TRIPP BULLETIN
VOL 11 NO.3 WINTER 2014
TRANSPORTATION RESEARCH & INJURY PREVENTION PROGRAMME
INDIAN INSTITUTE OF TECHNOLOGY DELHI

Research & Consultancy Projects

Sustainable urban transport in less motorised countries: research and education

Sponsor: *Volvo Educational Research Foundations, Sweden*
Project team: *Dinesh Mohan, Geetam Tiwari, Anoop Chawla, Sudipto Mukherjee, S.R.Kale, Sanjeev Sanghi, Puneet Mahajan, Niladri Chatterjee*
Objective: To develop resources and expertise in the control of adverse health effects of road transport in as integrated a manner as possible and wide dissemination of this knowledge. This process involves: (a) prevention of pollution or crash from taking place; (b) controlling the effects of emissions and minimizing injuries once people use motorized modes and crashes occur; and (c) management of adverse health effects when they do occur.

Establishment of Centre of Excellence (CoE) in the area of urban transport

Sponsor: *Ministry of Urban Development, Government of India*
Project team: *Coordinator TRIPP*
Objective: The CoE will form part of a collaborative network set up by Ministry of Urban Development in support of its programme on urban transport at the national level. The Centre will participate in the strengthening of country resources, in terms of information, services, research and training.

Pedestrian safe public transport systems: infrastructure, operations, vehicles, policies and legislation

Sponsor*: Volvo Educational Research Foundations, Sweden*
Project team: *G. Tiwari, S.Mukherjee, N.Bolia, A.Chawla, K N Jha, D.Mohan, S Sanghi, P. Mahajan, N. Chatterjee, K.R.Rao*
Objective: (I)Develop pedestrian accessibility assessment tools and demonstration projects to assist city authorities and public transport companies to identify priority location for creating safe and comfortable pedestrian access to public transport stops. (II). Develop city, state and central level legislation to ensure implementation of pedestrian priority designs and traffic management strategies. (III) Develop road map for pedestrian compliant safety standards for vehicles in consultation with the automobile industry.

Estimation of emissions and fuel consumption of in-use vehicles in different driving conditions

Sponsor: *Petroleum Conservation Research Association (PCRA), India.*
Project team: *Geetam Tiwari, Dinesh Mohan and S.R. Kale*
Objective: Estimation of emissions and fuel economy on the basis of an average Indian driving cycle amongst different city sizes both in terms of infrastructure design and modal shares, and estimate emissions and fuel economy of different vehicles which are operating in this environment. A detailed methodology to document variation in traffic environment in a city (Delhi), and a methodology to select vehicles representing the vehicular fleet of the city will be developed. Vehicles thus selected will be tested on a vehicle dynamometer to estimate emissions and fuel economy. The project is expected to assist in better estimates of vehicular emissions in cities. It will also assist in estimating the impact of various traffic management strategies on vehicular emissions and fuel economy, and thereby help authorities in meeting local, national and international goals of emissions, fuel economy and ambient air quality.

Safety assessment and risk management for Patna river front development project

Sponsor: *Bihar Urban Infrastructure Development Corporation.*
Project team: G. Tiwari, D.Mohan, K.N.Jha, K.R. Rao and G. Agrawal
Objective: (i) Safety assessment demonstrating the carrying capacity of the proposed riverfront design and its accesses with the projected demand, analysing structures and accessibility
(ii) Preparation of guidelines to be followed during operation of the river front to manage risks and safety hazards
(iii) Development of a risk management plan based on crowd modeling(movement and gathering of people under different scenarios) exercise to predict crowd movement during festivals.

Estimating risk to road users & impact of active traffic calming measures on vehicular speed in highway work zones

Sponsor: *Road Traffic Injuries Research Network, Mexico.*
Project team: *Geetam Tiwari*
Objective: The focus of this study is safety of workers and road users especially vulnerable road users (pedestrians, bicyclists, motorcyclists, etc.) present on highway work zones in India which includes the activities of Pillar 2 “Safer Roads and Mobility” considered under road safety as described in the Decade of Action Plan.

The proposed study aims at contributing to the development of guidelines for controlling speeds at highway work zones. The objectives of the study are: 1) to determine the speed characteristics of vehicles in highway work zones before and after the installation of active traffic calming measures. 2) to determine the characteristics of and distribution of fatal crashes within highway work zones and risk to workers and road users and compare the differences of the distributions of work zone crashes and non-work zone crashes.

Promoting low carbon transport in India

Sponsor: *UNEP Risoe Centre, Technical University of Denmark, Denmark.*
Project Team: *Geetam Tiwari, Dinesh Mohan, K.R. Rao, Ambuj Sagar and S.R. Kale*
Objective: Create an enabling environment for coordinating policies at national level to achieve a sustainable transport system. The Project would assess the policies and actions that align climate policies and transport investments by developing “Transport Action Plans (TAP)” in cooperation with multiple stakeholders including industry associations, financial agencies and the different ministries of the Government of India.

Study of community design for traffic safety in India

Sponor: *International Association of Traffic and Safety Sciences, Japan*
Project team: *Dinesh Mohan, Geetam Tiwari and Sudipto Mukherjee*
Objective: 1. To study the epidemiology of road traffic injury (fatal) patterns in six cities of India differentiated by population size and high and low rates of fatalities per unit population. 2. To understand the modal share of victims and vehicles involved in crashes and to estimate risk functions associated with different road users. 3. To obtain a preliminary understanding of road design from an engineering perspective, design of the built environment from a land-use perspective, and community design in a broader sense for control of road traffic fatalities in urban areas. 4.To suggest areas of detailed research for future studies.

Driver behavior study in India

Sponsor: *Nissan Motor Co Ltd., Japan.*
Project team: *Dinesh Mohan, Geetam Tiwari, Sudipto Mukherjee and Subhashis Banerjee*
Objective: 1.To understand driver behaviour characteristics in India to help introduce advanced driver assistance systems. 2. Clarify acceptance and characteristics of the systems that are under development and would be introduced to India. 3. Extract features of peculiar driver behaviour and seek opportunities of unique support function for India.

The **Transportation Research and Injury Prevention Programme (TRIPP)** at the Indian Institute of Technology Delhi, is an interdisciplinary programme focussing on the reduction of adverse health effects of road transport. TRIPP attempts to integrate all issues concerned with transportation in order to promote safety, cleaner air, and energy conservation. Faculty members are involved in planning safer urban and inter-city transportation systems, and developing designs for vehicles, safety equipment and infrastructure for the future. Activities include applied research projects, special courses and workshops, and supervision of student projects at postgraduate and undergraduate levels. Projects are done in collaboration with associated departments and centres at IIT Delhi, government departments, industry and international agencies.

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Excerpts from:

ASSESSMENT OF MOTOR VEHICLE USE CHARACTERISTICS IN THREE INDIAN CITIES: *Promoting Low Carbon Transport in India project, June 2014*

Dinesh Mohan, Rahul Goel, Sarath Guttikunda and Geetam Tiwari

Globally, fuel efficiency of vehicles is taking centre stage within the context of climate change, public health, and reducing dependence on oil. In India, efforts are underway to formulate fuel efficiency standards for cars. In this regard, this report gives an account of fuel efficiency and other vehicular characteristics of the existing fleet in India. This information forms an integral part of understanding the status of the current fleet, as a base case. This report presents case studies of three cities in India – Delhi (the capital city),Visakhapatnam in Andhra Pradesh, and Rajkot in Gujarat. Vehicular characteristics estimated include age distribution, annual mileage driven and number of in-use vehicles. For this, surveys have been carried out at fuel stations in the three cities. Age distribution of cars and motorised two-wheelers (MTWs) in the three cities show that more than two-thirds of the vehicles are less than 5 years old, and almost all of the vehicles are up to 15 years old– with an average age of less than 5 years.

Estimates of average annual mileage show that they are different for the three cities. The estimated average annual mileage (+ 95% confidence interval) of cars in Delhi is 12,199 ± 435 km, and the average annual mileage of MTWs in Delhi, Visakhapatnam and Rajkot are 12,804 ± 349 km, 9,238 ± 576 km and 7,255 ± 325 km, respectively. When classified by model years, data from the three cities show that the annual mileage of cars and MTWs reduce non-linearly with increasing age, following alogarithmic or exponential function. In the case of cars, the average annual mileage reduces by 42% in the initial 10 years, and in the case of MTWs, it reduces by 30-45%.

Average fuel efficiency of petrol cars in the three cities varies from 14.9 to 16.2 km/L. For diesel cars, the fuel efficiency varies from 16.3 to 17.4 km/L for engine displacement less than 1,600 cubic centimetres (cc), and 10.8 to 11.9 km/L for engine sizes greater than 1,600 cc. For MTWs, the range of fuel efficiency is 48.5 to 52.3 km/L. It is estimated that the actual number of inuse cars in Delhi lies in the range of 51-59%, while for MTWs the range is 40-45% of the total registered vehicles in their respective categories in the year 2012. The proportions of in-use MTWs in Visakhapatnam and Rajkot are 44%and 51%, respectively.

The vehicular fleet in Indian cities is much younger than in richer nations of the European Union and in the US, where the average age of cars is 8 years and 11 years, respectively. Data from Delhi and Rajkot indicate that average fuel efficiency of MTWs is reducing for the newer model years, possibly due to the induction of high-powered motorcycles in the fleet. In the case of cars, the data shows that the penetration of bigger cars is reducing the fuel efficiency of the diesel car fleet. Estimates of in-use vehicles from the three cities show that the cumulative registration number of vehicles from government sources overestimates the existing fleet of cars and MTWs by 100% and 150%, respectively.

The fuel efficiency of new cars in India is up to 20-30% more than the global average, owing to its high share of small cars. In addition, India has the lowest average weight of vehicles in the world, based on a study by Global Fuel Economy Initiative. The high growth rate of vehicles, in Indian cities, with a comparatively smaller existing fleet means that fuel efficiency standards will have their desired effect at a much faster rate than most developed economies of the world. It is estimated that, due to the high growth rate of vehicles, the replacement rate of fleet is also high. As a result, when implemented in India, new fuel standards will lead to 90% of vehicles conforming to those standards within 15 years.

The number of cars sold in India during the period of 2001-2011 was three times that of the 1991-2001 period. Consequently, household ownership of cars has increased from ~6% in 2001 to ~10% in 2011, (Census-India, 2012) which is still low compared to other high-income settings in the world. In India, the national import dependence for petroleum has reached more than 70%, which leads to a heavy economic burden, and vulnerability to international economics. According to the World Health Organization (WHO, 2011), India has 27 of the 100 most polluted cities in the world, of which 4 are in the top 10. Similar economic burdens and climate change issues are being experienced by many countries around the world, due to automobile use, especially those with high motorization rates. Since emissions are directly influenced by the fuel efficiency of vehicles, it has a central role in climate change mitigation strategies and reducing health effects, as well as economic burdens on national economies. In this context, the issue of fuel efficiency standards has been gaining increased attention in various settings around the world.

Internationally, many countries (including the four largest automobile markets–the United States, European Union, China and Japan) have adopted more stringent fuel efficiency standards to promote fuel-efficient vehicles, and India has started the process of doing so.

In order to set standards for fuel efficiency, there needs to be assessments of it in the current fleet, as a base case. Since the final objective is to reduce the total fuel consumed, to estimate the total consumption there is also a need to estimate vehicular usage and share of fuel type (petrol, diesel, CNG, LPG). In India, the only sources for obtaining fuel efficiency values for vehicles are the figures published by auto manufacturers. These are based on estimates using laboratory-based standard driving cycles, which do not necessarily reflect the real-world values. Studies from around the world have established that there is a significant gap between real-world and laboratory values of fuel efficiency of vehicles, which can be more than30%, expressed as percentage of real-world value. The gap varies over different settings, which is due to differences between laboratory and on road conditions such as driving patterns and use of vehicle accessories.

There are currently no studies available in India to estimate fuel efficiency of in-use fleet and respective vehicle usage. This study was conducted to determine on-road values of fuel efficiency for private motorized vehicles, along with other vehicular characteristics, which are necessary for obtaining estimates of fuel consumption by different vehicle types.

The issue of fuel efficiency (expressed as kilometres per litre, unless otherwise noted) of vehicular fleet in a setting can be largely classified in two parts. First is the fuel efficiency of new vehicles, which are being added to the existing fleet. Fuel efficiency of such vehicles will depend on the availability of the latest technology in the market, the prevailing preference of vehicle characteristics by the consumers, and other vehicle standards applicable for a setting. Second is the average fuel efficiency of in-use fleet, which is a more complex estimate as it is dependent on the characteristics of vehicle models sold in the past.

This also needs to account for the degradation in fuel efficiency, which occurs due to the usage of vehicles over a period of time. In terms of available information, the former is much easier to obtain, and will be

discussed later. This information is readily available (though highly inaccurate) from sources like auto manufacturers or other regular publications, such as Auto car and web-based sources like Carwale.com. By weighing the fuel efficiency values with the sales share of different models, an estimate of fuel efficiency can be obtained for new fleet. By contrast, information for the latter is much more difficult to acquire, and needs to be estimated using user surveys or laboratory tests of a representative sample of vehicles in the existing fleet.

It could be argued that fuel efficiency standards maybe one of the factors influencing the fuel efficiency of a new fleet. However, to conform to the standards, auto manufacturers will eventually make changes in one of the above-mentioned factors. In order to estimate the fuel efficiency of a new fleet, it is a common practice to use values provided by auto manufacturers and weigh those values by the respective sales shares of vehicle models. However, numerous studies from around the world have shown that values provided by manufacturers, which are essentially the values obtained from laboratories using a designated driving cycle, are significantly higher than the real-world fuel efficiency experienced by in-use vehicles. For settings such as the US, Canada and Western Europe, Schipper and Tax (1994) estimated the gap to be up to 30% of the actual value during the late 1980s. Dutch and German studies estimated this gap to be 10% and 17%, respectively, in the late 1990s (Zachariadis, 2006).

Among the latest studies is the one from China (Huo et al., 2011), which compared the laboratory and real-world fuel efficiency (expressed as litres per 100 km) of 153 car models with a sample of more than 60,000 vehicles, and found that 80% of car models have a gap of 0–30%, and that 66% have a gap of 5–25%.The study also found that the gap grows with increasing difference between the average real-world speed and speed of driving cycle. It is noteworthy that, when expressed in kilometres per litre, the fuel efficiency gap, as a percentage, is higher than when it is expressed in litres per 100 km. Schipper and Tax (1994) discussed five different factors which may be responsible for the difference between laboratory and on-road actual values of fuel efficiency.

It should be understood that for a given fleet, fuel efficiency alone is not sufficient to understand the complete picture. This is because the measurement of fuel efficiency is eventually used to estimate demand of automobile fuels. To forecast this demand, there is a need to assess various vehicular characteristics, which either influence fuel efficiency or the estimate of total fuel consumption. Currently, passenger cars use four different fuels (petrol, diesel, CNG and a small share of LPG), while two-wheelers are mostly petrol driven – and both cars and two-wheelers have an almost negligible share of electric vehicles.

Based on the fuel used, the fuel efficiency of different vehicles varies significantly from one another, and the shares of fuels are changing rapidly over time due to the changing prices and preferences of consumers, and the availability of CNG. Age is another major factor that influences fuel efficiency of vehicles – which reduces with increasing age.Total distance travelled, usually expressed as the distance travelled per year and referred to as annual mileage in this study, is directly related to total fuel consumption. To understand the energy intensity of distance travelled and the effectiveness of fuel efficiency standards, the annual mileage should also be classified by the age of the vehicles as well as the fuel type.

This report presents vehicular characteristics from three cities in India. Delhi is one of three cities in India with a population of more than 10 million (the others are Mumbai and Kolkata), while Visakhapatnam and Rajkot are of the 34 cities with a population between 1 to 2 million (Census of India, 2011). In Rajkot and Delhi, CNG is used by passengers, as well as freight based three-wheeled scooter rickshaws and other public transport vehicles, while both types run on diesel in Visakhapatnam. Of the three cities, Visakhapatnam has no CNG vehicles.

In order to estimate the existing patterns of vehicle use in the three cities, there needs to be estimations of fuel efficiency, distance travelled (in terms of annual mileage), age distribution, as well as an estimate of the number of in-use vehicles in each city. The number of registered vehicles in Indian cities is reported to be an overestimation, as it does not take into account vehicles that have been retired or are not in use. The following is a description of the transportation scenario in the three cities.

Delhi is not only intra-city but also has a significant share of inter-city travel because of the growth of satellite cities around it. During the last three decades, the population of its satellite cities – Ghaziabad, Faridabad, Gurgaon and Noida – grew seven times, reaching 5.3 million in 2011. This region has expanded to become one large agglomeration with a total population of ~22 million, giving rise to a high demand for travel in between these cities.

Visakhapatnam is a coastal city on the eastern coast of India. It is the second largest agglomeration in the state of Andhra Pradesh. Apart from being a major port city, it is primarily an industrial hub (steel, petroleum refining and fertilizer) providing a significant share of the city's employment in this sector. Public transportation in the city is provided by the state-run APSRTC, which runs buses within the city as well as to surrounding areas. In addition, public transportation in the city is served by para-transit modes, constituting mainly of auto-rickshaws.

Rajkot is the fourth largest city in the state of Gujarat. Within the city, travel is largely dominated by private vehicles, while public transportation is provided by para-transit modes – auto-rickshaws – operated by private owners.

1. A high growth rate of vehicles in Indian cities with a comparatively smaller existing fleet means that fuel efficiency standards will have their desired effect at a much faster rate than most developed economies of the world. It is estimated that fuel standards, when implemented in India, will lead to 90%of vehicles conforming to those standards within the next 15 years.

2. Various studies from different parts of the world (none available from India) have found a wide gap between the real-world and laboratory-based values of fuel efficiency of vehicles. The reported gap reaches up to 30%of the real-world value. With such a gap, the use of laboratory-based values, provided by auto manufacturers to estimate the baseline fuel efficiency of vehicular fleet, will overestimate the actual fuel efficiency.Therefore, there is an urgent need to carry out user surveys in Indian cities, in order to take stock of the current fleet – in terms of fuel efficiency and vehicle usage. While most countries have studies quantifying the gap, efforts in this direction are pending in India. In order to be able to ascertain efficacy of standards, these efforts need to be carried out and repeated at regular intervals.

3. Technological advances for internal combustion engines are promising to bring about a significant change in the fuel efficiency of vehicles in the near future.

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News

Does walkability matter? An examination of walkability's impact on housing values, foreclosures and crime

John I. Gilderblooma, William W. Riggsb, Wesley L. Mearesc. *Cities, Volume 42, Part A, February 2015, Pages 13–24*

In this study, researchers examined 170 neighborhoods in a medium-sized city to see whether walkability influences neighborhood sustainability. Until 2008, there had not been a reliable measure of the social, health, and economic impact of walkable neighborhoods. This dramatically changed when scholars were able to quantify walkability with tools such as Walkscore™; which measures how accessible daily living activities are by foot. The researchers investigated how walkability impacts the quality and sustainability of a neighborhood. They developed models that evaluated the correlation between an area's Walkscore™ and four broad measures of urban sustainability: neighborhood housing valuation; foreclosures; and crime. Our analysis shows a positive impact not only on neighborhood housing valuation but also on neighborhood crime and foreclosure. These results provide policy opportunities for planners and citizen groups to pursue strategies to encourage the development of more walkable and sustainable neighborhoods.

Global, regional, and national age–sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013

GBD 2013 Mortality and Causes of Death Collaborators, *Lancet, Volume 385, No. 9963, p117–171, 10 January 2015*

We estimated age-sex-specific all-cause mortality using the GBD 2010 methods with some refinements to improve accuracy applied to an updated database of vital registration, survey, and census data. We generally estimated cause of death as in the GBD 2010… Global life expectancy for both sexes increased from 65.3 years (UI 65.0–65.6) in 1990, to 71.5 years (UI 71.0–71.9) in 2013, while the number of deaths increased from 47.5 million (UI 46.8–48.2) to 54.9 million (UI 53.6–56.3) over the same interval. Decomposition of global and regional life expectancy showed the prominent role of reductions in age-standardised death rates for cardiovascular diseases and cancers in high-income regions, and reductions in child deaths from diarrhoea, lower respiratory infections, and neonatal causes in low-income regions. Global deaths from injury increased by 10.7%, from 4.3 million deaths in 1990 to 4.8 million in 2013. Most global road traffic deaths occur in low-income and middle-income countries and are rapidly increasing because of the growth in motorisation. Mortality rates caused by traffic-related injuries are increasing in low-income and middle-income countries. Pedestrians are most often affected, followed by car occupants and motorcyclists. Road injuries rank 5th in years of life lost due to different causes in 2013.

Outcomes After Out-of-Hospital Cardiac Arrest Treated by Basic vs Advanced Life Support

Prachi Sanghavi, Anupam B. Jena, Joseph P. Newhouse, *Alan M. Zaslavsky. JAMA Internal Medicine, 2014*

Most out-of-hospital cardiac arrests receiving emergency medical services in the United States are treated by ambulance service providers trained in advanced life support (ALS), but supporting evidence for the use of ALS over basic life support (BLS) is limited. This study was done to compare the effects of BLS and ALS on outcomes after out-of-hospital cardiac arrest… Survival to hospital discharge was greater among patients receiving BLS (13.1% vs 9.2%for ALS; 4.0 [95%CI, 2.3-5.7] percentage point difference), as was survival to 90 days (8.0% vs 5.4%for ALS; 2.6 [95%CI, 1.2-4.0] percentage point difference). Basic life support was associated with better neurological functioning among hospitalized patients (21.8%vs 44.8%with poor neurological functioning for ALS; 23.0 [95%CI, 18.6-27.4] percentage point difference). Incremental medical spending per additional survivor to 1 year for BLS relative to ALS was $154 333. Patients with out-of-hospital cardiac arrest who received Basic Life Support had higher survival at hospital discharge and at 90 days compared with those who received Advanced Life Support and were less likely to experience poor neurological functioning.

International Course

The Transportation Research and Injury Prevention Programme (TRIPP) at the Indian Institute of Technology, Delhi organized a seven day International Course on Transportation Planning and Safety from 30 November - 07 December 2014 at the Indian Institute of Technology Delhi. The course was co-sponsored by the Volvo Research and Educational Foundations, Ministry of Urban Development, Ministry of Road Transport and Highways,and Bajaj Auto Ltd. The course (an annual feature for the last 24 years), was attended by 95 participants faculty from 7 countries. The faculty members included Christer Hyden(Lund University, Sweden), Dinesh Mohan (IIT Delhi), Geetam Tiwari (IIT Delhi), Girish Agarwal (IIT Delhi), Hermann Knoflacher (Technical University of Vienna, Austria), Jac Wismans (Chalmers University, Sweden), Janusz Kajzer (Chalmers University, Sweden), Karin Brolin (Chalmers University of Technology, Sweden), Kavi Bhalla (Johns Hopkins School, USA), K N Jha (IIT Delhi), Mathew Varghese (St. Stephen's Hospital, Delhi), Puneet Mahajan (IIT Delhi), R.R. Kalaga (IIT Delhi), Shrikant Bangdiwala (University of North Carolina, USA), Sudipto Mukherjee (IIT Delhi), Sylvain Lassarre (IFSTTAR, France).

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A TRIPP Bulletin Insert

Excerpts from the Transport Discussion Series

Background

City transport affects our lives in many ways. We are dependent on transport systems to participate in various activities spread over different parts of the city and in different time periods. How people choose to travel in cities is dependent on individual characteristics but also to a large extent on the physical and operational environment created by public policies. Amongst the high income households in Delhi, very few people walk or use bicycles for short trips because walking and bicycling infrastructure is of poor quality and perceived to be unsafe. Today, with just 8% trips in cars, the city roads are 'congested'. More than 50% of the traffic fatalities involve pedestrians. Delhi is rated as one of the most polluted cities in the world. The modes of transport which are considered good for our health and environment-walking, bicycling and public transport are being used by 'captive' users.

Transportation Research and Injury Prevention Programme (TRIPP) at IIT Delhi in collaboration with India Habitat Centre (IHC)) is organizing a six session Transport Discussion Series – 2014. This discussion series is aimed at raising some of these important issues concerning transport systems of Delhi. Insights from the discussions will be compiled as a strategy summary for the city transport authorities and road engineers to enable speedy adoption of a 'sustainable and healthy transport system'.

Exhibition

The exhibition started with a welcome address from Mr. Rakesh Kacker, India Habitat Centre. Mr. K.T.S Tulsi, Member of Parliament, Rajya Sabha, was the chief guest of the day. Prof Geetam Tiwari gave a summary presentation of the six discussions and their highlights. It was followed by an interactive session moderated by Prof. Dinesh Mohan, IIT Delhi. The panel also included Mr. Abhijit Sarkar and Mr. P.K.Tripathi and Mr. Shishir Bansal. Power presentations were done by the exhibition participants. The invited speakers were A.B.Lal Architects, SGArchitects, Oasis Design, Institute for Democracy and Sustainability, Delhi Integrated Multimodal Transit Systems, Centre for Science and Environment and Centre for Green Mobility.

The second day showcased street plays and short films on subjects addressing mobility, air pollution and liveable cities. It was followed by a panel discussion moderated by Ashok B Lall with eminent panelists which include Mr. O.P.Agarwal, Mr. Ashok Srinivasan and Mr. Prasun Latant. The discussion focused upon the projects showcased in the exhibition.

Discussion 01: City and Transport Vision

Chair: Prof. K.T. Ravindran
Panelists: Dunu Roy, Hazard Center and
Anjali Aggarwal, Samarthyam

The primary theme of this event was to decode and assess the transport related provisions made by the city authorities in the official Master Plan for Delhi-2021.

Discussion Points

- Can the master plan address the strong relationships between 'shelter - transport - livelihoods'?
- Is the projected modal share of 80:20 (public vs private) achievable with the current transport policies?
- The kind of city we plan for and the paradox of universal mobility.
- Will the guidelines given in the Master Plan ensure equitable expenditure on infrastructure and distribution of road space?
- Can the policies in the Master Plan address the grave environmental issues raised by IPCC?

Issues raised / Solutions Suggested

- Delhi follows a top-down approach for the master plan preparation and therefore, is not inclusive.
- Car-centric planning vs NMT and public transport centric planning
- Universal mobility for the disabled as well as persons with reduced mobility (comprising elderly, children)
- MRTS can't work in isolation, needs to be supplemented with BRTS and efficient access/egress systems.
- Constructing more roads and flyovers will not ease congestion.

Discussion 02: Transport and Health

Chair:Dr. Mathew Varghese, St. Stephen's Hospital
Panelists: Anumita Roy Choudhury, CSE
Sarath Guttikunda, Urban Emissions.info

Delhi has the worst air quality amongst the major world cities. Vehicular emissions are major contributor to the worsening air quality. The Delhi government has implemented several measures yet the pollution levels have continued to worsen. Transport emissions and dependence on motorized transport is contributing to poor health. Is this trend irreversible?

Discussion Points

- Technological, infrastructural and regulatory provisions for reducing air pollution from transport.
- Is the 'pollution under control' program effective?
- Did flyovers and road widening help in reducing emissions from transport?
- Why aren't Indian authorities using WHO recommended air quality standards?
- How can we increase walking, cycling, and the use of public transport ?
- What can be done to reduce private vehicle usage?

Issues raised / Solutions Suggested

- Conversion to CNG vehicles was a regulatory recourse. Do we need the same for all pollution mitigation interventions?
- The problem of air pollution is not restricted to major cities.
- The latest fuel efficiency and vehicular standards are needed at the earliest.
- Designated transport hubs/nagar and rest area for trucks are needed along highways to avoid driver fatigue related crashes.
- Active modes of travel (NMT) and PT above can provide a sustainable solution to the problem.

Discussion 03: Returning Streets to People

Chair:K.L.Thapar, Asian Institute of Transport Development
Panelists: Parthaa Bosu, Clean Air Asia
Pradeep Sachdeva, PSDA

A majority of trips in Indian cities are made by walking accounting for 30 – 40% of the total trips made in million plus cities. Even if we commute by car, metro or bus we are still pedestrians for some part of the trip. Limited investment has been done by city authorities in pedestrian friendly infrastructure in Delhi. Footpaths in Delhi are mostly not usable and often encroached upon by parked vehicles, other modes, street vendors and garbage dumps.

Discussion Points

- Who walks in Delhi? Is it the urban poor? Are their voices heard?
- What are the barriers faced in implementing UTTIPEC guidelines?
- BRT provides for adequate pedestrian and NMT infrastructure. Still it is opposed, Why?
- Can we make Delhi walkable in the next 10 years?

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Continued from overleaf:

- Is the auto industry playing a role in determining policies related to fuel subsidies and extra user charges for private vehicles?
- How can we ensure safe and comfortable pedestrian crossings in Delhi? Pedestrian do not prefer subways and foot-over bridges.

Issues raised / Solutions Suggested

- Delhi streets and people – is it related to design, policies, regulation or the culture itself?
- Streets are meant for people and not cars.
- More people will walk if we provide footpaths, and they'll use bicycles if we ensure their safety.
- Car parking on footpaths – an accepted way of encroachment whereas vendors are termed illegal and penalized.
- People always respond to the system, but why does the system not respond to the pedestrians and bicyclists?

Discussion 04: Safety Sustainability and Future Urban Transport

Chair: Nitin Desai , TERI
Welcome:Siddhartha Lal, Eicher Motors
Introduction:Dinesh Mohan, IIT Delhi
Panelists: Amitabh Kant, Dept of Industrial Policy & Promotion
Romi Khosla , Romi Khosla Design Studio

The discussion focused on the book "Safety Security & Future Urban Transport" which includes articles from groups of experts belonging to very different fields on issues of future urban transport from a variety of viewpoints. The dominant theme is how the city and street structure contribute to objective and subjective perceptions of safety for everyone living there.

Discussion Points

- How can we get cohesive, socially responsible self-sufficient communities in urban areas – where they are being used as transit point and not as an end?
- Are there any examples of changes happening due to change in context and design?
- Why are we only focusing on street crime, while the crime in general in society is a larger perspective problem and dependent upon many socio-political characteristics of the system?
- Big city model is replaced by smaller and manageable city models. Should it be a top down approach or should it be a public movement?

Issues raised / Solutions Suggested

- The concept of crime prevention through environmental design (CPTED).
- Internationally, urban centres are moving towards compact cities with mixed land use favouring NMT.
- Close proximity to work, education and health infrastructures are indicators of success in community planning.
- Community participation, good governance and an acute sense of pride resulting from successful urban planning.
- We need a strong and ethical system of documenting, recording feedback, and regular updating of data thus acquired.

Discussion 05: Bicycling in Delhi

Chair:Sunita Narain, Centre for Science and Environment
Panelists:Rajendra Ravi, Instt. of Democracy and Sustainability
Sandeep Gandhi, SGArchitects

The discussion focused upon the state of cycling in the city, the problems faced by captive cyclists and the steps that can be taken to make Delhi cycle friendly. Cycle traffic constitutes upto 15% of the total traffic and they are present on all roads including arterials and sub-arterials. Cyclists include bicycles, passenger and goods rickshaws. Provision of a safe and attractive network of cycle infrastructure is of the utmost importance.

Discussion Points

- Does Delhi have a plan to make roads bicycle friendly? How can we provide a bicycle lane network on existing corridors?
- Why are our cities becoming more unfriendly and unsafe to cyclists and pedestrians? What steps can be taken to move our cities in the right direction?
- How can we create a network of existing cycle corridors?
- How can we provide safe bicycle routes to schools?
- Cycle tracks or additional Car-parking – The BRT experience and ensuring cyclist's right of way.
- What changes can be done in design which will help change aspirations?

Issues raised / Solutions Suggested

- Bicycling must include passenger rickshaw as well as goods rickshaw or the cycle rickshaw trolley.
- While 5-15% of the people use cycle rickshaw, it provides a livelihood to 24% of the population.
- Arterial roads having wide ROW i.e greater than 45m. They can be easily retrofitted with bicycle lanes (two phases and a total of 330 Km).
- The equitable distribution of road space and the reduction in vulnerable road user (VRU) fatalities are two prime concerns of the authorities.
- Removing encroachments from existing 50 km cycle tracks and footpaths requires active public participation.

Discussion 06: Moving People out of Congestion

Chair: Shri Bhure Lal, Chairman, EPCA
Panelists: A.K. Roy, Hazards Centre
M Ramsekhar, DIMTS

The discussion focussed on the current state of congestion on Delhi streets on what could be the strategies to move people out of congestion. It is estimated that Delhi has built over 90km of grade separated roads (flyovers or underpass) over the past 30 years; however the congestion levels have kept increasing and current peak hour average speeds in the city are less than 20km/h. This brings out the futility of congestion solving efforts, and need to focus on solutions for moving people out of congestion and not vehicles.

Discussion Points

- How can we provide exclusive right of way for buses? Why is it important?
- How can we make more people use public transport & NMT?
- Can we integrate the planning of bus and bicycle infrastructure with metro corridor planning?
- What best practices can be adopted to ensure that emergency vehicles take the least possible time to travel?
- Overall road planning and engineering is poor and does not support public transport.
- Woman cannot access public transport easily. Cluster buses are not disabled friendly and women safety continues to be an issue with cluster bus operations.

Issues raised / Solutions Suggested

- Buses are and will remain the backbone of public transport; the Metro system is very expensive to build and maintain.
- Shortage of buses needs to be taken up on a priority bases. Semi-low floor buses still pose a challenge in terms of accessibility.
- If the current trend continues, till 2021, the car usage will increase by 106% and bus ridership will decrease by 28 %. • DIMTS has managed to bring about 1000 cluster buses in services though the requirement is for 4000, owing to lack of parking space availability.
- Larger goals of climate change etc should be given priority over narrow personal interests.