Wolfgang Lehmacher

India Economic Summit 2009: Transforming Urban Transportation

Briefing Notes

10 November 2009
Executive Summary

- Urban transportation has emerged as one of the most significant challenges to developing economies, such as India, with large populations and a growing middle class
  - In India, urbanisation and rising incomes levels have increased the demand for transportation services however infrastructure investment has been unable to keep pace
  - Increased access to private motorisation is putting additional strain on India’s poor quality roads which already struggle to cope with inefficient public transport systems

- A number of new public transport models exist which have been successfully implemented in India and other countries around the globe, including rapid transit systems, trunk and feeder systems, hub and spoke systems and the skybus. Wide-spread adoption of these models may hold the key to India’s future infrastructure needs

- In the absence of government funding, urban transport planning bodies have turned to new financing methods to fund infrastructure investment including taxes, capital market funding, land value capture, private investment and private-public partnerships

- In addition to new models and financing, the development of efficient urban transport models requires supporting policy changes to integrate land and transport planning, manage demand for private vehicles and develop quality standards for public transport

- The transport and logistics industry has a responsibility to work with governments and transport planning authorities to reduce the impact of their business on road and other transport networks. This may include:
  - Reshaping consumer preferences for pick-up and delivery services
  - Establishing new models of delivery which leverage the joint assets of competitors
  - Implementing time shifting to reduce commuter congestion in peak travel periods
## Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lakh</td>
<td>100,000</td>
</tr>
<tr>
<td>Crore</td>
<td>10 million</td>
</tr>
<tr>
<td>BRTS</td>
<td>Bus rapid transit system – a transport system based on segregated lanes to allow buses to travel unimpeded by local traffic</td>
</tr>
</tbody>
</table>
Agenda

Public Transport in India
- Rising Transport Demand
- Overview of Existing Transport Systems
- Summary of Challenges

Designing New Transport Solutions
Population and Income Growth

The liberalisation of India’s economy coupled with its large population have been the most significant contributors to its rapid economic growth over the last 20 years.

- Following independence in 1947, India followed generally socialist policies with limited engagement with the globalising Western world.

- In 1991 following a financial rescue by the IMF, the then finance minister Manmohan Singh (current PM) instituted a number of policies to promote economic growth:
  - These included opening the economy to international trade, investment deregulation, privatisation, tax reform and inflation control.
  - Since the reforms, significant economic growth has been achieved with ~300 million Indians escaping from poverty and hunger.

### Population

- **1950-2050F**
  - CAGR_{50-02F} 1.5%

### Nominal GDP

- **1980-2014F**
  - CAGR_{03-14F} 10.6%

Source: Media reports, United Nations, International Monetary Fund
Urbanisation and the Growing Middle Class

The primary outcomes of India's economic growth include increased migration from rural to urban areas and a growing middle class

- The rapid growth of India's urban population has been driven by:
  - Increased demand for skilled professionals, including managers, engineers, doctors, technicians, etc. and the relatively higher salary growth in urban areas compared to rural areas
  - An expanding services industry which has created significant employment opportunities for young and educated workers
  - Increased access to education and training
  - Investment by foreign firms into local businesses

- In addition, continued economic growth means that India’s middle class(1) will continue to grow at a rapid pace
  - India’s middle class was 1% (7.6m) of the total population in 1985 and is forecast to reach 41% (585.9m) by 2025

- This will drive significant consumption
  - By 2025, the middle class will command 60% of total consumption in India

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Note: (1) The middle class in India is defined as those individuals with a per capita consumption between $US 1,200-1,500 p.a.
Source: Media reports, International Monetary Fund, McKinsey, United Nations World Population Prospects
Transportation Consumption

The growth of India’s middle class has been a key driver of the significant increase in transportation consumption, particularly in urban areas.

- Transportation is India’s second largest sector\(^{(1)}\) by consumption and is worth approximately US$61 billion to the economy.

- India’s transport sector comprises of two key categories:
  - Transport goods – including automobiles, two-wheelers and transport equipment
  - Services – including rail, air and bus transportation

- Currently, transportation consumption is approximately equal between rural and urban areas.

- However, the rapid increase in India’s middle class, concentrated in urban areas, is expected to drive significant growth in transportation consumption due to:
  - More people purchasing cars
  - More people travelling further distances to work
  - Higher demand for goods/services which require transportation for delivery

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**Indian Transportation Consumption**

<table>
<thead>
<tr>
<th>Year</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>10.3</td>
<td>5.9</td>
</tr>
<tr>
<td>1995</td>
<td>25.4</td>
<td>14.3</td>
</tr>
<tr>
<td>2005</td>
<td>61.0</td>
<td>28.9</td>
</tr>
<tr>
<td>2015F</td>
<td>139.9</td>
<td>57.4</td>
</tr>
<tr>
<td>2025F</td>
<td>300.9</td>
<td>98.7</td>
</tr>
</tbody>
</table>

\(^{1}\) Food is India’s largest sector

Source: Media reports, International Monetary Fund, McKinsey
Transport Congestion

Indian cities have become highly congested as the rapid increase in transport demand has outpaced the rate of infrastructure investment

- India’s demands for transportation services and infrastructure have risen considerably since economic liberalisation in 1991
- Although by global standards, India has considerably fewer cars per capita than many other countries, the congestion on Indian roads has been driven by the inability of infrastructure investment to keep pace with transport demand
- The traffic speeds in Mumbai and Delhi average 15 km/hour, whereas the average speed of traffic in London and Berlin is 17 km/hour and 27 km/hour respectively

**Vehicle vs. Road Infrastructure Investment**

No. of vehicles per 100 population; investment in new road construction 2000-2030F (Base year 2000 levels)

**No. of vehicles per 100 population**

<table>
<thead>
<tr>
<th></th>
<th>India</th>
<th>China</th>
<th>Brazil</th>
<th>Germany</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010F</td>
<td>1.7</td>
<td>2.9</td>
<td>20.9</td>
<td>60.2</td>
<td>82.5</td>
</tr>
</tbody>
</table>

- Between 2000 and 2030, the number of vehicles in India is expected to increase by 489%
- However, over the same period road construction investment is only forecast to increase by 92%

Note: OECD, media reports
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Public Transport in India

- Rising Transport Demand
- Overview of Existing Transport Systems
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Designing New Transport Solutions
Transport Comparisons

Despite having one of the world’s largest road and rail networks, India’s transport infrastructure struggles to cope with its large population.

<table>
<thead>
<tr>
<th></th>
<th>India</th>
<th>China</th>
<th>Brazil</th>
<th>Germany</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Road Network (km)</td>
<td>3,316,452(5)</td>
<td>1,930,544(4)</td>
<td>1,751,868(5)</td>
<td>644,480(3)</td>
<td>6,465,799(2)</td>
</tr>
<tr>
<td>Total Rail Network (km)</td>
<td>63,327(2)</td>
<td>77,834(1)</td>
<td>28,857(1)</td>
<td>41,896(1)</td>
<td>226,427(2)</td>
</tr>
<tr>
<td>Airports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- paved runways</td>
<td>250</td>
<td>425</td>
<td>721</td>
<td>330</td>
<td>5,174</td>
</tr>
<tr>
<td>- unpaved runways</td>
<td>96</td>
<td>57</td>
<td>3,279</td>
<td>220</td>
<td>9,921</td>
</tr>
<tr>
<td>Ports &amp; Terminals</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

- **India already has one of the most comprehensive road networks by country area in the world.**
- **However, many of the roads are of a poor quality due to overuse and poor construction materials.**
- **This indicates that targeted investment in new road construction, coupled with repair of existing roads, may help to reduce India’s congestion problems.**


Note: All other figures 2009

Source: CIA World Factbook
Transport Modes in India

Transport in India is divided between public and private modes

- **Private transport primarily comprises of two-wheelers and small vehicles**
  - Of these, two-wheelers represent the majority of private vehicles owned
  - As the access to low cost cars increases, it is expected that a number of two-wheeler private commuters will migrate to new vehicles

- **The OECD forecasts that private vehicle ownership in India is expected to increase from 0.9 vehicles per 100 population in 2000 to 5.3 vehicles per 100 population in 2030**

- **Given low vehicle ownership, the majority of Indians rely on walking or public transport**
  - India’s public transport system includes formal and informal operators
  - The demands on the public transport system, particularly in urban areas, have increased considerably with India’s growing population and increasing urbanisation

Source: McKinsey, Transport Policy
Private Transport
Low-cost Vehicles and Two-Wheelers

Two-wheelers and low cost cars are forecast to be the highest growth segments of India’s private vehicle sales as the Indian population increasingly shifts to private modes of transport.

<table>
<thead>
<tr>
<th>Two-wheelers</th>
<th>Low cost cars</th>
</tr>
</thead>
</table>

- **Two-wheelers**
  - Two-wheelers are the most prevalent form of private transport in India.
  - Between 1991 and 2000, the number of two-wheelers increased from ~14 to ~34 million.
  - The main advantages of two-wheelers over traditional cars is that they can be parked securely inside the home, they can carry passengers, they are easy to manoeuvre in heavy traffic and they can be purchased at a fraction of the cost of cars.
  - A significant disadvantage of two-wheelers is the high fatality rate in accidents – 5% of all two-wheeler accidents result in a fatality.

- **Low cost cars**
  - Low cost cars are expected to considerably reshape India’s private transportation industry.
  - The ~US$ 2,500 selling price of the Tata Nano is at least 50% cheaper than other car prices and more closely aligned with high-end two-wheelers.
  - In the long term, it is expected that a significant proportion of two-wheel drivers will shift to low cost cars like the Nano.
  - In addition to Tata, Bajaj Auto has also announced plans to launch an ultra low cost car in collaboration with Renault.

### Vehicle Market Share

- **Passenger**: 14%
- **Commercial**: 5%
- **Three-wheeler**: 4%
- **Two-wheelers**: 77%

### Sales Volume Forecast for the Nano

<table>
<thead>
<tr>
<th>Year</th>
<th>Forecast (thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009F</td>
<td>100</td>
</tr>
<tr>
<td>2011F</td>
<td>200</td>
</tr>
<tr>
<td>2013F</td>
<td>300</td>
</tr>
<tr>
<td>2015F</td>
<td>400</td>
</tr>
<tr>
<td>2017F</td>
<td>500</td>
</tr>
<tr>
<td>2019F</td>
<td>600</td>
</tr>
</tbody>
</table>

Public Transport
Formal and Informal Transportation Services

Significant population growth and increased demand for transportation services in India’s urban cities have spurred the development of informal transport operators.

- In India, transportation services are made up of formal and informal public transport providers:
  - **Formal public transport** includes railways, buses, ferries and airlines. These services are regulated by state or national bodies.
  - **Informal public transport** is unregulated and often operates using an owner-trader model without specified standards or barriers to entry. In India, informal transport include minivans, taxis, autorickshaws, rickshaws, bicycles and animal-drawn carriages.

- Informal public transport has grown significantly over the last 20 years as the demand for transportation in growing urban cities has increased:
  - In 2005, there were approximately 14 million people employed in India’s informal transportation sector.

### Formal and Informal Public Transport

<table>
<thead>
<tr>
<th>City</th>
<th>Modal Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chennai</td>
<td>Informal</td>
</tr>
<tr>
<td>Delhi</td>
<td>Formal</td>
</tr>
<tr>
<td>Mumbai</td>
<td>Informal</td>
</tr>
<tr>
<td>Ahmedabad</td>
<td>Formal</td>
</tr>
</tbody>
</table>

Source: IARIW-SAIM Conference, CEPT University, Wilbur Smith & Associates, IL&FS Ecosmart, Mumbai Metropolitan Regional Development Authority.
Public Transport
Rail Transport in India

Rail transport in India includes intercity/ interstate rail transport, suburban rail transport and metro systems

**Intercity/ interstate rail transport**
- Intercity/ interstate rail transport is conducted by the Indian Government owned Indian Railways
- Indian Railways provides passenger and freight transport services
- ~70% of revenues come from freight operations which are used to subsidise the passenger business

**Freight and Passenger Volumes**
Million tonne kilometres (LHS); Million passengers (RHS) 1950-2007

**Suburban and metro rail transport**
- Above-ground Suburban Rail services in India operate as a subsidiary of Indian Railways
- Suburban Rail transport in India is currently limited to four of its major cities – Mumbai, Kolkata, Chennai and Delhi
  - These services each operate via dedicated suburban rail tracks
  - In addition, Hyderabad, Pune and Lucknow have some suburban services which share the long distance tracks
- India’s underground and above-ground Metro systems are primarily funded by the private and public sectors
  - Metro systems provide transport within the central business district of cities
  - Metro systems already operate in Delhi and Kolkata with other metros under construction in Bangalore, Chennai and Mumbai

Source: Indian Railways, Delhi Metro Rail Corporation, Forbes
Public Transport
Bus Services

Despite many weaknesses, bus services are India’s most important public transport system accounting for over 90% of public transport passengers

- **Over 90% of Indian public transport passengers are carried by buses**
  - A significant number of Indian cities have no rail systems and rely primarily on buses, as well as minivans, autorickshaws, rickshaws and taxis

- **Bus numbers have increased significantly over the last 50 years, however still fail to meet the demands of Indian commuters**
  - The number of registered buses in India increased from 331,000 in 1991 to 669,000 in 2002
  - However, buses remain considerably overcrowded with some passengers forced to ride outside the vehicles

- **Severe road congestion, narrow streets and the absence of separate rights-of-way roads has made bus transport extremely unreliable and inefficient**
  - Most buses travel between 6-10km per hour in India’s urban cities

Source: World Bank, Review of Urban Transportation in India
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Designing New Transport Solutions

The Role of the CEP Industry

Appendix
Key Challenges Facing Indian Transport

India's transport systems face a number of key challenges which require substantial restructuring and investment to be overcome

- **Coping with increased demand for private vehicles**
  - Rising income levels, especially among India's growing urban middle class, has increased the demand for private motorisation
  - The introduction of new low cost cars is expected to make private vehicles considerably more accessible in India

- **Population growth and the rise in demand for public transport**
  - As India's population continues to grow, the demand for increased public infrastructure and transport services will increase

- **Increased congestion**
  - Inadequate and highly congested road and rail networks will struggle to cope with India’s large population and urban sprawl which is lengthening travel times

- **Strong economic growth and increased flow of goods**
  - India’s strong economic growth will fuel more demand for imports and exports, resulting in greater movement of goods and freight over road, rail, sea and air
  - This is placing further pressure on India’s already highly congested transport infrastructure

- **The scale of India’s transport challenge requires major infrastructure investment, as well as new technologies and approaches**
Despite attempting to respond to the infrastructure challenges it faces, India’s progress on road and airport projects has not been adequate.

### Roads
- Initiated in 1998, the National Highways Development Project (NHDP) is a major initiative to upgrade major highways across India.
- The project is planned to cover ~54,000 km of highway and cost ~€39 bn, with only parts of the project completed and some phases still seeking approval.
- In addition to the NHDP, a further 19 major national highways projects (highway improvement, construction of bridges, bypasses) have also been approved or proposed – amounting to investment of over €240 million.
- The OECD forecasts that India will be required to invest €7.4b per year on new road construction between 2010 and 2020 to adequately meet demand.

### Airports
- Upgrades of four main airports are underway, with some nearing completion:
  - Devanahalli Airport (near Bangalore) is nearing completion at a cost of €306m.
  - Construction of Hyderabad International Airport has recently been completed, for €279m.
  - Restructuring and modernisation of Delhi Airport will be completed in 2010, for €1,178m.
  - Restructuring and modernisation of Mumbai Airport will also be completed in 2010, at a cost of €1,586m.

Source: Department of Road Transport & Highways; National Highways Authority of India, Indian Government.
Indian Response to Infrastructure Shortfall (2/2)

Rail investment has been substantial and may help meet demand if it can be maintained, however ports upgrades are badly needed

<table>
<thead>
<tr>
<th>Rail</th>
</tr>
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</table>

- In the 2008-2009 Indian Railways Budget, planned investment of €40 billion over five years was outlined
  - This investment includes (but is not limited to):
    - Improvement of metro station facilities
    - Rolling stock production units
    - Multi-modal logistics parks

- The OECD forecasts that India will be required to invest €1.2b per year on new railway construction of between 2010 and 2020 to adequately meet demand

<table>
<thead>
<tr>
<th>Ports</th>
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- Upgrades are underway of a number of India’s major port facilities to upgrade cargo capacities, improve linkages with road infrastructure, and add specialised terminals for commodities such as LNG

- Major projects include:
  - Upgrades to the port at Cochin, including a new container terminal for completion in 2009 and LNG terminal in 2011, for a total cost of €824m
  - Upgrades and extensions to Jawaharlal Nehru, including an addition of a fourth container berth, for a total cost of €1,368m

- Smaller additional projects at ports in Kolkata, Mumbai and Tuticorin for a total cost of €461m

Source: Relevant websites of major Indian ports, Indian Railways
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Public Transport in India

Designing New Transport Solutions
Challenges of Urban Mobility

There are a number of challenges which urban planning and transport authorities are faced with when designing an efficient transportation system:

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrequent services with insufficient capacity</td>
<td>➢ Inadequate service capacity and waiting too long for transport services which may be overcrowded is a common problem in many cities in developing countries</td>
</tr>
<tr>
<td>Poor route coverage</td>
<td>➢ Poor route coverage may be due to inefficient route planning, a failure on the part of transport operators to expand as the city grows, or the lack of a proper secondary road/ rail systems which confines routes to major arterials only</td>
</tr>
<tr>
<td>Excessive fares</td>
<td>➢ Paying for public transport often accounts for a significant proportion of household spending for those on low incomes, and the level of fares is often a sensitive political issue. Where a large number of passengers have difficulty affording bus fares, the fares may be regarded as excessive</td>
</tr>
<tr>
<td>Excessive subsidy requirements</td>
<td>➢ One of the most common reasons for cities to reform their transport systems is an excessive subsidy requirement that is projected to rise and become unsustainable in future years</td>
</tr>
<tr>
<td>Traffic congestion</td>
<td>➢ Buses are often perceived to be a cause of traffic congestion. This is often the case where services are unregulated and provided by a large number of small operators</td>
</tr>
<tr>
<td>Poor safety</td>
<td>➢ Safety of transport services is often a cause for concern. An estimated 75% to 85% of fatalities in road accidents worldwide occur in developing countries, despite low levels of car ownership. A significant proportion of road accidents involve public transport vehicles</td>
</tr>
</tbody>
</table>

Source: The World Bank
Designing New Transport Solutions

Redesigning India’s transport systems requires the adoption of new operating models, financing methods and approaches to urban development and planning.

- India’s growing population and expanding urban areas require transport solutions which are robust and scalable to service populations in their tens of millions.
- Already, the demands on Indian cities transport systems dwarf many developed countries.
- Transport services must be low-cost to meet the needs of a population still emerging from poverty.
- In this context, India’s transport planners must seek:
  - New operating models/technologies
  - New financing methods
  - New approaches to the urban environment
Agenda

Public Transport in India

Designing New Transport Solutions

- New Technologies / Operating Models
- New Financing Methods
- New Approaches to the Urban Environment
New Technologies / Operating Models

Countries around the world have adopted a number of different urban transport models in order to meet demand for transport services

- India’s heavy reliance on buses is unlikely to shift in the near future – even significant metro rail investments will only address part of the demand challenge

- As a result, any new technologies or models should focus on replicating or improving the convenience and performance of the bus network

- Governments and transport bodies around the world have designed their transport infrastructure around a set of functional models, including:
  - Rapid transit systems – where rail or bus services operate on segregated tracks/ busways without being impeded by other traffic
  - Trunk and feeder systems – where distributed transport lines are used to transport passengers to mass transit lines
  - Hub and spoke systems – where rail and bus lines operate a central transport hub which is used as a point of transfer between services

- The most innovative transport authorities have been able to integrate two or more functional models into the design of their urban transport infrastructure

- In addition, new technologies have emerged in recent years which could provide an alternative to existing transport models
Rapid Transit System

Rapid transit systems enable public transport to operate unimpeded by local traffic and congestion, allowing faster travel speeds and more frequent services

- Rapid transit systems are bus and rail based systems which operate on exclusive busways/tracks to reduce interaction with congested traffic in order to increase the speed and frequency of services
  - **Bus Rapid Transit Systems** – buses travel on segregated busways
    - Examples include TransMilenio in Bogota (Columbia), Express in Curtiba (Brazil) and Leon (Mexico)
  - **Rapid Rail Transit Systems** – passenger trains/monorails which operate on their own tracks (i.e. tracks are not used for freight transport)

- Construction costs for rapid transit systems is comparatively low for bus based systems (~US$5-15m per km) and provide the capacity to carry up to 25,000 passengers per hour per direction
  - The primary constraint to road based construction is the availability of road space and the costs involved in widening of lanes and arterials

- Rapid transit systems seek to enhance the efficiency of passenger transport by:
  - Reducing travel impediments to allow high speed and reliable services
  - Encouraging development in areas surrounding pick-up/drop-off terminals
  - Dispersing passengers to urban fringes associated with low density urban sprawl

Source: The World Bank, Asian Development Bank, media reports, company websites
Trunk and Feeder Transport System

Trunk and feeder systems can be used in conjunction with rapid transit systems to transport passengers to different points along a high speed/capacity transport system.

- Trunk and feeder systems attempt to reduce road congestion and increase the efficiency of travel by making it easier for commuters to access high speed transport systems (the trunk).
- The trunk is usually a high speed mass transit vehicle, such as a bus rapid transport lane or a train system. These systems stop relatively infrequently at designated terminals across an urban area.
- The feeders can include smaller buses, cars, bicycles, walking, etc. Feeders represent an intermediate mode of transport which are used to pick up/drop off passengers in areas surrounding a terminal.
- Trunk and feeder systems are effective in enhancing the performance of public transport because they make mass transit systems more accessible to commuters which do not live close to terminals.
- The trunk and feeder approach is used by TransMilenio (Bogota, Colombia) which provides free transport to and from mass transit terminals using free green buses.
  - In addition, TransMilenio encourages passengers to ride a bike to the terminal by providing free and secure storage.
- Once passengers arrive at the terminal, they are able to board the larger/faster mass transit bus (red) which operates on segregated busways.

Source: The World Bank, Asian Development Bank, media reports, company websites
Hub and Spoke Systems

Hub and spoke systems reduce the number of vehicles required to operate a public transport system while also increasing the frequency and efficiency of service

- Hub and spoke systems are designed to overcome the inefficiencies of direct services by:
  - Reducing the number of vehicles required to operate the service
  - Increasing the frequency of services (more services can be run between a point and a hub vs. point to point)
  - Decreasing travel duration for passengers by operating more direct routes between the transport hub and destination points

- Hub and spoke systems work well in cities with a distributed population and a high volume of passengers commuting from all directions to a CBD
  - Hub and spoke systems are appropriate for bus, tram, train and ferry services

- Hub and spoke systems can be constructed at a relatively small cost by comparison to other public transport systems
  - It is only necessary to undertake significant infrastructure development at transport hubs which will be required to increase their capacity

- Critical to the success of hub and spoke models is effective scheduling of services to ensure that required transfers are co-coordinated
  - Trip pricing must also be adjusted so that it does not punish the passenger for transferring at the transport hub with additional costs

- Hub and spoke systems have been adopted in a number of systems around the world, including the Moscow Metro and the Melbourne public transport system

Source: The World Bank, Asian Development Bank, media reports, company websites
Skybus

The Skybus is an Indian developed mass transit alternative which has shown considerable promise, however the safety of the technology requires further investigation

- The Skybus concept was developed in India by B. Rajaram, the former managing director of Konkan Railways Corporation (KRC)
- The Skybus brings together the best characteristics of bus and train systems
  - Carriages are similar to buses, with a capacity of ~300 passengers per double carriage
  - Instead of running on top of rails/track similar to a train, the Skybus hangs below the rails and slides 10 metres above regular road traffic
- In addition, the Skybus is designed to be a fully automated system without the need for a driver
- The Skybus has a number of benefits:
  - Road space – it follows existing roads however does not take up road space
  - Passenger capacity – it has a similar capacity to other mass transit systems and metros (18,000-100,000 passengers per hour)
  - Non-invasive – it requires the least amount of land space
  - Cost effective and quick – the construction cost is lower than other technologies and can be constructed in any crowded and congested city within two years

<table>
<thead>
<tr>
<th>Skybus Experience in Goa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between May 2003 and September 2004, a 1.5km Skybus test track was constructed in Goa at a cost of Rs. 50 crore (~$US 10.7m)</td>
</tr>
<tr>
<td>KRC supported the construction which was able to transport passengers at 100 km/hour in an air conditioned carriage</td>
</tr>
<tr>
<td>During a test run, a brake malfunction occurred resulting in the use of an emergency brake</td>
</tr>
<tr>
<td>This accident resulted in the death of one of the passengers with two other injured</td>
</tr>
<tr>
<td>Since the accident the project has not progressed, however within the last 12 months Skybus has gained further media attention as a possible solution to India’s congestion problems</td>
</tr>
</tbody>
</table>

Source: Digital Journal
Public Transport in India

- Designing New Transport Solutions
  - New Technologies / Operating Models
  - New Financing Methods
  - New Approaches to the Urban Environment
Approaches to Funding

Access to appropriate funding models is central to the development of an inclusive public transport system

➤ The primary constraint to establishing an efficient urban transportation system is lack of funding for infrastructure development

➤ In most countries, the predominant source of financing of transport infrastructure and services has traditionally been the national or state government with those in the private sector taking a secondary role

➤ The need for more efficient alternatives for transport funding has stemmed from a changing perspective regarding the role of governments in the provision of transport services

➤ State governments, municipal councils and the private sector are now taking a more active role in generating and investing funds for transport infrastructure projects

➤ The three key models being adopted are:
  - User pays model (specific taxes)
  - Alternate state and government revenue (land capture value and bond issuance)
  - Private investment with infrastructure ownership/ rights
Approaches to Funding
User-pays Models

The user-pay model attempts to match the costs associated with construction of transport infrastructure with those who use the service

### Fuel Consumption Taxes
- Fuel taxes are the predominant form of funding for transport systems in Germany, Japan, the USA and others
- Fuel taxes are considered to be a user-pays funding model as vehicle owners are charged proportionally to their vehicle use (for which fuel purchased is a proxy)
- However, fuel taxes are unsuitable as a long-term source of infrastructure funding for two key reasons:
  - The establishment of sustainable transportation requires substantial reductions in private motorisation fuel use
  - The future supply of oil is uncertain
- Nevertheless, the use of fuel taxes to fund infrastructure investment is a viable option in the short-term

### Transit Related Funding
- Transit funding include forms of funding which vehicle owners and other stakeholders experience which are associated with transportation
- There are three common forms of transit fee:
  - Parking fees – used to generate revenue at and around transport hubs
  - Toll roads – used on major highways, bridges and tunnels in a number of countries with car usage data being collected with electronic tags
  - Other fees – including advertising, leasing rights-of-way and space/ premises leasing at and around transport hubs
- Transit funding alone is generally an insufficient source for transport infrastructure investment, however can be used to supplement other funding sources

User-pays funding is unlikely to be appropriate for infrastructure funding in India, where the majority of users are still very poor

Source: Media reports, Victoria Transport Policy Institute
Approaches to Funding
State/ Government Funding – Bond Issuance

Some Indian cities are adopting innovative approaches to generating funding for transport infrastructure investments, such as the issuance of municipal bonds.

- A major weakness of local governments and municipal councils is their inability to leverage their assets and mobilise funds to undertake transport investments
  - Most municipal governments do not know the value of their land or prepare financial statements required to receive a credit rating

- By conducting certain valuations and preparing financial reports to receive a credit rating, municipal councils are able to mobilise their local assets to raise funds in capital markets

- This provides an alternate funding mechanism for local governments to undertake transport infrastructure investment without financial support from state or central governments

**Bond Issuance in Ahmadabad**

- In India, the borrowing powers of municipals are restricted, with most authorities only permitted to borrow within certain limits and only with the permission of the state government

- In the past, municipal corporations have not made use of even these limited powers for developing their infrastructure and services

- In 1997, the Ahmadabad Municipal Corporation (AMC) undertook the process of obtaining a credit rating before issuing bonds to the value of $US 28 million

- Using the additional funds, AMC was able to improve the goods and services for which it was responsible, as well as invest in required infrastructure in the region

- Bond issuance and tapping capital markets is a path which more Indian municipalities should pursue to source funding for local infrastructure

Source: Asian Development Bank
Approaches to Funding
State and Government Revenue – Land Value Capture

Land value capture is an innovative way for planning authorities and infrastructure developers to recoup investment costs for transport systems

- Land value capture mechanisms attempt to capture the economic benefits accrued to land and property as a result of infrastructure investments
  - Common forms of accessing land value capture include betterment and land taxes, leasers, council rates, etc.

- These mechanisms focus on anticipating the rise in land value resulting from public investment and capturing this value for government through either:
  - Targeted taxation
  - Government investment in property, later sold for a profit

- Land value capture allows infrastructure developers/transport authorities to:
  - Recoup the investment in public infrastructure
  - Achieve a return on the windfall profits due to increased accessibility to the public
  - Prevent land speculation and provide a strong incentive for development in brownfield sites and abandoned properties in order to reduce urban sprawl

- In India, land value capture can be used in regions surrounding major urban cities to control urban sprawl and raise funds for investment

Betterment Tax in Hong Kong

- The betterment taxes in Hong Kong are based on full market value
- The Hong Kong government leases, under different restrictions, the land in station areas to the Mass Transit Railway (MTR) Corporation
- The leases for development are renewable and generally span 50 years or more
- Only 65% of MTR Corporation’s revenues come from ticket fares
- The remaining 35% of revenues come from proceeds from land rental, station commercial businesses and investments

Source: UCL
Approaches to Funding
Private Investment – Commercialisation

Commercialisation of public transport operators enables them to reduce costs and operate with a profit motive similar to private companies

- Commercialisation is the process of re-engineering public bodies to act more like private companies operating under similar profitability demands

- Within public transport, the commercialisation of services has been adopted by cities seeking to reduce the subsidy requirements of state-owned public transport bodies

- Challenges faced by public transport providers include:
  - Overstaffing and lack of fare revenue making services unsustainable
  - Excessive costs and the operation of non-transport units
  - Containing in-house functions whose products could be purchased on the market at better terms

- Implementing a commercialisation process requires a number of steps:
  - Gradual deregulation of the public transport sector
  - Identifying specific financial targets and objectives
  - Reducing workforce and reorganizing organisation structure by spinning off non-transport departments
  - Monitor and benchmark performance against global peers

- Commercialisation would allow India’s public transport bodies to operate in a leaner and more efficient manner

BKV (Budapest, Hungary)

- Budapest’s state-owned public transport provider, BKV was facing considerable pressure due to reduced subsidies
- Despite its extensive multi-modal system, BKV passenger numbers had declined from 90% of all trips in the late 1980s to 70-80% in the 1990s
- BKV was overstaffed and had operations in a number of non-core areas
- BKV used a commercialisation process to reduce its workforce and begin to use sub-contractors to perform duties
  - In addition to improving financial performance, BKV also sought to stem decreasing passenger numbers

- Outcome:
  - BKV was able to improve its cost recovery from fares (increased from 37% to 50%)
  - Customer fare evasion fell from 12% to 7%
  - 5% of operations were subcontracted to external parties

Source: Media reports, Asian Development Bank, World Bank
Approaches to Funding
Private Investment – Privatisation and Deregulation

Privatisation and deregulation represents a viable option for governments which lack a comparative advantage or expertise in operating a public transport system

- Privatisation is the process of transferring operations which were previously conducted by government departments to the private sector

- The primary reasons for public transport privatisation include:
  - Reducing operating subsidies and making the service sustainable
  - Improving the quality of service in an area where the government lacks expertise
  - Increasing the capacity of services while maintaining safety
  - Accessing investment funding where not available from public sources

- The process of privatising a public transport system includes:
  - Undertaking policy reform to allow entry of private operators
  - Making existing public transport systems more attractive for the private sector by cutting expenses and reducing staff numbers as well as seeking alternate revenue sources
    - This may also include investing in infrastructure surrounding public transport hubs
  - Establishing a central overseeing body to manage the process
  - Establishing standards and regulations which must be adhered to by private operators
  - Evaluating offers from the private sector to operate the system

Privatisation allows public transport to be managed by bodies with special expertise

Privatisation in Rio de Janeiro (Brazil)

- In 1997, Rio de Janeiro privatised its ferry boat company, state-owned bus companies and its suburban train and metro companies
- Rio’s public transport system carried 67% of commuters, with 77% of these travelling by bus
  - Rio’s system suffered from significant overcrowding
  - Significant congestion had decreased the air quality and the number of accidents had increased
- The privatisation of Rio’s system included deregulating policies to allow private entry, halving payroll costs, putting fare evasion control systems in place to raise revenues and offering subsidies to private operators which would reduce to zero over time
  - Bids were received from private operators with the lowest bidders (subsidy required) being awarded control over each of the systems for between 20-25 years
- The Rio de Janeiro experience illustrates that even in systems experiencing high deficits as a result of inefficient management, inadequate infrastructure and inferior equipments, concessions can be designed that attract the private sector

Source: Media reports, Asian Development Bank, World Bank
Approaches to Funding
Private-Public Partnerships

Private-Public Partnerships (PPP) are emerging as a financially viable way for governments to develop local infrastructure and services without bearing the full cost.

- PPP are projects which are jointly funded between the public and private sector
  - This generally involves an agreement between state/central governments with private enterprises to share the cost of undertaking a project
  - Agreements are generally over the medium to long term, involving the sharing of risks and rewards, expertise and funding

- PPP is an alternative to public funding where fare revenues do not cover all costs of operation

- PPP are often conducted under the build-operate-transfer (BOT) model:
  - Build – a public and private body sharing the cost of investment
  - Operate – the private body gains exclusive access to operate developed infrastructure for a period of time
  - Transfer – the private body transfers control of the developed infrastructure back to the public authority after the agreed period of time has lapsed

- In India, there are already 86 projects which are funded by PPP
  - The development of the Amritsar Bus Terminal has been jointly funded by local contractors and the state owned Punjab Infrastructure Board
  - The development of the metro system in Delhi was ~70% funded by international and private bodies

- PPP has proven to be a successful model for infrastructure investment in India


### Proportion of Operating Expenses Covered by Fare Revenue

<table>
<thead>
<tr>
<th>Location</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSTC (Calcutta)</td>
<td>62%</td>
</tr>
<tr>
<td>DTC (Delhi)</td>
<td>87%</td>
</tr>
<tr>
<td>BMTC (Bangalore)</td>
<td>105%</td>
</tr>
<tr>
<td>APSRT (Hyderabad)</td>
<td>92%</td>
</tr>
<tr>
<td>AMTS (Ahmedabad)</td>
<td>62%</td>
</tr>
<tr>
<td>PMT (Pune)</td>
<td>42%</td>
</tr>
</tbody>
</table>

*In India, the majority of public transport systems rely on subsidies to cover their costs*
Agenda

Public Transport in India

Designing New Transport Solutions

• New Technologies / Operating Models
• New Financing Methods
• New Approaches to the Urban Environment
New Approaches to the Urban Environment

In addition to selecting the correct transport model and funding mechanisms, there are a number of strategies which can be adopted to support more efficient public transport.

- Designing new transport solutions requires co-ordination between transport models, funding mechanisms and approaches to the urban environment and development.

- The four key supporting initiatives which should be undertaken to support new transport solutions include:
  - Reducing public transport demand through urban planning.
  - Managing demand for private motorisation by having cheap, efficient public transport alternatives.
  - Imposing quality standards for private transport systems.
  - Reducing transport strain from commercial vehicles.
Reducing Public Transport Demand Through Urban Planning

Adherence to a common infrastructure development plan enables better co-ordination between land and transport planning authorities, creating a more inclusive public transportation system

- Integration between land use and transport planning is critical to the development of urban areas which can be serviced by inclusive public transport systems

- Over the last century, global best practice has been to establish new cities and urban areas around a central transport system
  - The capital city of Punjab, Chandigarh (India) is a built up city with self-sufficient neighbourhoods with access to shops, markets and schools all within 10 minutes walk – this minimises the need for transport

- Integration between land and transport planning can be supported by establishing a central planning framework and authority
  - From the 1960-80s, Singapore’s problem-driven transport plan was developed around certain challenges including infrastructure deficiencies, poor land use planning, poor public transport and rising private motorisation
  - In 2007, construction began on a satellite city called Ørestad near Copenhagen. The Ørestad Development Corporation (ODC) was established with the dual task of building the metro in Copenhagen and developing the Ørestad Area

- Integration of India’s land use and transport planning will help to reduce urban sprawl, control private motorisation and establish a public transport network which meets demand

Source: Media reports, Asian Development Bank
Managing Demand for Private Motorisation
Drivers of Private Motorisation

Rising demand for private vehicles will be the primary driver of infrastructure need – this demand is the result of income growth and poor quality public transport

- **The primary driver of private motorisation is higher incomes**
  - Countries in the developed world such as the USA, France, Germany and the UK have high income levels (illustrated by a high GDP per capita) which results in more people purchasing private vehicles
  - In countries such as Brazil, China and India where income is low, there are far fewer vehicles per head of population

- **As income levels grow, commuters make the transition from public transport, cycling and walking to private motorisation**
  - A study completed by Indian Institute of Technology (IIT) found that over 28% of high income households (average income above Rs. 7,000 per month) commuted via private vehicles, while zero percent of low income households (average income ~Rs. 2,000 per month) had access to private vehicles, electing to cycle, walk or take the bus instead
  - Between 1957 and 1994, the modal share of non-motorised cycles in Delhi decreased from 36% to under 5%

- **Another driver of private motorisation is insufficient, infrequent or poor quality public transport**
  - Dissatisfied public transport passengers increasingly turn to private motorisation

![Vehicles per 100 population vs. nominal GDP per capita](chart)

There is a strong positive relationship between GDP per capita and the number of vehicles per 100 population

Source: OECD, IMF, IIT
Managing Demand for Private Motorisation
Creating the Right Incentives

Goverments can play an important role in managing the demand for private vehicles by creating incentives which make public transport a more attractive option

- Limiting excessive growth in private vehicle ownership will help Indian governments restrict infrastructure investment to manageable proportions
- Governments must establish consistent and substantial incentives to make public transport viable alternative to private motorisation
- Currently, the Indian Government provides subsidies to both the public and private transport systems using fare subsidies and petrol subsidies respectively
  - Were subsidies to be targeted solely at providing incentives for public transport, it is possible the quality of service could be improved
- There are a number of key initiatives which governments and other bodies can adopt to encourage the use of public transport:
  - Service improvement – the Government should provide financial support to improve the quality and quantity of public transport services by enabling capacity to be expanded, extra routes to be added and new stations and terminals to be built
  - Fare subsidies – public transport can be made more attractive by reducing the cost of tickets by introducing (or increasing) the subsidies applied to passengers fares
  - Business incentives – businesses can be supported through tax incentives or other mechanisms to promote public transport use of workers
    - One approach which has been introduced in Melbourne, Australia has been to offer free travel on train services concluding before 7am which has helped to distribute morning rush hour commuters

Source: Campaign for Better Transport
Managing Demand for Private Motorisation
Possible Long-Term Solution

Congestion charging attempts to encourage the use of public transport by making it more expensive to use private motorisation by attaching usage taxes to vehicles at specific times

- Congestion charging attempts to reduce car usage in particular traffic prone zones by charging car users/parkers a fee between certain hours
  - The system generally operates using cameras/scanners which are able to identify number plates and charge user's accounts accordingly

- Congestion charging can take one of 3 forms:
  - Distance based charging – where the amount paid by the car user is dependent on the distance they travel through a particular thoroughfare
  - Cordon charging – where the amount paid by the car user is based on the number of defined zones they pass through on their journey
  - Area charge – where fees are charged to all vehicles within an area

- Congestion charging is used by cities to improve traffic flow, allow better access for public transport, and provide disincentives to private vehicle use
  - Limited private vehicle use in city areas facilitates more efficiency public transport, less pollution and more public space
  - Indian cities should consider congestion charging as part of long term plans to improve city centres

The long time frames and planning challenges associated with infrastructure and urban renewal mean that Indian cities should begin planning now for how cities will look in 30 years

Congestion charging in London

- In 2003, London introduced a congestion charging zone for private commuters at a cost of £36m
  - Cameras were installed throughout the city which kept track of vehicle traffic and billed car owners for use
  - Commuters driving through central London were initially charged £5 per day. This was raised to £8 in 2005

- Despite the initial resistance, the results of the charging system were positive:
  - Traffic on the roads decreased by 20%
  - Total revenues per year of £160m
  - Increased utilization of buses and an a greater proportion of travel by walking/cycling
  - 37% increase in traffic speed

- Over 80% of the revenues generated by the initiative have been used to improve the London’s bus systems

- The London model is seen as a model for other congestion charging systems which are being considered in San Francisco and Brazil

Source: Media reports, Victoria Transport Policy Institute, Journal articles
Imposing Quality Standards for Private Transport Systems

Establishing and upholding quality standards allows public transport authorities to retain some level of control over private companies providing transport services to the public.

- A deregulated public transport system can operate effectively where a government authority allows private companies access to the public transport market but only when they meet vehicle safety and service quality standards.
  - Vehicles which meet the quality criteria are free to service routes of their choosing as long as they comply with general traffic regulations.

- However, this type of system presents a number of challenges:
  - The congestion of roads as transport services are generally concentrated on major route corridors.
  - Low coverage of less busy routes and poorer regions.
  - Potential for dangerous driving by drivers who attempt to maximize passenger loads if controls are not enforced effectively.
  - Lack of consistency/predictability of service for commuters without access to other forms of transport.

- Imposition of additional standards covering routes, fares, etc. can allow privately run services to effectively substitute for public transport, especially in cases where:
  - The public sector has no expertise to plan and implement a public transport system but wishes to retain some control over the safety and quality of service.
  - The public sector lacks the funds to establish its own transport system.

- Stronger regulation of private operators is a key step in improving informal transport systems in India in the short term.

Source: Media reports, World Bank

Transport reform in Santiago (Chile):

- The military dictatorship (1973-1989) in Chile resulted in a considerable deregulation of public transport, with the state dissolving the state-run public transport authority.

- By the 1980s, Chile’s public transport system suffered from an oversized and decrepit bus fleet which charged excessive prices and produced high levels of pollution.

- Between 1990 and 1991, Santiago introduced a number of quality standards for public transport operators including:
  - Restrictions on the number of vehicles in a fleet.
  - Maximum bus age of ten years.
  - Fare price floors and ceilings.
  - Requirement that buses to comply with Euro II emissions standards.

- Santiago’s public transport now operates on a rolling tender basis where a number of private operators serve the city and comply with established quality standards.
Reducing Transport Strain from Commercial Vehicles

Developing new models to deal with commercial vehicles will help to reduce road congestion in urban areas

- Commercial vehicles represent a significant burden on urban transport systems and are a major contributor to congestion

- There are a number of policy options which can be adopted by transport/planning authorities to deal with this burden, including:
  - Time restrictions – only allowing commercial vehicles to access the road network during certain off-peak times when commuting traffic is low (e.g. night-time)
    - This approach was adopted during the Beijing Olympics in 2008 where freight vehicles were only permitted to operate in the city area between midnight and 6AM to reduce congestion and smog
  - Congestion charging – a congestion charging systems which is tailored to commercial vehicles will make the cost of transport through built-up urban areas more expensive for commercial transporters
  - Route and capacity optimisation – it is possible to reduce the number of commercial vehicles in urban areas by ensuring that vehicles are filled to capacity and take the optimal route paths to reduce travel distance and time
    - This is also beneficial for freight transfer providers as costs can be minimised, and can be achieved through co-opetition

Some of these areas are explored in detail below

Source: California Highway Patrol
# New Models for Bus Services

India’s bus services have moved towards new business models in order to provide a reliable and efficient transport service

<table>
<thead>
<tr>
<th>Private Enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ The introduction of large scale private bus operators first occurred in Delhi in 1992 however services were unreliable and were operated by unqualified drivers who drove recklessly</td>
</tr>
<tr>
<td>➢ In the years following 1992, regulations were strengthened and better enforced for private bus operators</td>
</tr>
<tr>
<td>☑ Although service quality still remains low, private buses have emerged as economically sustainable</td>
</tr>
<tr>
<td>☑ Private buses attract twice as many passengers per bus than public operators</td>
</tr>
<tr>
<td>☑ Private buses experience half the amount of costs of public buses as they are able to employ staff on lower wages without benefits such as pensions or health insurance</td>
</tr>
<tr>
<td>➢ The World Bank found private buses earned twice the revenue per bus per day, required less than half the staffing per bus, cost less than half per bus km and actually made a profit while public bus firms ran a loss</td>
</tr>
<tr>
<td>➢ Private buses typically have no access to terminals and operate in some regions without regulation or monitoring</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bus rapid transit system (BRTS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ A BRTS is a system which allows certain buses to operate at a greater level of efficiency compared to traditional bus services due to segregated busways, rapid boarding, efficient fare collection, clean bus technologies and modal integration</td>
</tr>
<tr>
<td>➢ BRTS often require significant investment in infrastructure development in order to redevelop roads and overcome technology constraints</td>
</tr>
<tr>
<td>➢ BRTS have now been introduced in major cities including Delhi, Mumbai, Pune and Hyderabad</td>
</tr>
<tr>
<td>➢ BRTS currently represents the world’s best practice in urban design with cities in North America, South America, Europe and the Middle East all adopting similar models</td>
</tr>
<tr>
<td>➢ The development of a BRTS in Johannesburg, South Africa will be completed by the 2010 FIFA world cup</td>
</tr>
</tbody>
</table>

### Demand for Private Transportation

In addition to rising income levels, the ownership of private vehicles in India has been driven by three other key factors:

<table>
<thead>
<tr>
<th>Industry deregulation</th>
<th>Urbanisation</th>
<th>Poor public transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Until 1983, India’s transport sector was tightly controlled by government regulation and licenses.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- In 1983 and 1984, India’s vehicle industry was partially liberalised leading to increased foreign investment and an increase in light and commercial vehicles.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- India’s vehicle industry was significantly opened in during the early 1990s reforms resulting in sustained foreign investment and increased vehicles sales.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- The rapid increase in private motorisation is closely correlated with the growth of urbanisation in India.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- The 50% increase in India’s urban population between 1990 and 2004 was matched by a 400% increase in private vehicle ownership.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Urbanisation has resulted in a significant increase in the size of India’s urban cities, resulting in greater trip lengths.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Delhi’s urban area has increased five-fold since 1981 with average trip lengths increasing by 1.2-1.4 times.</td>
</tr>
<tr>
<td></td>
<td>- This urban sprawl has meant many of those living on the periphery of urban cities who have limited or no access to public transport have turned to private modes transport.</td>
<td></td>
</tr>
<tr>
<td>- The rapid increase in urbanisation has resulted in public transport being utilised at rates significantly over capacity.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Carriages on the Mumbai Suburban Railway were designed to hold 1,750 passengers however in peak hour, often hold up to 4,500 passengers.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Public transport is often infrequent and generally slow due to traffic congestion.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- As a result, many would-be public transport users have shifted to private vehicles.</td>
</tr>
</tbody>
</table>

Source: Halcrow Group, Oxford University, IDPR, McKinsey, Journal of Public Transport
**Indian Infrastructure Projects (1/2)**

Initiated in 1998, the National Highways Development Project is a major initiative to upgrade highways across India

<table>
<thead>
<tr>
<th>National Highways Development Project (NHDP)</th>
<th>Length (km)</th>
<th>Cost (bn €)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>Upgrade of ‘Golden Quadrilateral’ linking Delhi, Mumbai, Chennai and Kolkata</td>
<td>7,498</td>
<td>4.8</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Upgrade of major N-S and E-W corridors</td>
<td>6,644</td>
<td>5.4</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Upgrade of highways connecting key locations or to allow for high traffic density</td>
<td>12,109</td>
<td>12.8</td>
</tr>
<tr>
<td>Phase 4</td>
<td>Upgrade of highways which are not part of Phase 1, 2 or 3</td>
<td>20,000</td>
<td>4.4</td>
</tr>
<tr>
<td>Phase 5</td>
<td>Upgrade of some highways from four to six lanes</td>
<td>6,500</td>
<td>6.5</td>
</tr>
<tr>
<td>Phase 6</td>
<td>Construction of expressways linking major commercial and industrial townships</td>
<td>1,000</td>
<td>2.6</td>
</tr>
<tr>
<td>Phase 7</td>
<td>Construction of ring roads, bypasses, flyovers etc.</td>
<td>700</td>
<td>2.6</td>
</tr>
</tbody>
</table>

In addition to the NHDP, a further 19 major national highways projects (highway improvement, construction of bridges, bypasses) have also been approved or proposed – amounting to investment of over €240 million

Note: Based on exchange rate of INR/EUR = 63.1313 as of 16/11/08
Source: oanda.com; Department of Road Transport & Highways; National Highways Authority of India
Indian Infrastructure Projects (2/2)

Significant development of ports and airports is also planned

### Selected Projects of Major Indian Ports

<table>
<thead>
<tr>
<th>Port</th>
<th>Description</th>
<th>Cost (mn €)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chochin</td>
<td>LNG re-gasification terminal</td>
<td>507</td>
<td>Expected completion 2011</td>
</tr>
<tr>
<td></td>
<td>Extension of container berth and other facilities</td>
<td>95</td>
<td>Expected completion 2010</td>
</tr>
<tr>
<td></td>
<td>Development of fourth container and marine chemical terminal</td>
<td>1,045</td>
<td>Expected completion 2015/2016</td>
</tr>
<tr>
<td></td>
<td>Deepening and widening of main harbour and JN Port channel</td>
<td>127</td>
<td>Tenders invited</td>
</tr>
<tr>
<td></td>
<td>Improvement of road connectivity (Phase 1)</td>
<td>101</td>
<td>In progress</td>
</tr>
<tr>
<td>Jawaharlal Nehru</td>
<td>Improvement of Kolkata dock system, Haldia dock complex, and river-related works</td>
<td>158</td>
<td>Unclear</td>
</tr>
<tr>
<td>Mumbai</td>
<td>Construction of two off-shore container berths for handling vessels of 6000 TEU capacity</td>
<td>195</td>
<td>Unclear</td>
</tr>
<tr>
<td>Tuticorin</td>
<td>Inner harbour optimisation</td>
<td>108</td>
<td>In progress</td>
</tr>
</tbody>
</table>

(1): Not exhaustive; only major projects of key ports are listed

Note: Based on exchange rate of INR/EUR = 63.1313 as of 16/11/08
Source: oanda.com; Indian Government; Relevant websites of major Indian ports

### Key Airport Developments in India

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost (mn €)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devanahalli Airport (near Bangalore)</td>
<td>306</td>
<td>Expected to have been completed</td>
</tr>
<tr>
<td>Construction of Hyderabad International Airport</td>
<td>279</td>
<td>Completed (commissioned Mar 2008)</td>
</tr>
<tr>
<td>Restructuring and modernisation of Delhi Airport</td>
<td>1,178</td>
<td>Expected completion 2010</td>
</tr>
<tr>
<td>Restructuring and modernisation of Mumbai Airport</td>
<td>1,586</td>
<td>Expected completion 2010</td>
</tr>
</tbody>
</table>