TRIPP
TRANSPORTATION RESEARCH AND INJURY PREVENTION PROGRAMME

EIGHTEEN YEARS (1997 - 2015)

INDIAN INSTITUTE OF TECHNOLOGY
WHO COLLABORATING CENTRE
Contents

Transportation Research and Injury Prevention Programme 1
The Faculty 2
Institutional Cooperation 7
Recognition 8
Endowed Chairs 9
Sponsors 9
Research Areas 10
Projects: Completed 18
Projects: Ongoing 23
Ph.D : Completed 26
Ph.D : Current 27
M.Tech.: Completed 30
Seminars, Symposia and Workshops 35
Media and Communication 41
TRIPP Annual Lectures 43
Collaboration 44
Capacity Building 48
Research Papers 52
Books and Monographs 69
Transportation Research and Injury Prevention Programme

Genesis

The Transportation Research & Injury Prevention Programme (TRIPP) at the Indian Institute of Technology Delhi (IITD) began life in 1997 when it was discovered that many faculty members in different departments of IITD were working separately on transportation related issues in their individual capacities. Their strength was their expertise and commitment. Their weakness: absence of synergy among them and insufficient impact of their work on the society around them.

We combined our resources to develop a concept paper for the establishment of TRIPP and circulated it to national and international researchers, senior government officials, industry executives and international and non-government officials and organisations. Their comments were consolidated into a vision document and it was used to raise endowment and infrastructure funds from the Government of India, industry and other sources. With the seed money in place, TRIPP was established as an Interdisciplinary Programme of IITD at 1997.

Vision

The shared vision of researchers at TRIPP is to produce knowledge that addresses the unique transportation issues in less motorised countries. An effort to set up a system of research activities that respond dynamically to problems defined in localised contexts by including a heterogeneous set of practitioners integrating international concerns in an internally consistent format. The idea is to experiment with new forms of knowledge generation where there is a continuous negotiation between disciplines on the one hand and between scientists and society on the other.

Mission

The objective of TRIPP is to reduce the adverse health effects of transport by integrating mobility, safety and environmental concerns specific to India in particular, and other less motorised countries in general.

Progress

The establishment of TRIPP has facilitated the interaction among faculty members from different departments in IITD and with professionals from outside IITD (Indian Statistical Institute Delhi, Sanchal Hazard Centre Delhi, St. Stephen’s Hospital Delhi, All India Institute of Medical Sciences Delhi, Institute of Democracy and Sustainability Delhi) to work on complex interdisciplinary problems associated with urban transport. The group is unique because it combines expertise in transportation planning, road safety, computer sciences, biomechanics, epidemiology, medicine, social sciences, applied mechanics, chemical engineering, civil engineering, electrical engineering, mathematics, mechanical engineering, biomedical engineering and econometrics for work on safety and transportation issues. TRIPP is a WHO Collaborating Centre for injury control and safety promotion since 1997. TRIPP received Centre of Excellence Grant from Volvo Research and Education foundations from 2003-2014 and Centre of Excellence grant from Ministry of Urban development from 2009-2014.

Geetam Tiwari
Coordinator TRIPP
The Faculty

A.K. Gosain


Anoop Chawla

B. Tech. IIT Delhi, Ph.D. IIT Kanpur. Mechanical Engineering. Artificial intelligence, computer graphics and design methodology and modelling in CAD/CAM/CAE, vehicle crash simulation and crash reconstruction.

Anupam Dewan

Ph.D. (IISc Bangalore), Area of interest: CFD modelling and simulation of engineering turbulent flows and heat transfer; heat transfer enhancements.

A. R. Ray

Ph.D. (Delhi University). Centre for biomedical engineering. Biomaterials, vaccines and drug delivery, tissue engineering, polymer sciences

A.K. Swamy

Ph.D. (Univ. of New Hampshire, Durham, USA), Areas of Interest: Modelling Behaviour of Asphaltic Materials, Continuum Damage Modelling, Pavement Engineering, Rheology, Recycling of Pavement Materials.
Dinesh Mohan

Gazala Habib
Ph.D., supply chain management, planning, analysis and control of manufacturing systems.

Geetam Tiwari
Coordinator TRIPP, B. Arch, IIT Roorkee, Ph.D. University of Illinois, Chicago, Civil Engineering. Specialisation in transportation planning and traffic demand models with special reference to safety, of non-motorised vehicles, pedestrians, traffic on highways, rural and urban roads and public transport system.

Kalaga Ramachandra Rao
Ph.D. IIT/kh, transportation engineering, mass transit planning traffic flow modelling and road accident analysis.

K.N. Jha
Ph.D. construction technology and management. Construction Project Management, Project Success Factor, Asset Management, Schedule Cost, Quality and Safety.
N. Chatterjee

Nomesh Bolia
Ph.D., London University, operations research scheduling, modelling in wireless networks and logistics improvisation. Operations research, stochastic modelling; their applications to health systems, transportation and governance.

M. Balakrishnan
B. Tech, BITS Pilani, Ph.D. IIT Delhi, Computer Science and Engineering. Application specific processor design, high-level design and modelling. FPGA based design and design tools, hardware-software code sign and system synthesis.

Puneet Mahajan
B.E. Delhi University, Ph.D. Montana State University. Mechanical Engineering. Finite elements, contact and impact mechanics of composites, vibration behaviour of tractors, helmet design.

Ravi Shankar
PhD. (IIT Delhi), Area of interest: Supply chain management, operations management, project management, total quality management, strategic technology management, quantitative modelling, and knowledge management.
Sanjeev Sanghi

Seema Sharma
Ph.D(IITD) (Associate Professor), Marketing Research, Statistical Analysis, Economics and Productivity Analysis

Subhashis Banerjee
B.E. Jadavpur University, M.S. & Ph.D. Indian Institute of Science, Bangalore. Department of Computer Science & Engineering. Computer vision, robotics, real-time system, image processing and pattern recognition, image based rendering, vehicle recognition software.

Sudipto Mukherjee
B.Tech. IIT Kanpur, Ph.D. Ohio State University. Mechanical Engineering Department. Mechanical system design, computer controlled mechanisms, kinematics, AI, robotics, crash modelling, human tissue properties, mechatronics.

Sunil R Kale
B. Tech. IIT Delhi, Ph.D. Stanford University. Mechanical Engineering Department. Heat transfer and two-phase flow, combustion modelling, pollution and energy conservation, air flow in vehicle
V.B. Upadhyay

Ph.D. (McMaster), Econometrics, monetary economics and development economics

Associate Faculty (External)

A.K. (Dunu) Roy


Girish Agrawal

IITD, Ph.D. Purdue University. J.D, University of C, Berkeley, Professor and Head department of Civil Engineering, Shiv Nadar University.

Mathew Varghese

MBBS, MS (MAMC), Orthopaedics, Expertise in orthopaedic surgery and injury analysis. Currently involved in assessing effects of vibrations on spines of tractor drivers, analysis of injuries suffered by pedestrians hit by buses and trucks, and assessment of pre-hospital care methods. Head, Orthopaedics Department, St. Stephen's Hospital, Delhi.

Rajendra Ravi

Ph.D, Social Science. Urban social planner, researcher, author and editor. Over the last couple of decades, he has spent his time studying various facets of urbanization, Urban Transport, society and democracy. The engagement has led him to produce a substantial literature on the related issues.

Currently he is part of Sustainable Urban Mobility Network India (SUMNET), World Car-free Network, National Cyclist Union and Institute for Democracy and Sustainability (IDS) Delhi.
Institutional Cooperation

Division of Social Medicine, Karolinska Institutet, Stockholm: Professor Leif Svanstrom, Head of Division, Organisation of courses/workshops on injury control and safety promotion 1991-2014.


INRETS, France: Farida Saad, Marie-Chantal Jayet, Nicole Muhlrad, Sylvain Lassarre. The Institute National de Recherche sur les Transports et leur Securite, France Organisation.

Institute for Social and Health Sciences, UNISA, South Africa: Professor Mohamed Seedat, Director. Organisation of courses on Traffic Safety in South Africa.

Institute of Democracy and Sustainability, Delhi: Rajendra Ravi, Director. Working on non-motorised transportation, reclamation of space, and street vendor issues.

St. Stephens Hospital, Delhi: Mathew Varghese. Head Department of Orthopaedics. Involved in trauma care. Particularly in constructive surgery for complex trauma of the musculo-skeletal systems, road accident injury control and injury epidemiology research and pre-hospital care.

Harald Zellmer, Autoliv Research and Development. Autoliv, Germany.

Hermann Knoflacher, Institute for Transport Planning and Traffic Engineering. Technical University of Vienna, Austria.

Janusz Kajzer, Chalmers University, Sweden.

Joseph Fazio, Civil Engineering, South Dakota School of Mines & Technology, USA.

Kavi Bawa Bhalla, Ph.D. Cornell University, Johns Hopkins Bloomberg School of Public Health.

Mark H.P. Zuidgeest, University of Cape Town, Urban Geography and Information Systems.

Shrikant Bangdiwala, UNC-Chapel Hill School of Public Health, University of North Carolina, USA.

Chyster Hyden, Lund University, Sweden, pedestrian and bicycle Safety.

Karen Brolin, Chalmers University of Technology, Sweden. Biomechanics.
Recognition

Awarded the first International Centre of Excellence Award for research and training on Future Urban Transport by the Volvo Research and Educational Foundations, Sweden.

Recognized as a Collaborating Centre by the World Health Organization for Research and Training in Safety Technology.

Stockholm Partnerships Award for Sustainable Cities for creative interaction and cross-divisions problem solving for research, academia and other groups in cities all over the world.

In 2009 the Ministry of Urban Development (MoUD) sanctioned a grant in and for the period 2009-2013 for IITD recognizing it as a Centre of Excellence in Urban Transport. TRIPP/VREF-CoE AT IITD was selected to administer the MoUD grant. The Centre has been established with an aim to develop policies and solutions that minimise the adverse health effects of road transport in a manner which is economically, socially and politically viable. The objective of the Centre is to develop resources and expertise on making urban transportation efficient while controlling the adverse health effects of road transport in as integrated a manner as possible with wide dissemination of this knowledge. The research activities supported by VREF-CoE have been further strengthened by the MoUD grant for CoE in Urban Transport.

MoUD grant along with the extension of VREF grant has strengthened the existing programme at TRIPP and other associated departments and centres. Laboratory facilities at TRIPP, and other associated departments and centres. Laboratory facilities at TRIPP and other associated Departments at IITD have been upgraded with state-of-the-art software and equipment. A library dedicated to sustainable transportation has been established.

Prof. Geetam Tiwari was appointed honorary doctor for her visionary and socially beneficial research on transportation and safety by the Chalmers University of Technology, Sweden in 2012.

Prof. Dinesh Mohan, one of the world's leading experts on issues of traffic safety and human tolerance to injury was honoured with the Distinguished Career Awards by the University of Delaware in 2012.

Endowed Chairs

Henry Ford Chair for Biomechanics & Transportation Safety

TRIPP Chair for Transportation Planning

Volvo Chair for Transportation Planning for Control of Accidents and Pollution

Ministry of Urban Development Chair for Urban Transport and Traffic Planning

Ministry of Urban Development Chair for Urban transport and Environment

Ministry of Urban Development Chair for sustainable Transport and Safety Legislations.

TRIPP has endowed funding for appointment of two Post-doctoral Fellows.

Sponsors

Ministry of Commerce and Industry, Department of Industrial Policy and Promotion, Government of India: Infrastructure funds.

Asian Institute of Transport Development, New Delhi: Establishment funds

Volvo Research and Educational Foundations, Sweden: Establishment and research funds, one Volvo Chair for Urban Transport and four Volvo Foundation research fellowships for post-graduate students.

Ministry of Urban Development, Centre of Excellence Grant and Corpus Fund for three MoUD Chairs, three Post-Doctoral Fellowships and Ten Post Graduate Fellowships.
Research Areas

Urban Transport

Pedestrian Behaviour

Research on pedestrian behaviour was initiated in 2003 as a student project. A research paper published in 2007 on survival analysis of pedestrian behaviour on Delhi roads paved the way to further research in this area. Survival analysis of pedestrians waiting time showed that low survival time is inversely related to the delays. More pedestrians are likely to cross the road at the red light if the delays experienced by them increases. Basic behaviour is not very different than that reported from European and North American locations. Research is in progress looking at risk at various road designs constructed by the government in Delhi. A recently completed Ph.D. thesis on Statistical Modelling to Estimate Pedestrian Behaviour and Risk on Urban Roads explores pedestrian risk taking behaviour in greater detail. The prime motivator for this research was the importance of pedestrian safety in cities.

A significant investment has been made in Delhi for the provision of free left turns, construction of flyovers and grade separators to increase the speed of motorized vehicles, to reduce their delay, and to make arterial roads in Delhi signal free. With these types of road facilities the signalized crossings are converted into signal free crossings, causing more problems for pedestrians. Although signalized junctions provide pedestrians a protected crossing phase, most pedestrians tend to prefer using the available traffic gaps for crossing (Hamed, 2001). Pedestrians often cross roads away from signalized crosswalks, such as near bus stops, at the foot of flyovers, to save travel time or distance. Further, at free left-turns motorists generally do not yield to pedestrians using these turns. A significant number of pedestrians are found to be willing to take the risk while crossing roads at all types of crosswalks.

It is therefore important to study pedestrian behaviour in order that the risk faced by them can be minimized while the transportation facilities are improved for motorized traffic. A common phenomenon in Delhi is that a pedestrian has to fight for space on the road, because of a lack of safe and convenient pedestrian paths. This research has focused on pedestrian risk on crosswalks in cities because among various pedestrian facilities, crosswalks are one of the most complex ones, with high risk for pedestrians in congested urban areas, since pedestrians and vehicles share the same road space but at different or the same time intervals. The objective of this study is to examine the pedestrian road crossing behaviour exhibited by different types of pedestrians, and their road crossing risk while crossing the roads in an urban area, such as Delhi. We explored the utility of binary probabilistic modelling at different road crossing locations, and its performance measures in analysing the pedestrian risk and their crossing behaviour.
Assessment of Freight Movement by Non-Motorised Vehicles in Indian Cities

Data has been collected from primary and secondary sources to understand the economic, financial, safety and environmental issues of cycle rickshaws carrying freight in Delhi. The cycle rickshaw trolley (CRT) is a widely used non-motorised mode of intra-city freight transport in Delhi. While a number of studies are available for non-motorized passenger rickshaws, the role of CRT in urban goods movement has not been studied adequately. This study included a survey of 2000 CRT drivers in Delhi in 2011. The study highlights the contribution of CRT in city goods movement, savings in fuel and emissions and benefits to CRT drivers. If CRTs are replaced by motorized vehicles, CO2 emissions from vehicular traffic will increase by over 3% and hydrocarbon emissions will increase by over 8% and six to seven hundred thousand people will have to find alternate employment. The findings have a direct impact on various urban freight policies and welfare policies for the poor.

Bus Rapid Transit System (BRTS)

This project has involved detailed survey, design, and modelling effort in addition to coordination with government officials and the project management company RITES. The effort and time consumed would constitute a major proportion of the CoE activity. The corridor designed at TRIPP is operating in Delhi for the past six years. One major outcome in addition to efficient bus operations is a significant decrease in traffic accidents on the corridor, which can be attributed mainly to changes in design: separation of vulnerable road users and control of bus speeds. A number of undergraduate and graduate students have based their project work on analysis of the operation of the corridor. A status report on BRT systems in India has been completed and submitted to the Ministry of Urban Development and a BRTS Planning and Design Guideline has been prepared. Since 2009 two major documents have been completed on BRTS. (i) Design Guideline for BRT System (ii) Bus Evaluation analysis and Design (BEAD) Tool kit.

Bus Rapid Transit System Design Guidelines

Bus Rapid Transit Design Guideline has been developed to provide transportation planners and decision makers with information regarding the planning, design and implementation of a Bus Rapid Transit System project. The guideline has evolved over the years as our research team has continued to work from the conceptual level details to planning and design details during the implementation and construction phase of these projects.

The guideline also addresses the needs of planners and engineers planning the geometric and operational details of the BRT system. The guideline explains the BRT system in the context of Indian cities; it also guides the planners through the entire process of planning and designing a complete BRT system in Indian cities. It is hoped that the guideline will serve as an important tool for the city planner, policy maker and transport experts involved and provide them with a better understanding of the entire process.

Bus rapid transit system (BRTS) Design guideline and Evaluation Tool (BEAD)

More than 150 cities in the world now operate BRTS corridors. No two systems are identical and their characteristics vary. Their uniqueness is because the
system is flexible enough to allow variation and adaptation. Since BRTS makes use of limited vehicle types in exclusive lanes, one can obtain estimations of these features. The traditional approach of transportation project evaluation tends to measure only the speed and travel time savings, often for cars only and the change in safety parameters computed as fatalities/injury per unit of exposure. A tool for evaluation of different design characteristics of BRT systems (BEAD) has been developed by SGArchitects with support from TRIPP. This tool assesses the capacity and evaluates performance of proposed and existing BRT systems, using performance variables such as access trip composition, station access type, signal phasing, bus type, system type, junction configuration, etc.

**Estimation of Emissions and Fuel consumption of in-use Vehicles**

This work aims at documenting the emission and fuel economy of in-use vehicles in two cities (Delhi and Ludhiana). Estimation of emissions and fuel economy on the basis of an average Indian driving cycle does not capture variations that exist within a city and also amongst different size cities. Therefore, this project aims at documenting the variations in traffic environment that exists both in terms of infrastructure design and modal shares, and estimates emissions and fuel economy of different vehicles that are operating in this environment. Phase I of the project has been completed and results submitted to the funding agency. Phase II work will start in Ludhiana, a smaller city with different traffic characteristics from megacities like Delhi and Mumbai.

**Integration of Access, Mobility, Safety and Environmental Policies**

Transport projects funded by the central government in the last five years are being analysed to identify policy-making and/or policy improvement, and policy implementation opportunities for sustainable transportation with an emphasis on mitigating greenhouse gases and air pollution and promoting energy savings in the public transport sector in India.

Work on the health benefits of tackling climate change associated with urban land transport was completed in collaboration with the London School of Hygiene and Tropical Medicine. Major public health benefits will depend on the introduction of policies that combine reduced motor vehicle use, more walking and cycling, and low-carbon-emission motor vehicles. Since major benefits in Delhi are only possible if shares of active travel remain high, it is imperative that policies promoting traffic safety and reduction in fear of urban crime are given much more importance. Results of these studies were important as inputs to the national committee working on long-term transport policy for India. Partly as an outcome of this work TRIPP has participated in two new international projects:

“Public health impacts in Urban Environments of Greenhouse gas Emissions reduction strategies (PURGE)” funded by EU for a period of 3 years starting in February 2011. The Project objectives are to assess greenhouse gas reduction policies and their impacts on public health and well-being in urban areas. The project is being coordinated by London School of Hygiene & Tropical Medicine with partners from UK, China, Spain Czech Republic, Italy, India, china, Serbia, UK.

“Promoting Low Carbon Transport in India” funded by UNEP (UNEP Risoe Centre, Technical University of Denmark). The objective is to create an enabling environment for coordinating policies at a 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 different ministries and would include: indicators for measuring sustainability of the transport sector in India, integrated assessment at the national level of all the competing transportation technologies, policy analysis for reducing emissions, framework for climate proofing of transport infrastructure and application to a transport infrastructure. This project was funded for a three-year period starting April 2011.

**Road Safety Factors in Urban Areas**

Data collected for Indian and other cities around the world suggest that just quality of road design, vehicle safety standards and police enforcement levels do not adequately explain the variation in road traffic fatality among cities of similar size, population and income levels. Work done up to now suggest that width of urban roads, block size, and other urban characteristics may have a significant role in influencing crash rates. This work is continuing in greater depth as urban safety may be a significant factor influencing promotion of low carbon transport (walking, bicycling and public transport). Suggesting that urban safety may be a necessary though not sufficient condition for mitigating the effects of global warming.

At TRIPP, accessibility and safety indicators that rely upon knowledge of all types of users of a BRT corridor in Delhi have been developed. Using new indicators the implementation of BRT corridor in Delhi has resulted in travel time saving by 19% and increase in accessibility to destinations by 120% for bicycle users, 100% when bicycles are used to assess bus service on the corridor and by 730% for commuters who walk to access bus service. According to the new indicators risk to cyclists has been reduced to zero whereas the interaction between pedestrians and personal motorized vehicles needs further intervention to reduce risk to pedestrians.

A study on 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 was initiated in 2012. The purpose of the study is (a) to understand the modal share of victims and vehicles involved in crashes and to estimate risk functions associated with different road users; (b) 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. The study is funded by the International association of Traffic and Safety Science (IATSS), Japan.
Vehicle Safety

Epidemiological Research and Crash Modelling to Develop Safer Vehicles with Special Reference to Pedestrian and Bicycle Crashes

Predicting bone Fracture Propagation
Understanding of bone fracture patterns is crucial in reconstructing the nature of loading, in the lower limb and upper limb kinematics in vehicle-pedestrian crashes. This information is needed to design safer car and bus fronts. Failure is predicted using principles of continuum damage mechanics using critical dilatational cut-off stress failure criteria. Modelling techniques developed here will be incorporated in the human body model to make it more biofidelic for use in motor-vehicle pedestrian crash analysis.

Variation in Bone Modulus with Strain Rates
For development of detailed finite element models of the human body it is necessary to introduce strain rate dependent material properties of all tissue segments. This work is aimed at experimental determination of modulus of elasticity of bones from the human tibia to capture strain rate dependence and variation with density.

Effect of Active Muscles in Modelling Crashes
Almost all work done until recently to design vehicles for reduction in injuries in impact with pedestrians was based on dummy impact tests, human cadaver impact tests and computer models of the human body without accounting for the role of active muscles. This work attempts to understand the role of muscles with the objective of incorporating active muscles in the human body computer model. There is a significant difference in the reported values. Muscle contraction can increase the bending moment threshold of the knee joint by as much as 40% and the lateral bending stiffness by 60%. This changes the kinematics and forces experienced by a pedestrian in impact with a vehicle. We expect this work to be of greater significance in the design of safer fronts for cars and buses in impacts with pedestrians and bicycles at speeds less than 40 km/h in urban areas.

Positioning of Finite Element Human Body Models in Vehicles
FE human body models are created in a few standard postures. Reconfiguration of the model to mimic the spread of human activity prior to crash as an USP which has been a difficult task to engineer. The applicability of the tool developed is demonstrated by orienting the lower extremity model (with respect to pelvic bone) so as to generate models for various postures. A technique to reposition the spinal column based on the trunk flexion of pelvis rotation angle has also been developed.

Motorcycle Helmet Design
Motorcycles constitute a significant proportion of traffic modal share in most Asian cities, in Africa and South America. Optimal helmet design for safety and ventilation for adults and children has gained importance. Work for optimising helmet padding, shell characteristics, and air circulation was done over the past eight years, including finite element modelling, wind tunnel tests and impact tests. A report was prepared outlining the state of the art (for WHO) in the area of children use and injuries on motorcycles and associated safety issues. Work on a thermodynamic model for sweat evolution in a porous medium which is in touch with a part of the body of a human being has been stated. This model will enable us to analyse and optimize internal ventilation in a helmet. The purpose of the analysis will be enhancement of comfort leading eventually to the safety of the rider. We plan to use evolution
equations of three scalar unknowns: temperature, absolute humidity and sweat. Numerical simulation for these equations are being carried out with a collaborative project with Imperial College, London.

**Vehicle Recognition Software**

TRIPP in collaboration with the Department of Computer Science and Engineering and Kritikal Solutions Pvt. Ltd., a Technology Business Incubation Unit of IIT Delhi, is engaged in developing a multiple camera based traffic monitoring and analysis system that can be deployed in the dense traffic conditions of Indian roads. Determining the accurate counts of the number and types of vehicles plying on the road can be made available online at various locations and can be used for better planning of roads and highways. Once these data have been fed into the traffic controller they can dynamically change the pattern of the signal lights as per the actual traffic flow, which saves a lot of time and is cost-effective. The advantages are: (a) A vision based system that can potentially work reliably in extremely dense traffic situations. (b) Detection and tracking of vehicles under severe occlusion, without using predictive models like, a straight line trajectory, etc. (c) Dealing with a large number of vehicle types, of all shapes and sizes, including buses, trucks, cars, tempos, three wheelers, bicycles and pedestrians. (d) Automatically generating models for patterns of usual events in various deployments in Indian road conditions (which may all be different) and reliable detection of unusual events (from lane violations to accidents) under such situations and generating alerts. The second module of the software includes capability of recognizing buses, and work is continuing to extend it for two wheelers and side view of traffic.

**Stability of Urban Small Bus in Delhi**

Low cost small buses owned privately have been introduced in Delhi to augment the public transport fleet. These buses (locally termed Rural Transport Vehicles RTV) are involved in crashes including rollovers. On the request of the Delhi Government an exercise was taken up to evaluate the stability of these vehicles. In this work a full vehicle model of the RTV was developed in MADYMOTM. The model was validated and then used to predict rollover characteristics using slowly Increasing Steer, J-Turn, and Road Edge Recovery manoeuvres. These manoeuvres were conducted for three different loading conditions viz. RTV without passengers, RTV with unrestrained passengers, and RTV with restrained passengers, and the safe speeds are compared with those of other vehicles. The comparisons of results show that rollover characteristics of RTV are not as safe as other vehicles. These results indicate that strict speed control measures need to be applied to the operation of these vehicles and designs modified to make them more stable.

**Dynamics of Car-Bicycle Crashes**

This work investigates the correlation between throwing distance and impact speed / point of impact / angle of approach for varying bicycle-car crash configurations. Crashes between a bicycle and a car were simulated using multi body models developed in MADYMOTM. The Hybrid III 50th percentile male dummy model, available from MADYMO library has been used, and over 200 simulations have been carried out for two crash configurations. The variation in the angle of approach or point of contact causes significant changes. One significant limit of the study is that only one car model has been used. The change in throwing distance for other vehicles is yet to be studied. Further, variation in the bumper and bonnet height could also affect the throwing distance.
Impact Characterization of Human Body Muscle Tissues

Finite element modelling (FEM) for crash analysis has become an important tool for design purposes. However, the human body model still needs a great deal of improvement. This work is being done to add to the body of knowledge in this area as pedestrian and bicycle impact studies will benefit from improved models. Genetic algorithms (GA) have been used to identify the dynamic material properties of human passive muscle tissues for the strain rates relevant to passive muscle tissues for the strain rates relevant to automobile crashes. A novel methodology involving FEM and GA is implemented to estimate the material parameters by inverse mapping the impact test data. Isolated unconfined impact test conditions for average strain rates ranging from 132/s to 262/s are done on muscle tissues, which are subsequently modelled as isotropic, linear and viscoelastic material using three-element Zener model available in PAMCRASH™ explicit finite element software. Experimentally determined engineering stress vs engineering strain curves for erector spinae, hamstring and gluteus max muscles are reported in the strain rate range of from 250/s to 1000/s. The loading curves exhibit multi linear behaviour with increasing strain rate shifting the transition points between the slopes. In addition, influence of muscle activation on impact outcome is also being investigated at low velocity lateral impacts. Therefore, a group of muscles in the lower extremity are modelled using bar elements with the Hill material model. The reflex response of the muscle is then included. Simulations indicate that muscle activation decreases the probability of failure in knee ligaments.

Bus Ventilation

It is generally felt that public transport buses are uncomfortable especially in hot and humid climates, because they are not air-conditioned. Such buses are widely used in several parts of the world. So far no scientific studies have been done for location and sizes of windows in the bus; likewise no study exists for improving ventilation and comfort levels in the bus.

Many experimental and computational studies on the aerodynamics of vehicles in general and buses in particular have been performed in the past several years, the primary aim being to reduce the drag and, hence, improve the fuel economy of the vehicle. These studies were done with the bus modelled as a closed surface with smooth exteriors. However, no studies have been carried out on a bus with its windows open, and the resulting investigations about flow patterns. Thus there is a knowledge gap regarding ventilation studies inside a bus compartment. This project focused on developing a scientific knowledge base, which can be utilized for studying and improving the aerodynamics of such semi-closed bodies in general and the bus with open windows, in particular, which is more realistic.

Highway Safety

Lucknow - Muzaffarpur National Highway Safety Audit Project

The objectives were: (a) To review provisions regarding worksite safety management in the project’s contract documents; (b) To review the extent of compliance of various safety aspects at worksites; (c) To identify the strengths and deficiencies in the existing systems; (d) To recommend modifications/improvements in the existing systems and processes to improve safety management during road construction work (e) To transfer the safety audit knowledge to the key staff members of Construction Supervision Consultations and staff of the National Highway Authority of India.

The project was of special interest to us as Indian highways pass through a large number of rural and urban settlements of all sizes. One unexpected
finding was that some of the existing standards for road markings and signs do not seem to make a significant difference on crash rates. Consequently the Government has agreed to revise these standards. TRIPP has been given the responsibility of preparing a Work Zone Safety Manual for use by contractors and employees of the National Highway Authority all over the country.

**Research on Outcome of Pre-Hospital Trauma Care in Two Communities**

Pre-hospital care methods and costs have to be optimised at all locations, and evidence based data are required to understand the relative effectiveness of various pre-hospital care procedures. In collaboration with SAFER, Chalmers University, Sweden. SAFER and TRIPP (IITD) have started a trauma registry at the Sahlgrenska Hospital in Gothenburg and St. Stephens Hospital in Delhi. This is a protocol for research on outcome of trauma care in two communities: A mature trauma care programme with a fully functional pre-hospital care. Trauma care outcome will be significantly different between the two communities in terms of mortality, length of stay in the hospital, and end of stay dependency for family or social security support. The data collection from St. Stephens Hospital and post mortem cases has been completed in Delhi. Data coding and analysis will be completed in 2014.
Projects Completed

Bicycle Partnership Programme (BPP)
Sponsor: Interface for Cycling Expertise (I-ce), The Netherlands
Project team: Geetam Tiwari and Dinesh Mohan

Objective: To review GTZ source book; research background paper of identified issues; contribute to the development of training material; technical assistance BPP mission; Technical assistance to BOO partner cities; assistance to regional design manual.

Master Plan for Bus Rapid Transit System Integrated with Bicycle Network in PCMC (Pimpri Chinchwad)
Sponsor: Pimpri Chinchwad Municipal Corporation
Project team: Geetam Tiwari and Dinesh Mohan

Objective: To prepare A detailed Project Report for development of BRT corridors on different sections of Pimpri-Chinchwad region.

Planning and Implementation of BRTs Projects in Indore
Sponsor: Indore City Transport Services Limited, Indore
Project team: Geetam Tiwari and Dinesh Mohan

Objective: a) To study and establish the relevance and potential of BRTs in Indore: b) To develop a conceptual network of BRTs corridors: c) To make a preliminary estimate of the traffic potential on BRTs by corridors; d) To assess the necessary infrastructural improvements along the corridor(s) for operation of BRT services.

Technology Development for Safer Bus
Sponsor: Ashok Leyland Limited
Project team: Dinesh Mohan, Sudipto Mujherjee and Anoop Chawla

Objective: To study design features with reference to the safer technology under impact conditions.

Measuring Impact Properties of Human Body Parts
Sponsor: Department of Science and Technology
Project team: Anoop Chawla, Sudipto Mukherjee, Dinesh Mohan, Mathew Varghese

Objectives: To develop testing rigs for testing the impact properties of the soft tissues and to generate data about the dynamic properties of the soft tissues and to generate data about the dynamic properties of human body tissues. This data would include mechanical properties under impact conditions and their variations with strain rate and the energy of the impact.
Analysis of Road Traffic Crashes in Mumbai  
Sponsor: The World Bank  
Project team: Geetam Tiwari and Dinesh Mohan  

Objective: To do an analysis of fatal and non-fatal road accidents in Mumbai and New Mumbai to suggest remedial measures and changes in institutional structures.

Crash modelling of Three-Wheeled Scooter Taxi (TST)  
Sponsor: Bajaj Auto Ltd.  
Project team: Dinesh Mohan, Sudipto Mukherjee and Anoop. Chawla  

Objective: To prepare a geometric model of the three-wheeler for crashworthiness analysis for occupant and pedestrian impacts for modifying hazardous contact surfaces to minimise the injuries sustained by the pedestrian and the vehicle occupants.

Design of Commuter-Friendly Bus Shelters  
Sponsor: Delhi Transport Corporation, Delhi  
Project team: Geetam Tiwari and Dinesh Mohan  

Objective: Design of bus shelters facilities for commuter needs like rickshaw and three-wheeler parking, designated place for hawkers, and movement of bicycles and other slow moving traffic behind the bus shelter on a special lane.

Ergonomic Analysis, Vibration Reduction and Safety Improvements of Indian Tractors  
Sponsor: Department of Science and Technology  
Project team: Dinesh Mohan, Puneet Mahajan and Mathew Varghese  

Objective: A mechanical model to study the effect of ground roughness and vibration on tractor drivers' spines. Experiments to establish a correlation between the experimental, analytical and medical results.

Evaluation of Capacity Augmentation of Indian Highways  
Sponsor: Asian Institute of Transport Development and Ministry of Surface Transport.  
Project team: Geetam Tiwari, Rajeev Saraf and Dinesh Mohan  

Objective: To analyse traffic flow and the accident situation at different locations on Indian Highways to prepare guidelines for augmenting capacities in the future.

Evaluation of Road Safety Cooperation and Technology Transfer between Developed and Developing Countries  
Sponsor: Global Traffic Safety Trust  
Project team: Dinesh Mohan and Geetam Tiwari  

Objective: To analyse the effectiveness of international cooperation and consultancies in promoting road safety in developing countries.
Computer Simulation of Car-Motorcycle Crash Using PAMCRASH
Sponsor: Japan Automobile Research Institute, Japan
Project team: Anoop Chawla, Sudipto Mukherjee and Dinesh Mohan

Objective: Simulation of motorcycle crashes (with helmeted rider) with cars using finite element modelling and validate against actual tests done at the Japanese Automobile Research Institute (JARI) in Japan.

Gujarat ORET Prevention Project: Study on the Aetiology of Traffic Accidents and Injuries
Sponsor: TNO, The Netherlands
Project team: Dinesh Mohan and Geetam Tiwari

Objective: To find the causes and determinants of traffic accidents that happened along the National and State Highways in Sabarkantha district so that this knowledge can be utilized for designing proper interventions to reduce the incidence of traffic accidents.

Injuries in South-East Asia Region: Priorities for Policy and Action
Sponsor: WHO (SEARO)
Project team: Dinesh Mohan and Mathew Varghese

Objective: To design an information booklet to generate interest in the prevention and control of injuries.

Low Cost Safer School Bus Design
Sponsor: Eicher Motors Ltd., Indore
Project team: Dinesh Mohan, Rajesh Patel

Objective: To develop a safer design of school bus to suit Indian conditions with minimal increase in cost.

Master Plan for Bicycle Use in Delhi
Sponsor: The Government of the Union Territory of Delhi
Project team: Geetam Tiwari, Rajeev Saraf, Rajesh Patel and Dinesh Mohan

Objective: To develop a comprehensive plan appropriate with the design guidelines for the provision of bicycle paths in Delhi.

Master Plan for Bus Rapid Transit System Integrated with Bicycle Network in Pune
Sponsor: Pune Municipal Corporation
Project team: Geetam Tiwari and Dinesh Mohan

Objective: Preparation of detailed design specifications, planning norms and guidelines for development of BRT corridor at Pune City.

Methodology for Modelling of Airbags
Sponsor: Japan Automobile Research Institute
Project team: Anoop Chawla, S. Mukherjee and Dinesh Mohan

Objective: Work on development of methodology for finite element modelling of airbag deployment and development of human tissue properties and human body finite element model, car motorcycle crash simulations using FE and use of airbags on motorcycles.
Preparation of a Manual Titled When Someone is Hurt….A First Aid Guide for Laypersons and Community Workers
Sponsor: World Health Organisation
Project team: Dinesh Mohan and Mathew Varghese

Objective: To develop a first aid manual for laypersons based on an international review of literature.

Redesign of Truck Cabin
Sponsor: Ashok Leyland Ltd.
Project team: Dinesh Mohan and G.V. Soumitri

Objective: To improve the comfort and ergonomics of an existing truck cabin without major structural changes.

Review of Transport, Environment and Health Issues and Policies in Mega-Cities in Emerging Economies
Sponsor: World Health Organisation
Project team: Geetam Tiwari and Dinesh Mohan

Objective: Review of transport, environment and health issues and policies in mega-cities in emerging economies which will include (a) a literature review; (b) an annotated bibliography; (c) description of case-studies on transport, environment and health issues in Delhi; (d) a summary of key policy issues on transport, environment and health issues and research questions for mega-cities in developing economies.

Road Safety Educational Material for TV
Sponsor: Maruti Udyog Limited
Project team: Dinesh Mohan, Geetam Tiwari

Objective: To Develop short spots on road safety for TV using evidence based studies on what messages are likely to be effective.

Safer Truck/Bus Fronts
Sponsor: Volvo Truck Corporation, Sweden.
Project team: Dinesh Mohan, Anoop Chawla and Mathew Varghese

Objective: To assess the nature of injuries in pedestrians involved in truck/bus accidents admitted to St. Stephens Hospital and LNJP Hospital and to simulate pedestrian truck impacts using computer models with a view to design safer truck fronts.

Safety of Front Seat Passengers in the Tata Sierra: Analysis of Vehicle Performance Guidelines for Safe Design of Car Interior
Sponsor: TELCO
Project team: Dinesh Mohan, Anoop Chawla and Janusz Kajzer

Objective: To analyse the crash response of front seat passengers in a Tata Sierra using computer simulations and to propose changes in interior geometry and force deflection properties of surfaces to minimise injuries in a crash.

Setting up of Ergonomic Evaluation Facilities for Tractor Design
Sponsor: Eicher Tractor Engineering Centre, Ballabgarh
Project team: Dinesh Mohan, Rajesh Patel and Adarsh Kumar

Objective: To develop an ergonomic facility for improvement of tractor design.
Strategies to Reduce Vehicular Pollution in Delhi  
Sponsor: Central Pollution Control Board  
Project team: Geetam Tiwari and Sunil R. Kale  

Objective: To determine effect of traffic characteristics and vehicle driving patterns on atmospheric pollution in Delhi.

Traffic Management Plan for Indira Gandhi International Airport  
Sponsor: Airport Authority of India  
Project team: Geetam Tiwari and Dinesh Mohan  

Objective: (a) Study of existing problems related to circulation conflicts between passengers and parked motor vehicles at arrival and departure terminals both domestic and International (B) Redesign of arrival and departure circulation for pedestrians and vehicles based on existing and future demand (domestic terminal 1B, domestic arrival terminal and international arrival and departure wings).

Training Manual for Road Traffic Injury Prevention  
Sponsor: WHO  
Project team: Dinesh Mohan and Geetam Tiwari  

Objective: To develop a training manual with the following components: Understanding key concepts and terminology, Magnitude burden and determinants of road traffic injuries, Building and strengthening the evidence base, Planning and implementation of interventions, First aid, Pre-hospital care and hospital care, Building and sustaining road safety networks and partnerships, Influencing policy and programmes.
Projects: Ongoing

**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  

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.

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.

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
Sponsor: 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.

**Indicators of Reliability and Variability of BRTS/Bus Systems (INDIRA B)**
Sponsor: Indo-French Centre for the Promotion of Advanced Research
Project team: Geetam Tiwari and K.R. Rao

Objective: To assess some of the existing well known quality-of-service indicators, and to develop new ones. Performance indicators should be clear, easily understandable, and useful to the audience. The main outcome of this research is to develop a computer-based research tool consisting of different modules. This could be integrated into an operational platform for analysis and diagnosis of the quality of service of BRTS/ bus systems lines in different operational use. The applications will be tested in Delhi and generic modules will be developed for other cities.

**Select Study of Urban Freight in Delhi**
Sponsor: Volvo Research and Educational Foundations (VREF), Sweden.
Project team: Nomesh B Bolia, Geetam Tiwari, Nilanjana De Bakshi and Jose Holguin-Veras

Objective: (1) To characterise the demand for freight transport in Delhi by developing travel demand models to estimate the freight trips. (2) Analyse the impact of delivery restrictions that are imposed and comprehend the effectiveness of such policy measures.

**Construction of Bus Queue Shelters at Various Places in NOIDA – Cost Estimate and Technical Advice**
Sponsor: New Okhla Industrial Development Authority
Project team: G Tiwari, and K.N. Jha

Objective: 1) To comment and advise on the specification of Bus Que Shelters 2) To comment/advise on the cost estimate for BQS

**Selection of service provider for procurement, operation and maintenance of bus service of Noida, Greater Noida**
Sponsor: New Okhla Industrial Development Authority
Project team: G Tiwari, D. Mohan and K.R. Rao

Objective: To vet the draft limited RFP prepared by UMTC and provide comments for the same.

**Review and evaluation of traffic impact assessment (TIA) study of the transit oriented development (TOD) influence zone plan**
Sponsor: Shaktri Sustainable Energy Foundation
Project team: Geetam Tiwari and K.R. Rao

Objective: (1) To study and comment on the overall process being adopted for TIA modelling exercise (2) To ascertain the relevancy and accuracy of the data collected in surveys by means of pilot survey (3) To compare the results and findings of the exercise with other similar studies (4) To provide an independent evaluation of the validity of the study in context of Delhi
Ph.D: Completed

In-vivo measurement of constitutive properties
Scholar: Hemant N. Warhatkar

Institutional arrangements for the provision of urban public transport
Scholar: O.P. Agarwal

Tool for positioning human body FE model
Scholar: Dhaval Gani

A study on the effects of muscle contraction on the lower extremity response in car-pedestrian crashes
Scholar: Anurag Soni

Demand model for public transport trips: case study Delhi
Scholar: Mukti Advani

Characterization of the compressive impact response of muscles
Scholar: B. Karthikeyan

Dynamic studies on shell materials and ventilation in motor cycle helmets
Scholar: Praveen Kumar Pinoji

Transportation projects and their effects on the poor: integrating a social impact assessment methodology
Scholar: Anvita Anand

Optimal pricing of urban transport: a case of Delhi
Scholar: Akshay Sen

Methodologies for planning and evaluation of rural road network: an integrated functional accessibility approach
Scholar: B. Karagadurai

Rollover stability and safety analysis of three wheeled vehicles
Scholar: Tushar Rajaram Gawade

Development of a bicycle demand estimation model incorporating land use sensitive parameters: Case of Pune city India
Scholar: Himani Jain

Travel demand estimation of informal settlements in Delhi
Scholar: S.S.L.N. Sarma

Estimation of externalities in public transport system
Scholar: Pradeep Singh Kharola

Congestion modelling and mitigation on urban arterials
Scholar: Mohan Rao
Ph.D: Current

**Naturalistic driving behaviour study**
Scholar: Abhaya Jha

**Study of the effect of geometric design features on capacity of hill roads**
Scholar: Achyut Das

**Context aware technology and systems**
Scholar: Alok Nikhil Jha

**Multi objective optimization in construction project management**
Scholar: Amit Chandra

**Urban landuse and transport modelling**
Scholar: Amit Sharma

**Accident reconstruction based study on motorcycle crashes**
Scholar: Amrit Lal

**Estimating properties of thoracic organs**
Scholar: Anil Kalra

**Design and optimization of air ventilation system for improved heat transfer characteristics in helmet**
Scholar: Bhagwat Singh Shishodia

**Methodology for low carbon mobility plan for Indian cities**
Scholar: Deepty Jain

**Safety issues in project management**
Scholar: Dillip A Patel

**Modelling and risk assessment of heterogeneous traffic**
Scholar: Gaurav Pandey

**Methodology for design of vehicle front of an urban car for safety of vulnerable road users**
Scholar: Hariharan S

**Analysis of travel behavior and impact of demand management interventions on non captive bus users**
Scholar: Hemant Kumar Suman

**Establishing relationship between elements of highway engineering on crashes on national highways in India**
Scholar: H.M. Naqvi
Issues in human body FE modelling  
Scholar: Kanhaiya Lal Mishra

Human body model (thorax modelling and its validation)  
Scholar: Khyati Verma

Statistical modelling to estimate pedestrians’ risk and risk taking behaviour on urban crosswalks  
Scholar: Mariya Khatoon

Characterisation of long bones bending under impact  
Scholar: Mike Winifred Jimbry Arun

Private participation in metro rail projects in India: challenges and way forward  
Scholar: Mukund Kumar Sinha

Road Safety risk assessments of modern toll plazas and standardization of its geometric design  
Scholar: Navdeep Kumar asija

Urban freight studies  
Scholar: Nilanjana De Bakshi

Estimating traffic crash risk to different road users in urban areas and its impact on mode choice: case study Vadodara city, India  
Scholar: Pankaj Prajapati

To study the suitability of airbags for motorcyclists  
Scholar: Prashant Vidhyadhar Bhosle

Pavement materials  
Scholar: Priyansh Singh

Finite element human body modelling direction  
Scholar: P Devndra Kumar

Effect of traffic characteristics on vehicle emission  
Scholar: P.V. Pradeep Kumar

Human body finite element modelling  
Scholar: Rajesh Kumar

Measuring public health effects of urban transportation in Delhi  
Scholar: Rahul Goel

Mode choice initiators in public transport demand modelling  
Scholar: Sandeep Gandhi

Finite element human body modelling direction  
Scholar: Sanyam Sharma

Vehicle and crew scheduling optimisation of city bus systems  
Scholar: S.B. Ravi Gadepalli
Estimation of perceived and actual risk faced by pedestrians: case study Delhi, India
Scholar: Shalini Rankavat

Bus transit network planning for small to medium sized cities
Scholar: S.M. Hassan Mahdavi M.

Service level benchmarks for urban transport systems
Scholar: S.K. Lohia

Framework to determine the level of service of urban bus systems - case study: Delhi
Scholar: Sneha Lakhotia

Impact of traffic control measures on speed and driver behaviour in highway work zones
Scholar: Sumeet Gupta

Human body modelling requirements for vulnerable road users
Scholar: Wondwosen Ayelework Lakew
M.Tech. : Completed

Incentivization of public transport in Delhi (Accessibility)
Student: Mohammad Mahdi

Scheduling of diagnostic equipment
Student: Malyaj Srivastav

Incentivization of public transport in Delhi: role of Delhi metro
Student: Vineet Chauhan

Comparative assessment of existing subgrade improvement techniques for transport infrastructure
Student: Abdul Rashid

Impact of construction worker safety on transportation project economics
Student: Lalit Kumar

Estimation of turning movement and capacity of roundabouts
Student: Haroon Zamal

Estimation of PCE Values on Hill Roads
Student: Arstu Gautam

Risk analysis on highways
Student: Sandip Bhattacharjee

Travel time estimation on urban corridors using GPS probe data
Student: Randeep Basu

Rheological properties of asphalt containing SBS and HDPEH polymer
Student: Uma Devi Rongali

Characterisation of cardiac: muscle and aorta under dynamic compression and tensile impact respectively
Student: K Raja Sekhar

Characterisation of diaphragm under impact
Student: Jitender Kumar

Development and validation of models for small and medium sized cars for pedestrian impact simulation
Student: Majnoj Kiran Sanku

Agent based simulation of the travel demand for Patna city, India
Student: Amit Agarwal

Comparison of road and rail based public transport system on the basis of LCA
Student: Ashok Kumar
Analysis of roundabouts: A case study of Delhi  
Student: Hitesh Choudhary

Pedestrian/motion modelling at mass transit terminals: A case study of Delhi metro  
Student: Jyoti Prashad

Safety audit of selected highway section  
Student: Prem Sharma Lamsal

Safety at road construction zones  
Student: Md. Sajid Iqbal

Low carbon mobility plan: methodology and indicators  
Student: Sudeep Grover

Financial operational and safety performance of bus system: case study DTC  
Student: Abhijit Ghosh

City specific driving cycles for different modes in Delhi city  
Student: Aloy Nag

Trip generation forecasting model Patna city  
Student: Muslihuddin Jahed

Bus route rationalization  
Student: Mahesh Kumar Raman

Finite element analysis of geosynthetic reinforced flexible pavement  
Student: Satish Pandey

Parking regulations and demand assessment  
Student: Tapas Biswas

Optimization of geometric design and alignment of highway  
Student: Vaishali Kaul

Comparison of environmental impacts by different technologies of bituminous road resurfacing, on the basis of life cycle assessment  
Student: Vivek Arora

Driving cycle documentation and its effect on vehicular emission and fuel consumption  
Student: Ashutosh Singh Baghel

Aerodynamics of air flow through the engine compartment of a conventional bus  
Student: Akil Arshad

Crash reconstruction using multi body simulation and optimization technique  
Student: Raghu Vamsi Kanugula

Effect of road divider design on motorcycle stability  
Student: Debasis Sahoo
Comparison of exclusive lanes for buses: curbside lanes v/s median lanes
Student: Vishwa Deep

Traffic signal modelling using cellular automata
Student: Anjanee Kumari

Assessment of pedestrian risk at grade separated junction in an urban area
Student: Sumana Biswas

Optimal design of speed reduction devices in highways
Student: Pushpita Mondal

Evaluation of road safety management on road widening
Student: Ranjan Prakash

Development of real world driving cycles for various traffic conditions in India
Student: Harish Nalam

SHPB for bones
Student: Kranthi Teja

Pedestrian crash reconstruction and head injury correlation
Student: Ganesh R

Delta configuration based micro manipulation system
Student: Hemant Arora

Estimating factors influencing bicycle choice in urban areas – a case of Pune, India
Student: Shruti Lomte

Network assignment model for bicycles based on bicycle compatibility index
Student: Jyothi Chava

Analysis of traffic safety on selected highway segments
Student: Rishi Gupta

Estimation of environment pollution caused by urban transport system
Student: Harsha Chatterjee

Evaluation of bus rapid transit corridor Delhi
Student: Satendra Singh

Dynamic studies on shell materials and ventilation in motorcycle helmets
Student: Zafar Haider

Optimization of aggregate gradation using balley method
Student: Karanjeet Kour

Calibrating HDM 4-Lane divided highway
Student: Chandrama Prasad
Study on vehicular speed and delay analysis in Delhi bus transport system using time series analysis/OR/analytics in trucking logistics operations/dynamic routing of pickup/delivery vehicles
Student: Mehvesh Mushtaq
Development of bus performance measures
Student: Sandeep Gandhi

Impact of traffic calming at highway work zones
Student: Yogender Singh

Safety climate in Indian construction Industry
Student: Amit Bazaz

Finding and implementing factors improving safety and productivity simultaneously
Student: Meenakshi

Low carbon mobility alternatives for intra-urban freight movement
Student: Atul Kumar

Quality assurance for wearing courses in asphalt pavements
Student: Jiregna Debelo

Impact analysis of helmets and combined lagrangian-eulerian analysis of head
Student: Arun Baby

Characterization of polymers under high speed impact for use in FE modelling of automobiles
Student: Sounak Mojumder

Analysis of pedestrian behaviour
Student: Manjeet Singh Minhas

Car accident reconstruction and head injury correlation
Student: Varun Grover

Comparison of open and closed BRT system
Student: Narender Singh Pariwar

Road Safety audit on selected National Highway
Student: Amit Aggarwal

Evaluating the impact of free left turns on traffic behaviour at signalized intersections
Student: S.B. Ravi Gadepalli

Demand assessment for urban public transportation systems
Student: Dinesh Kumar

Planning criteria for urban public transportation systems
Student: Anantha Lakshmi P.

Material characterization of live body organ using inverse FEM analysis
Student: K.L. Mishra

Developing methodology for damage based accident investigation involving two wheeler
Student: T.S. Baviskar
Study of the ISO 13232 FST side impact configurations through computer simulation  
Student: Adity Shekhar  

Road Safety Audit of National Highways 8 (Delhi-Jaipur section)  
Student: Navdeep Asija  

Material characterization of soft issues under tension  
Student: Satnarayana Gondu  

Material characterization of soft tissues in compression and impact  
Student: Marathe Ratnakar Shrikrishna  

Evaluation of effectiveness of leg guard bars in an India motorcycle using computer simulation  
Student: Biradar Ashok Radragoud  

Crash simulation of RTV, Indian truck and buses using MASYMO  
Student: Ashish Nayak  

Modelling of rupture of material under impact loading  
Student: Walesh Kumar  

Road accident reconstruction  
Student: Lala Ram Patel  

Validation of human body FE models (human knee)  
Student: Abhijeet Singh Parihar  

FE modelling from MRI raw data and kinematical analysis of human knee joint  
Student: Girish Sharma  

Validation of human body finite element models for different impact conditions  
Student: Siddharth Jain
Seminars, Symposia and Workshops


This VREF co-sponsored conference was organized in Agra 2007 with the objective of contributing to the understanding of socio-economic and land use policy challenges facing us to address the mobility and access requirements of cities in the 21st Century. This was an attempt to open up the discussion on the shape our cities are acquiring, and hopefully influence policy choice. The participants deliberated on the following issues: (a) City structure and its effect on transport and inclusiveness, (b) Forms of governance and their influence on transport policy, (c) Alternative transport policies for personal and public transport – lessons learned, (d) City infrastructure (roads, parking, ring roads, etc.) and its influence on mobility and access, (e) Mobility, safety, and the environment, (f) Para transit, taxis and non-motorised transport, (g) Modern technologies, ITS, etc.

The crucial question was whether our decision-makers can learn to equally accommodate the needs and concerns of non-elite residents when planning for city development and learn from organic forms of city growth. Participants discussed issues concerning the structure of the city, use of mixed land use or zoned areas by business and residential locations, where we should permit mixed land use and what should be the density of living areas and business areas, place of hawkers and informal trade in the city, urban traffic safety issues and problems of urban governance. The conference was co-sponsored by the Ministry of Urban Development and Infrastructure Development Finance Corporation (IDFC).

Jubilee Seminar on Traffic Safety on 2nd December 2010 in Delhi

The Seminar included state of the art lectures on major issues concerning road safety by world experts followed by panel discussions. The attempt was to learn from the 20 years of history of road safety research practice, on how to bring international best practices into local contexts. International experts invited were: (i) Ian Johnston, National Transport Commission, Australia (The international experience in road safety), (ii) Yves Page, Renault Motors, France (The future in motor vehicle safety), (iii) Christer Hyden, University of Lund, Sweden (Traffic calming: The way ahead in mixed traffic), (iv) Herman Knoflacher, Technical University of Vienna, Austria (Transport policies: How & why safety has been neglected).

International Workshop on Safety, Sustainability and future Urban Transport (2012)

Complex issues involving the interaction of urban structures, urban layout, street design and architectural forms and their influence on human behaviour in transportation choices get neglected by most transportation planners. The participants at this conference focussed their attention on these interactions. Just the availability of clean vehicles, provision of public transport facilities,
and construction of bicycle tracks, will not be sufficient for ensuring that our cities in the future have sustainable consumption and healthy living patterns. One of the main concerns revolves around ensuring road users safety from traffic accidents and crime. The participants discussed how a city can be made safer, independent of enforcement and policing activities. This in the belief that unless people feel safe from crime and traffic accidents they will not willingly walk, bicycle or use public transport. Therefore, urban safety becomes a necessary though not sufficient condition for the promotion of sustainable urban futures. It was agreed that we must move away from planning cities around the car, and this will only happen if there is much more interaction among professionals from different disciplines. Everyone agreed that the built environment has a strong influence on both people’s subjective perception of safety and objective safety indices. A move toward designing safer streets and neighbourhoods has to become an integral part of our efforts to move toward a more sustainable future.

The conference was co-sponsored by VREF and Eicher Motors Ltd. The proceedings of the conference and a summary have been published by Eicher Motors Ltd.

**Annual International workshop on transportation planning and traffic safety (1997-2014)**

The International course on Transportation Planning and Safety has been organized annually since 1991. However with CoE funding the number of participants and collaborators increased. This seven day course brings together professionals working in the area of transportation planning, safety promotion, biomechanics of impact and vehicle crashworthiness, trauma and pre-hospital care, and acquaints them with state-of-the-art information. The course is especially designed for an interdisciplinary audience of traffic and road engineers, behavioural scientists, mechanical and automotive engineers, law enforcers, and police officers. The contents of the course are focused to give a global perspective on the road safety problem. The course has a common component for the first three days, followed by three parallel sessions on Traffic Safety, Biomechanics and Trauma and Pre-hospital Care in the next three days. In the last two years the course is followed by a one day research method workshop on “Statistical methods for traffic safety: Beyond simple descriptive”. This workshop is beneficial for doctorate students and graduates engaged in traffic safety research. The Course participants are made aware of the latest scientific knowledge regarding traffic planning, prevention of traffic accidents and injuries and current advances in vehicle crashworthiness and restraint systems, crashworthiness and restraint systems, and policies and methods which have been shown to be successful and those that have not worked in the past. The course enables the participants to improve or start their own programme on traffic planning and road safety, design data collection systems and avoid pitfalls common in data analysis, propose and implement road safety countermeasures and provide inputs for local and national road safety policies. The participants are selected on the basis of their involvement in transportation planning and road safety research, involvement in policy making and implementation of safety measures. An attempt is made to have a balanced mix of engineers, law enforcers, social scientists and medical professionals. Over the years approximately 800 professionals from 28 countries have attended this course. Twenty other workshops have been organised.

International Conference & Exposition on Safe Transport Solutions: Regulations and Practices, 4-5 November 2003, in association with Society of
Indian Automobile Manufacturers

International course on Transportation Planning and Road Safety, 8-14 December, 2003. The course was sponsored by Volvo Education Research Foundations, World Health Organization and Ford India Ltd. 21 participants attended the course out of which 13 participants represented 7 countries other than India.

Workshop on Future Directions in Transportation Research, 19th October 2004. The focus of the workshop was to strengthen and expand the TRIPP objective of partnering with other professionals from organisations outside IIT Delhi.

International course on Transportation Planning and Safety, 9-15 December 2004. The course was sponsored by Volvo Education Research Foundations (Sweden), World Health Organization, INRETS (France), IRCOBI (France), Ford India Ltd., and Ministry of Road Transport & Highways. 49 participants attended the course out of which 22 participants represented 16 countries other than India.

Organised the Delhi Bicycle Heritage Tour, 2nd October, 2005 is association with Firefox and Interface for Cycling Expertise, The Netherlands.

International course on Transportation Planning and Safety, 5-11 December, 2005. The course was sponsored by Volvo Education Research Foundations (Sweden), Ministry of Road Transport & Highways, India; Shell India Ltd.; Govt. of NCT Delhi, India and World Health Organization. 49 participants attended the course out of which 26 participants represented 13 countries other than India.


National Conference on Accessible Transportation, 17-19 March 2006 in association with Samarthya, National Centre for Promotion of Barrier Free Environment for Disabled Persons

International course on Transportation Planning and Safety, 4-10 December, 2006. The course was sponsored by Volvo Education Research Foundations (Sweden), TVS Motor Co., INRETS, France and World Health Organization. 55 participants attended the course out of which 22 participants represented 9 countries other than India.

International course on Transportation Planning and Safety, 10-16 December, 2007. The course was sponsored by Volvo Education Research Foundations (Sweden), INRETS (France), World Health Organization, TATA Motors, and Ministry of Road Transport & Highways. 59 participants attended the course out of which 35 participants represented 13 countries other than India.

Workshop on Disability and Access Awareness, 29th February 2008 in association with Samarthya, National Centre for Promotion of Barrier Free Environment for Disabled Persons.

International course on Transportation Planning and safety, 6-13 December, 2008. The course was sponsored by Volvo Research and Educational research Foundations (Sweden), INRETS (France), World Health Organization, Bajaj
Auto Ltd. And Ministry of Road Transport & Highways. 61 participants attended the course out of which 27 participants represented 12 countries other than India.

Traffic Calming Strategies to Improve Pedestrian Safety in India-National Dissemination cum Advocacy meeting, 28th October, 2009. In association with Consumer Unity & Trust society (CUTS International) and Department of Technology and Society, Lund University, Sweden and SIDA, Sweden.

International course on Transportation Planning and, 4-11 December, 2009. The course was sponsored by Volvo Research and Educational Research Foundations (Sweden), INRETS (France), World Health Organization, Bajaj Auto Ltd., Ministry of Urban Development and Ministry of Road Transport & Highways. 57 participants attended the course out of which 20 participants represented 7 countries other than India.


Workshop on Urban Mobility and Health Effects, 18-19th November 2010. In association with Chalmers University of Technology, Gothenburg, Sweden.


International course on Transportation Planning and Safety, November 29-07 December 2010. The course was sponsored by Volvo Research and Educational Research Foundations (Sweden), INRETS (France), world Health Organization, Ministry of Road Transport & Highways, Ministry of Urban Development, Ashok Leyland Ltd., Bajaj Auto Ltd., Tata Motors and TVS Motors Ltd. 82 participants attended the course out of which 35 participants represented 10 countries other than India.


International course on Transportation Planning and Safety, 5-12 December, 2011. The course was sponsored by Volvo Research and Educational Research Foundations (Sweden), IFSTTAR (France), World Health Organization (SEARO), Ministry of Urban Development, Bajaj Auto Ltd., Mahindra & Mahindra Ltd., Tata Motors and TVS Motors and TVS Motors Ltd. 77 participants attended the course out of which 33 participants represented 13 countries other than India.

Annual Seminar on Road Traffic and Work Zone Safety, 8th December 2011 International Workshop on Safety Sustainability and Future Urban Transport, 9-12th March 2012.

Workshop on Road Traffic and Work Zone Safety, 14th June 2012
Pedestrian Safety Initiative of India, 29th June 2012. In Association with Ashok Leyland Ltd.

Workshop on Rickshaws, 10th July 2012. In association with Eindhoven University of Technology, The Netherlands
An international course on Transportation Planning and Safety, 3-10 December 2012. The course was sponsored by Volvo Research and Educational Research Foundations (Sweden), Ministry of Urban Development, Govt. Of India, Ministry of Road Transport and Highways, Govt. of India, Bajaj Auto Ltd., Mahindra & Mahindra Ltd. and National Highway Authority of India. 87 participants represented 8 countries other than India.


Workshop on Mobility for All, 20th September 2013. In association with Samarthyam.

International course on Transportation Planning and Safety, 3-10 December, 2013. The course was supported by Volvo Research and Educational Research foundation (Sweden), Ministry of Urban Development, Govt. of India, Ministry of Road Transport and Highways, Govt. of India, and Bajaj Auto Ltd. 84 participants attended the course out of which 26 participants represented 5 countries other than India.


Workshop on NMT Planning and Design Guidelines: discussion and Review, 16-17th December, 2013. In association with Climate Works Foundation

**Transport Discussion Series 2014**

**Moving Around in Delhi : Vision 2030**

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 bicycle for short trips also because walking and bicycling infrastructure is of poor quality and perceived to be unsafe. Today, with just 8% trips on 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 set of six discussion series and an exhibition of projects at the end aimed at raising some of these important issues concerning transport system and streets of Delhi.

01 - City and Transport Vision – Delhi Master Plan, 27 May 2014

What kind of a city do we want? Can women, children, elderly and differently abled person access all activities safely? Discussing the mobility vision in the master plan.

Chair: Prof. K.T. Ravindran
Panelists: Dunu Roy, Hazard Center and Ajali Aggarwal, Samarthyam
02 - Transport and Health, 30 June 2014
Transport Emissions are affecting human health and also dependent on motorised transport. It is also contributing to poor health of our citizens due to lack of activity. How can we reduce adverse health effects of transport?
Chair: Dr. Mathew Varghese, St. Stephen's Hospital
Panelists: Anumita Roy Choudhury, CSE and Sarath Guttikunda, Urban Emissions.info

03 - Returning Streets to People, 28 July 2014
Pedestrians face hostile conditions on the road. Pedestrian paths have been occupied by parked vehicles. Since 100% of the city population is pedestrian sometime or the other, how can Delhi streets and transport system become pedestrian friendly.
Chair: K.L. Thapar, Asian Institute of Transport Development
Panelists: Parthaa Bosu, Clean Air Asia and Pradeep Sachdeva, PSDA

04 - Safety, Sustainability and Future Urban Transport, 29 August 2014
Safety and security are prerequisites for promoting sustainable transport. Can we plan and design our city to meet this requirement?
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

05 - Bicycling in Delhi, 30 September 2014
Bicycle is the most effective mode of transport in terms of energy consumption and use of space. It does not pollute the atmosphere and provides a range of health benefits reducing the risk of cardio-vascular diseases, cerebro-vascular diseases and dementia. However, due to unsafe roads, it is not a mode of choice by majority of the people. How do we make Delhi a bicycle friendly city by the end of the decade?
Chair: Sunita Narain, Centre for Science and Environment
Panelists: Rajendra Ravi, Instt. of Democracy and Sustainability
Sandeep Gandhi, SGArchitects

06 - Moving People out of Congestion, 03 November 2014
Most of the arterial roads in Delhi continue to be congested in peak hours. Ambulances and emergency vehicles get stuck in traffic jams. Can we redesign our roads and transport system to move maximum number of people in least number of vehicles?
Chair: Shri Bhure Lal, Chairman, EPCA
Panelists: A.K. Roy, Hazards Centre
M Ramsekhhar, DIMTS

07 - Moving Around in Delhi: Vision 2030 - Exhibition
22-23 November 2014, India Habitat Centre
Address by: Rakesh Kackeer, India Habitat Centre
Mr. KTS Tulsi, Prof. Dinesh Mohan, Mr. Abhijit Sarkar, Mr. P.K. Tripathi and Mr. Shishir Bansal.
Media and Communication

Films

High Capacity Bus Systems, The Wave of the Future
This video looks at traffic on the roads of a city like Delhi, and works towards a mass transit system that will answer the needs of the urban dweller. A system that is fast, efficient and above all affordable which should have space for all road users including pedestrians, bicyclists, cycle rickshaws and prioritise an efficient bus system.
Format – PAL Length – 10 min 32 secs. Producer – Suhasini Mulay Production

Way to Go…..
This video talks about the need for improvement in traffic circulation, options for changing the design of urban infrastructure for better management of the bus transport system.
Language – English Length – 19min 20 sec Producer – Suhasini Mulay Production

Changing Lanes
This video describes the development of the Bus Rapid Transit System in Delhi, its design parameters and the future of BRT systems in Indian cities.
Language – English Length – 12 min 31 sec Producer – Suhasini Mulay Production

Cycling: Mobility for Equity
This video talks about the importance of the bicycle in the transportation sector and the necessity of building its infrastructure in Indian cities.
Language – Hindi with English titles Length – 20 min 35 sec Presented by – IDS

Pedal Soldier of India
This video focusses on the social and economic status of rickshaw pullers, their livelihood, and their contribution to society. This video also talks about the need for rickshaws in urban transportation.
Language – Hindi with English titles Length – 20 min 36 sec Presented by – Lokayan and produced by Siksha

Special issues of magazines/journals edited by TRIPP faculty


Special issue of Seminar, #648, August 2013 on Safe Cities. Based on selected articles from the VREF International workshop on Safety, Sustainability and Future Urban Transport (2012) held in Delhi, India. (http://www.india-seminar.com/2013/648.htm)


**Popular articles in newspapers and magazines**

Over the last decade faculty members from TRIPP have published over fifty articles in national newspapers and magazines dealing with urban transport and road safety. These include The Hindu, Times of India, DNA, Civil Society, Indian Express, Business Standard and Economic Times.

Faculty members from TRIPP are invited to discussions on transportation issues by several national TV channels on a regular basis (about 3-4 times a year). In addition, their comments are frequently included in articles dealing with transport in the national newspapers.

Professor Geetam Tiwari was featured as part of the TIME-CNN International-shell program, Principal Voices..... As part of the Principal Voices program in 2005.

The national Civil Society magazine carried a detailed account of the Annual TRIPP lectures and the VREF International Workshop on Safety, Sustainability and Future Urban Transport (2012) held in Delhi, India.
TRIPP Annual Lectures

First Annual TRIPP Lecture by Prof. Herman Knoflacher, 14th December 2007.
Title: Urban Transport Planning in the Age of Global Warming

Second Annual TRIPP Lecture by Prof. David Banister, 16th March 2009.
Title: Cities, Mobility and Climate Change

Third Annual TRIPP Lecture by Prof. Murray MacKay, 8th March 2010.
Title: The Future of Traffic Safety and Sustainable Transportation

Fourth Annual TRIPP Lecture by Professor Ian Roberts, 11th March 2011.
Title: The Energy Glut: Transport and the Politics of Fatness and Thinness

Fifth Annual TRIPP Lecture by Prof. Fred Wegman, 22nd March, 2013.
Title: Road Transport: The Science of Safety

Sixth Annual TRIPP Lecture by Prof. David Satterthwiate, 13th March, 2014.
Title: How Can Transport Contribute to Other Urban Agendas

Seventh Annual TRIPP Lecture by Dr. Robert B. Noland, 16th March, 2015.
Title: Pedestrian Safety versus Traffic Flow: Finding the Balance
Collaboration

KRITIKAL SOFTWARE CO. Ltd.

TRIPP, IIT Delhi and Kritikal Software Co. Ltd. An incubation of IIT Delhi have developed a software namely “TRAZER”.

What is TRAZER?

TRAZER (TRAffic AnalyZER) is a technology that owes its birth to TRIPP, both in terms of the concept and initial funding. Kritikal which helped in developing and evolving the TRAZER Technology in its current form, provides an accurate and audit-able traffic data perfect for all traffic conditions.

TRAZER started as a development project for TRIPP to detect cars in a traffic video automatically using face detection methods. As time went by, depending upon specific needs and based on an extensive market survey, Kritikal has developed tailored TRAZER solutions to cater to a majority of research academia and the traffic and transportation industry.

• TRAZER Suite: This is a one-stop permanent solution to all the traffic survey and data collection needs. The software is not only efficient but also saves time and effort. It provides fast and automatic processing of both Video and Live feed (IP Camera). TRAZER Suite is a complete package which includes a Software and Scene Configuration module, an Automatic Traffic Counter and Classifier (ATCC) and a Collate-Feedback-Report (CFR) module. The software solution is being used by hundreds of researchers in about ten colleges across three nations.

• TRAZER Service: Several years of exposure to TRAZER development and testing has not only evolved the software into a powerful, robust and stable solution but has also resulted in a team within Kritikal who is trained and experienced in carrying out traffic surveys starting from collecting video data to generating extensive reports. With TRAZER Service, we offer this experience so that the customer need not worry about resource planning, resource training, adequate infrastructure and other details. In just one year, Kritikal has done traffic surveys for 5000+ hours of video at more than thirty
different cities and rural locations in India.

We believe that because of the uniqueness of Indian traffic conditions, India poses a challenge to traffic planners, city administrators and urban development consultants. Though there are some solutions available in the Western world for traffic planning, the same are not applicable in India and other developing countries. TRAZER has been helping the city planners and traffic consultants to analyse the traffic flow, study the statistics that are captured from the traffic video and using the data, plan the traffic conditions for any city in a more systematic manner.

**Benefits**

- TRAZER is the only camera-based system which caters specifically to the heterogeneous traffic of the developing countries.

- Provides rich and accurate information such as vehicle class, speed and trajectory.

- Removes the probability of human error in data collection and analysis.

- With the help of CFR module, 100% accuracy can be achieved.

- Verification can be done by going back to the stored data with the help of the CFR module.

- Works with standard off-the-shelf cameras to analyse pre-recorded videos.

- Capable of processing live feed from any IP Camera in real time.

- Use of cameras enables photographic evidence. Camera system can be used to provide a live picture (recorded) of the situation in the case of any untoward happening.

- The installed camera can also be used for surveillance purposes, especially useful in the case of VVIP movement, sensitive areas, etc.

- Different solutions to fit every pocket and a variety of needs.

- Product can also be customized to suit the specific needs of traffic planners.

- Cost effective solution for city planners and traffic consultants.

**Contributions to Research**

TRAZER is being used extensively by various research institutes in all corners of India for traffic research. Below are the links to some of the published research work which used TRAZER


Applications
Applications of TRAZER for city administrators, traffic consultants, highway toll auditors and researchers are:

- Traffic Census and Classification
- City Surveillance and Traffic Monitoring
- Speed and Trajectory Measurement
- Customized Traffic Statistics
- Intersection Studies
- Toll Booth Management/Audit

INSTITUTE FOR DEMOCRACY AND SUSTAINABILITY (IDS)

There are certain activities conducted by IDS with the help of TRIPP, IIT Delhi. The activities fall under three heads: research, workshops and publications. A summary of the activities is given below:

Research

2. ‘The bicycle in Delhi: its use and barrier to use.’ (2004)
4. Survey of bus users. (23rd April to 25th July 2005)
5. Commuters study ‘on board volume count survey’ (2005)

Workshops

1. Asian Social Forum. (2nd January to 7th January, 2003 in Hyderabad)
2. World Social Forum. (16th January to 21st January, 2004 in Mumbai)
4. Public hearing on non-motorized transport. (14th April to 16th April, 2004)
6. Low cost mobility. (3rd October to 7th October, 2005)
8. Importance of urban transportation in democratic urban transformation: concern, challenges, ideas and solutions. (15th November to 17th November, 2013)
Publications

1. Traffic ki Samaj, 2004  
2. Sustainable Urban Transport in Future, 2004  
4. Bicycle Master Plan of Delhi in English. (Re-print 2004)  

Advocacy & Campaign

2. Advocacy and Campaign for BRTs Delhi. (2005 onwards)

HAZARD CENTRE

The Hazard Centre is a unit of the Sanchal Foundation that was set up in 1997 for the specific purpose of providing professional services to the community and labour organisations. It consists of a multi-disciplinary team which has, for the past seventeen years, been assisting such organisations in identifying, understanding, and combating the ‘hazards’ that beset them. It has been collaborating with several experts and technical organisations in pursuance of this objective.

Hazard centre – TRIPP have been collaborating to conduct research studies for several years on planning and transport. Some of these studies are:
Capacity Building

Academic Capacity

Within our own COE the number of academic collaborations especially for interdisciplinary Ph.D. research increased as a result of VREF funding. This includes collaboration with the Humanities and Social Sciences Department, the Mathematics department, and several other engineering departments including civil, mechanical, applied mechanics and computer science.

Master’s programme in transportation engineering in the Civil Engineering Department has been strengthened with VREF funding. This includes modernization of traffic laboratory and support to M.Tech students as fellowships and research grants. Students have received financial support for research activities including participation in international seminars.

We have established an annual TRIPP Public Lecture (On sustainable transport) which honours a professional who is recognised internationally. The last six lectures were delivered by (i) Professor Hermann Knoflacher (Technical University Vienna), (ii) Professor David Banister (Oxford University), (iii) Professor Murray Mackay (Emeritus, University of Birmingham), (iv) Prof. Ian Roberts (London School of Hygiene and Tropical Medicine), (v) Prof. Fred Wegman (SWOV, The Safety Research Institute, The Netherlands), (vi) Dr. David Satterthwaite (International Institute of Environment and Development). Arrangements have been made to establish an endowment at the Indian Institute of Technology Delhi so that this lecture series will continue even after the funding from VREF ceases to exist.

CONTRIBUTION TO NATIONAL AND GLOBAL CAPACITY BUILDING AMONG POLICY MAKERS AND PRACTITIONERS

Significant influence in framing of the National Urban Transport Policy for India. The policy stresses planning for improving access in addition to mobility in urban areas. The role of non-motorised transport and public transit has been stressed in the policy. The introduction of bus rapid transit projects in about 10 cities is a result of the same being included in this national policy

National committee to frame guidelines for a national road safety agency was established as a result of TRIPP faculty members being part of the group advocating the same. Three members of TRIPP were included as official members of the committee. A National road Safety and Traffic Management Board bill, 2010, has been tabled in the Parliament of India.

Geetam Tiwari and Dinesh Mohan are Committee members of a National Transport Development Policy Committee set up by the Prime Minister’s office to frame transport policies for India for 2030.
TRIPP faculty members were involved in developing specifications for low-floor and semi-low-floor buses for India. These buses are being manufactured by Indian manufacturers now and have succeeded in reducing the price of such buses for the Indian market.

TRIPP faculty members were part of the committee to modernise the Motor Vehicle Act of India with important implications for improving traffic safety and making regulations regarding public transport more logical.

TRIPP faculty members are involved in revision of all urban road standards, highway construction standards concerned with safety, helmet standards, and some motor vehicle safety standards.

Associated with the production of the World Report on Traffic Injury Prevention by the World Health Organization. The report was released by the President of France and has been distributed worldwide. It has had a significant role in pushing the road safety agenda internationally. It has had a significant influence in the content of WHO road safety and pre-hospital care publications.

Associated with writing of chapters on safety, non-motorised transport, and informal transport for documents being produced by international organisations.

Associated with organising committees of numerous international conferences on sustainable transportation and safety.

**TRIPP Influence and Impact**

Researchers at TRIPP have set up a very innovative combination of current and future international knowledge with local findings. This knowledge has been produced in India within the socially dominant forms prevalent here. The professionals at TRIPP have set up a system of research which responds dynamically to include a heterogeneous set of practitioners collaborating on problems defined here in localised contexts but integrating international concerns in an internally consistent format. They have set up systems for local knowledge producing mechanisms which aid researchers in responding to demands of society. Such systems are in a very nascent stage of development here, in particular, and internationally in general.

We have been able to influence national urban transport and safety policy making primarily because of the initial recognition of the academic output including publications that attracted the attention of both forward looking bureaucrats and politicians. The scientific content of our work and technical modelling exercises gave further credibility. Some of us became members of technical policy making committees appointed by the city and national governments and we used this to obtain official consensus for some of the proposals.

One of the most significant achievements in his period was the conceptualisation and design of the first 18km bus rapid corridor for the Government of Delhi. This story begins in 1996. The Central Pollution Control Board of India asked us to provide them with a comprehensive plan for sustainable transport policies for Delhi. The team produced a report titled Delhi on the Move 2005 – Future Traffic Management Scenarios. There were three main ideas in the report: (a) the non-viability of metro systems (b) the success of high capacity bus systems initiated in Curitiba (Brazil), (c) The need to establish dedicated bicycle lanes...
on all arterial roads in Delhi as a pre-condition for efficient traffic flow. The study was widely reported in the press. The newly appointed Minister for Transport for Delhi took notice of the press reports and commissioned a study to prepare a Bicycle Master Plan for Delhi.

The government changed soon after that and the new Minister of Transport and the Chairman of the Delhi Transport Corporation showed renewed interest. This resulted in an International Conference on BRT in January, 2002. At the end of the conference, the Government of Delhi announced that it would initiate plans for establishing 5 BRT corridors in Delhi. Several meetings and presentations later, the Government of Delhi appointed a high level committee (which included a member from the CoE) to prepare plans for sustainable transport in Delhi. The Committee submitted its report in September 2002 and this led the way to the first corridor being designed with our participation and finally opened for operation in April 2008.

The second area of influence has been our focus on the safety of vulnerable road users as distinct from the focus in many of the high-income countries. In addition to academic publications we organised an international conference on vulnerable road users to highlight the issue (1991) and started an annual international course on traffic safety. These activities helped increase the interest in these issues nationally and among our own faculty members. More importantly, many professionals who attended these courses and conferences became more active and started supporting our work and views.

Among other things, the result of all this was that many of us participated in the preparation of the influential World Report on Road Traffic Injury Prevention (WHO), and were also appointed members of a national committee to look into the issue of creating a dedicated agency for road safety and traffic management for the country in 2005. Based on the Committee’s deliberations a National Road Safety and Traffic Management Board Bill is under the consideration of the Parliament of India.

Most faculty members associated with the CoE are members of international/national/local committee for policy making, standards, conference organisation. Professor Geetam Tiwari as the Editor-in-chief of the International Journal of Injury Control and Safety Promotion published by Taylor& Francis with effect from January 2009, heads the WHO Collaborating Centre for Research and Training in Safety Technology at IIT Delhi. Professor Sudipto Mukherjee has been elected to the Council of International Research Council on the Biomechanics of Injury (IRCOBI) with effect from 1 January, 2011. Professor Dinesh Mohan has been nominated a member of the National Transport Development Policy Committee established by the Prime Minister’s Office, and Chaired the National Sub-Committee on Road Safety and the Environment to prepare a report for India’s 12th Five Year Plan. Professor Geetam Tiwari has been nominated a member of the Working Groups on Roads and Urban Transport for the National Transport Development Policy Committee.

INDUSTRY COLLABORATION

TRIPP COE researchers have collaborated with the vehicle industry actively. Some of the important achievements as a result of this collaboration are listed below:

- Participated in the development of a prototype for a safer school bus for Eicher Motors Ltd. Eicher has incorporated the suggestions in their SKYLINE series which they advertise as the “The First Safe School Bus in India”.
• Participated in the development of the bus code and specifications for the first low floor buses in India, in particular with Tata Motors and Ministry of Urban Development, Government of India.

• Provided the conceptual design criteria for a low cost small vehicle in India to Bajaj Auto Ltd. Bajaj Auto is finally going to market this new vehicle as a “quadricycle” under the brand name RE60 (http://bajajauto.com/bajajre/green-story.html). The vehicle has a maximum speed of 60 km/h, seats 4, has a low fuel consumption of 35 km/I, will not be allowed on expressways and highways, and will initially operate as a taxi.

• Have been working with Ashok Leyland for safer pedestrian policies and provided conceptual inputs for safer bus fronts.

• Worked with Maruti Suzuki Ltd. In development of TV commercials for traffic safety.

• TRIPP researchers have a very fruitful collaboration with an IITD startup- Kritikal Solutions Limited. TRAZER ® (TRAffic AnalyZER) developed by Kritikal solutions is a technology that owes its birth to TRIPP. Both in terms of the concept and initial funding TRIPP supported KritiKal which helped in developing and evolving the TRAZER technology to its current form. TRAZER ® provides accurate and audit-able traffic data perfect for all traffic conditions.

**FUTURE PLANS**

The activities in the next five years include: Expanding the knowledge base by adding faculty members with expertise not available at present. Establishing a sponsored M.Tech programme for in-service engineers and officers. Expanding the Ph.D. programme by offering 5 more scholarships in interdisciplinary areas. Strengthening the M.Tech. Programme in terms of laboratory facilities and adding 5 more scholarships. Provide continuity to research work by the availability of seed money to augment resources obtained from sponsored projects.

The National Transport Development Policy committee (NTDPC) was constituted by the Government of India in 2010 to formulate a long-term transport policy. The committee submitted the final report to the prime minister on 10th March, 2014. The committee has given strong recommendation to support the kind of interdisciplinary research that has been the focus of TRIPP CoE. Therefore we see a possibility of receiving support from Government of India in the coming years and expanding research on sustainable transport issues.
Research Papers

2014


Benchmarking vehicle and passenger travel characteristics in Delhi for on-road emissions


2013


Geetam Tiwari (2013), 'Impact of planning polices and design interventions on road traffic crashes: case studies from Delhi,' in D. Mohan, ed. (ed), Safety, sustainability and future urban transport. New Delhi, Eicher Goodearth Pvt. Ltd.


2012


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2011


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2010


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2009


Anurag Soni, Anoop Chawla, Sudipto Mukherjee, Rajesh Malhotra. 2009, Sensitivity analysis of Muscle Parameters and Identification of Effective Muscles in Low Speed Lateral Impact”. SAE World Congress, Detriot,


Pinnoji PK and Mahajan P. 2009, Damage and Delamination Study in Composite Shells for a Motorcycle Helmet, 15th International Conference on Composite Structures (ICCS15), Porto, Portugal.


2008


Mohan, D. 2008, "Road traffic injuries: a stocktaking" Best Practice & Research Clinical Rheumatology, 22:4, 725-739... Abstract


2007


S. Mukherjee, D. Transportation Research – Safety and Sustainability), 32:4, 445-458.


2006


Soni, A. and Mukherjee, S. 2006, Effect of active muscle forces on the response of knee joint at low speed lateral impacts In Proceeding of SAE World congress & Exhibition, Detroit, USA.


2005


Praveen Kumar Pinnoji, Puneet Mahajan. 2005, Impact analysis of helmets for improved
ventilation with deformable head model in Proceedings International Conference on the Biomechanics of Impact, IRCOBI, Medrid, Spain.

2004


Chawla, A., Mukherjee S., Mohan, D. and Parihar, a. 2004, Validation of Lower Extremity Model in THUMS. In proceedings International Conference on the biomechanics of Impact, IRCOBI, Austria.


2003


2002

Adarsh Kumar, Dinesh Mohan, Rajesh Patel and Mathew Varghese, 2002, Development


2001


2000


1999


1998


Kumar, A., Mohan, D. and Mahajan, P. 1998,”Tractor Related Injuries in North India”, Accident Analysis and Prevention, 30:1, 53-60.


1997


Books and Monographs


Road Safety in India: Challenges and Opportunities, Dinesh Mohan, Omer Tsimhoni, Michael Sivak, Michael J. Flannagan. 2009.


The Travel Behavior of Inhabitants of Informal Settlements: A Case Study of Delhi. TRIPP SERIES REPORT, SSLN Sarma and Geetam Tiwari, 2013


Forecasting Travel Demand by Non-Motorised Transport, TRIPP series report, Geetam Tiwari and Deepty Jain, 2013


