Land use transport integration by preparing the transportation infrastructure plans at the same time when the land use plan is made. This process ensures an integrated planning process despite of the fact that different agencies are involved in the preparation of the detailed sectoral plans keeping in the overall concept plan objectives in mind.



Figure 4.11: Planning Framework Singapore



## 4.4 Hong Kong

### 4.4.1 Introduction

Hong Kong is a city-state in the People’s Republic of China covering 1104 sq km with a population of more than 7 million (Transport Department, 2011). It was under British colonial rule until 1997, when the British finally ceded Hong Kong to China. Much of Hong Kong’s planning policy framework can be traced to either colonial or post-colonial regimes. With an extremely high density of 6544 persons/ sq km (Census 2011, 2012) and scarcity of land, planning for land-use as well as transport have been a challenge for the Government Planning Authorities. The city has grown on only 30% of the total land, the rest of which is mountainous terrain (Tiry, 2007).

Planning in Hong Kong is carried out on a long term (up to 2030) and a medium term (up to 2020) basis by drafting the HK2030. These plans are prepared including alternate options included in the spatial strategies. The Land-use and the Mass Transit Railway (MTR) are integrated, with mostly residential and some non-residential construction around the transit nodes. Planning for the road network and the integration of multi-modal transit facilities have been implemented in tandem with Transit Oriented Development using the Consolidation and Decentralization policies in Hong Kong to bring about integration of the land use and transportation.



#### 4.4.2 Land-use Transport Integration

##### Network and Streets

The road length of Hong Kong is 2086 km in 2011 (Transport Department, 2012), and Hong Kong's roads are the most heavily used in the world (Highways Department). The dense development and difficult topography are challenges for road development in Hong Kong. The city is dependent on a public transport system that consists of railways, trams, buses, mini-buses, taxis and ferries and 11 million passenger journeys are made on the public transport system per day (Transport Department, 2011). While the average daily passenger journeys by bus have decreased from 3964 in 2007 to 3788 in 2011, those through the Mass Transit Railway (MTR) network has increased from 4213 to 4730 between 2007 and 2011 (Transport Department, 2012). The city is thus increasingly dependent on its MTR network.

Due to the dense development, especially in older areas of Hong Kong, walking still remains the mainstay of transport in those areas, although cycling in the city can prove difficult due to the terrain.

Figure 4.12: Rail Network Hong Kong

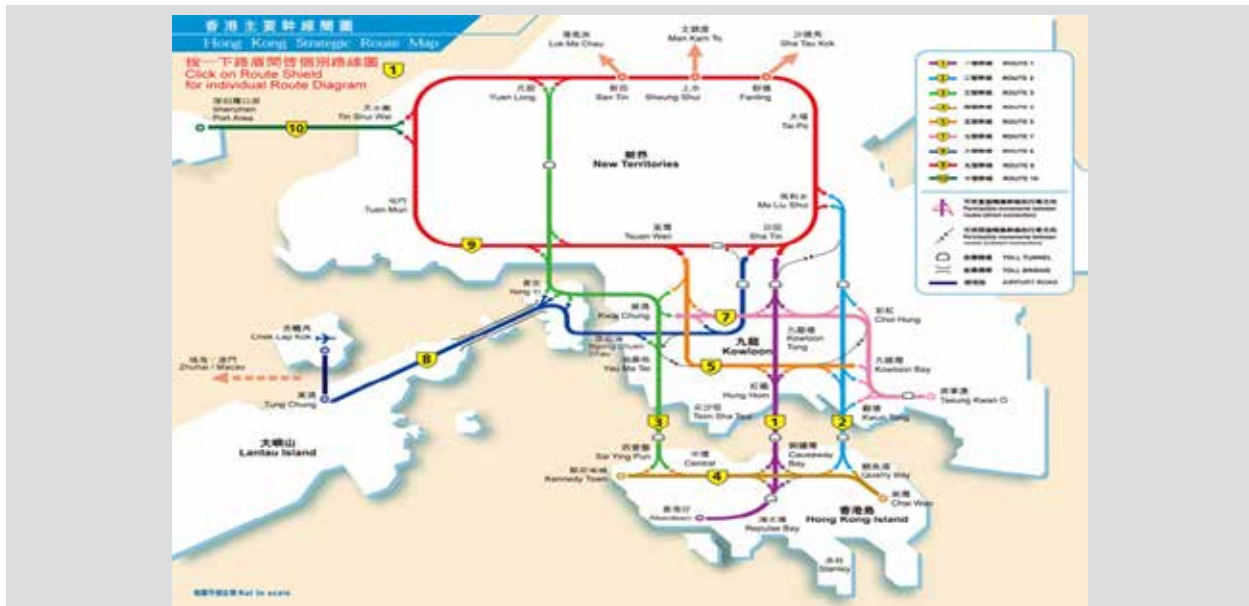


Source: Dr. Wing-tat HUNG, Hong Kong University of Polytechnic





Figure 4.13: Transit Map Hong Kong



Source: Strategic Route Map, [www.td.gov.hk](http://www.td.gov.hk)

### Transit Oriented Development and Value Capture

Transit Oriented Development has been shaping the development patterns of Hong Kong since it was introduced in 1999 (Lo, 2002). As a result, over 90% of all motorized trips in Hong Kong are made via public transport and the major share of this is through the rail network or MTR.

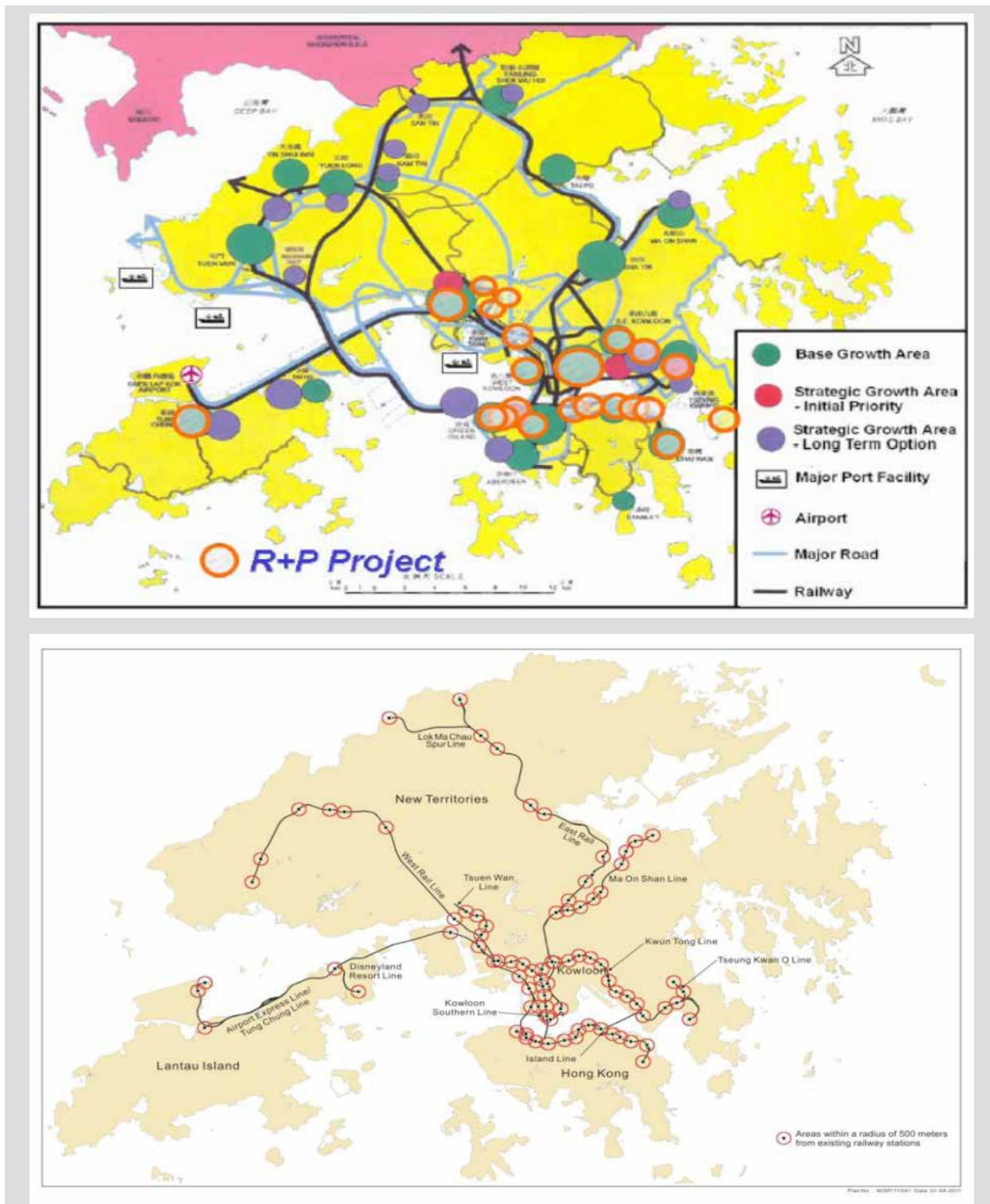
The pressures of extracting return out of scarce and expensive land as well as tackling potential congestion due to high levels of private vehicle ownership have been met by creating compact mixed-use character within walking distance of MTR nodes. In 2002, about 41% of Hong Kong’s population lived within 500 m of an MTR station and one in five households lived within 200m of a station (Cervero & Murakami, Rail + Property Development: A Model of sustainable transit finance and urbanism, 2008).

The Hong Kong Government has been aggressively pursuing transit value capture to finance further expansion of MTR infrastructure. The MTRC, which owns and operates the rail network in Hong Kong and Kowloon, operates on commercial principles and property development has been the chief tool to generate revenue. The model of value capture is called “Rail + Property” (or R+P) wherein the Property Division of MTRC constructs and maintains property adjacent to MTR stations (Cervero & Murakami, Rail + Property Development: A Model of sustainable transit finance and urbanism, 2008). The land near stations is under public control and avoids speculative markets as well as uses the benefits accrued in public interest. Half of the railway operators’ income is from the property development and housing premiums have increased by 5-30% (Cervero & Murakami, Rail and Property Development in Hong Kong: Experiences and Extensions, Sept 2009 vol. 46 no. 10).





Figure 4.14: Integrating Transit with Housing



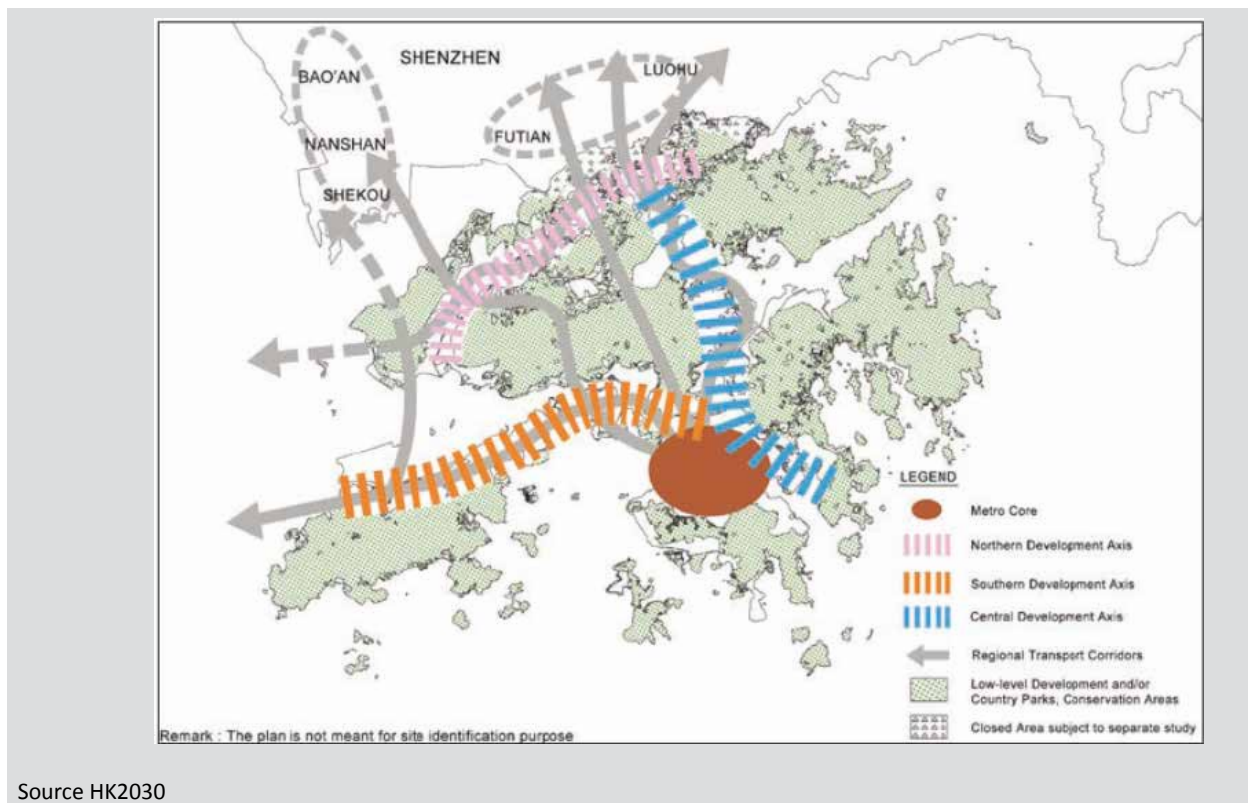
Source: (Cervero and Murakami, Rail + Property Development: A model of sustainable transit finance and urbanism)



Future directions of growth have also been planned for in the HK2030. The urban core areas shall remain the focus of development and activity, while further development opportunities shall be found along three axes, all aligned with rail transit. These three axes will be developed as special corridors for the following functions:

- Metro Development Core for high density commercial and business activities and high rise residential development
- Central Development Axis for community type housing and educational institutions
- Southern Development Axis for tourism related facilities and logistics
- Northern Development Axis, which is located close to the boundaries of Shenzhen, for non-intensive commercial development that capitalizes on the strategic advantage of its boundary location.

**Figure 4.15:** Development Axis in Hong Kong



Source HK2030

### Legal Instruments

Recognising the importance of sustainable development, the planning strategy of Hong Kong according to HK2030 has been to initiate more brown-field development than green-field. The Government continues to play the role of facilitator and lets the market take control of development of the land, although it uses the “land-banking” concept in order to ensure availability of land for future land intensive uses like special industries. The Hong Kong Government derives different alternatives for development by first identifying options for individual land uses to screen out land for conservation, a broad assessment of choices and finally determining the Preferred Development Option.

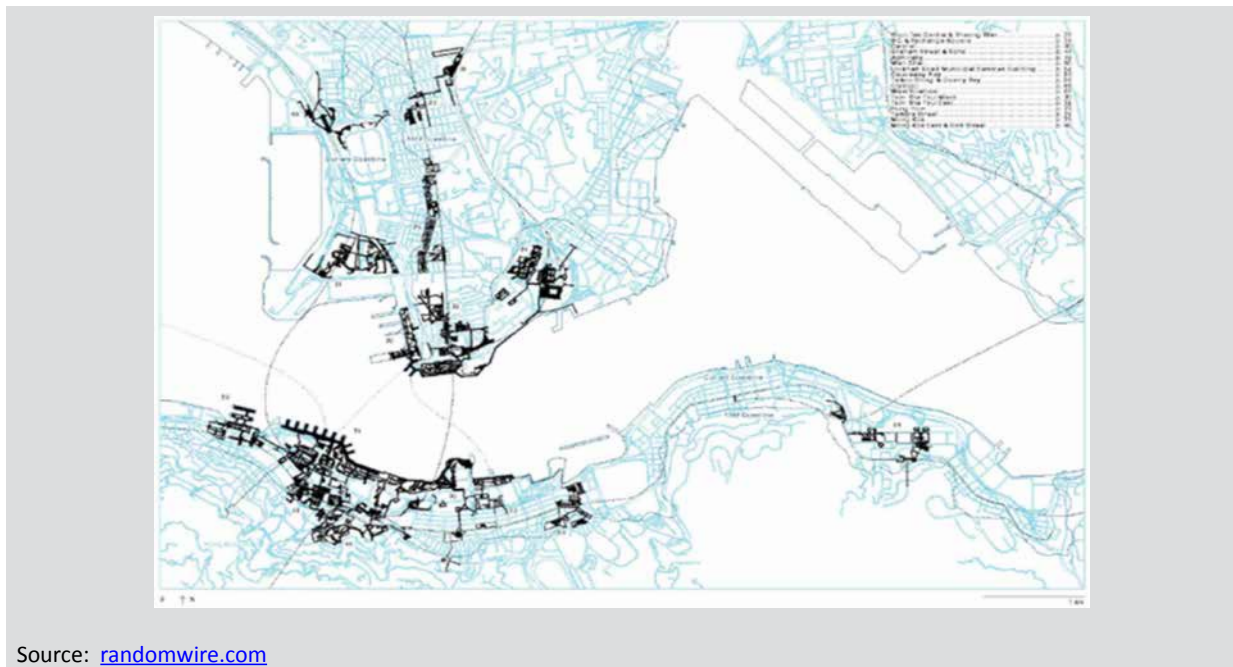


Two kinds of strategies have been chosen as the Preferred Development Option according to the HK2030 i.e. Consolidation and Decentralization options. The spatial development pattern under the Consolidation strategy is underpinned by the clustering of the bulk of development around Mass Transit nodes to facilitate fast movement of people through public transport and existing built-up areas are better utilized, while taking care of urban design considerations such as heritage conservation objectives, in new developments. The Decentralization strategy aims at creating new territories to provide mixed-use development for housing, employment and other possible uses. The spatial development pattern of an area, or its Preferred Development Option, is an interactive and collective decision making process by the Government and the Community.

### Accessibility Improvements

The Hong Kong Transport Department has recognised the importance of making transit nodes accessible and promoting walking as an efficient, environmentally friendly mode of transport. Pedestrian schemes initiated by the Transport Department include complete pedestrianisation of streets, part-time pedestrianisation with vehicle access only at certain times of the day and no on-street parking spaces and traffic calming measures on streets, depending on public demand, land use, pedestrian capacity and safety issues on the streets. Each of these pedestrian schemes are a part of comprehensive planning of the pedestrian environment, transport network, land use on the streets, and the overall landscape of the district as well.

**Figure 4.16:** Pedestrian network providing accessibility to PT network



Source: [randomwire.com](http://randomwire.com)

The HK2030 aims for 'equal access to urban infrastructure irrespective of income, religion, race or abilities' (Hong Kong Government, 2012). Physical access to the public transport for the elderly, people travelling with infants or toddlers or the specially-abled individuals, has been improved on the existing infrastructure as well as future designs. Staff is trained to assist them while boarding or alighting at platforms. Taxis or private cars are permitted to pick up or drop people with disabilities in the restricted zones (Transport Department, 2012).



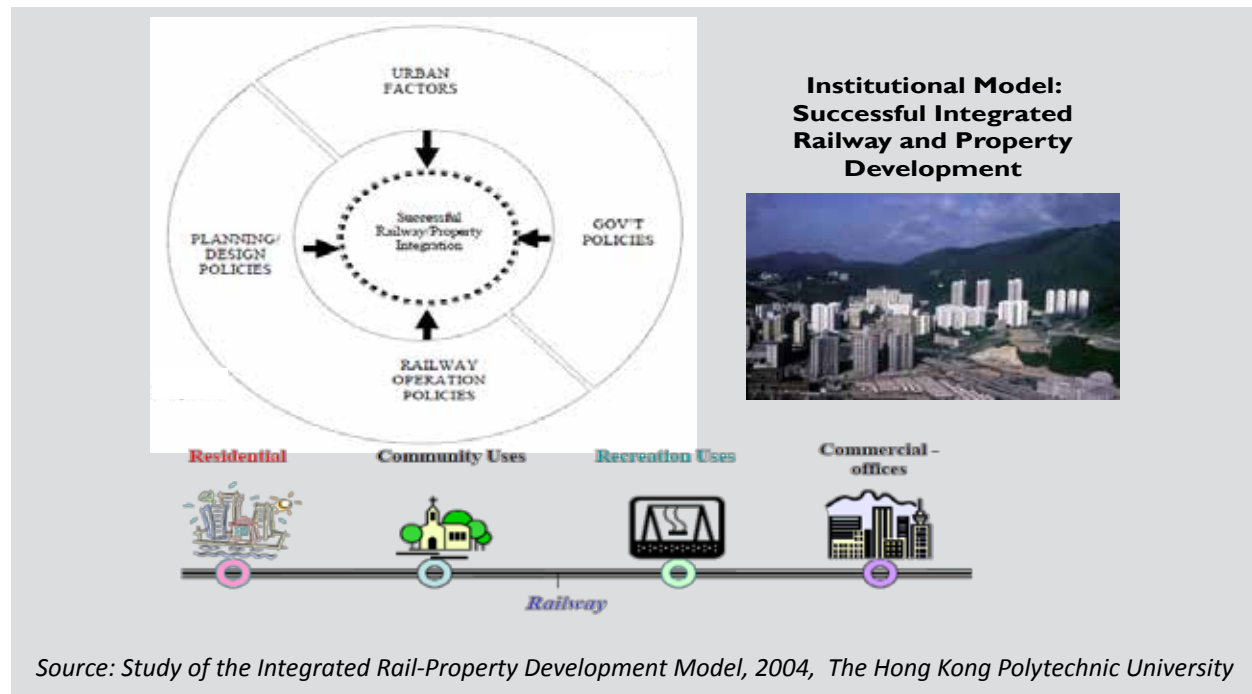


A number of spatial planning concepts are used in order to improve accessibility of public transport like prudent use of land resources by planning for high density mixed use development around railway stations and utilizing the development opportunities in existing built environment to their full potential, while taking into consideration the urban design constraints.

### Integrated Transit Facilities

The Mass Transit Railway, the Airport Express, the airways, the ferries, busses and other railways are seamlessly and efficiently integrated in Hong Kong in order to ensure maximum utilization of the multi-modal public transport. The Hong Kong core urban areas are well connected to the New Development Territories that have been developed between the 1970's and 1990's. The fares are integrated in all modes of public transport through a single Octopus Card (Udall, 2007). The trams are generally taken only by tourists in order to experience the quaint charm of Hong Kong. The Hong Kong planners have also integrated pedestrian systems and other transport feeder services to maximize the usage of railways (Cervero & Murakami, Rail + Property Development: A Model of sustainable transit finance and urbanism, 2008).

Figure 4.17: Integrated Transit Facilities Hong Kong



The public transport in Hong Kong is operated and owned by the Mass Transit Railway Corporation (MTRC), in which the majority stake holder is the Hong Kong Special Administrative Region Government, and other stakeholders include many private operators, in a build-operate-maintain model. The integration of the private and public stakeholders ensures entrepreneurial and business-minded attitude of the company's managers resulting in positive returns on investments, while keeping broader public interest and town planning objectives in mind (Cervero & Murakami, Rail + Property Development: A Model of sustainable transit finance and urbanism, 2008).



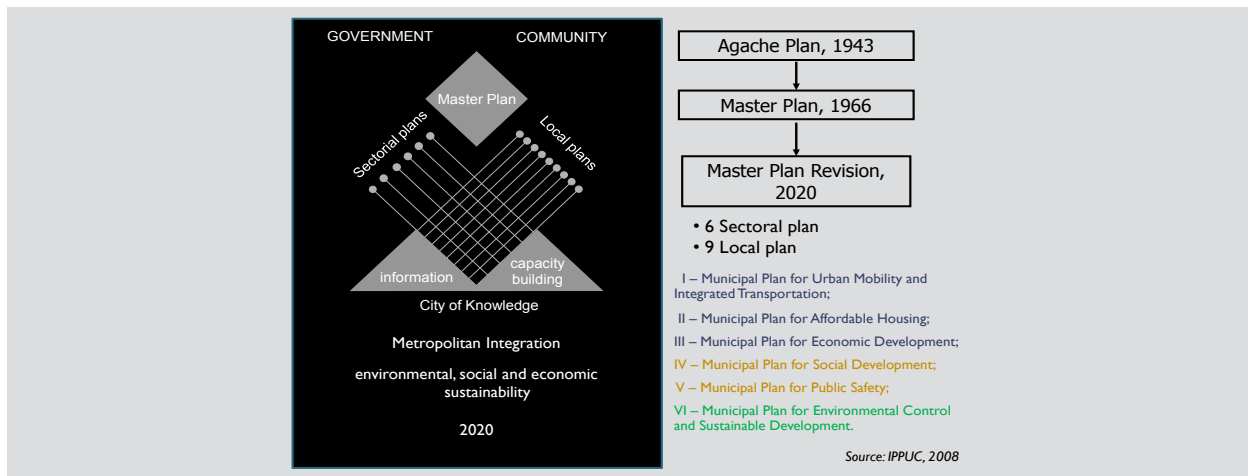
## 4.5 Curitiba

### 4.5.1 Introduction

Curitiba is the capital of the state of Parana in Brazil. The city has experienced rapid urbanization since the 1970's with careful urban planning and integration of its land-use and transportation system. It covers 435 sq km with a population of 1.8 million people in 2007 and a density of 4200 persons/sq km (Prefeitura de Curitiba, 2012).

Curitiba has a long history of planning since the 17<sup>th</sup> Century. The first urban plan was drafted in 1943 by French Urbanist Alfredo Agache, called the Agache Plan (Prefeitura de Curitiba). The Master Plan of 1965, which is into effect currently, integrated the functions of housing, work, recreation and circulation. The implementation of the Master Plan was initiated in 1971 by Research and Urban Planning Institute of Curitiba (IPPUC) (Prefeitura de Curitiba). It is the first city to implement the Bus Rapid Transit (BRT) concept with dedicated bus-ways and feeder systems in the 1970's and the Integrated Transit Network (RIT) in the 1980's.

**Figure 4.18:** Planning Process in Curitiba



The planning and implementation of accessible public transport, land-use and road network concurrently, using instruments like Transit Oriented Development and Transfer of Development Rights have ensured effective integration of land use and transportation in Curitiba.

### 4.5.2 Land-Use Transport Integration

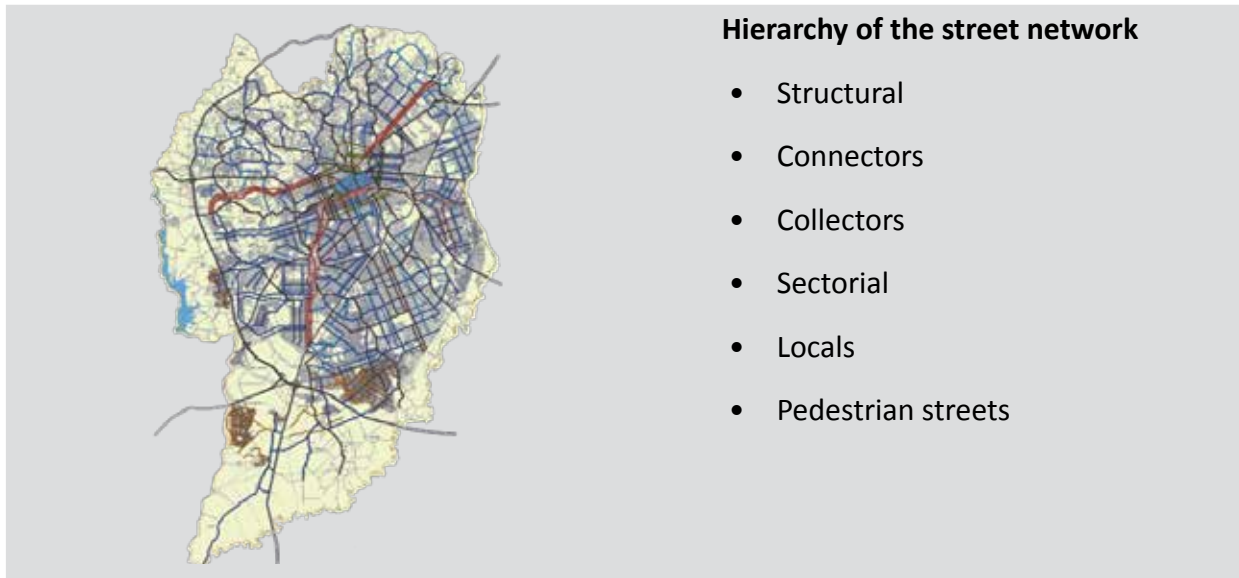
#### Network and streets

In addition to public transport and land-use, the street network system of Curitiba is 'the third leg of the planning tripod' (IPPUC). The Agache Plan defined a street network with a radial layout for the city. In the Master Plan of 1965, the street network was then defined on the Northeast-Southeast axes, with linear expansion plans of the city. But the city showed spontaneous radial and concentric growth, resulting in a rise to transportation problem with increased circulation. A hierarchical and complete road network has been planned for the metropolitan region of Curitiba.





**Figure 4.19:** Complete Street Network



Hence the city's street network has been planned to tackle congestion while keeping in mind people's aspirations of owning cars. The neighbourhoods have been connected independent of the downtown area. A Central Slow Traffic Belt has been created in order to protect the pedestrians' interests. City's main streets within the Central Belt have been restricted to motorized vehicles. Moreover, existing streets or structural avenues have been connected by priority avenues, providing new alternatives for flow of traffic, without the need to pass through the downtown. Old streets have been retained as access roads and collector roads accommodate local neighbourhood traffic. An approximately 120 km Biking Path Network has been implemented in the '90's along railroads, riversides, and selected streets.

**Figure 4.20:** Trinary System Curitiba



Source: IPPUC

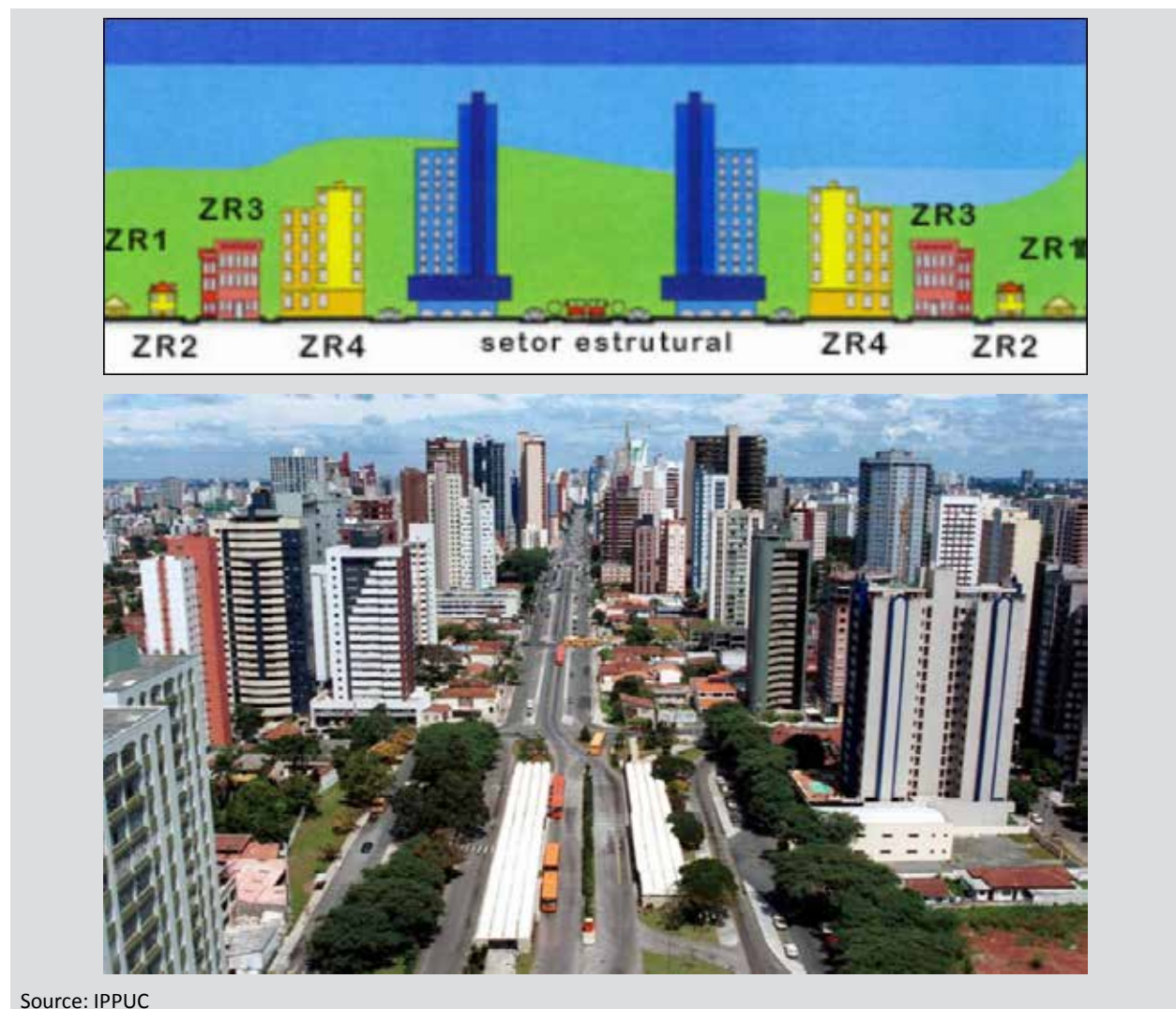


Finally, a typical block of street network has three roadways, thus called a ‘Trinary System’ (Lindau, Hidalgo, & Facchini, 2010). The median bus-ways and tube stations are on the central avenue which is dedicated to the BRT and the local traffic that accesses the buildings and parking. The parallel streets are used solely by high-speed traffic including direct buses, with each meant for traffic in one direction.

### Transit Oriented Development and Value Capture

Curitiba has used urban planning as an instrument to guide public as well as private investments for the socio-economic development of the city. Land within two blocks of the transit network has been zoned for high density mixed use development (Goodman, Laube, & Schwenk, 2005-2006). Beyond this, the densities are tapered in proportion to the distance from the bus-ways, thus achieving linear Transit Oriented Development. TOD not only intensifies development around transit nodes, but also aids in the conservation of environment, by creating limited very high development axes. Although property values have increased substantially along the transit corridor, the city has not reaped its benefits as no value capture mechanism has been implemented (Lindau, Hidalgo, & Facchini, 2010).

Figure 4.21: Varying FSI



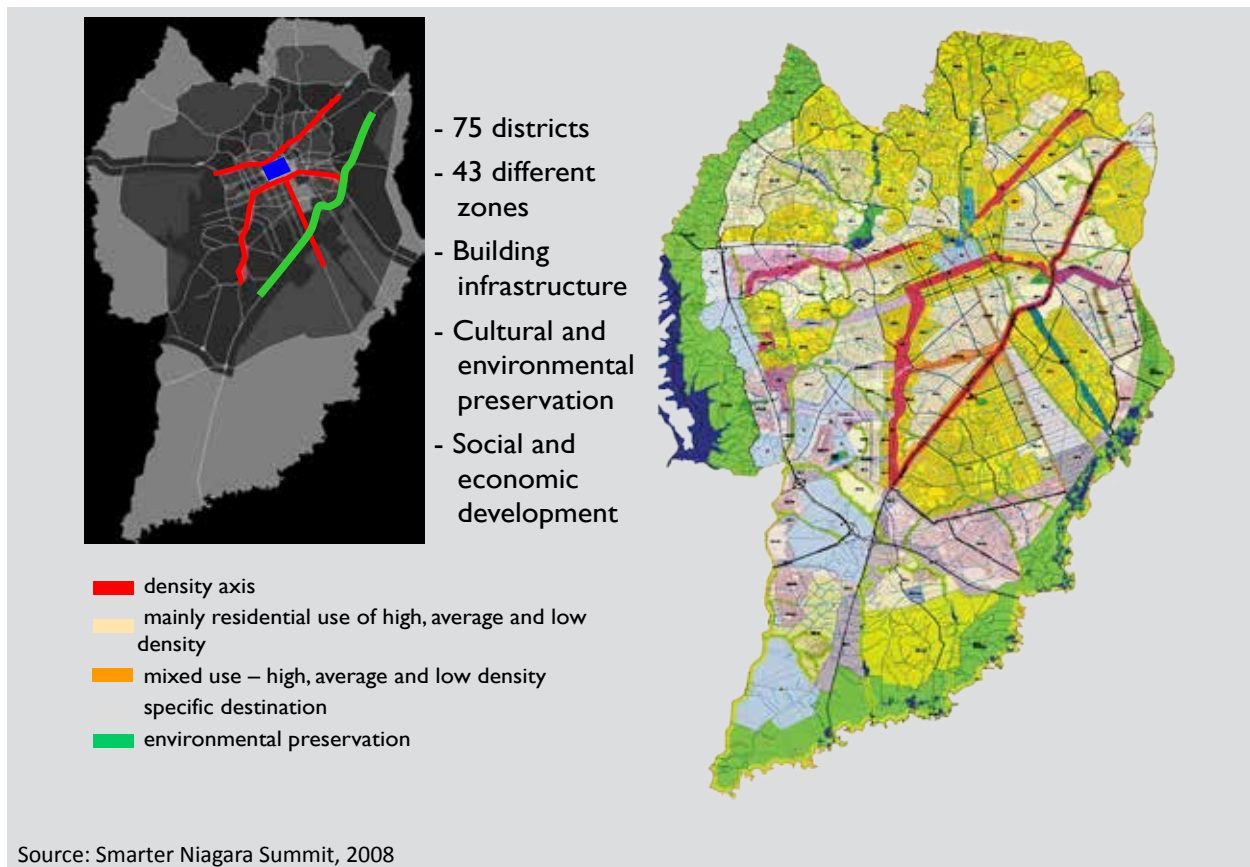
Source: IPPUC





Transit Oriented Development in Curitiba ensures that residential, business and recreational areas are built in high density areas close to the public transit nodes. Also, industrial areas are developed with residential zones surrounding them, and not mixed with them, to improve quality of life of workers, by reducing travel times as well as ensuring unpolluted places to live in. This practice has been followed not only within the city, but also in the Curitiba Metropolitan region as well in partnership with the municipalities. According to the de-concentration policy followed, regional centres are developed in order to create equitable population space distribution. High traffic generating areas such as shopping complexes, commercial centres and high rise residential areas are constructed within accessible distances of the public transit stations.

**Figure 4.22:** Strategic Alignment and TOD in Curitiba



Source: Smarter Niagara Summit, 2008

The TOD has served to increase the ridership on the BRT Corridor and a modal shift has been observed. 32% of Curitibaanos commute daily using the BRT, owing to Transit Oriented Development (Prefeitura de Curitiba). It is estimated that about 27 million car trips per year have been reduced due to the modal shift to the BRT and about 2.1 million passengers travel on the BRT daily (ICLEI, 2011).

### Strategic alignment

The BRT corridor has been designed along the street network of Curitiba. The Express, Articulated and Bi-articulated buses operate on the North-south and East-West axes. The downtown line is circular, covering the downtown areas, while the Interbairros (inter-district) buses connect different neighbourhoods via the collector roads. The RIT also operates the “Ligeirinhos” or Direct lines which operate like subways on



wheels, catering to punctual needs of daily commuters (IPPUC). The Metropolitan Area is covered by the BRT since 1966 when the State Government permitted the Urban Development Agency (URBS) of Curitiba to operate the same.

The bus stops are placed at every 500 m in order to cover maximum destinations within accessible distance. But a good part of the daily commuters are metropolitan passengers who are not interested in the frequent stoppages of the buses. Hence, rapid buses and direct lines are operated for such passengers as well.

The transport network also consists of other kinds of services including:

- Circular Centre connecting neighbourhoods to the downtown area
- Special school lines for students with special needs
- Inter-hospitals connecting the city's several hospitals
- Tourism lines connecting tourist attractions and city plans (IPPUC).

### Legal instruments

The Transfer of Development Rights (TDR) mechanism is used in order to conserve natural and built heritage and aid the Transit Oriented Development in Curitiba. It was introduced in 1983 and called the Building Rights Transfer Act (IPPUC). This Act proposes that building rights be transferred from certain areas with natural, historical, cultural or architectural heritage to other areas of the city, provided the heritage structure is preserved (IPPUC). Instead of imposing restrictions on owners of heritage sites on how to use their land, they are provided incentives to conserve their heritage properties by giving building rights to them in other areas, typically the high density zones adjacent to transit-ways.

Planning of the transport corridors precedes urban development in Curitiba, and hence, TDR is effectively implemented as an instrument to enforce high density linear development along the transit corridors. TDR has been used in order to concentrate development on the transit corridors, while conserving the environment and heritage buildings as well.

As a result of integration of transport and land use through TDR and Transit Oriented Development, 17% of the area is conserved land, 58% is mainly residential, 16% is mainly commercial, 6% is mainly industrial and the rest 3% is for other uses. Most of the residential and commercial is mixed use development.

## 4.6 Stockholm

### 4.6.1 Introduction

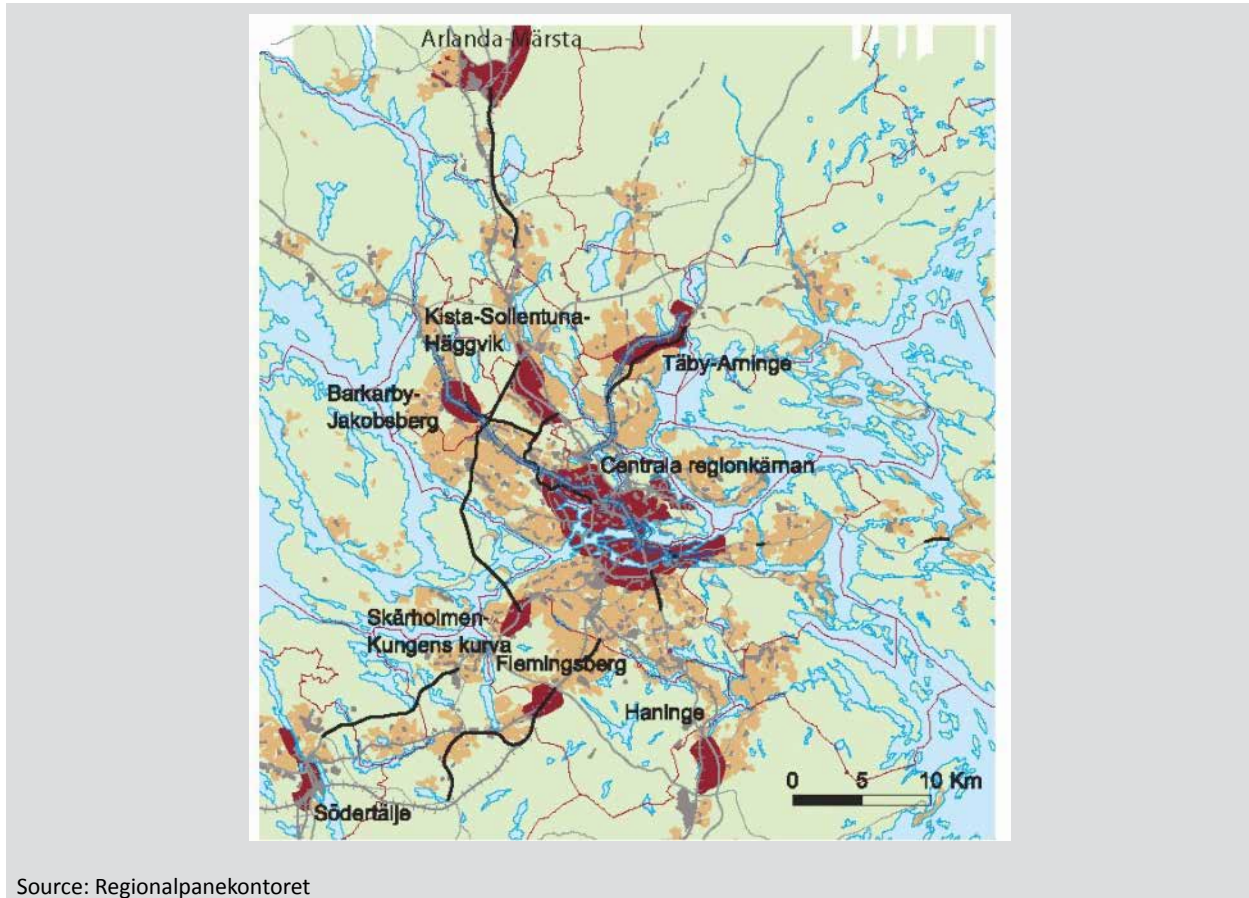
Stockholm is the capital of Sweden. It covers an area of 209 sq km of which 21 sq km is water and its population is a little more than 0.8 million (City of Stockholm, 2012). It was the first city to receive the European Green Capital award in 2010 by the EU Commission for its 'urban qualities, unspoiled nature and sustainable development' (City of Stockholm, 2012)

Stockholm city has formulated a plan called "Vision 2030" which defines long term strategies for sustainable development of the city. Along with this, the city authorities have also formulated a medium term (up to 2020) Transport Plan for the public transport network. Stockholm has achieved sustainable growth through an extensive and accessible public transport system integrated with land-use planning of



not just the city but of the entire Stockholm County. The sustainable growth has come about due to a well coordinated planning effort in order to regenerate declining urban pockets by connecting them through transport, and implementing Transit Oriented Development.

**Figure 4.23:** Polycentric Structure with 8 Sub Centres



Source: Regionalpanekontoret

## 4.6.2 Land-Use Transport Integration

### Network and Streets

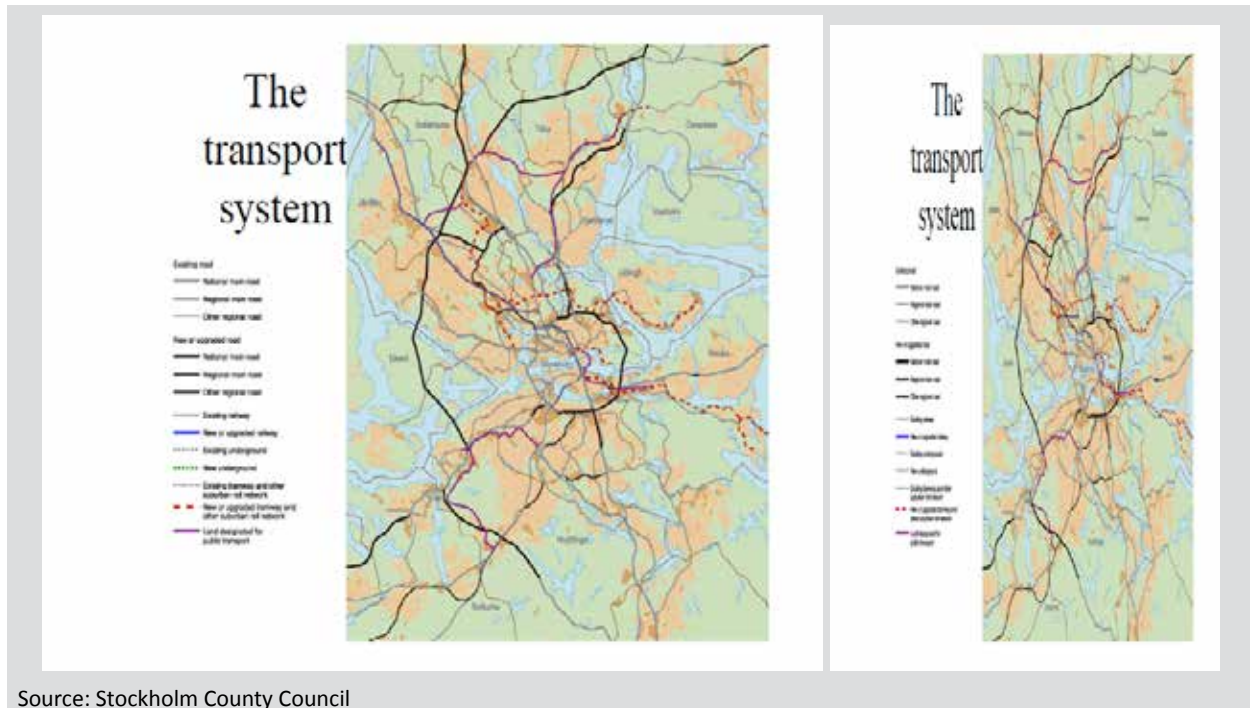
The transport infrastructure is an instrument for inter-connecting municipalities and the regional centre of the Stockholm region (Ingo, Viehhauser, & Inregia, 2005). This infrastructure includes extension of light rail as well as motorway bypass roads and ring roads connecting the areas. Stockholm has transformed from ‘a pre-war mono-centric city to a planned post-war multi-centred metropolis’ due to this inter-connection of municipalities in the Stockholm county (Newman, 2008). Each of these urban centres are not self sufficient in themselves, but are connected by an extensive rail system with feeder bus services to the rail stations.

Majority of travels in Stockholm are serviced by buses (SL, 2010) and hence, constant improvements are being carried out in order to enhance accessibility and reduce journey times in buses. Accessibility of buses has been improved on approach roads to the Stockholm city from other parts of the region, as well as on stretches with increasing levels of congestion. Several trunk bus routes are being planned to be converted to BRT routes with dedicated Right-of-Way to buses over other traffic.





Figure 4.24: Road network Stockholm



Source: Stockholm County Council

The existing streets of Stockholm region are grid streets with traffic calming measures and increase connectivity of various neighbourhoods to the city centre. The well-connected street network also allows for efficient transit circulation, short walking distances and alternative route options. The grid based network of streets also translates into multiple access roads to the transit stops, hence supporting the Transit Oriented Development in the region. The streets have bike lanes and pedestrian-friendly design. Bike and pedestrian bridges have also been constructed in order to encourage people to walk or cycle.

Stockholm also experimented with a trial of a dynamic pricing system that charged road toll according to the time of the day. Along with this, the Stockholm transport authorities bought 200 new buses, added trains during peak hours, express bus routes and “park and ride” lots. In response to the relative pricing structure as well as the improvements of the public transport, people shifted to public transport for the trips that were necessary and delayed other kinds of trips to times when they could travel without paying tolls. This eased congestion on the streets, as well as increased ridership on public transport. The toll has also induced a modal shift to Non-Motorised Transport (NMT) from private motorised vehicles.

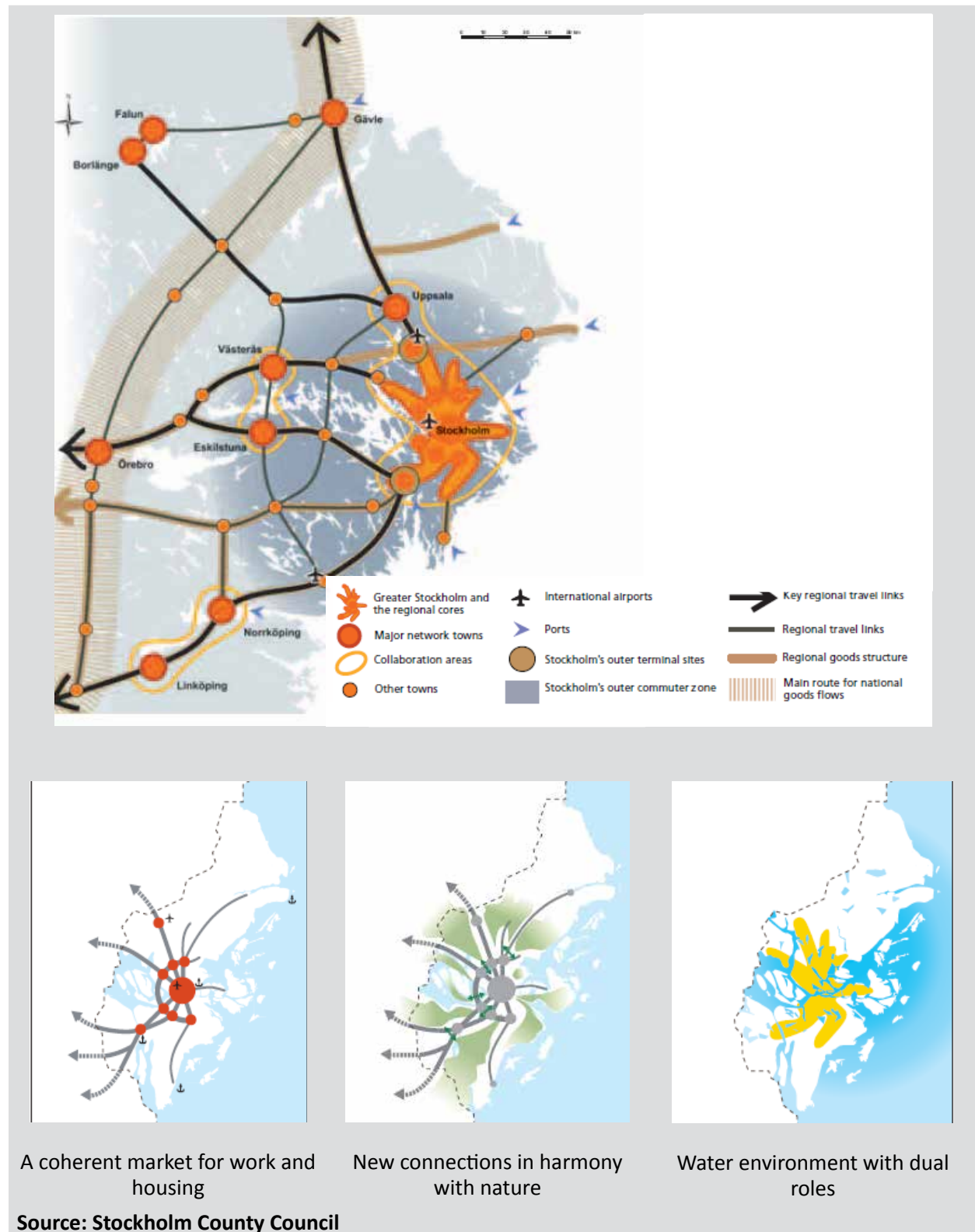
The next phase of development called the Dennis Package, according to Vision 2030, will double the transit system with an orbital rail service, a downtown semi-rapid transit bus service as well as road infrastructure which will be heavily tolled (Newman, 2008).

### Transit Oriented Development

Stockholm has managed to combine both re-urbanization of its old urban centres and transit oriented development through its regulations that integrate transport systems and land-use patterns. It has had to deal with scarcity of land by planning for brown-field transit oriented development. Thus the strategy for future growth of the Stockholm region is towards further densification, or ‘building the city inwards’ (Stockholm County Council, 2001). The population density of its inner city, outer suburbs and the municipality as a whole has increased between 1980 and 1990 (Newman, 2008).



Figure 4.25: Stockholm Structuring the Region with Strategic Alignments





This increase in density has been brought about by creating mixed-use, highly dense areas, while keeping in mind design characteristics of the inner city. The inner city of Stockholm is expanding and neighbourhoods around it are being transformed into mixed-use urban centres with recreational facilities and proximity to nature as well (City of Stockholm, 2012). As new residential areas develop in central Stockholm, the LRT line expansion is also planned to connect the downtown area and the east-west suburbs (City of Stockholm, 2012).

The compact street network forms an overall development framework for transit supportive land-use planning. The shopping malls are conveniently located within walking distances of the transit stops, allowing for free movement for pedestrians. The housing construction around the transit nodes is mostly medium to high density, with retail usage on the ground floor.

The urban regeneration of its satellite towns has also been planned according to the TOD concept. Each of these satellite urban centres have been created into walkable communities with a commercial and cultural centre. The housing according to the General Plan of Stockholm is within 550 yards of the transit points.

### **Inter-jurisdictional co-ordination**

Effective regulation in order to plan and integrate transport and land use in Stockholm has resulted in about 700,000 people from the Stockholm region travelling by public transport. The public transport is operated by various private operators on a contract basis with the apex transport authority of Stockholm SL Corporation. SL Corporation is the body that plans, commissions and monitors the transport system of Stockholm, while transport contractors are responsible for detailed planning, delivery and interactions with commuters (SL, 2012).

The SL Corporation reports to the Stockholm County Council, an elected political body. The County Council nominates members on the board of another political committee called the Traffic Committee, which is responsible for the public transport on land, sea and for people with disabilities. It is also responsible for the Traffic Supply Plan of Stockholm and cooperates with the neighbouring municipalities, counties and other stakeholders 'to achieve well-functioning traffic solutions in the region' (SL Organization).

The Stockholm County Council is also the Regional Planning Authority as mandated by a special legislation (Stockholm County Council, 2001). The planning for land-use and public transport are done concurrently by the Office of Regional Planning and Urban Transportation, while taking into account the inputs from the Transport Authority SL Corporation and local municipal councils. The Municipal Councils of the region enjoy a high level of autonomy as far as planning is concerned. The plan thus drafted is a comprehensive document which directs future growth of the entire region, which consists of 26 municipalities. There is an emphasis on the coordination between the municipalities in order to develop Stockholm into a polycentric region, with each satellite town co-dependent on the other towns within the region and connected by a robust transportation network.

## **4.7 Ahmedabad**

### **4.7.1 Introduction**

The city of Ahmedabad is a historic city established in 1411 A.D on the eastern banks of the river Sabarmati. Since the times of its inception, it has been a centre for trade and commerce. It is well-known for its cotton-textile industry and was called the "Manchester of the East". Today, the city limits cover 466 km with a population of 5.5 million and density within the municipal limits as high as 11,800 persons/ sq



km (CoE, CEPT University, 2008). The city is growing at a decadal growth rate of 22.31% according to the provisional Census 2011 figures (Office of the Registrar General and Census Commissioner, India, 2010-11) and is currently the seventh largest metropolis in India.

Ahmedabad has a long planning history, wherein encouraging mixed land-use, developing road network and infrastructure precede urban development. The Urban Local Body of the city follows the mechanism of Development Plan-Town Planning Scheme for the provision proper hierarchy of road network, public amenities and recreational facilities.

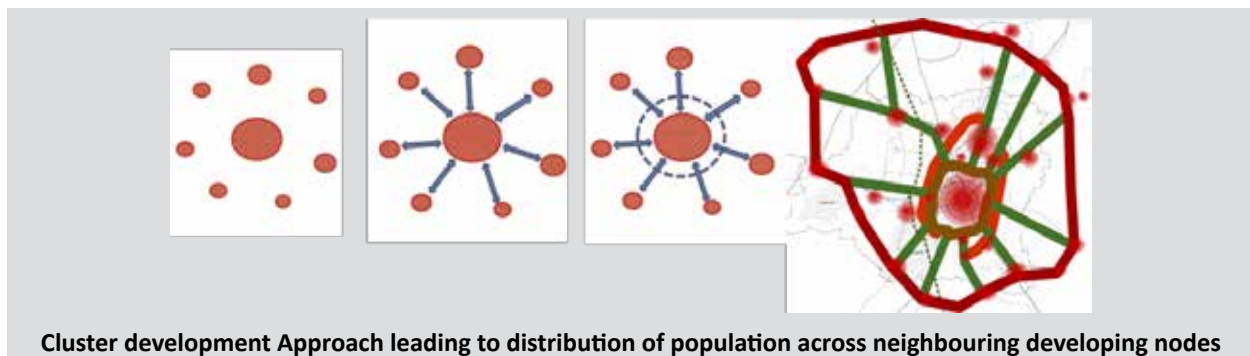
Effective town planning mechanism through the DP-TP Scheme that ensures mixed-use development, compact structure of the city and a complete hierarchical road network of the city, along with this a transport network that is aligned strategically in order to cover the entire city and bring about intensified development and urban regeneration are best practices in order to integrate the planning of land-use and transportation.

#### 4.7.2 Land-Use Transport Integration

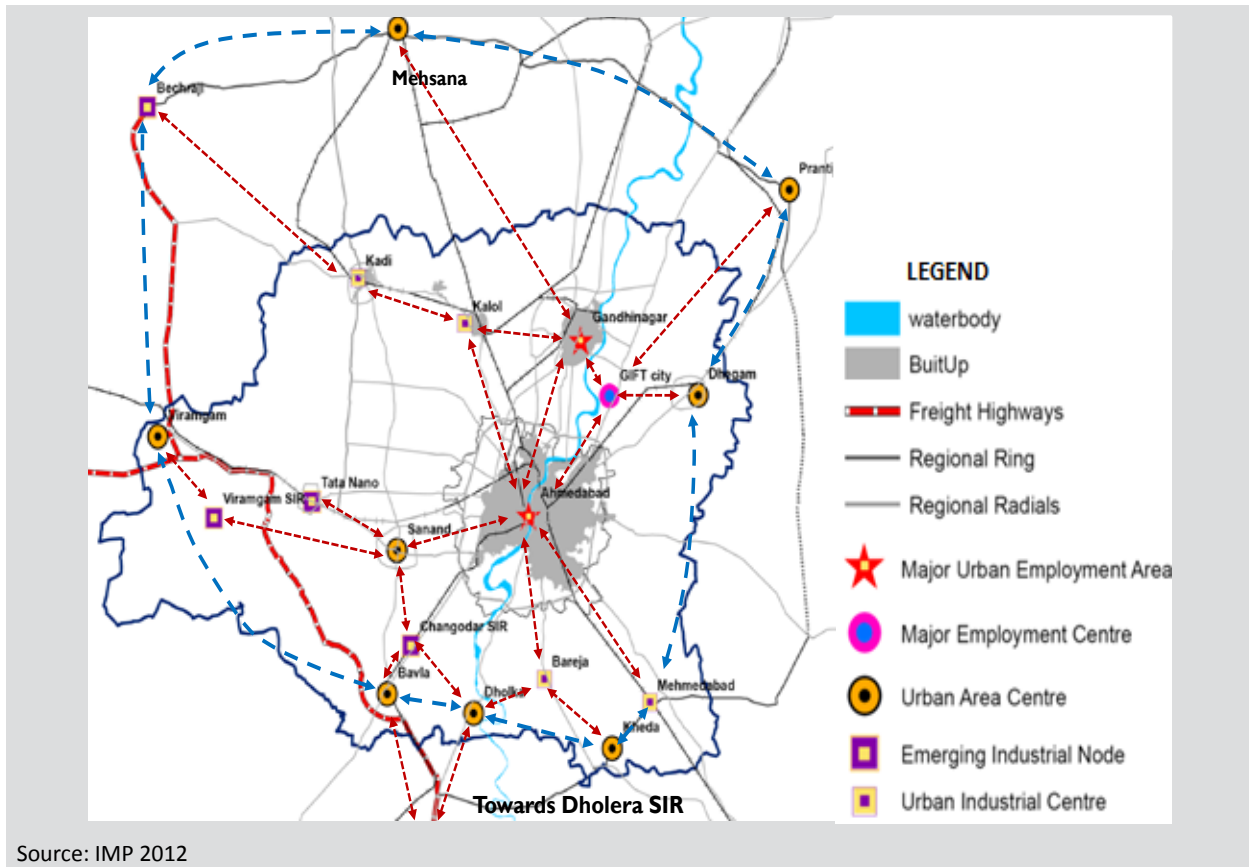
##### Urban Structure

Ahmedabad has a poly-centric structure. It has retained a 'relatively compact structure' with mixed use development owing to effective town planning practices, although it has shown 'gradual tendencies of dispersal' especially in the peripheral areas of the city (CoE, CEPT University, 2008). The growth of the city has been in a ring-radial structure, owing to a planned road network of ring roads and well-defined radials in the Development Plan of the city. The development of the road network has preceded urban development and has been instrumental to the growth of the city.

**Figure 4.26:** Cluster Development Approach Ahmedabad







The city has dispersed activity distribution. The industrial areas are all in the eastern parts of the city; trade is concentrated mostly in the central parts while institutions are in the western parts of the city. The city has a low rise high density character with almost 20 % of its population staying within 1 km of its operational transit network (BRT), which is likely to increase to about 80% once the complete transit network is built.

### Network and streets

As mentioned before, Ahmedabad has a balanced ring-radial network of streets, with 5 ring roads and 20 radials with a road length of 2400 km (CoE, CEPT University, 2008). The city has grown on both eastern and western parts of the river Sabarmati which are connected by 7 bridges (CoE, CEPT University, 2008). The road network of the city has contributed in the high density development and compactness of the city.

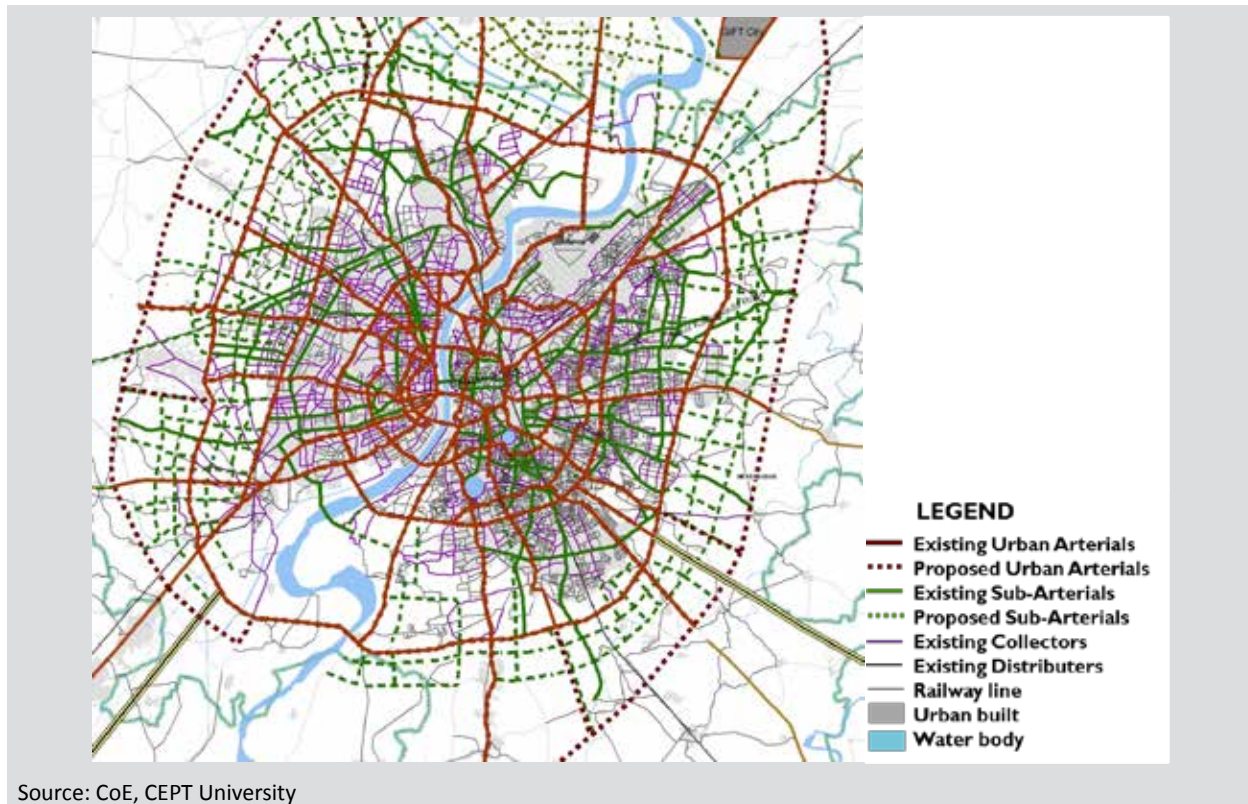
The 20 well defined radials include 12 in the west and 8 in the east of the city and act as important axes of development. As the need to connect these radials arose, the 5 ring or orbital roads were planned in Ahmedabad. These roads have experienced fast-paced development in the last decade.

Roads constitute about 7.5% of the entire city area, and about 12% of the developed area within the city. The network density appears reasonable as compared to many other Indian cities, and it translates to an average road width of about 12m.





**Figure 4.27:** Road Network Ahmedabad



Source: CoE, CEPT University

While designing the BRT network in the city, the concept of complete streets has been followed by developing the dedicated Right of Way, with median bus-ways and BRT Stations on the central avenues of the roads with a width of 26m or more. The rest of the road space is occupied by privately-owned vehicles, para-transit and regular buses. Bicycle tracks and footpaths with pedestrian crossing have been developed on major roads in order to ensure safety of pedestrians and cyclists.

### Strategic Alignment and TOD

A multi-modal transport network has been planned for the city of Ahmedabad as recognition of the fact that no single mode can cater to the rising travel demands of the population. Currently, Ahmedabad is serviced by road-based public transit services; the regular bus service is provided by the Ahmedabad Municipal Transport Services (AMTS) and the Bus Rapid Transit System (BRTS) by Ahmedabad Janmarg Limited.

AMTS covers almost 97% of the developed area within the AMC limits with 212 routes covering 550 km of road network (CoE, CEPT University, 2008). The network of AMTS has been so aligned that 80% of the routes pass through areas with low and middle income households.

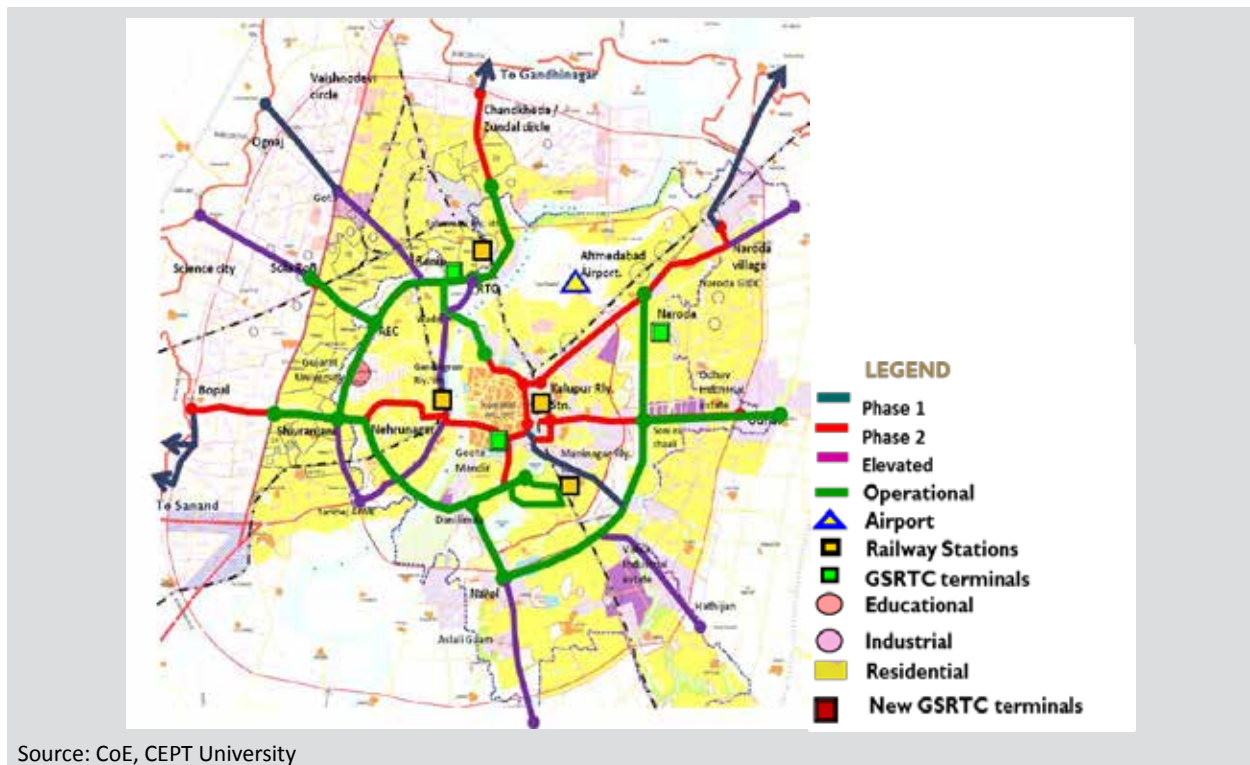
The Janmarg or the Bus Rapid Transit System (BRTS) started its planning in 2005 and the first phase is operational since 2009. The BRTS has been planned for a network of 216 km, with a phased implementation plan of this currently (45 km of operational network in phase I, 44 km of under construction network in phase II, 40 km and 84 km of proposed network in phase III and IV respectively). Along with the alignment of the routes of the BRTS, the AMC has implemented DP proposals of widening roads within the inner city to a width of 30 m. The AMC has also demolished encroachments from the road alignments in the intermediary zones.



The BRT has been aligned for maximum spatial coverage possible and hence, a “network approach” has been adopted instead of a “corridor approach” the idea is to “connect busy places and avoid busy roads”. The BRT bus-ways have been aligned such that the existing road users may avail the same or better level of services and the facilities on these roads have been upgraded. The BRT aims to improve mobility rather than add to existing levels of congestion in the city.

The network selection of the Janmarg has been an instrument to bring the city centre back into focus from a dispersed pattern of travel, regenerate the development of derelict industrial land of closed textile mills in the eastern parts of the city, make livelihood in the industrial areas accessible to the urban poor, and ease the congestion on the roads through comprehensive coverage of the BRTS. The spacing of the stations at less than 600 m makes the BRT accessible to larger sections of the population and improves origin to destination connectivity. Moreover, the intensified development along the transit routes of the Janmarg has improved coverage and generated employment in the city.

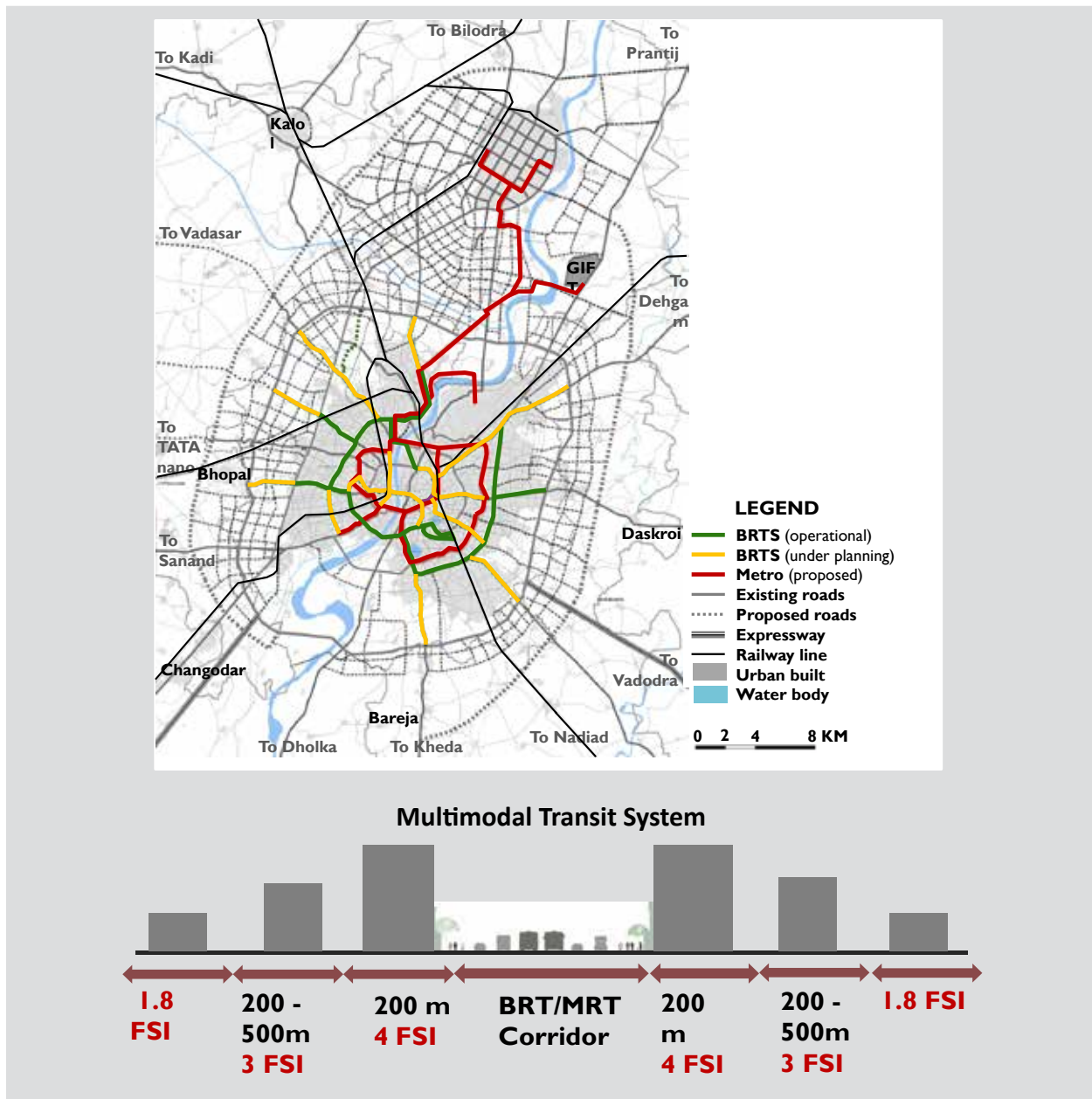
Figure 4.28: BRT Alignment



Source: CoE, CEPT University



Figure 4.29: Multimodal Transit System with TOD Ahmedabad



Finally, the existing regular bus services or the Ahmedabad Municipal Transport Services (AMTS) have been altered to complement the BRT and create a trunk and feeder system. Routes of AMTS have been realigned in order to avoid parallel routes and competing services.

The ridership on the network has increased ten times from 13,000 per day in 2009 to 135,000 per day in November 2011. The busses operate with an average headway of 2.5 minutes in the peak hour with 95 percent on-time departure rating on an average. The service also has an affordable distance based fare structure with a minimum of Rs 2 for 1.5 km, and maximum Rs 5 for 5 km. The public has consistently rated the system 8.5 out of 10 over the last 32 months (CoE, 2012)





As per the Integrated Mobility Plan Ahmedabad 2012 increase in the FSI is also proposed along the BRT and the MRT network.

## Legal Instruments

### 1. DP-TP Scheme as Legal Instrument of Comprehensive Planning

Rapid economic development and urbanization have led to the mandate of the Gujarat Town Planning and Urban Development Act (GTPUDA 1976), according to which planning of the Ahmedabad city is a two-step process: the formulation of a Development Plan (DP) for the urban development area on the periphery of the municipal limits, and the preparation of Town Planning Schemes (TPS) to implement the proposals of the DP. The Development Control Regulations and the building bye-laws control the zoning in the city.

- **Development Plan**

The Ahmedabad Urban Development Authority (AUDA) is in charge of the area peripheral to the municipal limits, delineated for the purpose of planning, as per the GTPUDA 1976. The “Development Plan” is prepared for the Urban Development Area, as the first step of the planning process. It is a macro-strategic plan that directs the growth of the city and envisages the infrastructure development through comprehensive planning for land-use zoning, open spaces, environment, water supply and sanitation, transportation, etc. The DP is revised every 10 years and is modified whenever a need arises to plan for a changing context. The first Development Plan of Ahmedabad was drafted in 1965, post which it has been prepared with strategic periodicity in 1976, 1987, 2002 and now is under revision for a draft in 2012. The city authorities have taken up the initiative to prepare the revised Development concurrently with the transportation plan for the region following the approach of planning for desirables so as to ensure better integration of landuse and transport in the city.

- **Town Planning Schemes**

The “Town Planning Schemes” mechanism is a land readjustment tool for implementation of the Development Plan proposals and they are prepared for smaller portions of the city/ development area, typically for 100-200 hectares. These are detailed micro-level plans that simultaneously reorganize land holding to set aside land for future public use by reducing portions from each plot, while appropriately adjusting land values for increment after infrastructure development. At present there are 192 TP Schemes covering a total area of 314 sq km.

This two-step process is an innovative mechanism for land sharing between the public authorities and private land owners without having to resort to the Land Acquisition Act<sup>5</sup>. The developmental costs are recovered in this scheme from the enhanced land value in the form of betterment charges. Land is appropriated for public uses up to 50% and land banks are created for housing of the urban poor and also to recover infrastructure costs. Most importantly, this mechanism ensures equitable distribution of resources and integration of transport infrastructure and urban development.

- **Development Control Regulations**

The DP-TP Scheme process is implemented through the “Development Control Regulations” and “Building bye-laws”. The Development Control Regulations are pertaining to sub-division of land, land

---

5 The Land Acquisition Act, 1894 is used for acquiring land for public purposes in most other states of India. According to the LAA, the public authority can acquire land from the private land holders and pay the current land value as compensation. The land owners thus lose out on land as well as the increment from infrastructure development on their land. This act has resulted in conflicts in many cases in the past.



use type, intensity of use, extent of site coverage, form of buildings, etc. The building bye-laws specify standards for plot sizes, floor space index, margins, open spaces, approach road, etc. The DCR and bye-laws together ensure mixed land use and uniform density due to uniform FSI. Land-use zoning in the city enables commercial activities on all roads of 18 m or more width, ensuring mixed-use development and creating Ahmedabad into a “Shopping street city”.

The above mechanism is used to maintain the high density development and retain the compact structure of the city. It is an instrument wherein infrastructure development, especially road infrastructure, is done in tandem with urban development.

## 4.8 Bangalore

### 4.8.1 Introduction

The provisional Census 2011 figures indicate that the urban population of Bangalore is 8.7 million with a decadal growth of 51% (Office of the Registrar General and Census Commissioner, India, 2010-11). The city covers an area of 741 sq km and has a population density of 4378 persons/ sq km.

Bangalore, once known as the “city of gardens”, is fast growing into an “urban jungle” due to fast-paced urban development and economic growth. It has cashed in on the surge in the Software Services sector, to become the Information Technology hub of India. The growth in the economy of the city has resulted in a phenomenal increase in population and household income in the city. The city has had to deal with the challenges of an accelerated growth in the ownership of private vehicles, inadequate road capacity, and falling shares of public transport in the modal split (KUIDFC, 2007). The “Comprehensive Traffic and Transportation Plan (CTTP)” has been drafted in 2007 by the Karnataka Urban Infrastructure Development and Finance Corporation taking into consideration these issues. The integration of modes, operations as well as institutional is being used to achieve integration of land-use and transport.

### 4.8.2 Land-Use Transport Integration

#### Integrating Transit Facilities

The Bangalore Metropolitan Region is currently served by the Metro and buses. A Light Rail Transit (LRT)/ Monorail, Commuter Rail System (CRS) and Bus Rapid Transit System (BRTS) are planned for the BMR. The goal of the planning authorities of Bangalore is to make public transport the ‘backbone of the city’s transport system’ (KUIDFC, 2007), for which they have planned an extensive transport network that can be accessible to maximum population of the city.

The CTTP stresses on integration of the public transit facilities in order ‘to minimize the need to change and when change is essential to make it as convenient as possible and with minimum time loss’ (KUIDFC, 2007). The public transit network is planned in such a manner that radial corridors operate on ‘direct origin to destination routes’ (KUIDFC, 2007) circular routes act as interchanges for the radial routes, and collector corridors operate in areas some distance from mass transit nodes.

A feeder service has been planned to provide a convenient and quick interchange to commuters. Planning for the feeder services would be done on the basis of passenger demand forecasting and depending on the distance of commuting to the nearest transit node.

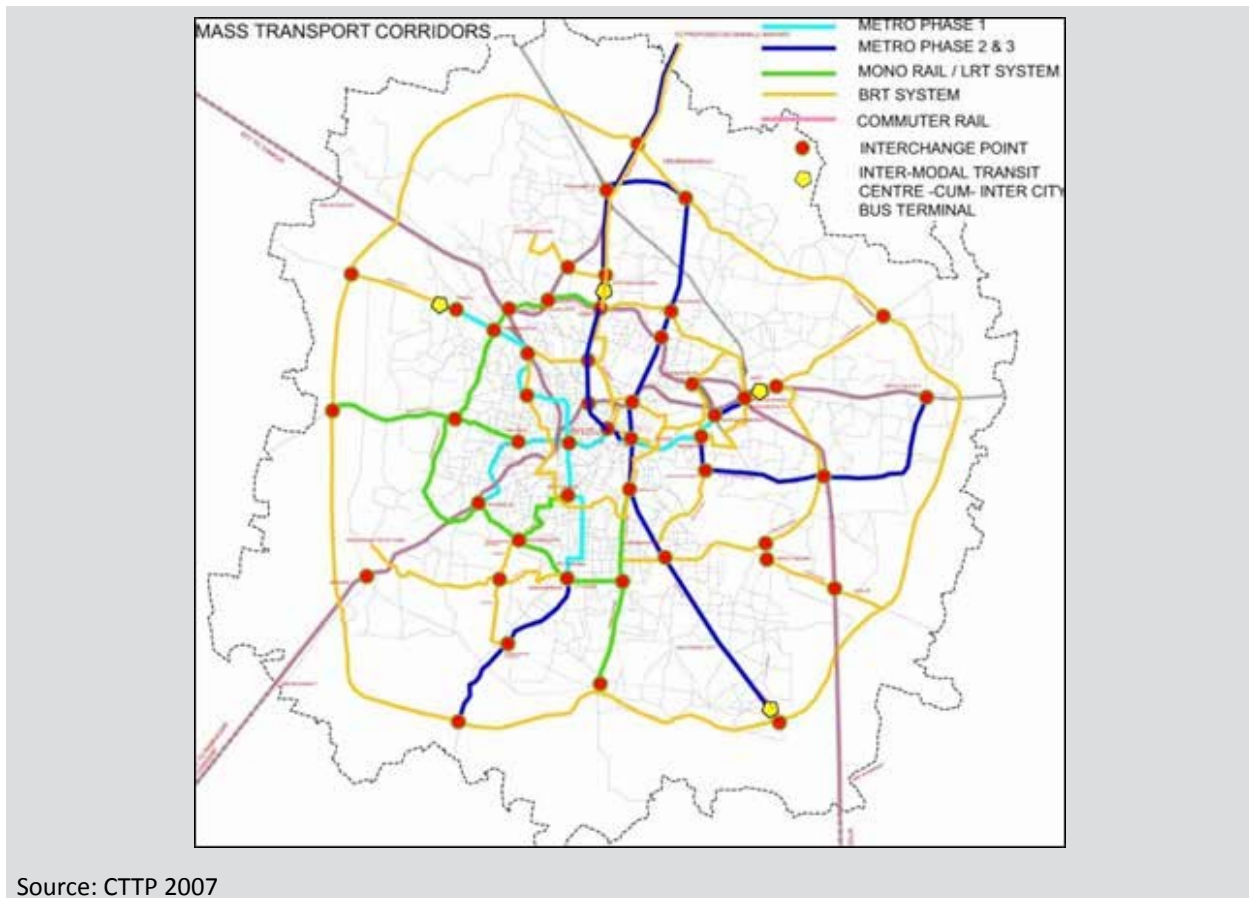
The city has planned two major inter-modal interchange terminals, the first to accommodate interchange between the Bangalore Metropolitan Transport Corporation (BMTC) bus service, Karnataka State Road





Transport Corporation (KSRTC) regional bus service, Bangalore Metro Rail Corporation (BMRC) and a “city centre” complex and the second to connect the BMTC, KSRTC, railways, BMRC and the Airport Rail Link. In addition to these, 47 major interchanges have been proposed at required intersections of mass-transit corridors.

**Figure 4.30:** Mass Transit Network Bangalore



Source: CTPP 2007

The transit nodes have been planned for a sideways or vertical interchange, involving minimum walking and increased safety of commuters. Facilities like approach roads, circulation of traffic, pedestrian ways and parking facilities have also been upgraded on these stations.

Operational level integration has also been planned by synchronising timings of mass transit and feeder services for convenience of passengers. A common ticketing system and an integrated information system for up-to-date information of routes and timings are provided for the users of the system. In order to bring about an institutional level of integration, the Karnataka State Government has sanctioned the establishment of the Bangalore Metropolitan Land Transport Authority (BMLTA), which will function as an ‘umbrella organization to coordinate planning and implementation’ of the public transit system (KUIDFC, 2007).

Bangalore Metropolitan Transport Corporation (BMTC) is the first urban transport organization to receive JnNURM funding for a national pilot project for ‘Traffic and Transit Management centers’ (TTMC). These centers will be the first of its kind in and Indian city. Under the Scheme funding has been received for the construction of 10 TTMC’s (Jayanagar, Vijayanagar, Banashankari, Koramangala, Shantinagar, White Field



(ITPL), Kengeri, Yeshwanthpur, Domlur & Banneraghatta) , of these 9 has already been commissioned and the last one will be commissioned shortly. The authority has received a grant of about 430 million under JnNURM to improve the infrastructure at the bus stations in the city. (BMTC)

Under this initiative the following facilities are proposed to be developed-

- **Terminal** - Bus bays, platforms, seating & lighting, public conveniences, information systems, safety and security
- **Bus maintenance depot**- Maintenance bays, washing platform, bus parking, services and utilities, fuel filling station, amenities for crew
- **Passenger amenities**- Bangalore one centers, other citizen amenity centers, ATMs, daily needs shopping
- **Park and ride**

The above mentioned infrastructure is in line with the National Urban Transport Policy to provide an integrated transportation system with adequate facilities and amenities to cater to the requirements of all user groups. The idea is to minimize/ reduce congestion on main road through efficient traffic movement and smooth flow of all types of traffic to and from the terminal such that there is no congestion/disturbance caused to traffic along the main road. Such a transit facility is also helpful in minimising conflict between various modes-Passengers, buses and private vehicles and to achieving efficient passenger and vehicle processing time. Such an initiative will also encourage use of public transport and provide first-mile connectivity through provision of park and ride facilities in the proposed bus terminal.

# Annexures

---

## Land use Transport Integration: Concepts

The following concepts of urban development and transport planning, when planned in an integrated fashion, will enable efficient land use transport integration.

**Density:** Higher densities enable more people to reside in a smaller area. This thereby reduces the demand and utilization of resources for infrastructure development for the same. Dense urban fabric allows cities to remain smaller in size, thereby reducing the travel distances within the urban settlement.

**Land use Mix:** A good mix of land use within an urban fabric will ensure self contained neighbourhoods and a city. Land use mix will ensure that a variety of facilities like jobs, education, entertainment etc are available within walking distances or accessible by other non-motorised modes, from the place of residence. This thereby will reduce the need for travel through motorised modes. Major city level activities and land uses need to be clubbed at certain nodal points within a city. This will ensure that one can engage in multiple activities at a single urban node.

**Strategic Network:** The various activity nodes when linked with a good network of roads and an efficient mass transit system will enhance accessibility within the city. Linking all major activity nodes with mass transit will ensure more public transit patronage, a more sustainable mode of travel.

**Multimodal Transit:** The various modes of transport when linked with each other in an efficient manner will enhance mobility of a city. This will include physical integration of the various modes in a manner that there is minimum distance to walk and minimum time taken to transfer from one mode to the other.

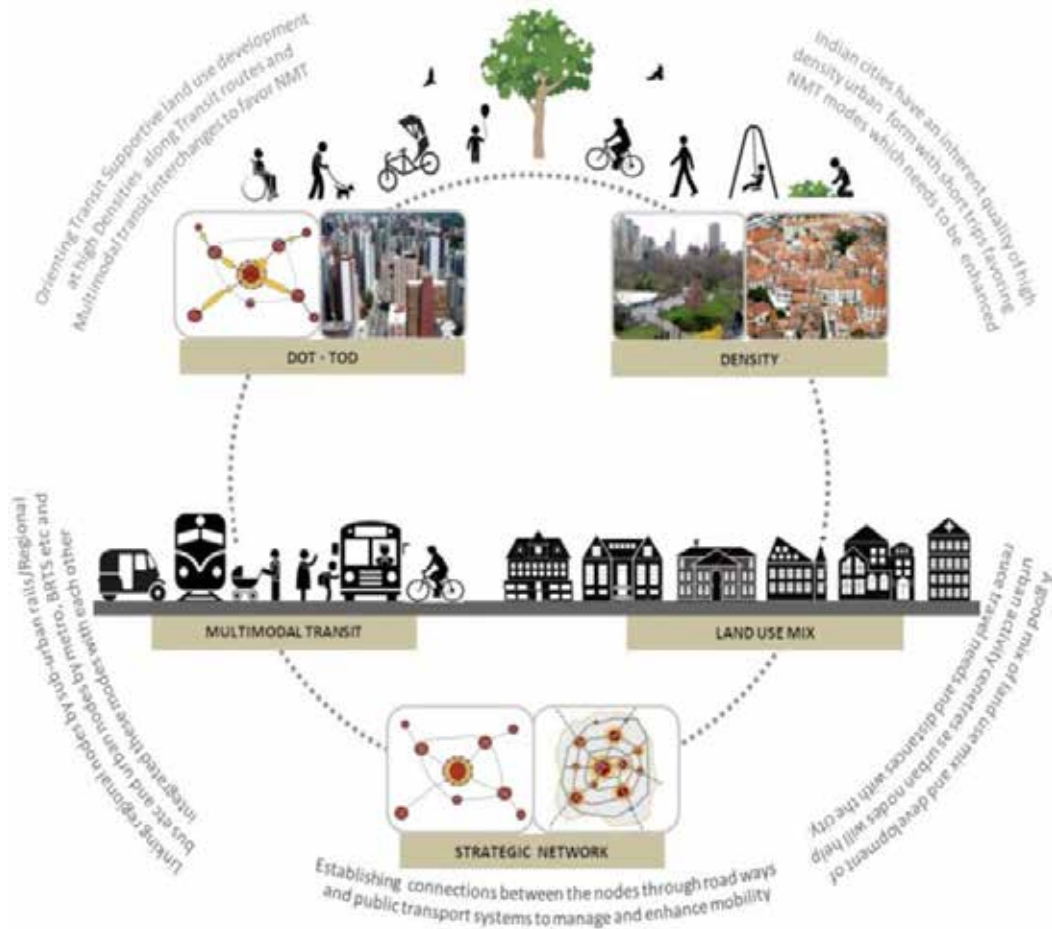
**TOD and DOT:** While transit systems are strategically aligned to connect major development/activity nodes of a city, there exists a reverse reaction of; development following mass transit systems. This principle/ concept of Development Oriented Transit and Transit Oriented Development ensures land use transport integration in cities.

## Integrating Land use and Transport: a Cyclic Process

It is vital to understand, that there exists no 'single step by step' process to achieve land use-transport integration. Also, not all the concepts of land use transport integration may be applicable concurrently in a city. The manner in which each of the concepts are applicable, will be determined by the nature of existing settlement pattern, strategies, socio-economic and political background, etc of a city. Some cities may have explored some of these concepts and hence would require only strengthening of existing concepts or addition of supplementary concepts. Others may need strategic introduction of some of these concepts from scratch. Hence the planning process of integrating land use and transport is never a predetermined process. It can be defined as a cyclic process, as rendered in figure below; where one element influences the other in a manner that the socio-economic and environment impacts of urban development be minimized.



## 1. Cyclic Process of Land use - Transport Integration



Indian cities vary in size, density, settlement pattern, socio-economic systems and hence, varying mobility patterns. Hence it is important to consider this phenomenon while planning for city development. Some mega cities may require interventions at a regional level to influence land use and transport integration, while smaller cities may require only interventions at city level.

## Concepts that enable Land use Transport Integration

While general conclusion that high density development is essential for ensuring sustainable urban development, specific questions still remain. There are no clear guidelines to suggest where, when and how much to densify and direct growth. Even more difficult task is to find appropriate strategy to achieve the desirable development pattern. This section deals with these critical issues to the extent possible. The following are specific questions we need to answer.

### Density

#### What Density is appropriate for sustainable development of cities?

- It is recommended that a medium density (GROSS DENSITY - European standards) is best suited for the development of cities. It is recommended to avoid very low and very high GROSS densities.

- This medium density can be achieved by either optimally mixing high and low densities at various locations of a city or by allotting an average low rise-high density for the whole of the city.
- It is important to mix the advantages of low (availability of open spaces) and high densities (shopping facilities, public amenities etc) in cities. This can be achieved by developing multiple sub-centres within the city.



Combination of low and high rise densities in London  
Source: <http://www.wired.co.uk/magazine/archive/2012/05/how-to/make-the-most-of-london>



Low rise high density of Munich  
Source: <http://worldshot.net/Munich-Germany-vacations-photo-221.shtml>

### What factors govern the formation of an urban form with a particular density?

It is important to understand the factors that have governed the formation of the existing density of your city, over the years. Some of these factors facilitate higher densities, while others limit its density like:

#### Limiting factors:

- **Climatic factors:** Hot and Humid climatic condition gave rise to an urban settlement formed by houses/buildings placed apart. This dispersed settlement pattern helps good cross ventilation, a necessity that shapes cities in Kerala, Assam, west Bengal, Arunachal etc
- **Natural features:** Earthquake zones,
- **Physical barriers:** zones near airport, Hilly terrain which restricts bigger foot prints and taller buildings

#### Facilitating factors:

- **Climatic factors:** Dry and arid climatic condition gave rise to houses that are built closer to each other to avoid the hot dry wind and narrow winding streets which are cooler compared to the temperature outside the urban settlement ex: cities of Gujarat, Rajasthan etc
- **Political and legal measures:** Proactive government, tools like Town planning schemes of Gujarat state that help direct and facilitate optimum density growth.
- **Presence of potential land:** Derelict areas

### Can cities across the sub-continent of India, have a single standard density?

Socio-economic, cultural, topographical and climatic features vary across the length and width of India.





This has influenced the housing typology and hence varying settlement pattern and urban fabric of cities across the country. These factors determine the density of each city which has resulted in its density variations across the country. Hence standardization of a density for cities across the country is not a viable solution.

**2. Variations in urban densities**


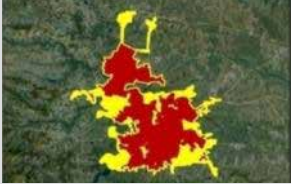







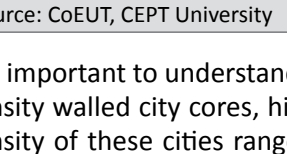
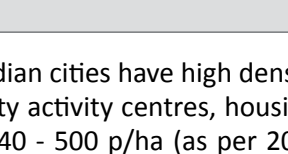
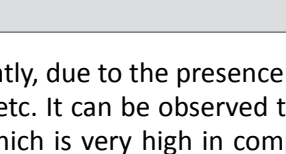
<p>Sprawling low density city of Trivandrum Source:</p>	<p>Compact high density of Mumbai Source: <a href="http://www.flickrriver.com/photos/humayunnapeerzaada/2881584481/">http://www.flickrriver.com/photos/humayunnapeerzaada/2881584481/</a></p>

The table below illustrates the densities of major cities in the country and the respective developed areas. It shows the change in developed areas (red – urbanized area by 2001 and yellow - urbanized area by 2011) within a span of ten years and their respective change in gross densities.

**3. Developed area boundaries and respective urban densities of major Indian cities**

<p><b>MUMBAI</b> 2001 density – 500 2011 density – 339</p>	<p><b>KOLKATA</b> 2001 density – 299 2011 density – 233</p>	<p><b>DELHI</b> 2001 density – 140 2011 density – 123</p>



<p><b>HYDRABAD</b> 2001 density – 200 2011 density – 119</p> 	<p><b>BANGALORE</b> 2001 density – 192 2011 density – 90</p> 	<p><b>CHENNAI</b> 2001 density – 185 2011 density – 114</p> 
<p><b>AHMEDABAD</b> 2001 density – 265 2011 density – 232</p> 	<p><b>PUNE</b> 2001 density – 203 2011 density – 172</p> 	<p><b>SURAT</b> 2001 density – 352 2011 density – 287</p> 
<p><b>KANPUR</b> 2001 density – 199 2011 density – 175</p> 	<p><b>JAIPUR</b> 2001 density – 171 2011 density – 134</p> 	<p><b>LUCKNOW</b> 2001 density – 160 2011 density – 92</p> 
<p><b>NAGPUR</b> 2001 density – 168 2011 density – 106</p> 	<p><b>PATNA</b> 2001 density – 191 2011 density – 109</p> 	<p><b>BHOPAL</b> 2001 density – 177 2011 density – 132</p> 
<p>Source: CoEUT, CEPT University</p>		

It is important to understand that Indian cities have high densities inherently, due to the presence of high density walled city cores, high density activity centres, housing patterns etc. It can be observed that the density of these cities range from 140 - 500 p/ha (as per 2001 data), which is very high in comparison to the standards set by **UDPFI** (125 p/ha). This inherent quality is to be explored as a potential tool by Indian planners as these high densities has helped to keep trip lengths low in India, in comparison to most developed nations.

But it can be observed that over the last decade, cities have been expanding (highlighted in yellow) with lower densities, which has resulted in an overall decrease in their urban gross densities. The city densities in 2011 vary from 90 - 339 p/ha. It is hence recommended that the important to retain the inherent high densities of our cities and avoid the present day tendency towards sprawl. It is recommended that cities which have gross densities below 125 p/ha, aim to increase their densities, without compromising the quality of the urban spaces. This can be achieved by **Re-densification** within their developed area. They can do so, by considering the limiting factors for densification. This will ensure that cities are developed in a compact fashion.

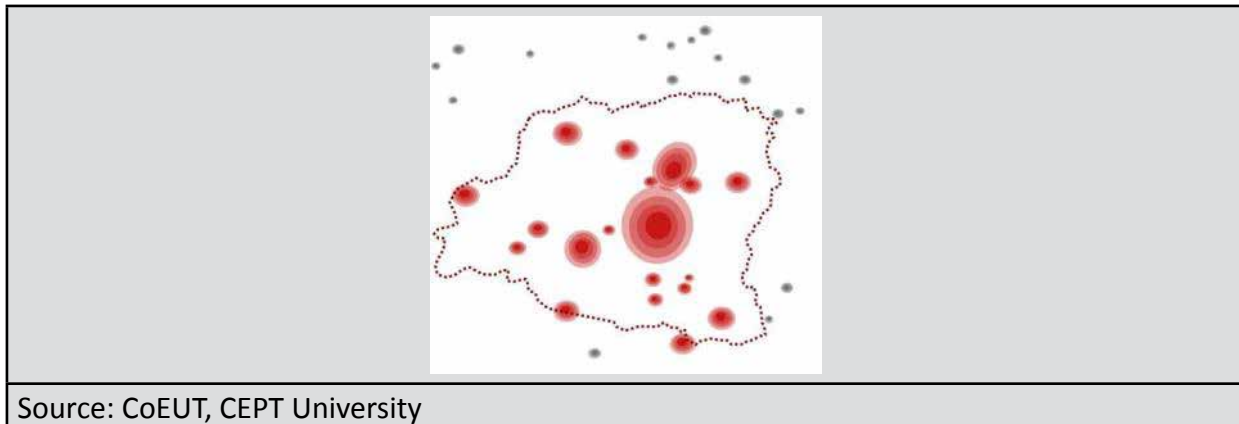
The alternative method is to distribute the projected growth of the city with its neighbouring growth centres within the metropolitan region, to form a **Regional Cluster**.



### What is a regional cluster? Why is clustering important in directing and distributing growth?

A regional cluster refers to a group of towns, the parent city, villages, SIRs, SEZs and other growth centres with inter-related activities and relationships, located within the metropolitan region. These growth centres are from here on referred to as **'regional nodes'** in the toolkit.

#### 4. A typical regional cluster



Source: CoEUT, CEPT University

A region may not be dominated by a single city, but shared by regional clusters. Growth potential of the various growth centers are to be explored and growth distributed across the region. Growing cities are to be regarded as 'Cities within a City' by identifying and redistributing activity and land use to develop multiple centers within it. In order to achieve land use transport integration it is important to work on all various concepts of land use and transport enhancements in and foresee their integration.

The regional nodes are typically inter-dependent with each other for various requirements like employment, educational, institutional, health, entertainment etc. This inter-dependency is highest with the parent city. Hence planning for any of these nodes demands a metropolitan level understanding and planning. Planning at a metropolitan scale, by considering the growth potential of all the regional nodes will help direct and distribute future growth of a city with its neighbouring regional nodes and hence help retain the growth and city size of the parent city.

A metropolitan area is not defined for most Indian cities. In this case, an understanding of the inter-relationship between the regional nodes should be used to guide and define the respective metropolitan area of a city.

### Why is zoning at a metropolitan level important?

**Mix of land use at a metropolitan scale:** Cities function as regions with inter-related metropolitan nodes. For the efficient development and functioning of this metropolitan regional cluster, it is important to identify the prominent land use/activity each node supports to decide on its . For example, Sanand near the city of Ahmedabad, an industrial node would provide majorly employment, whereas Dharwad, Karnataka acts as the institutional hub which is inter-dependent to the main city of Hubli.

The process of identification of potential nodes at a metropolitan should consider the following:

- There should be a balance of activities between nodes so that people can rely on the metropolitan nodes for jobs, resources and activities apart from solely relying on the parent city for all needs.





- Industrial nodes should be identified and developed so that there are multiple job opportunities and options to reside apart from the parent city. These industrial nodes should be developed in a manner that there remains the option of employees to commute to the particular node from the main city or residential facilities that can accommodate employees within the node
- Lakes, rivers, ponds, water tanks, forest, other delicate zones like mangroves etc are to be preserved and developed in a manner that these zones serve as metropolitan greens. These zones within the metropolitan area will offer weekend leisure trips to a great extent to be confined to shorter distances.

**Mix of land use at an urban scale:** Each metropolitan node should be self contained in a manner that it offers a good mix of land use that encourages more people to settle in these zones, thereby reducing the load and sprawl of the parent city. The land use mix within the parent city should be so structured that it reduces the need for travelling longer distances within the city to meet everyday needs. To ensure a good land use mix and structure, it is recommended to develop urban nodes within each metropolitan node.

**What is an urban node? What are the characteristics of an activity centre?**

Urban nodes are major activity centres like central business district, major transit station areas, city markets, educational and institutional hubs, commercial and entertainment hubs etc. These **Urban nodes are activity centres of high density**

**How can you densify your regional node (parent city or neighboring clusters)?**

A city can achieve higher densities than its present state, by either adding more density to the existing developed area of the city and by adopting high density development standards for new neighbourhoods.

**a. Re-densification:**

This is a process of densifying the existing low density areas of a city. This can be achieved by the following methods:

- **Re-development:** It refers to rebuilding/restoring (existing building or neighbourhoods) to a better condition. In doing so, the floor area and number of floors could be increased to accommodate more capacity in the given area.

<p>Collins street, Melbourne CBD</p>	<p>40-50 floor buildings added in to accommodate high densities</p>	<p>Historic facades conserved to retain the human scale.</p>

- **Infill development:** <sup>6</sup>It involves building and developing in vacant areas in city centres or urban settings. This promotes the betterment of these city centres and leaves rural areas and open spaces undeveloped. Advocates state that infill development can reduce traffic congestion, save open space, and create more liveable communities.

6 <http://www.kzoo.edu/convene/clearinghouse/Infill%20development.htm>



**Re-generation** is a process of developing inner city areas with large amounts of derelict and un-used land. Special urban development councils are often formed which has the power to acquire and reclaim land, convert old buildings and improve infrastructure through the investment of government money. These projects also attracted private sector investment through offering companies reduced taxes and other benefits and in doing so they promoted industrial, residential and community developments. Regeneration projects contribute to positive social change of the area along with environment and economic regeneration.



**b. New Developments:**

New developments are inevitable in any growing city. Though the process of re-densification within the already developed area of the city would help reduce the need for new development, new developments are inevitable in the city periphery. The aim is to retain the area of such new developments as low as possible. The basic planning and design considerations for neighbourhood planning:

<p>High Densities: The density in the residential neighborhoods may be lesser in comparison to the city center. But it is important to plan high density neighborhoods to help retain exiting cities from drastic sprawl. It is important to understand that high density does not always mean high rises. High densities can be achieved by low rise compact development.</p>	
--	--





**Green Open Spaces:** The myth of lack of open spaces in a compact city can be mitigated by courtyard typology of built form. The open space design should be such that a group of buildings enjoy a common open area. This should accommodate small play areas, gathering space, vegetable gardens etc.



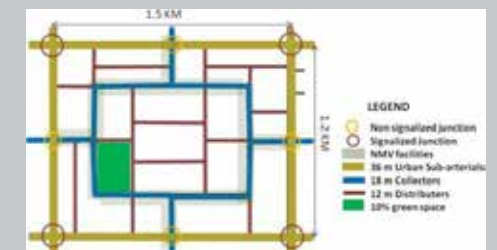
**Mixed use:** Relatively self-contained neighbourhoods make it easier for people to access basic amenities within walkable distances. It is a good practice to mix the land use in a single building, as shown in figure. Most medieval urban cores have commercial activities on the ground floor, offices and institutions on the first/second floor and residential on the top most floors. This ensures surveillance on the immediate street 24 x 7 and makes such neighbourhoods more safe, livable and multi functional.



**Neighborhood centers:** The major activities like shopping, entertainment, small scale employment centers, institutions etc should be planned centrally in a manner that it is easily accessible. Clustering of these activities around an open space would help enhance the utilization of the center and help accommodate weekly markets and fairs, as shown in figure.



**Street network and hierarchy:** Street network and its hierarchy typically define the boundary of a neighborhood. The collectors connect the neighborhood to the urban sub-arterials. Typically all distributors connect all residential units to the collectors.



**Neighborhood streets:** To be designed as pedestrian priority streets. Selected streets abutting high pedestrian activity like neighborhood center, parks, schools etc should be car free zones. Streets can be made safer by providing speed regulations for motorized vehicles.



**Public transit connectivity:** It is important that neighborhoods are accessible through a mass transit system. The arterials and sub-arterials that carry mass transit systems of a city should be well connected by distributors and collectors. There should be para transit facilities



**Transit Interchanges as activity nodes**

**Local area access**



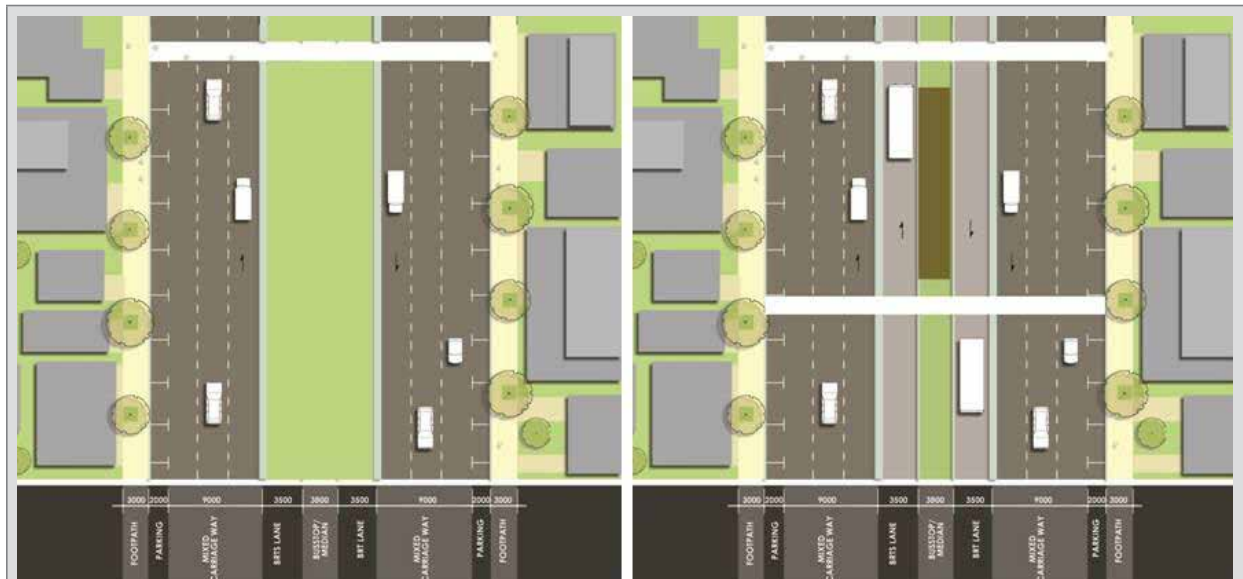
### What is a Complete Street Network?

A Complete Road network is the one that is a well-knit system of roads which enhance accessibility within the city in the best possible manner. A complete network should have a clear hierarchy of roads, as illustrated in the hypothetical example below. It can be observed that the major roads form a ring radial pattern, structures the city and its travel patterns. It is seen that this pattern is broken at various locations in the city which are identified as missing links.

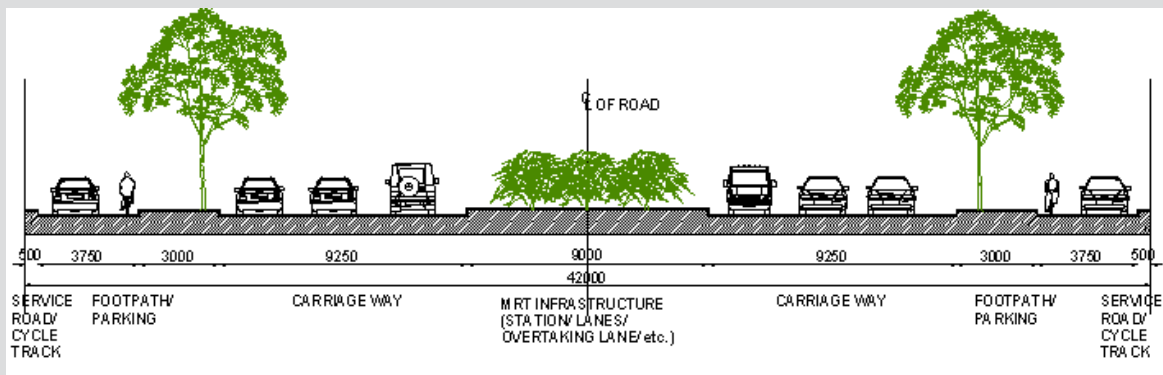
### What is a Transit Ready Street?

Transit Ready Streets are designed in a manner that it allocates extra space in the road way, which can accommodate any kind of mass transit in future. The roadway design is such that it has reserve space in the centre or at sides, designed as a strip of green space along the length of the road at the time of construction and is flexible enough to be used for laying mass transit infrastructure when time demands.

#### 5. Transit Ready Street to accommodate any Mass Transit in future



Cross Section design – Transit Ready Street



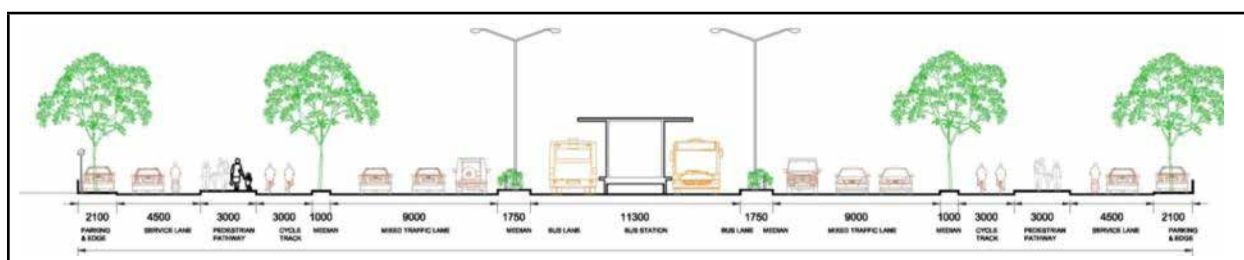
Source: CoE-UT, CEPT University



## Road hierarchy

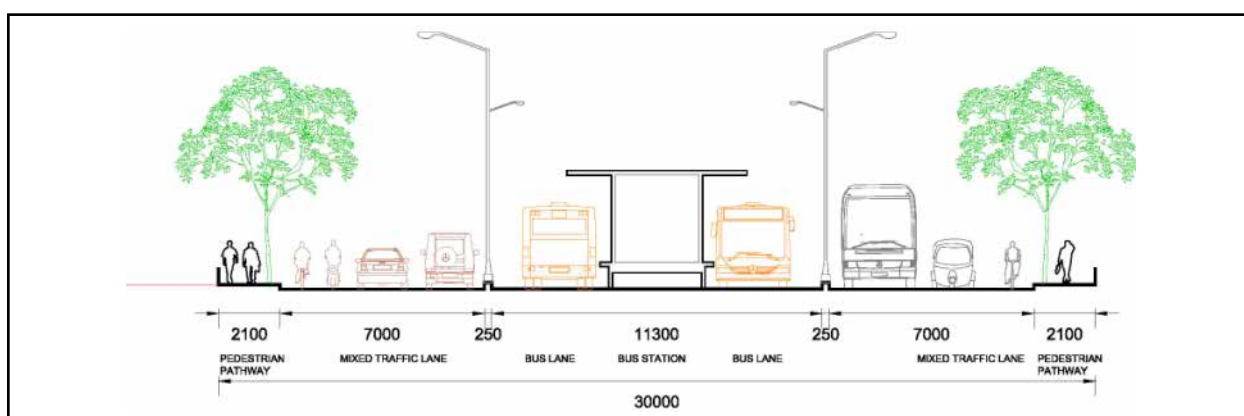
Road classification is a tool that can be used to achieve efficiency of travel for all modes and the safety and convenience of all road users. Road classification can be termed as *'the grouping of roads in categories as per the type of function they cater to'*. Since functions vary, standards for each 'group' would vary.

**Arterial** – level 1 urban road of the city: The highest level of roads in the example is the arterials, consisting of major rings and radials, designed for mass transit, high speed and heavy traffic flow or even regional traffic at times. Arterial roads would function as the primary network for carrying traffic and hence recommended to be developed as Transit ready Streets. Essentially, traffic movement would be their primary function. The figures below depict the recommended cross sections for arterial roads. Depending on specific situation, the road may be designed for transit (BRTS or metro) and may have provision for bicycle tracks. However, in any case, the cross section would include a divided carriageway with 2-3 lanes for mixed traffic in both direction and a footpath.



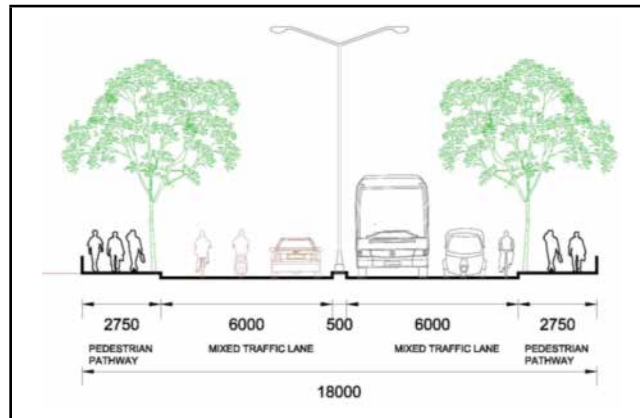
**Sub-arterial** – level 2 urban road of the city: Sub-arterial roads connect arterial roads and lead to formation of 'blocks', classified as sub-arterial roads of level 2 hierarchy. They would also carry city level traffic and hence are recommended to be developed as transit ready streets, though not of the same scale as level 1. The figure below depicts the proposed cross sections for level 2 sub-arterial roads. Depending on specific situation, the road may be designed for transit (BRTS or metro) and may have provision for bicycle tracks. In case, the road is specifically planned as part of NMT master plan, additional measures to reduce speed through traffic calming measures would be taken. However, in any case, the cross section would include a divided carriageway with 2 lanes for mixed traffic in both direction and a footpath.

## 6. Recommended cross sections for Sub-arterial roads

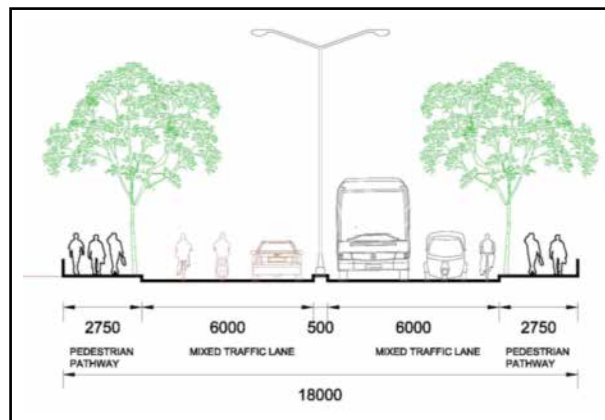




## 7. Recommended cross-section for collector roads



**Collector** – level 3 urban road of the city: All roads that provide connection between blocks/ neighbourhoods are classified as level 3 collector roads. These roads are meant to collect traffic from neighbourhoods and feed them to level 2 and level 1 roads. The figure below depicts the proposed cross sections for level 3 collector roads. In case, the road is specifically planned as part of NMT master plan, additional measures to reduce speed through traffic calming measures would be taken. The cross section may not have a median. However, in any case, footpaths would be provided at road edge.







Recommended cross section for Distributer roads

**Distributor** – level 4 urban road of the city: Level 4 local streets are internal roads within neighbourhoods. They are the last link to residential destinations and join level 3 collector roads only. On no account would they directly connect with level 1 and 2 roads. The figure below depicts the proposed cross sections for level 4 local streets. In case, the road is specifically planned as part of NMT master plan, additional measures to reduce speed through traffic calming measures would be taken. The cross section would not have a median. However, in any case, footpaths would be provided at road edge.



## 8. Characteristics of various hierarchical roads in the city

Arterial roads	Sub-arterial roads	Collector roads	Local streets
 <p>For the example above, all the ring roads would come under this classification. All the radials too would be classified as arterial roads. These roads would lead from the city centre to the periphery and be major carriers of urban traffic.</p>	 <p>In the example above, sub-arterials are the radials that are continuous for long stretches, but do not directly lead from city centre to outer neighbourhoods. They would, in many locations, connect two rings directly. Other than these radials, roads that are part ring or parallel to rings would also be considered.</p>	 <p>In the example above, all roads that provide connection between blocks/ neighbourhoods are classified as level 3 collector roads. These roads are meant to collect traffic from neighbourhoods and feed them to level 2 and level 1 roads.</p>	 <p>Level 4 local streets are internal roads within neighbourhoods. They would be the last link to residential destinations and would join level 3 collector roads only. On no account would they directly connect with level 1 and 2 roads.</p>
<p>Arterials would have the following specific characteristics:</p> <ul style="list-style-type: none"> <li>• They would be complete roads with consistent RoW.</li> <li>• They would lead to formation of a pattern that is clearly distinguishable.</li> <li>• The RoW would be 40 m or more. However, in case of existing arterials that are less than 40m, the existing RoW would continue.</li> </ul>	<p>Sub-arterial roads would have the following characteristics:</p> <ul style="list-style-type: none"> <li>• The RoW would be consistent throughout the length.</li> <li>• They would contribute to formation of clearly visible blocks within the large blocks formed by level 1 arterial.</li> <li>• The RoW would be between 18m to 36m. However, in case of existing sub-arterials that are less than 18m, the existing RoW would continue with an attempt to increase to at least 18m through a new road line.</li> </ul>	<p>Collector roads would have the following characteristics:</p> <ul style="list-style-type: none"> <li>• They would form links between blocks.</li> <li>• They would allow access to private properties, except wherever they meet higher order roads. In these cases, access would be restricted to a distance of 25m from junction stop line.</li> <li>• The RoW would be between 12 to 18m.</li> </ul>	<p>These roads would have the following characteristics:</p> <ul style="list-style-type: none"> <li>• They would allow access to private properties.</li> <li>• They would not have local bus routes running through them.</li> <li>• The RoW would be between 9m to 15m.</li> </ul>





Design standards for Arterials:	Design standards for sub-arterials:	Design standards for collector roads	Design standards for level 4 local streets:
<p>All open junctions would be signalised.</p> <ul style="list-style-type: none"> <li>Junctions would not be closer than 500m. In specific situations, they may be 350m apart.</li> <li>Minimum level for lighting: 40 lux.</li> <li>Recommended design speed : 45-65 kmph.</li> <li>On-street parking would be prohibited.</li> <li>In no case would on-parking be permitted for a distance of 75m from the stop line.</li> <li>Access to adjoining properties would be prohibited, except for cross-sections where service roads are provided. In case of existing roads, where service roads are not possible, vehicular entrances and exits would be situated 25m beyond the approach to junction.</li> <li>Pedestrian crossings would be provided at every open junction through zebra crossing. Zebra crossing would also be provided at critical locations such as schools, colleges, transit facilities even between two junctions. Generally, zebra crossings should be provided at least once between two signalised junctions.</li> <li>Rain water disposal system in the form of storm water drains would be mandatory.</li> </ul>	<p>The following design standards are suggested for level 2 sub-arterial roads:</p> <ul style="list-style-type: none"> <li>All open junctions which meet the same level as well as level 1 have to be signalised. For level 2 roads meeting level 3 roads, appropriate decision based on site situation would be taken.</li> <li>Junctions would not be closer than 350. In specific situations, they may be 250 apart.</li> <li>On-street parking would be prohibited. It would be permitted only in specific situations after recommendation of traffic police or AMC. However, in no case would on-parking be permitted for a distance of 40m from the stop line.</li> <li>The minimum level for lighting would be 30 lux.</li> <li>Care would be taken to ensure that vehicular entrances and exits are situated 25m beyond the approach to junction.</li> <li>Pedestrian crossings would be provided at every open junction through zebra crossing. Zebra crossing would also be provided at critical locations such as schools, colleges, transit facilities even between two junctions. Generally, zebra crossings should be provided at least once between two signalised junctions.</li> <li>The design speed would be between 35-50 kmph.</li> </ul>	<p>The following design standards are suggested for level 3 collector roads:</p> <ul style="list-style-type: none"> <li>Junctions would generally not be signalized. At specific junctions, where the traffic volumes are high, signals would be considered.</li> <li>Open junctions can be 200-300m away.</li> <li>On-street parking would be allowed, except near junctions.</li> <li>The minimum level for lighting would be 30 lux.</li> <li>Care would be taken to ensure that vehicular entrances and exits are situated 25m beyond the approach to junction.</li> <li>Pedestrian crossings would be provided at every open junction through zebra crossing. Zebra crossing would also be provided at critical locations such as schools, colleges, transit facilities even between two junctions.</li> <li>The design speed would be between 25-40 kmph.</li> </ul>	<p>The following design standards are suggested for level 4 local streets:</p> <ul style="list-style-type: none"> <li>On-street parking would be allowed, except near junctions.</li> <li>The minimum level for lighting would be 25 lux.</li> <li>The design speed would be between 15-25 kmph.</li> </ul>
<p>Source: Integrated Mobility Plan for Greater Ahmedabad Region, CoE-UT, CEPT University</p>			



### Can a single mode cater to the mobility needs of your city?

- No single mode alone can cater to the transit requirements of a city.
- Also, each mode of mass transit has specific performance levels. Hence encourage different types of mass transit systems, the combination of which works best for a given city.

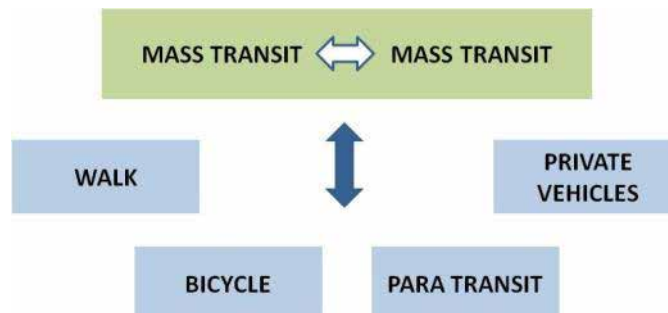
### What is an Integrated Multimodal Transit System?

<sup>7</sup>The organizational process through which the planning and delivery of elements of the transport system are brought together across modes, sectors, operators and institutions with the aim of increasing economic and social benefits.

The definition above simply states that a city's transportation system should respect and consider every mode of transport in the city and, plan and operate the various modes in an integrated manner. The principle behind planning in this fashion is to help increase the mobility options in the city.

#### There are two levels of integration for a multimodal system:

1. Interchange between mass transit systems (ex: metro to tram, BRTS to tram etc)
2. Interchange between a mass transit system to para-transit, NMT, private vehicles etc



For the functioning of a multimodal system in a city, it is important to physically integrate the various modes and systems. Studies show that cities which have efficiently integrated multi-modes provide more sustainable options of mobility. This is illustrated in table below, through the example of Munich and its multiple mobility options and the manner in which each mode is physically integrated with the other.

7 SOURCE: Article 'on the move: delivering integrated transit system in Britain' by John Preston, Adam Marshall & Lena Tochtermann



## 9. Integrated Multimodal system in the city of Munich

### A person in Munich has the following mobility options for an entire journey or part of the journey

- He may choose to walk or cycle to a mass transit station which is located on an average of 1.km away
- Good quality footpaths and dedicated bi-cycle lanes starting from his compound boundary to any mass transit station (tram, bus, metro)
- Safe pedestrian and bicycle crossing at all traffic junctions



- Bicycle parking facilities at every tram and metro stations
- The location for the bicycle parking is such that there is minimum distance of walk from the point of parking to the station
- The image shows the parking lot and the stairs that lead down to the metro station.
- Munich also has bicycle rentals at transit stations.



- Not all areas are accessible by a single mode in the city. But it has a good network of trams, buses and metro system that is efficiently integrated with each other.
- A person may choose to travel by tram from his home to a metro/bus station and change modes to reach his destination
- The image shows the interchange station between a tram and a bus.



- He may choose to travel by a para transit like hire a taxi, opt for a car rental or a car share ('drive-now') system.
- The image illustrates the availability of taxi services right outside the central train station and the manner in which various modes are integrated.





- He may choose to carry his bicycle in a train
- This facility is available in most sub-urban trains in the city.
- This facility helps sub-urban commuters to carry their bicycles to the city and commute by their own bicycles in the city and carry them back.



- Special trains to the airport every 1 hour
- Specially designed trains with luggage space



### Multi-modes of India

Indian cities have a variety of multi-modes that cater to the mobility needs. It ranges from cycle rickshaws, auto rickshaws, mini buses, vans, jeeps, taxis etc to tractors, bullock carts, camel carts etc which also function as modes of transport. This is apart from national rail, state and city buses, private cars and two wheelers. Few metropolitan cities in the country have newly introduced mass transit systems like metro and BRTS. While planning for an integrated multimodal system in the Indian cities one should:

- Have an understanding of the role played by each mode in catering to the mobility needs in the city.  
Ex: A section of the Indian society use bullock carts, tractors etc to commute from nearby villages and from the suburbs to commute to the city. Management of these systems once it enters the urban roads is crucial.
- Formalise para transit systems to improve its efficiency and safety.
- Provide for para transit pick up points for passengers at mass transit stations to ensure good last mile connectivity.

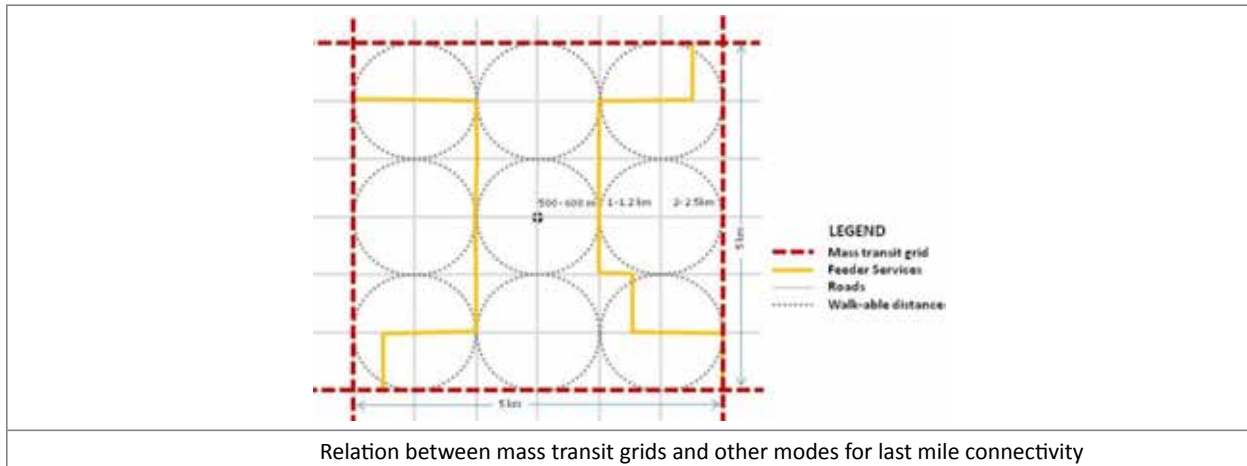
### What is an efficient Public transit network grid?

- The Public Transit network for a city consisting of a single or multiple mode of mass transit should be so designed that it forms a route network that offers maximum accessibility in the city. The network thus formed by various mass transit systems, forms '**transit grids**' across the city.
- The transit grids should be smaller in size in the city centre, thereby assuring more transit options in the denser (population and employment) areas of the city.
- The 'transit grid' can be larger blocks towards the periphery of the city.
- There should be other public transit systems like the city bus services, Para transit systems, etc which complement this mass transit systems and network. The relation behind the mass transit grid and other transport modes is as shown in Figure below.

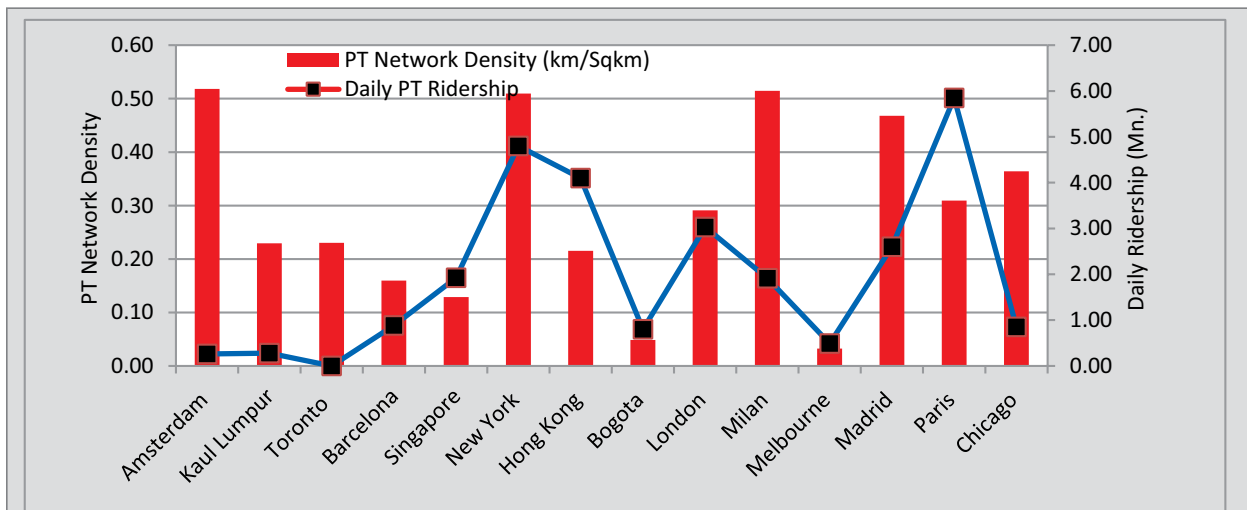




- The example below illustrates the mass transit grid recommended for any medium city. The transit routes are proposed along the major rings and radials of the city, forming an average grid of 5km x 5km. The mass transit system, once implemented, insures access to mass transit within an average distance of 2.5 km from any point in the city, through feeder services like city buses, auto-rickshaws, bicycle etc. The figure below shows the basic principle of a mass transit grid size for a city, which explains the feeder service grids and walk-able distances/grids.



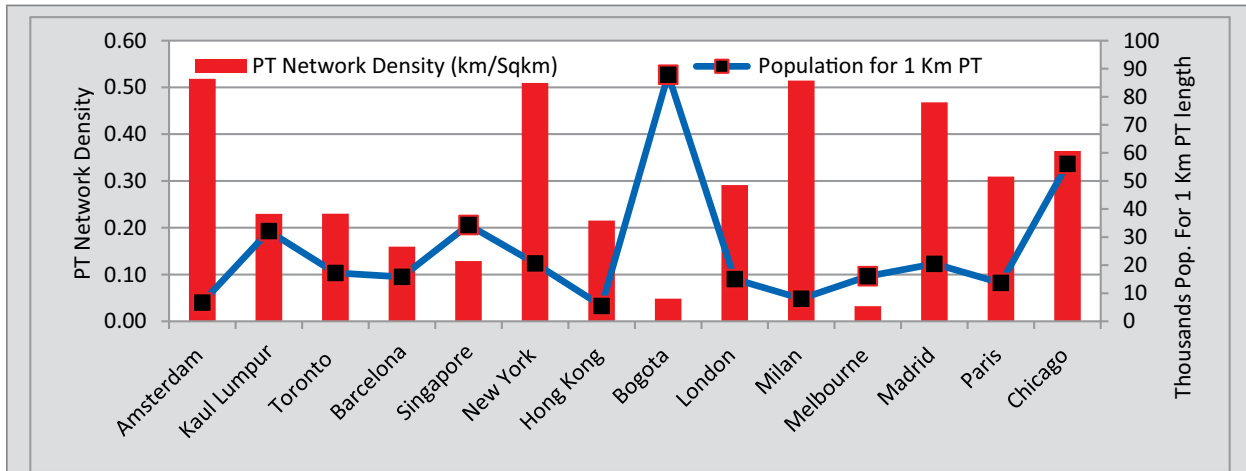
### What is an ideal mass transit density?



An analysis on the PT network density and daily ridership for 14 best practice case cities shows an average of 29 km of PT for 100 sqkm area

Source: Integrated Multimodal transit system for Ahmedabad, Masters in IP and UTPM, 3<sup>rd</sup> Sem lab work, CoE-UT, CEPT





Similarly, a study on PT Network Density and population of 14 best practice case cities shows that there exist an average of 36km PT network for 1 million population in these cities.

Source: Integrated Multimodal transit system for Ahmedabad, Masters in IP and UTPM, 3<sup>rd</sup> Sem lab work, CoE-UT, CEPT

### What is Transit Oriented Development (TOD)?

TOD is defined as higher-density mixed-use development within walking distance – or a half mile – of transit stations. TOD is about creating attractive, walk-able, sustainable communities that allow residents to have housing and transportation choices and to live convenient, affordable and pleasant lives. For this quality of performance, projects should:

- Increase “location efficiency” so people can walk and bike and take transit
- Boost transit ridership and minimize traffic
- Provide a rich mix of housing, shopping and transportation choices
- Generate revenue for the public and private sectors and provide value for both new and existing residents
- Create a sense of place



### 10. Best practice case cities for TOD



Curitiba:



Toronto:

#### What are the characteristics of TOD?

- Defined area for special development
- Density higher than the areas outside the zone

#### TOD in Indian Context

TOD is a concept that exists in all cities, where over the years, the major roads of our cities, on which the public transport systems (mainly buses) and other modes of transport ply, have seen primary land use development with higher densities and mixed land use. Though the term was coined in the US, transit oriented development pattern can be traced along all major public transit routes in cities. This development pattern is inherent to Indian ways of city development, hence making it important to study and analyse the TOD pattern. This will help develop TOD guidelines for Indian cities.

#### What is Transit Supportive land use?

Not all kinds of land use and activities support mass transit. The land use along TOD zones should be such that it attracts maximum passengers. Typically, it is observed that activities such as high density employment centres, high density – mixed income housing, commercial centres etc are trip attraction centres. For efficient demand capture for mass transit systems, it is important to understand and define the land use that is to be permitted in the TOD zones.

#### What is a multimodal interchange node?

For efficient land use transport integration, it is important to integrate the various transit modes with activity zones at each of these nodes. Hence the various nodes of the city gets interlinked with better transit facility substantiated with commercial, institutional and entertainment activities. The definitions:

- **Interchange** - the act of transferring between modes.
- **Interchange facility** - a purpose-built facility where interchange takes place, such as a railway station, bus station or bus/tram stop.

9 [www.tfl.gov.uk/interchange](http://www.tfl.gov.uk/interchange)



- **Interchange Node** - a wider area encompassing one or more interchange facilities creating a multi modal hub, and public spaces.

Interchange can be either the physical action of transferring between services or modes as part of the passenger's journey or it can be the physical location that provides access to multiple modes of Public Transport systems. An interchange hence facilitates efficient connectivity of mass transit systems with modes of last mile connectivity like NMT, para-transit and private vehicles

- To make transfers between modes easier, quicker, and more convenient thereby help emerge more frequent travel opportunities to emerge from existing and hence new passengers will broaden travel horizons.
- Minimizing the need to travel, by concentrating new jobs and homes around accessible locations.
- Improving access to facilities and services in metropolitan and urban centers.
- To act as a catalyst for socio-economic and physical regeneration in local communities
- Providing safer and more secure journeys
- To provide facilities for disabled passengers
- To encourage Modal shift from public transport to walking and cycling
- Enhancement of the urban realm and creation of a 'sense of place'
- Improving personal safety and security by tackling social inclusion
- Achieving energy efficiency

### What are the characteristics of a multimodal interchange?

- Nature/Hierarchy of the interchange depending on Location, type and no. of modes meeting at the interchange.
- Higher FSI/ Density
- Transit supportive Land use Integration
  - Commercial
  - Institutional
  - Entertainment
  - Transport
- Modal Integration
- NMV facilities

### What are the types of interchanges?

Interchanges will vary in type and scale based on the number and type of modes meeting at a particular point. It is important to understand the basic principles that govern these factors. The Figure below shows the various kinds of interchanges based on the types of mass transit that meets at a particular interchange.



### 11. Types of Interchanges

ROAD – ROAD INTERCHANGE	ROAD – RAIL INTERCHANGE	ROAD–RAIL-AIR INTERCHANGE
		
<ul style="list-style-type: none"> <li>- Intra-urban movement will be from bus stop to bus terminal</li> <li>- This may include facilities like depot/ workshops</li> </ul>	<ul style="list-style-type: none"> <li>- Inter city movement</li> <li>- More than one major interchange would help smooth flow of passenger traffic.</li> </ul>	<ul style="list-style-type: none"> <li>- Inter city movement</li> <li>- Two – four interchanges seen in major cities offering smooth flow of passenger traffic.</li> </ul>
AIR ROAD INTERCHANGE	INTERCHANGE OVER SPACE	ROAD–WATER INTERCHANGE
		
<ul style="list-style-type: none"> <li>- Inter city movement</li> </ul>	<ul style="list-style-type: none"> <li>- Different terminals located in a single building</li> <li>- less travel time and more comfortable</li> </ul>	<ul style="list-style-type: none"> <li>- Limitation of river navigational services</li> </ul>

Source: IP and UTPM,2010, Sem 3, CEPT University, 2010

### Classification of facilities at a typical Multimodal Interchange

- 1. Basic Terminal Facilities** - These account to the mandatory facilities which needs to be provided at each terminal such as: ticketing counter, Ticket wending machine, Enquiry counter/ information kiosk, Waiting area/ sitting, Washroom, First aid, Security, Accessibility for disable etc
- 2. Transit Supportive Facilities** - These are the facilities which would help facilitate the transportation activities within the terminals and to help increase the comfort of passengers by providing for the basic needs within terminal area. These facilities include; Passenger parking, Para transit parking, Kiss And Ride, Pick And Drop, Telephone booth, ATM, Clock room, Computer/printing, Emergency, Tourism desk, Travel agency counter, Food court/ coffee shops, Retail shops, book shop.
- 3. Additional Facilities** – Certain combinations of mixed land use within the terminal building or within the influence area encourages public transport as it help integrate basic activities with mobility. These include presence of institutions (schools, colleges etc), offices, Library, Money exchange, Medical –





Health Centers/Hospital, Bank, Post service, Xerox/printing, Restaurant/Hotels, Supermarket/shopping mall, Offices, Rental car service, Gift shops, Florist, Gaming zone, Photo studio, Saloon, Handicraft, Theatre, Spa centre

The basic classification of facilities as per hierarchy of level for interchange node is as shown in the table below. It was observed from the cases of various cities that the range of facilities provided for each level of interchange.

### What are the facilities at Interchanges?

Table 3: Design program and considerations for Transit Interchange hubs according to hierarchy of levels.

	SPECIFICATIONS	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
1	<b>INFLUENCE ZONE</b>	1KM RADIUS FROM THE HUB 2 X 2 KM = 4 SQKM	750 M RADIUS FROM THE HUB 1.5 x 1.5 KM = 2.25 SQKM	500M RADIUS FROM THE HUB 1 X 1 KM = 1 SQKM	500M RADIUS FROM THE HUB 1 X 1 KM = 1 SQKM
2	<b>FSI</b>	6	5	4	3.5
3	<b>TERMINALS</b>	Metro Railway Station BRT bus station AMTS station	Metro Railway Station BRT bus station AMTS station	Railway Station BRT bus station AMTS station	BRT bus station AMTS station
4	<b>ACCESS AREAS</b>	F.O.Bs, Stairs, Elevators, Escalators Subways Zebra crossings with pedestrian crossing signalling	F.O.Bs, Stairs, Elevators, Escalators Subways Zebra crossings with pedestrian crossing signalling	F.O.Bs, Stairs, Elevators, Escalators, Subways Zebra crossings with pedestrian crossing signalling	Zebra crossings with pedestrian Crossing signalling
5	<b>PUBLIC AMENITIES (Within the terminal)</b>	<b>(24x7 activities)</b> Toilets Rest Areas/Waiting spaces (combined/separate) Information Counter/centre Internet Café Telephone booth ATMs	Toilets Rest Areas/Waiting spaces (combined/separate) Information Counter/centre Internet Cafe Telephone booth ATMs	Toilets Rest Areas/Waiting spaces (combined/separate) Information Counter/centre Telephone booth ATMs	Toilets Rest Areas/Waiting spaces (combined/separate) Telephone booth ATMs
6	<b>LANDUSE (Transit supportive commercial development)</b>	<b>(24x7 activities)</b> McDonalds'/ restaurants 7 eleven Milk booth Newspaper stall Tea stalls Snack bars	McDonalds' 7 eleven Milk booth Newspaper stall Tea stalls Snack bars	McDonalds' 7 eleven Milk booth Newspaper stall Tea stalls Snack bars	McDonalds' 7 eleven Milk booth Newspaper stall Tea stalls Snack bars





	SPECIFICATIONS	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
		Local street markets Super markets Malls/Commercial complex - Souvenir shops - Regional Shopping - Book stall High density Office towers Mid- density residential Hospital Hotels/Lodges and Restaurants Child day care centre	Local street markets Super markets Malls/Commercial complex - Souvenir shops Neighbourhood convenience retail High density Office towers Mid density residential Medical Centre Hotels/lodges and Restaurants Child day care centre	Local/Informal street market Super markets Malls/Commercial complex Neighbourhood convenience retail Mid-density Office towers Mid density residential Medical Centre Hotels/lodges and Restaurants Child day care centre	Local/Informal market Super markets Malls/Commercial complex Neighbourhood convenience retail Low-density Office towers Mid density residential Medical Centre Hotels/lodges and Restaurants Child day care centre
7	<b>PARKING</b>	Short-term parking Long-term parking Full day parking	Short-term parking Long-term parking Full day parking	Short-term parking Long-term parking	Short-term parking
8	<b>NMV facilities (route selection)</b>	<ul style="list-style-type: none"> <li>- Identification of desire lines (shortest route) connecting important nodes/institutions etc to the terminal</li> <li>- Development of the street to pedestrian friendly - Specially designed streets</li> <li>- Wider Footpaths, Bicycle routes along transit routes</li> <li>- Redefining the land use - informal markets, cafes, provision of space for temporary shops</li> <li>- Pedestrian facilities</li> <li>Placement of institutions within walk able distance</li> </ul>			
9	<b>Public spaces (area to be reserved)</b>	City plaza Identification of possible public domains <b>Entertainment</b> - Open air theatres, temporary exhibition spaces, performance platforms, art and craft emporiums			
10	<b>Para Transport facilities</b>	Taxi stands Auto rickshaw stands Bicycle rentals Car pooling	Taxi stands Auto rickshaw stands Bicycle rentals Car pooling	Taxi stands Auto rickshaw stands Bicycle rentals Car pooling	Taxi stands Auto rickshaw stands Bicycle rentals Car pooling
11	<b>Green Open Spaces</b>	Parks Sports grounds Botanical gardens Reserved green/woods			



### Supportive land use along Transit routes

- **Influence Zone:** 500M buffer on either sides of the road
- FSI – 3
- **Public amenities:** Zebra crossings with pedestrian crossing signalling
- **Parking:**

- High density office towers

#### **Transit supportive commercial development**

Institutions - Schools, Universities

High density Office towers

Mid- density residential

- Hospital
- Hotels/lodges and Restaurants
- Child day care centre
- **NMV facilities (route selection):** Short-term parking along the transit lines near transit stations, important nodes, junctions and at other locations where ever possible as per availability of ROW.
- **Public spaces (area to be reserved):** City plaza, Identification of possible public domains  
**Entertainment** - Open air theatres, temporary exhibition spaces, performance platforms, art and craft emporiums
- **Para Transport facilities:** Taxi stands, Auto rickshaw stands, Bicycle rentals, Car pooling
- **Green Open Spaces:**
- **Public spaces (area to be reserved)**
  - City plaza
  - Identification of possible public domains  
**Entertainment** - Open air theatres, temporary exhibition spaces, performance platforms, art and craft emporiums
- **Parking:** Short-term parking along the transit lines near transit stations, important nodes, junctions and at other locations where ever possible as per availability of ROW.



- **Land use (Transit supportive commercial development)**

- High density office towers
- Transit supportive commercial development
- Institutions - Schools, Universities, Hospital
- High density Office towers
- Mid- density residential
- Hotels/lodges and Restaurants
- Child day care centre

# Bibliography

---

Alonso, & Sinclair. (n.d.). *Modelling the Allocation of land to Completing Uses*. Retrieved 2013, from [www.faculty.geog.utoronto.ca](http://www.faculty.geog.utoronto.ca): <http://faculty.geog.utoronto.ca/DiFrancesco/GGR220Lec4.pdf>

BMTC. (n.d.). Sustainable Transport Initiatives in BMTC.

Census 2011. (2012, Feb 21). *Hong Kong Census: Population Densities*. Retrieved May 14, 2012, from <http://www.census2011.gov.hk/en/main-table/A202.html>

Cervero, R., & Murakami, J. (2008). *Rail + Property Development: A Model of sustainable transit finance and urbanism*. Berkeley: UC Berkeley Centre for Future Urban Transport.

Cervero, R., & Murakami, J. (Sept 2009 vol. 46 no. 10). Rail and Property Development in Hong Kong: Experiences and Extensions. *Urban Studies*, 2019-2043.

Cervero, R., & Murakami, J. (2008). *Rail+Property Development: A Model of sustainable transit finance and urbanism*. Berkeley: UC Berkeley Centre for Future Urban Transport.

City of Stockholm. (2012, Jan 23). *Future of Stockholm: Infrastructure and Accessibility*. Retrieved May 15, 2012, from <http://international.stockholm.se/Future-Stockholm/Infrastructure-and-accessibility/>

City of Stockholm. (2012, Mar 15). *Future of Stockholm: Urban Development*. Retrieved May 15, 2012, from <http://international.stockholm.se/Future-Stockholm/Urban-development/>

City of Stockholm. (2012, Mar 1). *Stockholm by theme*. Retrieved May 16, 2012, from <http://international.stockholm.se/Stockholm-by-theme/>

City of Stockholm. (2012, Feb 2). *Stockholm facts*. Retrieved May 16, 2012, from <http://international.stockholm.se/Press-and-media/Stockholm-facts/>

CoE, C. U. (2012). *Janmarg- BRTS Ahmedabad 32 month of Commercial Operations*.

CoE, CEPT University. (2008). *Bus Rapid Transit System Plan- Phase II*. Ahmedabad: Unpublished.

CoE-UT, CEPT. (2013). *Toolkit on Strategic Integrated Mobility Plan*. Ahmedabad: unpublished.

Construction News. (1998, Dec 10). *London Boosts for inner-city Regeneration Plans*. Retrieved May 11, 2012, from Construction News UK: <http://www.cnplus.co.uk/news>

EXTR@Web. (2006). *Land Use and regional Planning, Achieving integration between transport and land use*.



Goodman, J., Laube, M., & Schwenk, J. (2005-2006, winter). Curitiba's Bus System is a Model for Rapid Transit. *Race, Poverty and the Environment* , pp. 75-76.

Greater London Authority. (2010). *Mayor's Transport Strategy*. London: Greater London Authority.

Greater London Authority. (2011). *The London Plan 2011: Spatial Development Strategy for Greater London*. London: Greater London Authority.

Highways Department. (n.d.). *Road Network*. Retrieved May 14, 2012, from [http://www.hyd.gov.hk/eng/road\\_and\\_railway/road\\_network/road.htm](http://www.hyd.gov.hk/eng/road_and_railway/road_network/road.htm)

Hong Kong Government. (2012). *Hong Kong 2030, Planning vision and strategy*. Hong Kong: Department of Transport.

ICLEI. (2011). *EcoMobility: Curitiba, Brazil, A model of transit oriented planning*. Bonn: ICLEI Local Governments for Sustainability.

Ingo, S., Viehhauser, M., & Inregia. (2005). *WP 2 - Integrated Polycentric Land Use and Transportation Policy Case Study Review Part II*. Metropolitan Areas Baltic Sea Region.

IPPUC. (n.d.). *Public Transportation*. Retrieved May 15, 2012, from <http://www.ippuc.org.br/ippucweb/sasi/home/mostrarpagina.php?pagina=32&%20idioma=5>

IPPUC. (n.d.). *Street Network*. Retrieved May 15, 2012, from <http://www.ippuc.org.br/ippucweb/sasi/home/mostrarpagina.php?pagina=11&%20idioma=5>

IPPUC. (n.d.). *Zoning and Land Use*. Retrieved May 15, 2012, from <http://www.ippuc.org.br/ippucweb/sasi/home/mostrarpagina.php?pagina=13&%20idioma=5>

Jenks, M., Burton, E., & Williams, K. (1996). *The compact City: A Sustainable Urban Form?* . E & FN Spon, an imprint of Chapman & hall .

Kenworthy, J. (2008, Jan 16). *Model Cities: Asia*. Retrieved May 14, 2012, from Institute for Social Sustainability, Murdoch University: [http://www.istp.murdoch.edu.au/ISTP/casestudies/Case\\_Studies\\_Asia/modasia/modasia.html](http://www.istp.murdoch.edu.au/ISTP/casestudies/Case_Studies_Asia/modasia/modasia.html)

KUIDFC. (2007). *Comprehensive Traffic and Transportation Plan 2007*. Bangalore: KUIDFC.

Land Transport Authority. (2008). *Land Transport Master Plan*. Singapore: Land Transport Authority.

Land Transport Authority. (2012). *Public Transport@SG*. Retrieved May 13, 2012, from <http://www.publictransport.sg/content/publictransport/en/homepage.html>

Lemoine, C., & Predali, F. (2009). *Urban Structure and Public transport fare structure: Comparison between polycentric and mulitpolar structures*. Paris: Institut d'Amenagement et d'Urbanisme.

Lindau, L. A., Hidalgo, D., & Facchini, D. (2010). Bus Rapid Transit in Curitiba, Brazil. A Look at the Outcome After 35 Years of Bus-Oriented Development. *Transportation Research Record, Vol. 2193* , 17-27.

Lo, W.-m. R. (2002). *Rail-Transit-oriented Development in Hong Kong: The Case study of the Mass Transit Railway*. Hong Kong: Centre for Urban Planning and Environment Management, University of Hong Kong.





- Mayer, H. (1996). In Favour of the Compact City. In M. Jenks, E. Burton, & K. Williams, *The Compact City: A Sustainable Urban Form*. E & FN SPON, An imprint of Chapman & Hall .
- MoUD. (n.d.). Guidelines and Toolkits for Urban Transport Development in Medium Sized Cities in India .
- Neuman, M. (1994). *Neuman\_CC Fallacy*. Retrieved from [http://courses.washington.edu/gmforum/Readings/Neuman\\_CC%20Fallacy.pdf](http://courses.washington.edu/gmforum/Readings/Neuman_CC%20Fallacy.pdf)
- Newman, P. (2008, Jan 16). *Model Cities: Europe Case Studies*. Retrieved May 15, 2012, from Murdoch University Institute for Social Sustainability: [http://www.istp.murdoch.edu.au/ISTP/casestudies/Case\\_Studies\\_Asia/european/european.html](http://www.istp.murdoch.edu.au/ISTP/casestudies/Case_Studies_Asia/european/european.html)
- Office of the Registrar General and Census Commissioner, India. (2010-11). *Provisional Population Totals Paper 1 of 2011*. Retrieved May 17, 2012, from Census India: [http://www.censusindia.gov.in/2011-prov-results/census2011\\_PPT\\_paper1.html](http://www.censusindia.gov.in/2011-prov-results/census2011_PPT_paper1.html)
- POLIS. *PILOT, Background on integration of land use planning and Sustainable Urban Transport Planning*.
- Prefeitura de Curitiba. (n.d.). *An Integrated City*. Retrieved May 15, 2012, from <http://www.curitiba.pr.gov.br/idioma/ingles/cidadeintegrada>
- Prefeitura de Curitiba. (2012, May 15). *Curitiba City Profile*. Retrieved May 15, 2012, from <http://www.curitiba.pr.gov.br/conteudo/perfil-da-cidade-de-curitiba/174>
- Prefeitura de Curitiba. (n.d.). *Here progress travels by bus*. Retrieved May 15, 2012, from <http://www.curitiba.pr.gov.br/idioma/ingles/progressoonibus>
- Prefeitura de Curitiba. (n.d.). *The Agache Plan*. Retrieved May 15, 2012, from <http://www.curitiba.pr.gov.br/idioma/ingles/planoagache>
- Preston, J., Marshall, A., & Tochtermann, L. (2008). *On the Move: delivering integrated transport in Britain's cities*. London: Centre for Cities.
- Roychoudhury, A. (2000, Aug 31). Singapore: Breathing Easy. *Down to Earth* .
- SL. (2012, Mar 22). *Political Control of SL*. Retrieved May 16, 2012, from <http://sl.se/sv/Om-SL/Det-har-ar-SL/Organisation/>
- SL. (2010). *Public Transport Plan 2020*. Stockholm: SL.
- Stockholm County Council. (2001). *Stockholm City Plan 1999*. Stockholm: Stockholm City Planning Administration.
- TERI. (n.d.). Retrieved 04 10, 2012, from <http://www.teriin.org/upfiles/projects/ES/ES2010UD03.pdf>
- Tiry, C. (2007, Jan 17). Hong Kong, An urban future shaped by Rail Transport. Hong Kong.
- Transport Department. (2012, May 11). *A Guide to Public Transport for People with Disabilities*. Retrieved May 14, 2012, from [http://www.td.gov.hk/mini\\_site/people\\_with\\_disabilities/2009/13-2.html](http://www.td.gov.hk/mini_site/people_with_disabilities/2009/13-2.html)
- Transport Department. (2012). *Average Daily Public Transport Passenger Journeys by Public Transport Operator*. Hong Kong: Transport Department.



Transport Department. (2012). *Key studies on Public Transport Patronage, Road Length, Vehicle Ownership and Road Accidents*. Hong Kong: Transport Department.

Transport Department. (2011, Jul 29). *Transport in Hong Kong: Public Transport: Introduction*. Retrieved May 14, 2012, from [http://www.td.gov.hk/en/transport\\_in\\_hong\\_kong/public\\_transport/introduction/index.html](http://www.td.gov.hk/en/transport_in_hong_kong/public_transport/introduction/index.html)

Transport for London. (n.d.). *Interchange Best Practice Guidelines*. Retrieved May 12, 2012, from <http://www.tfl.gov.uk/microsites/interchange/>

Udall, M. (2007). *Hong Kong Public Transport*. Retrieved May 14, 2012, from <http://www.workinginhongkong.com/transport/public-transport.htm>

Urban Redevelopment Authority. (2012, Mar 30). *Master Plan 2008 - Planning for Sustainability*. Retrieved May 12, 2012, from <http://www.ura.gov.sg/MP2008/intro.htm>

Urban Redevelopment Authority. (2008). *Master Plan 2008*. Singapore: Urban Transport Authority.

Urban Redevelopment Authority. (2012, Mar 30). *Master Plan 2008: Planning for Singapore's future*. Retrieved May 12, 2012, from <http://www.ura.gov.sg/MP2008/intro.htm>

White paper . (2011). *Creating growth, Cutting Carbon - making Sustainable local Transport Happen*. Department of Transport, UK.

Zhong, C., Huang, X., Arisona, S. M., & Schmitt, G. *Identifying Spatial structure of urban Form Functional Centers using Travel Survey Data: A case study of Singapore*.



