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Here are some excerpts from two of our manuscripts being readied for publication which focus on the promotion of low-carbon transport in India:

NMT Infrastructure in India: Investment, Policy and Design

Geetam Tiwari and Deepti Jain

This study shows the declining shares of walk and bicycles in India since the past two decades. Various studies show increasing risk to pedestrians and bicyclists and deteriorating quality of infrastructure for them. Despite the given condition and a declining share of bicycle NMT dominates the modal share in Indian cities. Since bicycle ownership is high in India and the majority of trips are short trips (< 5 km), there are a significant number of potential users. Cycle rickshaw is an important non-motorised mode used both for passenger and freight traffic. Pedestrians, bicyclists and rickshaws are also important modes to access public transport systems. There are major gaps at the level of data collection and demand estimation for non-motorized traffic. Injury data at national level does not present correct information regarding the risk to NMT users. Some of the key findings of the study have been summarized as follows:

- Experience from other countries show how the impact of developing safe infrastructure for NMT resulted in increased use, fuel savings and reduced emissions even at places where car ownership was high as in European cities.
- Delhi and Nanded examples show benefits to NMT users when dedicated infrastructure is created for NMT
- In Indian cities focus of the local bodies is towards construction of bridges, flyovers and sub-ways contributing to the increasing flow of motorized vehicles and increasing risk and detours for NMT users.
- Even after adopting policies at the national level (NUTP) and availability of funds through JnNURM there seems to be a lack of will to improve infrastructure for NMT. Projects directly related to development of NMT have not been proposed. Also the lack of understanding of the need of NMT infrastructure has resulted in discontinuity and removal of NMT infrastructure even at the locations where they have been approved and constructed.
- Some projects have been approved through JnNURM to improve infrastructure for NMT however the objective of the authority is still to provide smooth and easy flow of traffic (motorized vehicles) for example in Bengaluru. The priorities are required to be changed to develop an appropriate environment for movement of NMT users.
- Relatively small stretches of BRT projects have been approved for implementation along which NMT infrastructure is to be improved. However, provision of good level of NMT infrastructure requires meeting the aspects of continuity, contiguity, safety, security and directness. Small stretches are insufficient to meet the desired levels. There is a need to develop a comprehensive network throughout the city.
- Focus of the local authorities is to reduce congestion and provide uninterrupted flow to motorized vehicles. This approach is resulting in the removal of infrastructure for NMT where they have been provided as in Ahmedabad and Delhi.
- Provision of appropriate infrastructure for NMT has short term and long term benefits as in the case of Delhi. However a strong enforcement and development of a comprehensive network is important to achieve the set objectives.
- Scenario based study done to understand the implication of improving NMT infrastructure in – Delhi, Pune and Patna shows that the maximum impact of improving NMT infrastructure is realized in Pune in terms of reduced CO2 emissions. However in Delhi, though percentage reduction is not that much, quantitatively there is a high potential to reduce a large amount of CO2 emission once NMT infrastructure is developed.

Case Study of Metro Rails in Indian Cities

Geetam Tiwari and Rahul Goel

India has currently four operational metro rails namely Kolkata metro in West Bengal, Delhi,Metro and Delhi Airport Express Link in National Capital Region (NCR) of Delhi, and BangaloreMetro in Karnataka. Similar rail projects are being planned and/or under construction inAhmedabad in Gujarat, Bhopal and Indore in Madhya Pradesh, Chandigarh, Ludhiana in Punjab,Jaipur in Rajasthan, Kochi in Kerala and Pune and Mumbai in Maharashtra and Hyderabad in Andhra Pradesh.

Constantly increasing numbers of poor people continue to live in informal settlements without services. Well over 3 million people are estimated to live in Jhuggi- jhopri (JJ) clusters (unplanned squatter or slum settlements) which is projected to increase to 4.5 million by 2011 and to 6 million by 2020 (Anand, 2007; Tiwari 2003). As the city carries out its development process, it leads to eviction of the people living in lowincome households leading to loss of their access to regular employment and livelihood opportunities in addition to education, health care, and other social necessities.

Since 2000, more than 100,000 jhuggies in Delhi have been displaced 10–25 km away from their original location (Tiwari, 2003). Similar eviction and relocation of jhuggies took place with the development of Delhi metro which acquired large tracts of land along its lines. According to the Environment Impact Assessment report of Phase I of Delhi metro, the project needed 348.45 hectares of land and needed to relocate 2502 jhuggies (Hazards centre, 2006).

Several household from different slum settlements were relocated to a designated resettlement colony called Holambikalan, located on the North-West periphery of Delhi. A survey of 201 households in the resettlement colony was carried out in 2004 (Anand, 2007). The survey found impacts on the relocated household in their socio-economic profiles as well as their accessibility. It resulted in financial, social and domestic hardship all round.

Delhi Metro is a system which runs mainly on electricity. It has electricity consumption from traction (running of trains) as well as for non-traction purposes (air-conditioning of underground stations, lighting of stations, lifts, and escalators, etc.). As seen in the section on Cost and Revenue streams, electricity contributes 25 to 30 percent of the total operating cost of Delhi Metro. For evaluating such a system, it becomes essential to estimate the emissions attributed to the operation of this system. According to a 2007 estimate, electricity generation in India contributes 37.8% of CO2 eq. emissions (CO2, SO2, NO2) (MoEF, 2010).

This is because production of electricity in India is mainly by coal-based thermal power plants. In 2009, 69% of electricity in India came from coal (IEA, 2011). Since coal in India has higher fly-ash content (30- 40%), electricity generation leads to generation of particulate matter (PM), a source of air pollution, in the form of fly-ash (Senapati, 2011). Therefore, Delhi Metro has no direct emissions within the city of its operation but contributes to carbon emissions at power plants during generation of electricity used for its operations. The implications of the case study of the Metro in Delhi are equally relevant for all the upcoming metro projects in the other cities.

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

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Girish Agrawal, JD, PhD, PE, GE
Girish Agrawal joined IIT Delhi in July 2012 as Visiting Faculty with a joint appointment in TRIPP and the Department of Humanities & Social Sciences. He is a product of IIT Delhi, graduating with a B.Tech. in Civil Engineering in 1985 followed by a Masters degree and Ph.D. from Purdue University. In the Fall of 2003, he took a sabbatical from being a consulting engineer and became a full-time student of law at UC Berkeley's Boalt Hall School of Law, graduating with a Juris Doctor in 2006. He is a licensed Civil Engineer and a licensed Attorney at Law in California.

What are your primary areas of interest?

Broadly speaking, I work on the interrelated questions of law and policy as they pertain to development of physical infrastructure. I am particularly interested in exploring and interrogating the complexities motivating the rush to 'develop' infrastructure.

Law and Policy, even just the law and policy surrounding physical infrastructure, is a broad area, are there particular issues you work on?

Yes, this is a broad area, but I don't think it can be broken down into sub-components easily. For instance, the two basic questions one needs to ask for the development of any transportation infrastructure are: Who benefits from it? And who pays for it? Trying to answer these two seemingly straightforward questions raises a lot of other questions. Where did the raw material come from? Who extracted it? Whose land was it extracted from? Who processed it? Who transported it? Who put it together to create the highway or the bridge? Whose need is the highway or the bridge or the airport meeting? Whose livelihood is affected by the 'development'? One could go on indefinitely.

My current work is centered on transportation safety – both from the perspective of transportation users and transportation construction worker health and safety.

First, from a user perspective, I think we need to focus on safety in a democratic way, not simply from the point of view of those who use motorized means of transport. Let me elaborate. Until fairly recently, most work on transportation safety focused on vehicle safety and associated roadway design. But, over the last few years, starting somewhat earlier in India and other similarly situated countries, the focus is shifting towards the safety of pedestrians and non-motorized vehicle users. These last two categories are the plurality, if not the majority, of roadway users in India. I am looking at how our existing motor vehicle laws and implementation policies need to be modified to put the safety of these users front and center.

Second, and perhaps equally important when we talk of transportation safety, what are the safeguards for the health and safety of the construction workers who build the roads and ports and bridges we use. And here I look at the safety of not only construction workers, but also the factory workers who produce the steel and cement, and the miners who extract the ores and quarry the rocks. Health and safety is one of the two most critical issues that every worker faces – the other, of course, being wages.

How do law and policy fit into the mission of IIT Delhi?

First, IIT is not a trade school. As such, saying that IIT students should only learn about the technical aspects of their chosen specialization does them a disservice. These are all smart, young people, brilliant in many ways, and we should be working to expand their horizons. My hope is that I can initiate the process where we graduate students who look at infrastructure as something integral to the socio-economic well being of the society they are a part of, not just as a series of technical problems to be solved.

In choosing to work in the area of law and policy, have you 'abandoned' your technical training as a Civil Engineer? Tell us something about your study and work experience.

Nothing of the sort. I am still very much an engineer – just one who has come to believe that engineering cannot be practiced in a vaccum. In fact, until a few months ago, I spent most of my working hours as a Principal Engineer for Willdan Engineering, a consulting firm based in Southern California, where I managed foundation engineering design and construction support services for all Willdan projects; I served as the in-house geotechnical and environmental assessment expert for engineering teams working on large infrastructure projects, and led the engineering team providing geotechnical consulting and construction quality control services to a number of county and city public works departments throughout California.

A bit of history. After graduating from IIT Delhi in 1985, I went to Purdue University for graduate school. For my master's dissertation, I did experimental work on building highway embankments that could function well under extreme weather conditions. The quality assurance procedures I developed are still being used by the state Department of Transportation. Then for my doctoral work, I investigated the applications of Artificial Neural Networks as computational tools for modeling and forecasting soil behavior. The primary focus was on developing a rational and straight-forward methodology to evaluate the potential for earthquake induced liquefaction in soil deposits. Simultaneously with my doctoral research, I also conducted a four-year research study to identify and mitigate problems experienced with driving of thin shells for steel-encased concrete piles used for highway bridges in Indiana. After I received my PhD, I stayed on at Purdue for a year as a Visiting Assistant Professor, teaching a course in applied mechanics and doing research and consulting work with some senior faculty.

In the Fall of 1993, I moved to California as a Staff Geotechnical Engineer with Earth Tech (then the Earth Technology Corporation). Over the next 20 years, I switched firms a couple of times, expanding my areas of interest and levels of responsibility each time, and worked on a wide variety of projects, providing geotechnical engineering and environmental assessment services for commercial, industrial, residential and institutional developments, and for ports and harbors, public works, major transportation projects, including many bridges, local roads, freeways, toll roads, water, and waste water facilities. In between I passed the requisite exams and obtained my Professional Civil Engineer (PE) license in 1995, and then later, in 2000, also became certified to use the title Geotechnical Engineer (GE) in the state of California. Almost all of my professional work as a civil engineer has been in California, split almost evenly between Southern and Northern California – 9 years in the Los Angeles area and 11 in the San Francisco Bay area.

At IIT I will be teaching classes in what are considered "hard core" civil engineering areas, pavement design and transportation infrastructure design, and doing research, advising students, and some consulting in pavement engineering, construction zone safety, foundation engineering, subsurface stratigraphy assessment, etc. So, no, I have not "abandoned" my technical training. Just expanded my field of view.

Can you give us some examples of your ongoing law and policy work?

Over the last eight years, I have worked with public interest law groups both in the U.S. and in India. In India primarily with the Human Rights Law Network, the largest, non-profit, public interest law firm in India. And in the U.S., with legal clinics associated with Boalt Hall, the UC Berkeley School of Law, and a couple of non-profit organisations based in California who work on issues affecting the South Asian diaspora. I also work with an international group which works with local groups who are struggling to preserve their homes and their livelihoods against the onslaught of global mining giants. This last is a core part of my work in India where I look at labor rights and land rights – both issues arising from the accelerating extraction of natural resources and production of construction materials in India.

With HRLN, starting in 2003, I helped initiate and obtain funding for a national legal aid initiative to monitor and enforce the rights of Dalits. As part of this work I also co-authored a book on the rights of Dalits under Indian law and India's obligations to eliminate descent-based discrimination under various international treaties. This book, *Dalits and the Law*, was published in 2005, and is an attempt to fulfill the widely felt need by Dalit activists and lawyers for a single published source that brings together the legal materials relevant to the civil and human rights of Dalits. In addition to the text of laws and government rules and orders, the book presents and analyzes important decisions by various High Courts, and by the Supreme Court, on cases arising from violations of the rights of Dalits. The book was well received and is on the prescribed curriculum of at least five law colleges in India, that I know of, and is held in the libraries of more than 25 law schools in the U.S. and around the world. It is relevant to note here that Dalits also constitute a large segment of the migrant construction labor force in India.

Among multiple other initiatives I have participated on with HRLN, my work on impact litigation designed to enforce health and safety norms for Delhi Jal Board workers perhaps ties in most with my interest in worker safety and land rights.

At UC Berkeley, as a part of the International Human Rights Law Clinic, I worked with a group of students and faculty and conducted field surveys in the New Orleans area to document the problems being faced by migrant workers employed in the post-Katrina clean-up and reconstruction, and researched stakeholder involvement in enforcement of state and federal wage and hour laws and health and safety regulations.

At IIT Delhi, I am currently engaged in two projects with TRIPP. The first is for the RS-10 component of the Global Road Safety Partnership (GRSP), being managed by WHO and the International Red Cross. And the second is in generating a contextualized history of the Bus Rapid Transit system in Delhi.

The goal of the RS-10 project is to support the Indian Government to implement good practices in road safety in line with the national road safety strategy. Road Safety policies in India vary across states. This was not a major concern when the volume of interstate road traffic was relatively low, with a correspondingly low rate of road fatalities and serious injury. But with the accelerating growth in interstate movement of goods and people by road over the a last 20 years, the rate of traffic related injuries and deaths has dramatically increased, and it has become imperative that there be a much greater degree of coherence between the road safety policies and implementing legislation across the country.

I aim to assess the political settings and context at both a national and state level to identify levels of support for the road safety policy issue, including conducting a political map of the various national actors connected to the road safety legislative framework at National and State levels. Specifically, I am working to produce a map of the national political actors to understand the dynamics around the proposed updating of the Motor Vehicles Act of 1988, and the creation of a lead road safety agency. At the state level, my focus is on mapping of the Andhra Pradesh political context for assessment of the issues around lack of enforcement of the helmet law.

Starting in late July of this year, almost from the moment I stepped into the TRIPP offices, I have also been engaged in assisting various litigation teams challenging the attempted dismantling of the current phase of the BRT. Now that the litigation is over, and public transit users have prevailed, at least for the moment, I am working on a history of the BRT from a law and policy perspective, specifically looking at how changes in policy were initially driven by litigation and how certain interest groups are attempting to do an end run today around the political process by challenging the public transport policy of the Delhi government in court.

One final question. What classes are you teaching at IIT Delhi?

This semester I taught the pavement design portion of a 200-level Transportation Engineering course. This is a core class, required of all B. Tech Civil Engineering students. I taught the basics of designing roadways for under a range of traffic loading and on a variety of soil conditions. In addition to teaching the engineering principles and methods for roadway design and construction, I also introduced the students to the idea that a roadway is more than just a means to carry traffic, it is also a reflection of the priorities of the political and economic elite.

Next semester I will be teaching two courses – Industry and Work Culture under Globalization, an undergraduate elective class offered under the aegis of the Department of Humanities and Social Sciences, and Transportation and Traffic Infrastructure Design, a graduate class open to MTech and PhD students in Civil Engineering. The globalization class will be structured as a seminar exploring the impact of globalization on workers across a spectrum of industries. The first half of the course will acquaint students with the history of what is commonly understood as globalization. The second half will analyze a variety of viewpoints on the benefits and drawbacks of globalization for the worker as distinguished from the business owner or the state. My aim is to both increase students' understanding of globalization as beneficiaries, consumers, or possible victims, and to develop students' ability to get past the rhetoric of development and figure out the real costs.

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News

Prospective study of healthy older drivers: No increase in crash involvement or traffic citations at 24 months following a failed on-road assessment
Petra A. Hoggartha, Carrie R.H. Innesa, John C. Dalrymple-Alforda, Richard D. Jonesa.
Transportation Research Part F: Traffic Psychology and Behaviour, Volume 16, January 2013, Pages 73–80

Abstract
There is a general belief that requesting driving assessments for older drivers without evidence of cognitive impairment is a poor use of resources. There is, however, limited empirical evidence to support this view. We prospectively followed 56 neurologically-healthy drivers aged 70–84 years for 24 months to determine whether a non-enforced pass or fail outcome on an on-road driving assessment was related to the subsequent incidence of self- and officially-reported crashes and traffic offences. There was no significant relationship found between pass or fail outcome and either later crashes, or crashes combined with the more common occurrence of traffic offences. However, drivers who drove more km at the initial assessment were more likely to have a crash or traffic offence in the following 2 years. This prospective study suggests that an on-road driving assessment provides little indication of crash and traffic offence likelihood in the subsequent 2 years in the context of older drivers who do not have cognitive impairment.

Risk factors for injury accidents among moped and motorcycle riders
Aurélie Moskal, Jean-Louis Martin, Bernard Laumon
Accident Analysis & Prevention, Volume 49, November 2012, Pages 5–11

Abstract
For both moped and motorcycle riders, being male, not wearing a helmet, exceeding the legal limit for alcohol and travelling for leisure purposes increased the risk of accident involvement. The youngest and oldest users had a greater risk of accident involvement. The largest risk factor was alcohol, and we identified a dose–effect relationship between alcohol consumption and accident risk, with an estimated odds ratio of over 10 for motorcycle and moped riders with a BAC of 2 g/l or over. Among motorcycle users, riders without a licence had twice the risk of being involved in an accident than those holding a valid licence. However, the number of years the rider had held a licence reduced the risk of accident involvement. One difference between moped and motorcycle riders involved the presence of a passenger on the vehicle: while carrying a passenger increased the risk of being responsible for the accident among moped riders, it protected against this risk among motorcycle riders.

International Course

The Transportation Research and Injury Prevention Programme (TRIPP) at the Indian Institute of Technology, Delhi organized a seven day International Course on Transportation Planning and Safety from 3-10 December 2012 at the Indian Institute of Technology Delhi. The course was co-sponsored by the Volvo Research and Education Foundations, Ministry of Urban Development, Bajaj Auto Ltd., Mahindra & Mahindra Motors Ltd. The course (an annual feature for the last 22 years), was attended by 80 participants from 9 countries. The faculty members included Anoop Chawla (IIT Delhi), Christer Hyden(Lund University, Sweden), Dinesh Mohan (IIT Delhi), Farida Saad (IFSTTAR, France), Geetam Tiwari (IIT Delhi), Hermann Knoflacher (Technical University of Vienna, Austria), Janusz Kajzer (Chalmers University, Sweden), Karin Brolin (Chalmers University of Technology, Sweden), K N Jha (IIT Delhi), Mathew Varghese (St. Stephen's Hospital, Delhi), Puneet Mahajan (IIT Delhi), Jeff Crandall (University of Virginia, USA), R.R. Kalaga (IIT Delhi), Shrikant Bangdiwala (University of North Carolina, USA), Sudipto Mukherjee (IIT Delhi), Sylvain Lassarre (IFSTTAR, France).

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Transportation Research and Injury Prevention Programme
Room MS 815 (Main Building)
Indian Institute of Technology Delhi
Hauz Khas,
New Delhi 110016, India

Phone: 91-11-26596361, 26596557
Fax : 91-11-26858703, 26851169
Email : ird8541@cbme.iitd.ernet.in
http://tripp.iitd.ernet.in

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A TRIPP Bulletin Insert

Infrastructure for Low Carbon Transport in India: A Case Study of the Delhi-Mumbai Dedicated Freight Corridor

P. Pangotra and P.R. Shukla

(http://www.unep.org/transport/lowcarbon/publications.asp)

EXCERPTS:

The Delhi-Mumbai Dedicated Freight Corridor (DFC), known as the Western DFC, is one of the largest transport infrastructure projects being implemented in India. It is expected to revolutionize freight movement in the country and would thereby play a crucial role in sustaining national economic growth while inducing regional economic development. The DFC project also signifies a major transition in the freight transport sector as it would result in increasing the relative share of rail, which is a more energy efficient, environment friendly and less carbon-intensive mode of transport compared to the other available modes.

The overall conclusion of the study is that large rail transport projects have a high potential to reduce CO2 emissions from the transport sector in India. Further, the perspective plans suggest that large transport investments have the potential to induce regional economic development provided complementary investments in economic and social infrastructure are made. Putting a monetary value on such co-benefits is not possible as the project is still in the planning stage.

India's economy has seen unprecedented growth during the last decade, averaging 7 -8% per annum. While this growth has created a great deal of opportunity, it has also resulted in many challenges, especially for infrastructure required to sustain the rate of growth. Transport is viewed as one of the most important infrastructures for the national economy. In national transport systems, freight transport acts as the critical link between ports, markets and manufacturing centres.

There is increasing recognition among policymakers in India that transport infrastructure could become a serious bottleneck for future economic growth. This is particularly the case for freight transport, as high growth in freight traffic is expected to continue in the medium and long-term. The capacity of the existing rail network for freight transport is saturated on most of the trunk routes and the road network is also highly congested. It is apparent that economic growth at the current pace cannot be sustained without substantial addition to transport and logistics infrastructure.

Although rail is clearly the more energy efficient and environment friendly mode of transport compared to road, recent trends in freight movement show that the share of rail in total freight traffic has been steadily declining. Current policies of uneconomic pricing and cross-subsidy of passenger services by freight traffic are primarily responsible for inadequate investment in augmentation of the rail network capacity. Funding bottlenecks are the main reason for delays in completion of railway projects. Another major issue is the neglect of multi-modal integration, which has resulted in inefficient allocation of freight traffic between rail and road.

In 2006, the Ministry of Railways adopted a long-term strategic plan to develop six high capacity, high speed dedicated freight corridors (DFC) along the "golden quadrilateral" that connects India's four largest cities, and its diagonals. The Dedicated Freight Corridor Corporation of India limited (DFCCIL), a special purpose vehicle (SPV) company, was established to implement the DFC projects. The Delhi-Mumbai DFC, also known as the Western DFC, is one of the two corridors being constructed at present. The remaining four corridors would be taken up subsequently. The Government of Japan and the World Bank are providing financial and technical support for these projects.

The DFC project is one of the largest infrastructure projects ever implemented by the Indian Railways. Its main rationale is that the DFCs would enable the Indian Railways to meet the growing demand for freight transport and induce modal shift of freight traffic from road to rail. The most important benefit of the DFC for the Indian Railways would be the higher operational efficiency in both freight and passenger services since the congestion on existing rail network would reduce significantly. In addition to efficiency improvements, the DFCs would contribute to substantial energy savings and significant reduction of greenhouse gas (GHG) emissions. These, in turn, could provide additional revenues to the Indian Railways through mechanisms such as carbon credits.

Many countries around the world use rail infrastructure for "long haul operations", which is another term for freight corridors, specifically built for transportation of bulk freight goods by railways. However, few countries have dedicated freight corridors. Among the ones that do, the most prominent are Australia, South Africa, China, The Netherlands and USA.

This case study of the Delhi-Mumbai DFC is based on the premise that large infrastructure projects, such as the six proposed DFCs, are important drivers of the national economy, while also having major implications for policy issues related to sustainability of energy resources and environmental impacts. The study is part of a larger research project on "Promoting Low-Carbon Transport in India", which is a major initiative of the United Nations Environment Programme (UNEP) aimed at helping policymakers at the national level achieve a sustainable transport system. The broad purpose of this study is to examine the implications of the proposed DFC project for achieving the twin goals of low-carbon growth and sustainable development.

The following are the major policy recommendations from this case study:

1. Potential to generate large CO2 reductions with significant co-benefits
   - The DFC project would not only contribute to CO2 mitigation but would also result in substantial development benefits, including infrastructure development, regional economic growth and employment generation.
   - Therefore, ensuring time bound completion of the project, to have it fully operational by 2017 -18, would keep costs under control as well as demonstrate the project development capacities of DFCCIL.
2. Critical role of support infrastructure
   - The creation of matching support infrastructures, like freight terminals, special wagons, stack containers etc., would play a crucial role in the success of the project. Therefore, such infrastructures should be adequately provided and become part of a comprehensive plan.
3. Successful implementation of the DMIC project would maximize secondary development benefits
   - Development benefits of the DFC can be realized only by concurrent implementation of the DMIC project since the DMIC region would act both as origin and destination of freight traffic. Any delays in their implementation can affect the financial viability of the freight corridor.
   - The transport system of the DMIC region should be integrated with the DFC by providing appropriate infrastructures, such as Multi-Modal Logistics Parks and freight terminals at suitable locations.
4. Accelerated implementation of the remaining five DFCs would yield maximum economic returns in the long-run
   - The six corridors together would make the national freight transport system low-carbon, energy efficient and thereby more sustainable. Therefore, the remaining corridors should be taken up for implementation at the earliest time.
   - The strategy requires innovative policies for mobilization of financial resources, ability to implement large projects, planning for balanced regional development, and good governance at all levels.
5. Importance of long-range planning to make the national freight transport system low-carbon and conducive to sustainable development
   - National energy policies, in terms of energy security, safety issues and

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environmental concerns, have obvious implications for future development of the freight transport system.
- Policy decisions regarding location of power plants, cement plants and manufacturing centres would have important implications for development of freight transport infrastructure.
- To meet the rising demand for freight transport and make the system more efficient, use of pipelines for transport of oil products and natural gas should be expanded.

Low-Carbon Mobility in India and the Challenges of Social Inclusion: Bus Rapid Transit (BRT) Case Studies in India

D. Mahadevia, R. Joshi and A. Datey

(http://www.unep.org/transport/lowcarbon/publications.asp)

EXCERPTS:

The term 'sustainable mobility' (prioritizing accessibility) covers all forms of transport that minimize fuel consumption and carbon emissions by reducing the need to travel itself (Knowflacher, 2007) (Banister, 2008)'. Knowflacher (2007) argues that the traditional hypothesis of urban transport planning, which emphasises the 'growth of mobility' and 'travel time saving by increasing speed', ends up creating more transport, environmental, and socio-economic problems allover the world. It also creates higher mobility-oriented infrastructure and urban form, which makes it difficult for more sustainable modes to operate. There is a great danger of creating the situation of being stuck with automobile-dependent urban infrastructure. The transport interventions across the world are attempting to provide accessibility for all people, and to facilitate their reaching their desired destinations in a timely fashion, rather than just planning for the high speed mobility of a few. In the context of climate change, the notion of transport sustainability becomes more specifically a matter of reducing carbon emissions. Low-carbon mobility is prioritized - involving zero-carbon modes like walking and cycling or any other shared or public modes of transport.

In the context of 'Equity', Vasconcellos (2001) argues that transport provision is not an end in itself. The 'end' has to be the equitable appropriation of space and the corresponding access to social and economic life. There have been massive investments in the urban infrastructure in the developing cities and it is a timely debate in policy-making as to whether these investments are used for the betterment of everyone in society. Without equity, the sustainability would not be achieved in the true sense. The idea of equity is a paradigmatic approach to policy-making where everyone's share in the system is recognized and provided.

In spite of the NUTP, the debate on the best form of public transport continues in '"the Indian cities and the BRTS is compared and contrasted with the metro, the latter being more capital intensive than the former. According to rule-of-thumb calculations, metro rail systems would cost typically Rs. 1500 million per km (30 million US$) for above ground and Rs. 2500 million per km (50 million US$) for underground system whereas BRT system would cost no more than Rs. 100 million per km (2 million US$). Due to the lower once-off and lifetime costs, the BRTS should be preferred over the metro. Furthermore, the BRTS has more flexibility in expanding the transit network and widening the coverage.

The major conflicts at the city-level are the conflicts related to road space use between the different users. Except Ahmedabad. all other BRT systems have been criticized in the local popular media for 'taking away the prime road space from regular traffic'. This clearly shows that the urban opinion-making is hijacked by the vocal elite classes who are also the owners of private vehicles and who resist more equitable distributions of road space. The foremost policy recommendation for Indian cities is to actively follow and implement the objectives of the National Urban Transport Policy (NUTP). The NUTP has clearly outlined the pathways for low-carbon mobility for Indian cities. The cities should be actively encouraged to take up BRT projects and public bus improvement projects along with plans for walking and cycling facilities. The on-street parking policies in India also have to play an important role as demand management tools. Those not owning private motorized vehicles, such as the low-income group, should be supported in continuing their low-carbon mobility practices. The poor working women should be specifically encouraged to use public transport. Based on these broad recommendations, the following issues are specifically highlighted.

The MoUD India has been a key promoter of low-carbon mobility projects such as the BRT in various cities. Cities that have shown interest in building BRTS often lack the expertise and human resources in understanding the full implications of such a project. The cities need handholding and planning knowledge for projects as complex as BRTSs. There is a great need to develop planning guidelines for models of BRTS in the Indian context endorsed and commissioned by the MoUD. City officials and planners need to be systematically trained not only about the technical aspects of the BRTS but also about the social marketing of such projects. MoUD has conducted various training programmes and workshops with many bilateral and multilateral agencies. However, it has not resulted in expanding the dedicated team of experts at the central level or at the city level to deal with the complexities of the BRTS projects. Because of this, the early enthusiasm for the BRTS projects has not been sustained in recent years.

Out of a total of 63 cities eligible for the national funds under JnNURM, only about 10 had shown interest in building a BRTS. Out of which only four cities, namely Ahmedabad, Delhi, Pune and Jaipur, have buses running on continuous dedicated corridors. Given the challenge of transport infrastructure in Indian cities, many other cities should be encouraged to come forward to upgrade their transport system. It is important that the national funds provide positive incentives for the cities to take up low-carbon mobility projects such as the BRT. And such incentives should become exemplary for other cities to take similar paths.

Instead of discussion and dispute around open or closed systems, the efficacy of the BRTS would depend a lot upon how meticulously the system is designed in terms of level boarding, junction design, and operational planning. A system which allows easy and faster boarding-alighting (than regular buses), minimises the waiting time of the commuters and prioritises BRT buses at the junction and is likely to get more support from commuters. It is possible to achieve these three crucial components of the BRT in both the systems provided it is planned and implemented for that purpose. From the urban governance point of view, building up a transit system like BRT requires a long-term vision and commitment of continuously investing in the system.

It is important to understand that no single PT system can cater to the needs of transit in any city. Furthermore, different existing and proposed transport systems need to be integrated with each other in terms of physical access, fares/ticketing, institutions and social marketing, as some of the successful examples in the world show us. The BRTS therefore should not be seen as one pre-fixed system and cities should be given a chance to adapt it according to their own needs and requirements. They should provide easy access to the commuters and should also remain affordable for the economically disadvantaged, as they are the most dedicated users of bus systems in cities. The BRTS have to be developed as inclusive systems accommodating the concerns of the NMT users and the informal sector, as that is the need of many cities in developing countries.