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# REPORT ON URBAN TRANSPORT PLANNING

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**ABSTRACT:** Since the early 1990s, India's growing economy has witnessed a rise in demand for transport infrastructure and services. India is the second most populated country in the world, and a quick developing economic system, is seeing horrible road congestion troubles in its towns. Due to population growth and the emergence of economies in developing countries, and the high economic growth in developed countries, the rapid development of technology makes cities more attractive and thereby increases the growth of urbanization. One of these requirements are the fast and optimal transport from one place to another within the city. Therefore, urban management is seriously challenged with adoption and good management of urban transport systems. Efficient and reliable urban transport systems are crucial for India to sustain high economic growth. The significance of urban transport in India stems from the role that it plays in reduction of poverty, by improving access to labour markets and thus increasing incomes in poorer communities. Services and manufacturing industries particularly concentrate around major urban areas, and require efficient and reliable urban transport systems to move workers and connect production facilities to the logistics chain. The government of India has dedicated Rs. 2, 34,000 crore inside the urban infrastructure region. Bus mass rapid transit (BRT), metro rails and mono rails are being built in extraordinary cities to encourage the usage of public shipping. However still there's a steep boom Private vehicle. A few cities like Pune, Hyderabad and Delhi-NCR, with their rapid growths inside the IT sector, even have a steep increase in population. In this research study an attempt was made to identify the problems faced in urban transport system with previous case studies and solution are drawn to improve the transport system in urban areas.

**Key Words: Urbanisation, traffic, economy and transportation.**

## 1. INTRODUCTION

### 1.1 General

From the beginning of history, human sensitivity has revealed an urge for mobility leading to a measure of Society's progress. The history of this mobility or transport is the history of civilization. For any country to develop with right momentum modern and efficient Transport as a basic infrastructure is a must. **Transport** (British English) or **transportation** (American English) is the movement of people and goods from one place to another. The term is derived from the Latin *trans* ("across") and *portare* ("to carry").

India’s transport sector is large and diverse, it caters to the transport needs of 1.1 billion people. In 2012-2013, the sector contributed about 5.2 per cent to the nation’s GDP, with road transportation having a major share of it.1 Good physical connectivity in urban and rural areas is essential for economic growth. Since the early 1990s, India's growing economy has witnessed a rise in demand for transport infrastructure and services. Efficient and reliable urban transport systems are crucial for India to sustain high economic growth. The significance of urban transport in India stems from the role that it plays in reduction of poverty, by improving access to labour

markets and thus increasing incomes in poorer communities. Services and manufacturing industries particularly concentrate around major urban areas, and require efficient and reliable urban transport systems to move workers and connect production facilities to the logistics chain. Mobility flows have become a key dynamic in the rapid urbanization process of Indian cities with urban transport infrastructure constituting the skeleton of the urban form. Despite the increasing levels of urban mobility in Indian cities, access to places, activities and services is becoming increasingly difficult in terms of convenience, cost and time. In fact, present levels of urban mobility are already generating a crisis situation characterized by high levels of congestion, environmental pollution, traffic fatalities and inequity eventually leading to a situation of undesired accessibility crisis. With over a quarter of India's urban population below the poverty line, the mobility problems of the poor are of special concern. The unaffordability of private transport or the lack of public transit options forces this segment of the urban population to walk or cycle increasingly long distances, and, consequently, suffer severe pollution. As Indian cities continue to spread outward, those residents too poor to afford motorized transport will be increasingly put at a disadvantage, and further cut off from employment, recreational, educational, medical and other activity sites they need to access in the city.

## 2. LITERATURE REVIEW

**Shandiz et al.20** proposed a method for controlling traffic lights to have maximum flow in route and which results in moving traffic. This algorithm uses real situations. The sensors send the traffic flow information on a computer, and then based on Genetic Algorithm (GA) timing of green light is adjusted. Simulation result shows the total capability of cross and road is reached supported real information. In aims to look at the connection between transport emissions and air quality concentrations and additionally to permit them to speak. Air Quality Stations send air data to Data centre then based on that data the Data centre Request restriction from traffic management. After restricting vehicles Traffic monitoring centres activate monitoring traffic and then data centre requests extra buses from public transport management. Simulation results show that the system will modify the pollution assessment.

**Robert L. Bertini, Christopher M. Monsere** represented in their research the benefits of ITS in the Urban areas addressing the congestion and safety issues. While reviewing the literature associated with the ITS research worker mentioned the scope of ITS edges primarily based upon real world experiences. This report highlights citing in every class national and international example and blends documented edges of ITS. Discussion on blood vessel and expressway Management Systems; Freight Management Systems; Incident Management Systems; Transit Management Systems; Regional Multimodal and human info Systems; Emergency Management Systems and knowledge Management. ITS implementation in urban region might result into following potential benefits: vas Management System might decrease delays in implementation, expressway Management System will decrease happening of crashes and additionally reduces overall period, Transit Management Systems focuses on automatic vehicle location and transit signal priority, Incident Management System improves public supports to the DOT activities. The benefits like increased safety, efficiency, accessibility, quality etc is simpler with regional co-operation.

**Dinesh Mohan described** the ITS and its application group with specific categorization like traveller information, traffic, commercial vehicles etc. The researcher identified that there is substantial relationship of ITS effectiveness with behavioural

adaptation. By illustrating examples like opposing brake system, route system, aboard driver helps etc it's clear that the person – machine interaction outcome is extremely advanced and it is discovered that technology alone can't deliver ends up in ITS. The major concern space concerning safety will be self-addressed with the employment of ITS tools like adjective controller, Advanced Traveller Information System (ATIS), Violation detection system etc and vehicle primarily based systems like Intelligent Speed Adaptation, Collusion Avoidance System, and Alcohol Interlock System etc. are also being promising impact on effective transportation management. The public transportation is addressed and its connectedness in ITS is illustrated. To sought-after out the matter of traffic jam, safety, and pollution etc. behaviour adaptation may be a crucial issue.

**Gurdit Singh, Divya Bansal, Sanjeev** presented in their paper existing techniques used in India for controlling of road traffic and ITS need in the present context. India has non lane road traffic system wherever every kind of vehicles are utilizing the roads that creates Associate in Nursing congestion within the traffic at varied locations. Particularly, in underground cities and medium cities this holdup downside is intense. In Asian nation standard traffic management system is employed by use of traffic lights, traffic policemen, traffic signs etc. The restriction in development in road infrastructure because of area limitation creates a hurdle in dominant the holdup downside. ITS techniques utilized in the developed countries might not be practicable in Indian context as there's huge distinction within the developed countries traffic management and Indian traffic situation. In Asian nation rather than focusing upon mounted detector technique, use of sensors like GPS, Wi-Fi, Camera and electro-acoustic transducer within the smart phones are often useful in estimating traffic conditions and avoiding the traffic congestion.

## 3. TRAFFIC AND TRANSPORTATION PROBLEMS

### 3.1 Growth of Urban Centers

Urbanization is taking place at a fast rate in India. Population residing in urban areas, according to 1901 census, was 11.4%. This increased to 28.53% in 2001 and 31.2% in 2011. According to a 2007 survey by UN State of the World Population report, by 2030, 40.76% of country's population is expected to reside in urban areas. While the main reason for urbanization in India is attributed to the eleventh five-year plan that aimed at urbanization for the economic development of India, other reasons like economic opportunities, infrastructure facilities in the urban areas, growth of private sector after 1990 and growth of employment opportunities in cities are also responsible. As of 2011 census of India, there are 53 metropolitan cities (city with more than one million population) in India and the number of medium size cities with population of 0.1 million or above have increased from 5161 in 2001 to 7935 in 2011. The top ten metropolitan cities in terms of population (Census, 2011) are given in Table.

**Table 1. Ten Most Populous Cities of India**

| Rank | City | Population |
|---|---|---|
| 1 | Mumbai | 18,414,288 |
| 2 | Delhi | 16,214,838 |
| 3 | Kolkata | 14,112,536 |
| 4 | Chennai | 8,696,010 |
| 5 | Bengaluru | 8,499,399 |
| 6 | Hyderabad | 7,749,334 |
| 7 | Ahmedabad | 6,352,254 |
| 8 | Pune | 5,049,968 |
| 9 | Surat | 4,585,367 |
| 10 | Jaipur | 3,073,350 |

### 3.2 Transportation Systems Deficiencies

Transport systems are closely related to socioeconomic changes. The mobility of people and freight and levels of accessibility are at the core of this relationship. Economic opportunities are likely to arise where transportation infrastructure is able to meet mobility needs and insure access to markets and resources. From the industrial revolution in the 19th century to globalization and economic integration processes of the late 20th and early 21st centuries, different regions of the world have been affected differently by economic development. International, regional and local transportation systems alike have become fundamental components of economic activities. A growing share of the wealth is thus linked to trade and distribution. An inadequate or non-sustainable transportation system will hamper the economic growth of the nation. The negative consequences of inadequate transport are congestion, accidents and mobility gaps.

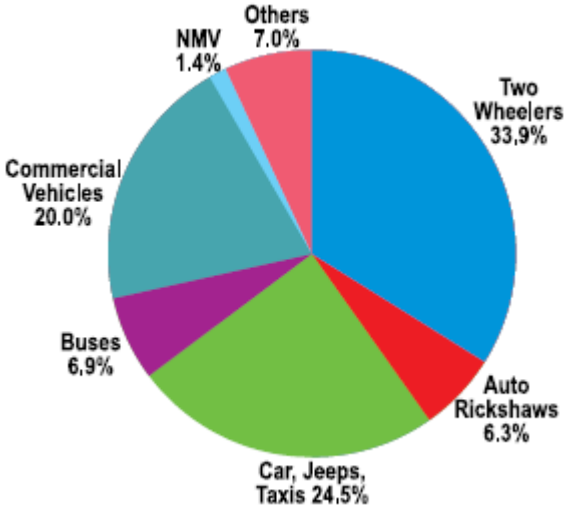


**Figure 1. Percentage of Accidents by Vehicle Type in 2017**

While the share of urban roads in total road network in the country is less than 10%, they constitute about 42% of total accidents and about 35% of fatalities. the details of accidents data on urban and rural roads in 2017. About 38% of total accidents took place on the junctions during the calendar year 2017. The total loss to the nation due to road crashes is estimated to be around 3% of GDP, which is quite alarming.

### 3.4 Pollution and Health Impacts

Air pollution is one of the major environmental issues in most of the urban cities of India. Majority of the urban population is exposed to the poor air quality adversely affecting their health apart from various other adverse environmental consequences. Road transportation sector has been identified as one of the major contributors of urban air pollution. The problem of outdoor air pollution is quite serious in most of the cities in India where air pollution levels generally exceed the air quality standards stipulated by Central Pollution Control Board (India). According to a recent WHO report (WHO, 2018), around 4.2 million people die every year worldwide due to outdoor air pollution. Further, among the world's 15 most polluted cities, 14 are in India (including Delhi). In fact, the air pollution has become the fifth largest killer in India with an estimated 1.5 million premature deaths per year due to air pollution related diseases. In developing countries like India, cost, accessibility and convenience are the main reasons for extensive use of road-based transportation. Road-based transportation in India carry almost 90% of all passenger traffic and about 67% of freight traffic daily (MoRTH, 2018). The common air pollutants emitted through the motor vehicles exhaust include Carbon Monoxide (CO), Oxides of Nitrogen (NOx), Sulphur Dioxide (SO2), Unburned Hydrocarbons (HCs), particulate matter (PM2.5, PM10) and other organic compounds derived from combustion. Further, over 70–80% of air pollution in India and other megacities in developing countries are attributed to vehicular emissions caused by a large number of older vehicles coupled with poor vehicle maintenance, inadequate road infrastructure and low fuel quality.

### 3.5 Urban Infrastructure Issues

The bane of urban traffic in India, is a mix of motorized traffic which moves at higher speed, and, the non-motorized traffic and pedestrians, vying for a place on the already inadequate space on the road. This is so because hardly ever attention is given to clearly demarcate space for the non-motorized traffic. The problem is compounded by inadequate and often chaotic parking and encroachment of footpaths by vendors. Infrastructure for urban traffic and transportation generally relates to highways, railways, no motorized systems and pedestrians. This would consist of bridges, viaducts, flyovers, elevated roads, tunnels and underpasses. Invariably, planning of most of these structures in the urban scenario presents a big challenge, because of the constraints from the existing systems, both above ground as well as underground. The latter often presenting the more complex problems. The safety of existing buildings in the vicinity also has to be addressed, while planning new transportation structures. For the aforesaid reasons often the ideal alignments and choices of the system may not be feasible and, most such projects call for greater engineering skills for successful planning, design and implementation. Furthermore, implanting a large and permanent structure within the existing environs has significant repercussions with often serious detrimental effects on the environment. This aspect though ignored for long has begun to be considered in recent years.

### 3.6 Gaps in Laws and Regulations

Presently, there is no legislation at central, state or local level that comprehensively covers urban transport requirements of Indian cities. The current systems of laws, regulations and governance for urban transport are the legacy of an era when Indian cities were sparsely populated and had not yet witnessed the kind of transport problems they are encountering today. Many Acts that are in place today are the legacy of the British Raj and a few of these have evolved to address specific issues in urban transport resulting in fragmentation or overlap of jurisdictions. For example, there are three Acts that are specific to metro systems in India which need to be examined and appropriately amended to be mutually consistent in their treatment of this transport mode

- Tramways Act, 1886, is for operation of trams on the road surface within the municipal limits
- Metro Railways (Construction of Works) Act, 1978, covers the needs of construction of metro railways in metropolitan cities and for matters connected therewith.
- Delhi Metro Railway (Operation and Maintenance) Act, 2002, provides for the operation and maintenance, and to regulate the working of the metro railway in the metropolitan city of Delhi. Earlier, Kolkata Metro had enacted a similar act for operation and maintenance of Kolkata Metro as an adjunct to the Indian Railway Act.

### 3.7 Distorted land markets affecting transport infrastructure development

Very high costs of land acquisition along with arduous and time-consuming processes are a major barrier for planning integrated urban transport infrastructure. About 70 per cent of delays in all infrastructure projects in 2008 were due to problems related to land acquisition. One of the factors is the heavily distorted land market, caused by zoning and development control rules in cities that limit the supply of land that can be devoted to commercial, industrial or residential use. Significant amount of public lands keep large portions of well-located land outside markets. Cumbersome and time-consuming rural to urban land conversion rules increase cost of acquisition. Laws such as Urban Land Ceiling and Regulation Act (ULCRA) have put many properties under litigation and thus kept them outside

the supply of developable land. The Floor Area Ratio (FAR) and Floor Space Index (FSI) regulations as espoused in the Development Control Regulations (DCR) are too low compared to international benchmarks (FSI in Mumbai is restricted to 1.33). Exceptions to these rules are traded on a highly selective and non-transparent basis, offering little incentive for land owners to surrender their lands for infrastructure development. An attempt to develop well-planned townships outside the existing city limits and eventually relocate major activity centres to decongest the city has met with limited success. In most cases, there is inadequate transport infrastructure to serve these new suburban developments and the residences located around them. Because of such policies and unplanned growth in the Indian suburbs, they have been characterised by a mix of industrial development, dumps and incompatible land uses.

## 4. IMPROVEMENTS FOR TRAFFIC AND TRANSPORT SYSTEM

### 4.1 Travel Demand Management (TDM)

TDM is a way of influencing individual travel behaviour and providing expanded options to reduce the actual demand (or number of vehicles) on transportation system of a city. The focus is on managing the demand side of the transportation equation rather than increasing supply by widening or building new roads or expanding the vehicle fleet. As a regional strategy to improve transportation system performance, TDM can reduce highway congestion and traveler delay, improve air quality, and improve access to jobs, schools, and other opportunities using mass transport or integrated multi-modal systems, by using existing infrastructure.

TDM is a system management strategy, which focuses on techniques to provide travel choices for individual travelers. Thus, TDM requires that there be a range of travel choices in public transport and IPT with integration for seamless travel opportunity, which is to be organized by the managing agency. The objective of such TDM strategies is to reduce the demand for private/ single occupancy vehicle trips by diverting trips to transit, walking, and cycling, and therefore, such measures can simultaneously increase through put of persons along a corridor along with the benefit of reduced energy consumption in passenger-km of travel and consequent reduced pollution.

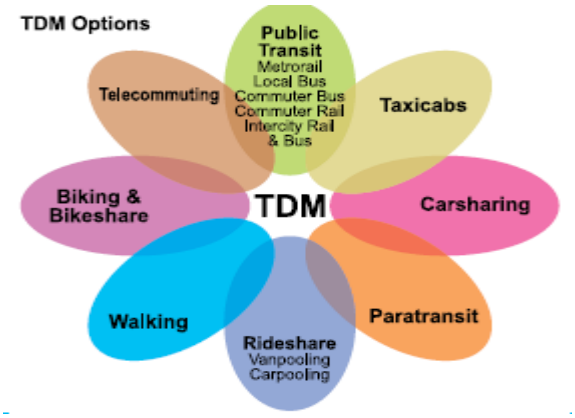


**Figure 2. TDM Measures (Source: Mobility Lab)**

### 4.2. Transport Infrastructure

In the urban environment structures for Traffic and Transportation infrastructure essentially relate to highways, rail-based systems and pedestrians. The projects may take the form of bridges, viaducts, flyovers, elevated roads, tunnels and underpasses. In the planning of most structures in urban environment, physical constraints above and below ground invariably present a big challenge. The geometry, length, width and depth of the structure as well as the location and size of its components need the expertise of experienced hands at the conception stage. The alignment as well as positioning of sub-structure and foundations may not be ideal from the functional or structural point of view as they are often dictated by existing or planned facilities or buildings as shown in Figure

**Figure 3. Alignment and Pier Locations Dictatedby Existing Road**

**Figure 4. Underground Metro Tunnel Using Precast Segments**

**Figure 5. Three Level Interchange Involving Subway Structure**

Underground Metro structures require enormous contiguous areas to be dug deep below the ground level. As shown in Figure these can be often very close to existing structures whose safety needs to be ensured. The alignment of the Metro tunnels connecting the underground stations may often have to traverse below existing buildings. Special expertise of Structural and Geotechnical Engineering requires to be mobilized to ensure safety of public and workmen in such situations.

**Figure 6. Level Traffic Interchange Integrating Road and Metro**

## Geometric and Loading Standards

The current Indian Roads Congress provisions, and, a few other norms for Indian cities or abroad given below, describe the scenario relevant to this section.

**Geometrics**

The IRC code on General Features of Design, IRC-5-2015, stipulates the road width should be calculated on the following basis:

- The width of carriageway shall not be less than 4.25 m for a single lane bridge, 7.5 m for a two-lane bridge and shall be increased by 3.5 m for every additional lane of traffic for a multiple lane bridge. If a median/central verge is constructed in a wide bridge thus providing two separate carriageways, the carriageway on each side of the median shall provide for at least two lanes of traffic and width there of shall individually comply with the minimum requirements stipulated above.
- The median shall be a minimum of 1.2 m wide, in which case crash barriers shall be provided in the median.
- IRC-5-2015 also indicates that the minimum vertical clearance provided over roads should be 5.0 m for non-urban areas and 5.5 m for urban areas. In case of structures over local or collector streets, where only light commercial vehicles are plying and where alternative routes for heavy commercial vehicles and fire tenders are available within a short distance, the

authorities may relax the clearance requirements stated above.

- At locations where over-dimensioned vehicles are frequently plying, the authorities may consider providing increased vertical clearance. For footways and cycle tracks, a minimum vertical clearance of 2.25 m shall be followed.

**Loading Standards**

The IRC code on Loads and Load Combinations, IRC-6-2017, indicates that the design should cater to one or more of the specified hypothetical vehicles or trains (of the military type), viz. Class

70R (wheeled and Tracked), Class A & Class B. In addition, IRC-6-2017 also stipulates two additional loading conditions. The first is the Congestion factor (values varying from 1.15 to 1.7 for spans ranging from 10.0 m to 70 m and above) for bridges and flyovers/ grade separators and is applicable on the effects of the specified hypothetical vehicles. This Factor becomes operative for structures close to areas such as ports, heavy industries and mines and any other areas where frequent congestion of heavy vehicles may occur. The second is the IRC Class SV vehicle loading applicable for Special Multi- Axle Hydraulic Trailer vehicle (20-axle 385 t GVW with a 20 t prime mover) plying on the structure by itself. IRC 5 mentions that the loads, special local conditions and traffic intensity for which a bridge is to be designed, shall be prescribed by the authorities as per relevant clauses of IRC 6.

### 4.3 Multi-Modal Transport and Reduction of Private Vehicles

Freedom for movement is an eternal need the techno-social-economic revolution is driving transport demand in an unprecedented way (like in lightning speed), where distance is no longer considered to be a deterrent. It is understood that in future, the demand for travel will rise faster than population or average income or even the rate of GDP growth, just because of the pressure of urbanisation. The primary requirement will be for the personal mobility, which is rising in many countries at more than 1.5 times the GDP growth. Further, the cultures and technologies have already converged in case of personal mobility and transport demand, especially in urban areas. So far, an indiscriminate policy of grade-separations, widening of roads, more signalisation, etc. (favouring primarily personalised modes only) in cities have led to a "Black Hole Theory of Transport Development". Fragmented systems of overlapping networks of public, private and paratransit modes exist without any complementarity along with aggravated situation of missing NMT and pedestrian infrastructure. In future, the transport will be demanded as equitable, seamless, safe, autonomous, zero-pollution, faster and productive. The 9th Five year Plan (1997-2002) recognized that heavy investment was required to develop rail based public transport system in cities and National Urban Transport Fund was created. Government of India funded ` 56,182 crore to develop Metro Rail system in 10 cities, which is 25% of the total project costs. BRT systems were introduced in 10 cities in India viz, Delhi, Ahmedabad, Pune, Surat, Jaipur, Indore, Bhopal, Visakhapatnam, Vijayawada and Rajkot with a total approved cost of ` 4,532.39 crore. where 50% of the cost was funded by central government through JNNURM program. Supply side policies for development of Trunk route public transport system were reflected in the earlier 11th and 12th Five year plan of the erstwhile Planning Commission, and Three Year Action Plan of NITI Aayog.

### 4.4 Parking Policy

Rapid motorisation and lack of sufficient space are one of the major factors to influence the mobility and accessibility in a city. As a result, demand for infrastructural facilities for parking is increasing. In particular locations of the urban areas, total number of motor vehicles exceeding the total number of heads per

family, the parking scenario is woefully falling short of the current requirements. Tremendous pressure on parking spaces leading to a serious concern on traffic congestion, accidents, unequal demand and supply ratio, environmental hazards etc. There is a need to focus on the common issues and challenges faced by the parking sector in major cities as well as medium sized cities.

**4.4.1 Types of Parking Facilities**

Parking facilities can thus in a major way be divided into two types: On-street and Off-street. These can be indoor and outdoor, public or private. It can be a parking garage, or a parking space that belongs to the property of a person's house. The different types of parking facilities are given below:

**Parking Lot**

A parking lot is an area that is assigned for parking. Normally, the parking spaces are marked on the ground with white or yellow lines that form squares, each of which fit one car.

**Parking Garages**

A parking garage is also called car park, parking structure, parking building, parking ramp or parking deck. There are several types of parking garages:

**(a) Single level parking garage**

A single level parking garage is a parking garage that has only one floor.

**(b) Multilevel or multi-storey parking garage**

Multilevel or multi-storey parking garages are parking garages that have multiple floors to park at. The design of a multilevel parking garage can be very different. The most common design is a garage with ramps to move from one level to another. Parking garages that also use lifts to go from level to level with manual operations. There can also be parking garages with robotic systems that move cars from one level to another. The floors of the parking garage can either go up, down or both.

**(c) Underground parking garage**

An underground parking garage has levels below the surface. Most often underground parking garages are located in city centres and malls, where there's not much space available to build a parking facility.

**(d) Automated parking garage**

This is a multilevel parking facility with an Automated Parking System (APS). The automated parking system will move a car to the available parking space somewhere in the tower. The cars can be moved vertically and horizontally with the use of hydraulic or mechanical lifts. The benefit of a multilevel parking facility with an automated parking system is that more cars can be accommodated in a compact space because the cars are parked by robots, and, no one needs to get in or out of the vehicle.

**(e) Semi-Automated Parking System**

A Semi-Automated Parking System uses a mechanical system to move cars to their parking space. However, it needs a human action to work, either by the driver or an attendant. This action can be as simple as pushing a button.

**Car Ports**

A car port is a covered structure where one or more cars can be parked. Car ports are usually located on people's driveways next to their house. These are private property that comes with the house. Car ports do not have four walls: Normally they only have one or two walls and sometimes they are attached to a wall of the house it belongs to. Car ports offer limited protection from bad weather conditions like rain and snow.

**Parking Spaces on the Side of the Street/Roads**

The spaces that are laid out for the use of parking on the side of the road, where that can be charged or be free, are considered as parking facilities. This usually only happens in residential areas where it isn't crowded.

**Figure 7. Example of On-Ground Parking Lot**

**Figure 8. Example of Automated Parking System Car Stacker)**

#### 4.4.2 Intelligent Transport Systems (ITS) in Parking Facilities

ITS is the application of computer technology where it gathers data about the transport system, processes it, and then uses the processed data to improve the management of the transport system, and/or to provide the transport users with more and better information on which to base their transport decisions. ITS can help transport planners to achieve policy objectives in many different ways. It can help to tackle congestion, pollution, poor accessibility and even social exclusion. It can also help to reduce journey times and improve reliability – either in actuality, or simply by changing people's perceptions. And it can improve the efficiency with which transport systems function. In certain circumstances – for example, Advance Parking Management System

(APMS) and Parking Guidance Systems – it can help to reduce parking search time bringing overall benefit to the society. Sophisticated booking and scheduling software can help to maximise parking space utilisation. Such APMS can be promoted in PPP (Public Private Partnership) mode as there is going to be huge initial investments involved and of course, the recovery can always be made from the benefits generated after implementation.

The benefits of APMS are given below:

- Reduction in travel time, fuel consumed and emissions while searching for available parking space
- Better use of parking capacity due to real-time counting and guidance.
- Efficient circulation due to guidance of vehicles directly to vacant floor or area
- Higher revenues for the parking facilities
- Higher customer satisfaction

### 4.5 Sustainable Urban Transport

With the increase in population, transport demand in terms of private vehicles is continuously increasing in our cities with a growth rate of about 12% per annum. As the city size increases, the share of the public transport is supposed to increase and the share of private transport modes (namely car, two wheelers etc.) should reduce for balanced mobility in the urban area. However, there is always mismatch between supply and demand of transport, causing unbalanced modal splits. Because of that, private vehicle share is continuously increasing and public transport share is decreasing as the city size increases.

**Steps Needed for Sustainable Public Transport Systems**

In order to achieve the sustainability in the public transport systems the following major steps should be considered.

- Quality Enhancement of Public Transport System: Identifying and improving certain parameters of public transport which can

enhance quality of public transport and influence the private vehicle commuters to shift to public transport

- Feeder Transport System for major mode of Public Transport Systems: The last mile connectivity has to be implemented adequately to increase the share of public transport. This should consider accessibility aspects of feeder modes with appropriate infrastructure
- Parking Facilities at major Public Transport Terminals: To attract more private vehicle users towards public transport modes, appropriate parking facilities need to be provided at the public transport terminals
- Intelligent Transport Systems in Public Transport: The Information Systems in public transport would attract the private vehicle users and increase the ridership also. However, it is very important to decide which ITS technology is more appropriate in terms of overall effectiveness and practical feasibility for different objectives of transportation
- Evaluation of Sustainable Transportation System (environment, social, safety and economy): A continuous evaluation system in terms of sustainability should be there in order to quantify benefits from the implemented systems and keep on modifying the policies and parameters to see the effectiveness in terms of sustainability as a whole
- By considering the above steps, the sustainable public transportation systems can be appropriately implemented by the authority's/transport corporations, policy makers etc. The schematic representation of above parameters that are to be considered in achieving sustainability is shown in Figure 9.

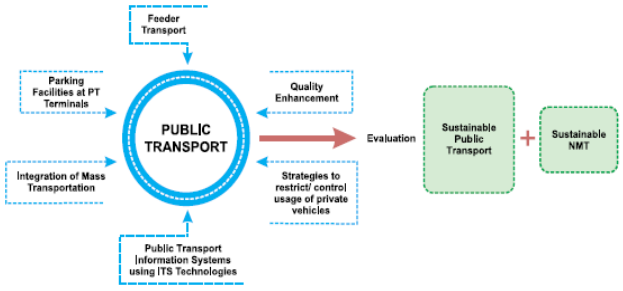


**Figure 9: Proposed Methodology for Achieving Sustainable Transportation System**

### 4.6 Intelligent Transport Systems (ITS)

As mentioned elsewhere too, Indian cities have a tremendous problem of traffic congestion, unpredictable delays due to traffic snarls, consequent increased atmospheric pollution, related road rage problems, enormous waste of man-hours due to the delays, etc. The basic problems behind this scenario arise from: limited land available for good roads, rapidly increasing population, steeply rising vehicle ownerships (4 wheelers and 2 wheelers), increasing shift away from public transport systems, inappropriate mix of road users (powered vehicles, bicycles, carts, cattle, pedestrians, poorly parked vehicles, encroachments, hawkers), culture issues arising from basic indiscipline, etc. Some of the other issues are: lack of real time data on traffic congestions in various locations; traffic congestion due to excessive usage of key corridors by multi-velocity users; grid-locks at intersections due to indisciplined moves of vehicles and accidents; inefficient operations of signals; lack of knowledge of possible alternative routes to bypass traffic congestions; bus passengers not knowing the bus arrival times and travel times; difficulties in locating available parking areas; congestion and delays in Toll booths due to slow process in manual toll collection, etc. Another major problem is serious violations of traffic rules and difficulties of identifying traffic violators in congested junctions and urban roads. Freight movements within urban area is also critical, and ITS for efficiency of freight movement

may be considered for better urban transport environment.

### 4.7 Proposed policy reforms

The ultimate outcome of urban transport policy is how we achieve sustainability in urban transport delivery. Clearly, the problem lies in identifying, implementing and monitoring policy measures that are effective in addressing specific issues in a synchronized and coordinated way by the various agencies involved in urban transport. After a thorough assessment of expert suggestions and review of global best practices, policy interventions that were perceived as potentially effective are further detailed in the following sub-sections:

#### a) Re-aligning legal and regulatory instruments

As mentioned earlier, sustainable urban transport vision in India can occur only through an enabling constitutional and regulatory framework. A comprehensive urban transport act should be enacted by each state defining the roles and responsibilities of the multiple city and state level authorities with regard to public transport, land use and public transport integration, safety, NMT, IPT etc. For this purpose, a model law could be developed by the central government which could be adapted by state governments for their state.

#### b) Institutional Restructuring

Innovative ideas and integrated policies towards sustainable transport need strong supporting institutional and governance structures. Political will, sound leadership, transparency, adequate resources and accountability are essential in timely implementation of effective policy interventions that eventually ensure public trust. Also vital to the entire process are the capacities and professionalism within planning institutions as they create compelling visions of urban futures. Moreover, participatory mechanisms must be in place to ensure that planning and investment decisions are socially inclusive, and engage public in a shared common vision for their city and neighbourhoods.

#### c) Resource Mobilization

For the UMTA or DPC to effectively govern and carry out its mandate of urban transport coordination, access to resources is critical. Resources include access to public finance, skilled and technically qualified pool of man power and relevant and up-to-date data for planning and decision making purposes. Following sub-sections elaborate on these critical resources.

#### d) Planning reforms

NUTP 2006 highlights the intrinsic linkage of transport demand and land use planning, and the need to develop an integrated master plan for each city. An integrated approach to land use and transport planning requires an organic integration of multimodal mobility within a holistic land use system where synergies and interconnections are promoted. For an integrated planning system, it is proposed that the Comprehensive Urban Transport Act should mandate the integrated preparation of the following statutory plans:

- Local Transport Plan (LTP) at the ward level form the most detailed urban transport and land use planning document to be prepared every 10 years and revised every five years (See Box 5). Ward committees should be responsible for preparation of LTPs with support from UMTA. LTPs provide the UMTA with an opportunity to set out studies of, and make recommendations to improve, locations of trip attractors (trip destinations) and residential locations (trip origins), along with a range of demand management and public transport measures, as well as supply measures to provide for balanced use of road space, public transport integration and appropriate patterns and forms of development.

- Comprehensive Mobility Plan (CMP) should be prepared by UMTA and should review the land use patterns in the present master plan and mobility and land use measures proposed in the LTP from the city wide mobility optimisation point of view, and select a preferred pattern of land use and transport integration through engagement with stakeholders and citizens. If the recommendation by the CMP on urban growth pattern differs from the one in the master plan, the CMP recommendation should be reflected in a future version of the master plan. For cities where a master plan is not available, a CMP must be prepared first and used as an input for the preparation of the master plan.
- Master plans should continue to be prepared by the appropriate planning authority as per the Town and Country Planning Act of that state. However, it should be prepared such that the CMP forms an integral part of the master plan and the urban growth patterns in both these statutory plan documents should be in sync with each other. At the operational level, the UMTA should spearhead the preparation of the Comprehensive Mobility Plan for the city as per the standard guidelines framed by the MOUD. It should also provide technical and financial support to local ward committees in the preparation of LTPs. Stakeholder and citizen involvement needs to be an integral part of the whole planning process in all stages of planning to ensure public support for the shared city vision and proposed interventions. On preparation of the CMP, UMTA should be obliged to submit it to DPC or MPC for approval. On its approval, projects in the plan are to be prioritised and implemented by respective executing agencies under strict oversight from UMTA.

## 5. CONCLUSION

Accessibility and urban mobility are critical for promoting sustainable urban economic development in Indian cities. They are also directly connected to urban stock and flows – in terms of spatial development and consolidation of the built form. However, urban mobility has not contributed to desired outcomes owing to car-centric policies adopted by successive plans and projects at the city level. Urban mobility is multi-dimensional in terms of policy and operational implications. Therefore, coherence in policy interventions and linkages among processes are essential. Improved accessibility is neither achieved by adding more roads, rail or vehicles, nor through ad hoc spatial interventions such as traffic management techniques in isolation to achieve delocalization and decongestion. Present urban transport issues such as congestion, road accidents, pollution, etc. cannot be wished away by conventional interventions that favour public funding and investments for private transport instead of public modes of transport More public resources need to be allocated to developing NMT and high capacity public transport infrastructure. It is also important that urban transport sector is treated as an integrated whole through systems financing and pricing. Urban transport systems influence the spatial morphology and configuration of built form of its cities. The paper suggests that sustainable mobility systems in Indian cities can only be achieved when robust, integrated and participatory institutions are created and enabled through clear responsibilities, legislative authority, financial independence and professional competence to effectively enhance accessibility of our cities. Most importantly, mechanisms for transparency, oversight and accountability of such institutions towards its people need to be ensured. The

following are some of the key points to improve urban transport system. They are

1. An all-India cadre should be set up consisting of Traffic & Transportation personnel, including ITS experts in various fields (planning, IT, utilities, mechanical systems, etc.) for faster and more efficient delivery.
2. Considering the vital importance of metro rail development for easing out the urban traffic problems, it is imperative that this is provided with greater independence rather than being encumbered by the norms, practices and controls of the conventional railway systems.
3. National-level policies, to drive the multi – modal transport environment, will have to be framed for, promoting and implementing expeditiously in a planned manner, integrated Public transportation systems such as metros and BRT, with special provisions for NMT (bicycles and pedestrians etc.) for various urban centres.
4. A policy be framed to enable the setting up of a National database of all motorised vehicles covering smart number plates and all driving licenses adopting smart card driving licenses, etc., and, real time traffic accident data capture and management.
5. Automation to be introduced into Toll Collection, Traffic Control Systems including detection of traffic offences and issue of challans, besides the development of a City Traffic App for multi-modal transport system in a city, giving map-based information for transit from point A to point B across all available systems.
6. IRC codes should permit necessary deviations in geometrics and loading standards to be applied judiciously for urban situations, which call for it.
7. In order to facilitate appropriate planning of infrastructure for Urban Transportation, it is imperative that the space in cities, both above and below ground, is surveyed and accurately mapped in the digital mode, to be available to planners and the engineering organizations.
8. Implementation and functioning of Unified Metropolitan Transport Authority (UMTA) and Urban Transport Fund (UTF) and integration in urban transport development. Furthermore, it is imperative that the Government of India consider for legislation in the form of the Urban Transport Act to strengthen UMTA and its implementation in the states.
9. A nationwide drive to improve safety on the road has to be taken up in a comprehensive manner, involving all the stakeholders, through appropriate media campaigns, etc as the safety statistics are very alarming and getting worse day by day.

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