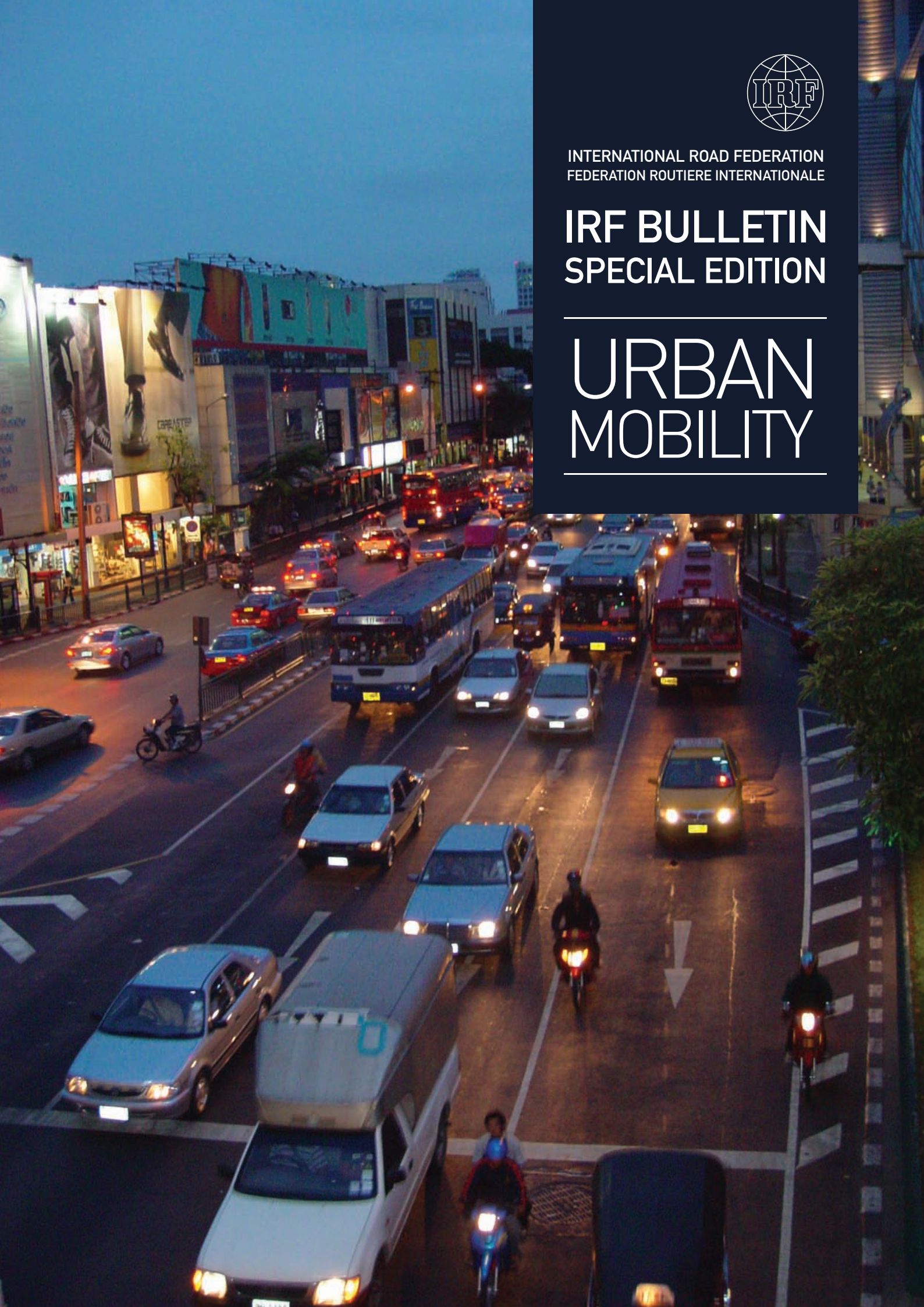


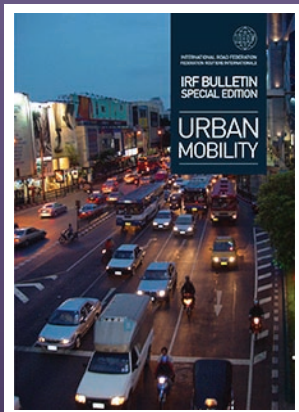


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URBAN MOBILITY





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SPECIAL EDITION

URBAN
MOBILITY

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- Financing and institutional arrangements for road asset management
- Road asset management systems
- Sustainable practices in the construction and maintenance of roads
- Road transport, safety and the environment



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Sustainable urban mobility policies and plans place the emphasis on transportation systems that are more benign in terms of their impacts on the environment. They notably promote non-motorised means (walking and cycling) and public transportation, and also

aim to reduce the use of private motor vehicles. The measures implemented represent a mixture of physical changes and user information systems that are designed to reduce traffic volumes and emissions, increase accessibility, improve safety, change travel habits and provide a better quality of life for all citizens. Urban mobility measures, therefore, fundamentally involve changing behaviour.

Already approaches consistent with these principles are being developed, both in Europe - notably through the CIVITAS initiative which gave rise to the Action Plan on Urban Mobility adopted by the European Commission on 30 September 2009 - and beyond, especially in Brazil and India.

As will be seen in these pages, most cities that have implemented sustainable urban mobility plans and measures have experienced a wide range of benefits. The examples featured highlight a particularly important ingredient of sustainable mobility planning, which is the willingness of cities to try out new ideas and learn from each other. Equally critical is the willingness of city authorities to consult with citizens on problems and solutions, and to involve them in the design, implementation and monitoring of results.

Last but not least, developing sustainable urban mobility involves knowledge sharing (including both good and 'not such good' experiences) as well as a willingness to admit "I don't know..." and seek help when needed.

Peter Midgley

Urban Transport Theme Champion with the global Transport Knowledge Partnership (gTKP), Switzerland

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ROAD CONSTRUCTION

Incomplete Streets in Asian Cities

Alvin Mejia, Bert Fabian & Sudhir Gota
Clean Air Initiative for Asian Cities,
CAI-Asia Centre, The Philippines

The competition for road space, accessibility and mobility in Asian cities often leaves a trail of blood! Sadly, pedestrians are among the main casualties. They account for a significant share of total fatalities, and the magnitude is much higher in cities where pedestrian facilities do not do justice to the demand. For example, while the pedestrian fatality share in India at national level is 13%, the figure rises to more than 40% in metropolitan cities like New Delhi, Bangalore and Kolkata.

Many Asian cities still have relatively low motorisation indexes and significant segments of the populations rely on foot travel for daily commuting. The current trip mode share data from Asian cities indicates that, on average, nearly 30% of trips are being made by foot. However, with deteriorating facilities, the mode share is increasingly motorised, with pedestrians becoming marginalised, as shown in Chart 1.

Given such deterioration of facilities, and the resulting enforced migration of people to motorised modes, it would be apt to say that pedestrians “are victims of policy neglect” (Economic and Political Weekly, vol. XLIV, No. 33, 15 August 2009). While code provisions aimed at catering for people who walk do exist, they are not often based on sound principles. Many concepts for pedestrian infrastructure are designed on the assumption that pedestrian behaviour mimics that of vehicles, for example travelling in a linear path, with faster movement indicating efficient flow. What analysts often forget is that walking is a complex movement pattern, which involves activities such as waiting, shopping and meeting people. Thus, it is wrong to design a facility that assimilates people to vehicles travelling at a uniform speed, as often envisioned in capacity analysis.

In order to understand more precisely the requirements of those on foot, pedestrian interview surveys were carried out in 13 Asian cities during early 2010, namely, Manila, Ulaanbaatar, Lanzhou, Kathmandu, Kota, Jakarta, Cebu, Davao, Karachi, Hong Kong, Ho Chi Minh City, Hanoi and Colombo. Nearly 4,500 people were interviewed and there were some surprising results, as shown in the table on page 5.

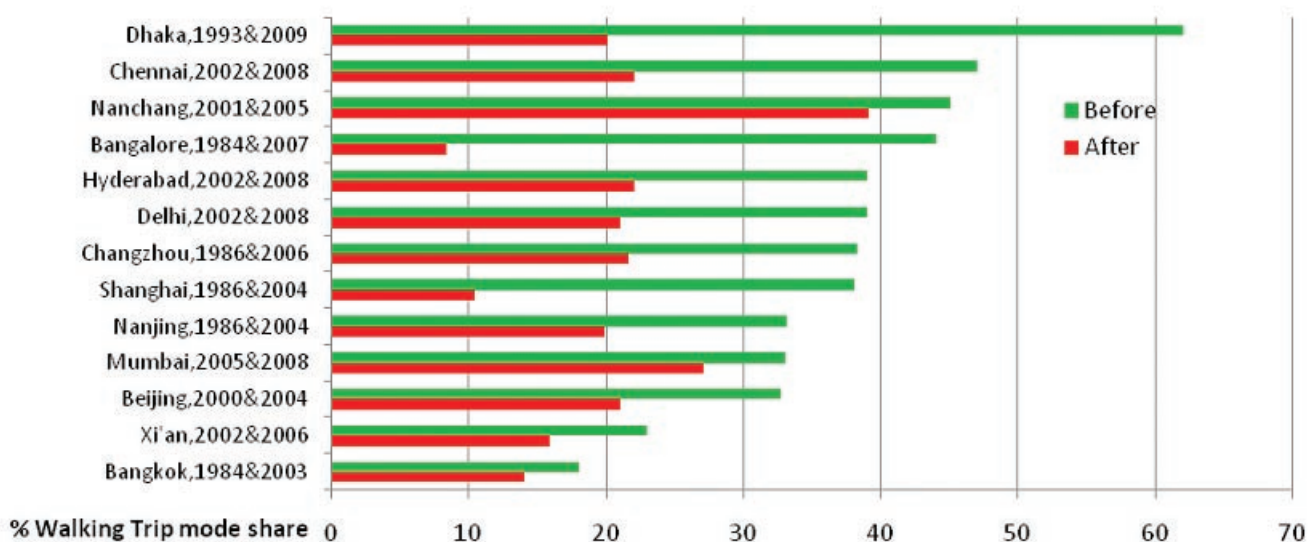


Chart 1: Walking trip mode share changes in selected Asian cities (various sources)

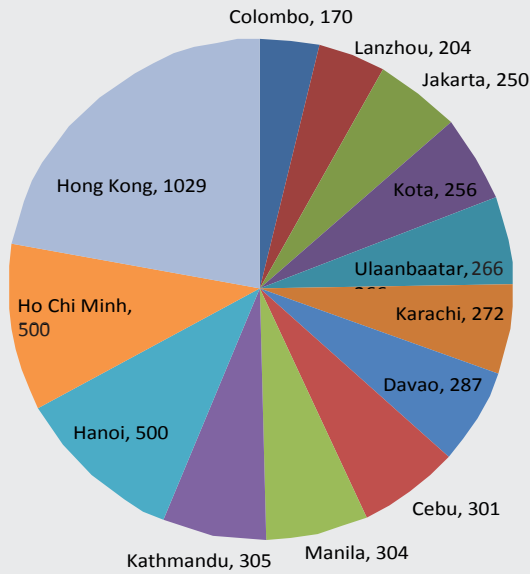


Table 1: Indian Design Guidelines (IRC103-1988)

Design	Common Practice	Remarks
<p>Footpaths should have a minimum width of 1.5m on both sides. The LOS (Level Of Service) concept dictates the maximum width. The result of such a school of thought is that pedestrians are provided only a minority share of space (most often less than 10% of road space) and in many instances no space at all!</p>		<p>Footpaths are frequently burdened with materials, utilities and encroachments.</p>
<p>Dead width of 0.5m and 1m to be added to sidewalks running alongside houses and commercial areas.</p>		<p>Very often footpaths are not extended in commercial and residential areas.</p>
<p>Footpath width to be increased at bus stops and recreational areas.</p>		<p>Bus stops provide a classic case of conflict between pedestrians waiting to catch a bus and pedestrians walking to reach their destinations.</p>
<p>Height of footpath to be above that of the carriageway, and supported by an unmountable kerb.</p>		<p>In order to prevent vehicles from encroaching the space, sidewalks are frequently separated by barriers which do not allow access to disadvantaged groups. Note the quality of footpaths and roads.</p>
<p>Mid-block pedestrian crossings should be provided when the distance between intersections is a minimum of 300m.</p>		<p>Mid-block crossings are rarely found on streets.</p>
<p>Controlled mid-block crossings should be provided where peak hour volumes of pedestrians and vehicles are such that PV^2 (crossing pedestrians multiplied by vehicles) > 1 million (for undivided carriageway) or 2 million (for divided carriageway); where the stream speed of traffic is greater than 65 km/h; and where the waiting times for pedestrians/vehicles have become inordinately long.</p>		<p>Cities need to have a greater number of controlled crossings in order to ensure priority for pedestrians.</p>



Table 2: Results of pedestrian interview survey



Pedestrian interview survey respondents

36% of respondents consider the pedestrian environment to be in the “bad” or “worse” categories.

49% of respondents prefer to cross at grade crossings, whereas only 15% were interested in using subways.

Nearly 45% of respondents are only willing to walk 50 metres to access crossings. Nearly 33% are willing to walk 100m to access pedestrian crossings. This is critical as many traffic codes prescribe 200-300m as crossing separations.

If the walking environment is not improved, 82% of respondents indicated that they would shift to other modes. This is critical as it would increase motorisation and exacerbate externalities such as climate change.

65% of respondents believe that they are most exposed to air pollution when walking or waiting for buses.

Respondents considered the areas surrounding public transport terminals to have the worst ‘walkability’.

30% of respondents have trip lengths of less than 3 km. This indicates that by providing connectivity and utilising urban solutions, significant numbers of people could walk to their destinations, provided sufficient facilities are in place.

Dissecting the available guidelines and contrasting them with pedestrian needs, it is clear that there is a need urgently to overhaul the prevailing provisions for pedestrians in Asian cities. The current guidelines are often ambiguous or inequitable, and rarely enforced.

Clearly, there is a need to change the character of Asian streets by giving due consideration to pedestrians as the primary consumers of the road space, rather than retrofitting to their needs at a later stage. Similarly, it is imperative to adopt guidelines that are better suited to the full context and character of pedestrian needs, and the land use choices required to address them equitably and effectively. Many Asian cities still need to develop well-designed, shared roads, with traffic calming facilities, in order to accord due priority to pedestrians and provide complete streets.

Streets which are accessible for all, and which grant priority to the most vulnerable travellers!



Pedestrian overpass in a relatively low vehicle traffic area on a two lane road in Cebu city. Infrastructure for whom?

Acknowledgements: This paper borrows insights from the Asian Development Bank’s forthcoming publication “Walkability in Asian Cities”. The authors wish to thank the Bank’s Jamie Leather as well as CAI-Asia colleagues and Clear Air Partnership members for their help in conducting the surveys.



A Durable and Cost Effective Treatment for Special Use Lanes and Pedestrian Areas

Arthur M. Dinitz

Transpo® Industries, Inc., USA



Each year the traffic safety industry invests millions in research and development to ensure tomorrow's roadways will be even safer and more forgiving.

After recognising an unmet demand for high performance area markings, preferential lanes and pedestrian areas throughout the United States, Transpo combined its expertise and knowledge of the U.S. transportation industry with the know-how and longstanding success of its resin supplier, Evonik, in Asia and Europe, to bring the re-engineered **T-28 Color-Safe Surface™** to the United States.

Traditionally, area marking was undertaken via a multi-coat application method that consisted of applying a base coat on the surface, broadcasting the aggregate, removing excess aggregate and then applying a top coat. Transpo has re-engineered the resin and aggregate compounds into the T-28 Color-Safe System, a single coat application process that is simple, durable and affordable.

Cities throughout the world are seeking ways to increase compliance and safety on roads and highways while improving traffic flow. Bicycle lanes have been implemented to enhance bicycle access, bus lanes have been painted to improve transit services and pedestrian plazas have been built to increase pedestrian safety and comfort. Such clearly delineated preferential lanes/areas have been proved to increase visibility and reduce unauthorised use, which in turn boosts safety, especially in cities with high traffic flow.

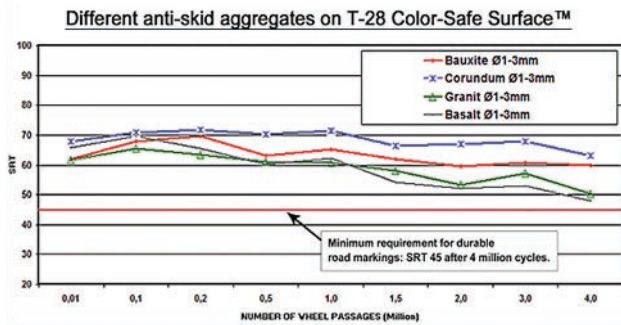
T-28 Color-Safe Surface is an acrylic based resin system that can be used for both area markings and anti-skid surfacing. The resin and aggregate compounds are capable of full cure in a wide range of temperatures without requiring external heat sources. The material has been used around the



world and has exhibited excellent durability. It has shown a minimum service life of 3 years and has been identified as the only road marking material to pass the 4 million tyre test. The T-28 Color-Safe Surface System is easy to apply and repair and has a low life cycle cost due to the high quality of the material. Besides demarcating designated areas, T-28 Color-Safe Surface can also be used to improve the aesthetic appeal of historic towns, college campuses, parking lots and driveways. Furthermore, it has been proved effective as a surface coat for enhancing skid-resistance on hazardous turns and other high accident areas of asphalt and concrete roadway, and the high definition colour has a pronounced traffic calming effect.

In this latter respect, Color-Safe is available in a variety of high definition colours and aggregates sizes. Its fast cure time allows the surface to be opened to traffic within a short period of time, and its excellent bonding characteristics on concrete and asphalt surfaces allow the material to maintain its colour and skid-resistant surface for years.





Most area marking materials currently in the market are of the paint-based thermoplastic variety and are unsuitable for high traffic areas. Such materials tend to fade in a matter of weeks or months and require frequent maintenance.

In contrast, as an acrylic based material, T-28 Color-Safe Surface has exceptional adherence qualities to concrete and asphalt surfaces, which prevents perimeter cracking and embrittlement due to age. The material further exhibits superior interlayer bonding characteristics on a variety of surfaces, as well as on existing markings. The high wear resistance of T-28 materials eliminates uneven wear in areas of high braking and turning, unlike most paint based systems.



The material is UV resistant which allows it to maintain its high definition colour, even after years of service. Given this excellent colour retention property, any required pavement cuts can be simply recoated with T-28, and the new application will blend uniformly with the original. High thermal and mechanical stability in cold and hot climates allow the material to maintain its form even in adverse weather conditions. The acrylic resin is also resistant to de-icing chemicals.

If refreshing is needed after years of service life, it suffices to simply clean the surface thoroughly and reapply material. The material has excellent inter-coat adhesion so there is no need to remove or replace the existing material.

Use of Moveable Barriers in Construction Work Zones on Urban Streets and Arterials to Mitigate Impacts and Enhance Safety

Paul Grant

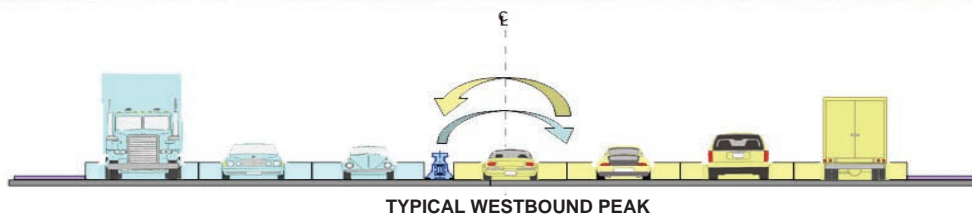
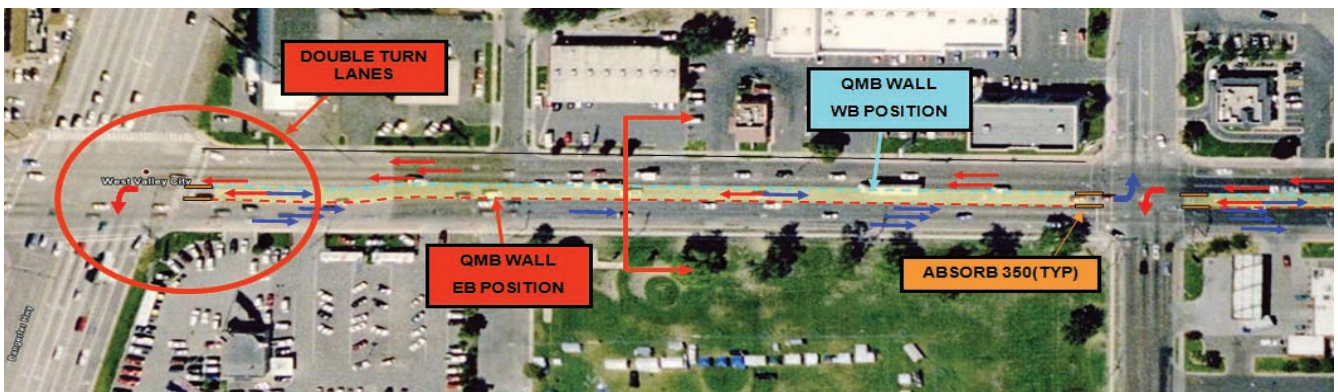
Barrier Systems Inc., a company of Lindsay Transportation Solutions, USA



Work has recently been completed on the 3500 South arterial, which carries traffic from West Valley towards downtown Salt Lake City and the University of Utah. Reconstruction by the Utah Department of Transportation (UDOT) Region 2 has added two centre lanes that now form the State's first dedicated Bus Rapid Transit (BRT) lanes, and has also replaced sidewalks and added raised medians.

Given the significant average daily traffic, which varies between 38,000 and 48,000 vehicles throughout the corridor, keeping traffic moving was the most important and the most difficult task during construction. The first phase of the project called for two lanes to be open for traffic in each direction, and plastic barrels were used to separate directional traffic and to delineate the work zone. The work zone area was confined and restricted, and it lacked positive protection, which created dangerous conditions as confused motorists occasionally turned into the work zone. In addition, accidents occurred when drivers made left turns through the barrels to access businesses. The situation also contributed to congestion. The contractor needed a larger, more protected work space, and the traffic management plan needed a way to limit the number of left hand turn options without restricting traffic flow. For the second phase of the project, it was decided that a moveable barrier system would be used to create a larger work zone, while at the same time minimising the impacts on traffic and limiting left-hand turns. Historically, moveable concrete barrier has only been used on highways and bridges, so this would be the first time that the solution had been adopted on a major arterial in the U.S.

It was determined that moveable barrier could keep two lanes open to traffic in the peak direction by using a total



Movable Barrier Traffic Control Options 3500 South Arterial, Salt Lake City, UT.

of only three lanes, instead of the four required when using barrels. This would give the contractor an extra lane to expand the work zone, keeping workers safe and accelerating construction. 1.7 miles (2.7 km) of moveable barrier were deployed as a positive separation between east and westbound traffic, and the barrier was moved several times daily to create a 1/2, 2/1 traffic pattern based on peak traffic needs. The barrier was transferred 12 feet (3.7 meters), or one lane width, in one pass at 5 mph (8 km/h). The entire transfer took approximately 20 minutes, including repositioning the traffic control and signage.

Thanks to the expanded work zone, the contractor was able to use larger, more efficient equipment, and work unimpeded for longer periods of time. This resulted in the elimination of one complete phase of construction, effectively reducing the total number of phases from three to two. The accelerated construction schedule enabled the contractor to finish the project seven months early. In a report commissioned by UDOT, and compiled by T.Y. Lin International, the user delay savings made possible by the early completion were estimated at between USD 1.3 to 1.4 million (vehicle operating costs were not included). The benefits flowing from the use of moveable barrier also included reduced user costs, shorter travel distances, improved safety, lower impacts to businesses, reduced fuel use and diminished air pollution. The report conservatively estimated the total benefits of using moveable barrier

on the project at between USD 1.7 to 2.4 million, with a benefit/cost ratio of 4:1. The authors also expressly stated that if the full range of benefits were taken into account (such as the reduced emissions and the benefits accruing to businesses from early completion), the benefit/cost ratio would be greater than 10:1.

In addition, the T.Y. Lin report estimated that the barrier eliminated 20 to 25 left-turn crashes while in operation, leading to an estimated reduction in crash costs of an additional USD 1,000,000.

Quickchange® Moveable Barrier (QMB™) has been used in construction work zones in the United States and internationally for more than twenty-five years.



URBAN PUBLIC-PRIVATE PARTNERSHIPS

Untying the Knot in Urban Road Networks: how Public-Private Partnerships can help

Caroline Visser

International Road Federation (IRF),
Geneva, Switzerland



INTERNATIONAL ROAD FEDERATION
FEDERATION ROUTIERE INTERNATIONALE

This article reflects the current work of the IRF Working Group on Public-Private Partnerships, chaired by Michel Démarre of the French National Federation of Public Works (FNTP).

Several constraints are faced by (local) authorities in the provision of efficient urban road networks:

- **Spatial constraints:** on the extension of urban road networks, and proportionately high land acquisition costs;
- **Technical and organisational constraints:** tight links between project planning and other disciplines like spatial planning and social policy make urban road projects highly complex endeavours from a technical point of view. In terms of organisation, there are often several authorities sharing responsibilities in the urban jurisdiction, which adds a layer of complexity;
- **Fiscal constraints:** when public budgets are allocated, transport is competing with other public service needs. Transport budgets are usually insufficient to keep the infrastructure up to pre-defined service levels. When budgets do become available, they tend to be of short/medium tenure, and fail to fulfil the need for sustainable financing to enable the continuous investments required to keep urban road infrastructure up to standard.
- **Capacity constraints:** authorities need capacity and competence in several disciplines in order to be able to deal with technically and organisationally complex projects. These capabilities are not always present, especially in local administrations.

IRF case studies on urban Public-Private Partnerships

The challenges discussed above were the main drivers that inspired the IRF Working Group to begin exploring urban Public-Private Partnership (PPP) issues in depth, with the aim of assisting (local) authorities as well as contractors in setting up partnerships in this challenging environment. To this end, the Working Group has carried out a number of case studies covering different types of urban partnerships, so as to identify specific challenges and how these may be best addressed through a partnership approach.

A working classification of urban PPPs has been used in order to provide a broad distinction between cases, and to cover a wide diversity of possible schemes.

- **Urban congestion charging:** schemes which impose a fee on vehicles to enter a certain cordoned area within an urban zone, implemented through partnership contracts pursuant to which both the public authority and private contractor concerned bear financial risks.
- **Urban toll roads:** toll motorways in urban areas that are the object of concessions granted to private operators. The private operator generally designs, constructs, maintains and operates the road in exchange for the right to levy tolls from the users. High Occupancy Toll (HOT) lanes would also fall under this working definition.
- **Combined road and real estate development:** PPP schemes in which functions/aspects like road development, housing development and/or business accommodation are combined to attain optimum quality and enable cross-subsidising of project-elements so as to promote a viable business case.
- **Urban road operation partnerships:** schemes under PPP that aim to make better use of existing urban road infrastructure capacity by using Intelligent Transport Systems (ITS). Projects concerning parking partnerships and interfacing with other modalities, like mass transit systems and rail, could also be included in this category.
- **Long-term maintenance contracts for urban road networks:** schemes under PPP addressing long-term



Table 1 - IRF Urban PPP case studies

Category	Case Studies
Urban congestion charging	91 Express Lanes, California (United States)
Urban toll roads	M6 Toll (United Kingdom) Melbourne CityLink (Australia) A14 Paris (France) A86 West, Paris (France) Attica Tollway, Athens (Greece)
Combined road and real estate development	<i>Sytwende, Voorburg (Netherlands), A2 Maastricht (Netherlands)</i>
Urban road operation partnerships	M50 Dublin rehabilitation and installation of ETC (Republic of Ireland)
Long-term maintenance contracts for urban road networks survey	Portsmouth PFI (United Kingdom), St. Louis-de-France, Quebec (Canada), <i>Birmingham PFI (United Kingdom)</i>

maintenance (sometimes including upgrading) of the urban road network, in which revenues are based on performance.

Table 1 gives an overview of the case studies. Those in italics are still under development.

With respect to each case study, the Working Group has, inter alia, looked into the rationale for a PPP approach, the urban context, the partnership structure, the difficulties overcome and the societal benefits.

Benefits captured through a partnership approach

When considering how partnerships can help in complex urban road projects, the following key elements are assumed to constitute a PPP contract:

- The **combination of several tasks** in a single contract, e.g. design, construction, maintenance, finance and operation.
- A **service level oriented** contract focusing on achieving pre-set quality levels rather than activities and quantities.

- **Specific cost recovery mechanisms and financing schemes** either through direct user charges (tolls) or performance related payments by the client authority (either privately financed in full, or jointly public-private).
- **Specific risk sharing arrangements;** whereby all risks are made explicit and allocated to the partner best able to manage and/or mitigate the given risk.

In the following paragraphs, the benefits captured through a partnership approach are briefly highlighted and illustrated by examples from the urban PPP case studies.

1. Continuous attention and timely funding for roads

A detailed financial plan lies at the basis of any PPP contract, so "budgets" are effectively approved at the time of contract signature. In practice, this means that the contractor has considerable flexibility in terms of his planning and can, for example, adapt to favourable weather or other conditions. Looking at the life cycle of the infrastructure asset (e.g. the road), this means that he can plan to undertake his maintenance during times that are economically optimal since he does not depend on annual public budget cycles for money to become available.

Example:

The Portsmouth PFI (Public Finance Initiative) is a 25-year project awarded by Portsmouth City Council (PCC) to Ensign Highways Ltd., for the "fence-to-fence" management and maintenance of 480 km of roads, 19.000 street lighting points and 84 structures. In the past, the PCC had only been able to carry out general responsive maintenance on its road network due to budget constraints. Under the PFI, the road network has been brought back to appropriate standards during a "core investment" period and is being maintained to these standards throughout the duration of the contract. The contractor is paid a monthly fee by the PCC, based principally upon availability and performance.

2. High quality and level of service

Many of the cases under study have shown high levels of quality and service being offered to the road users. This is mainly related to the fact that in PPP the level of service is made a contractual obligation.



The M6 Toll is a 42 km dual three-lane motorway bypass of the M6, just north of Birmingham in the United Kingdom. The contract is for a 53-year concession, awarded by the national Highways Agency to Midland Expressway Limited for obtaining planning approval, designing, building, financing and operating the road.

The M6 Toll offers road users distinct quality of services compared to alternative routes: it notably ensures better maintenance, improved signing, travel time savings and freer traffic flow.

3. Socio-economic benefits materialising sooner

On the basis of some of the case studies, it is clear that without the involvement of private finance, socio-economic benefits, such as travel time savings and increased safety records, would simply not have materialised within a reasonable time span, if at all, as there were no public budgets available.



The Melbourne CityLink in Australia is another example of accelerating much needed investment

in road infrastructure. The Link refers to a 22 km motorway connecting 3 major freeways in the Melbourne conurbation and divided into 8 tolling zones, where tolls are collected electronically. The State of Victoria assigned a 34-year concession to City Link Melbourne Ltd., and the project has since contributed to an increase in GDP levels. Indeed, the estimated economic growth attributable to the project is AUS\$ 300 Million. The north-western suburbs of Melbourne have benefited through improved accessibility and a quicker development pace, while users have been able to enjoy reduced travel times and increased travel time certainty.

4. Innovation

Road projects in an urban context tend to face more constraints, especially in terms of available space. This obliges contractors to come up with innovative solutions. A partnership approach is better adapted to encouraging and facilitating such innovation due its level of service orientation.



In the case of the A86 West toll concession project near Paris, the French state opted for an underground route in order to protect forests, historical heritage and inhabited areas. Cofiroute, the contractor, came up with an imaginative solution, consisting of two superimposed independent carriageways in a single tunnel tube, with each "floor" carrying one-way traffic. The tunnel is reserved for use by light vehicles with a maximum height of 2 metres.



Common issues

The case study work also led the Working Group to conclude that there are a number of issues that are common to most, if not all, urban PPP projects. These include willingness of users to pay for urban tolls, a wide enough choice of competent companies to stimulate the best competitive bids, and the need for sufficient capacity on the part of the governmental agencies and contractors concerned to manage complex urban road projects.

The latter not only implies possessing the requisite knowledge and experience but also having the right mentality. Compared to a traditionally procured project, for example, the authority has less technical involvement and needs to take on more of an auditing/monitoring role.

All these issues and more are being actively explored in the ongoing activities of IRF's PPP Working Group. If you would like to know more, please contact Caroline Visser at cvisser@irfnet.org.

Public-Private Partnerships in Public Transport in Indian Cities

Amitava Basu

President, Intercontinental Consultants and Technocrats Private Limited, New Delhi, India



Recognising the importance of efficient urban transport – notably in the light of escalating populations and the fact that urban centres currently contribute over 60% of GDP – the Government of India has drawn up a National Urban Transport Policy (NUTP) that focuses on moving people and not vehicles. It also places particular emphasis on Public-Private Partnerships (PPPs) and innovative financing methods to raise resources.

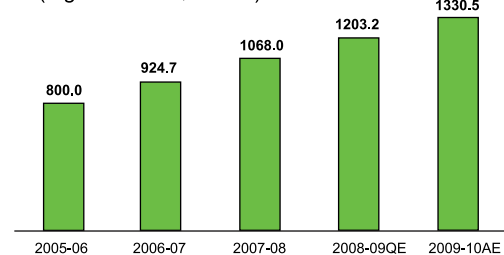
Public-Private Partnership in urban transport

PPP implies projects based on a contract or concession agreement between a governmental entity and a private sector company for delivering an essential service upon payment of user charges. While a PPP mechanism changes

the means of delivering services, it does not change the authority that is accountable for their provision. It is still the governmental entity's obligation to provide the service required. The only change is in the role of the governmental entity, which assumes a managerial function rather than engaging in actual operations. In other words, the governmental entity is entrusted with the responsibility of being an overseer of operations rather than a resource manager.

India's GDP at Current Prices, 2005-10

(Figures in US\$ Billion)



Note: GDP figures for 2009-10 are AE - Advance Estimates; QE - Quick Estimates
Source: Economic Survey 2009-2010 (www.indiabudget.nic.in)

The involvement of the private sector in this domain, which has traditionally been public, is a sensitive matter. It necessitates a detailed process of consultation with the end consumers and the members of the state transport authority, not only to raise awareness but also to thoroughly gauge stakeholder concerns. The consultation is a very important step, which needs to be carried out before the bidding process is started.

The state transport authority also needs to ascertain whether any approvals need to be obtained from a higher





authority before engaging private operators in the provision of urban public transport projects that it has a mandate to provide. Similarly, there may be a need for adopting provisions in the authority's byelaws, or other administrative instruments, to ensure that an appropriate environment for PPP arrangements is in place.

This being said, there has been a significant rise of late in PPPs for urban transport in India.

Three examples of successful projects are outlined in more detail below:

Example 1:

Pune Municipal Corporation and Pimpri Chinchwad Municipal Corporation have merged their respective bus transport authorities into a Special Purpose Vehicle (SPV) known as Pune Mahanagar Parivahan Mahamandal Limited (PMPML). PMPML currently operates 1,250 buses and, on average, carries 1 million passengers daily, over 282 routes. The buses are operated by PMPML on a PPP basis. Private operators procure the buses and lease them to PMPML. PMPML defines the physical specifications of the buses and the number it requires. These buses are then operated and maintained by the private operator on routes identified by PMPML. PMPML also provides administrative support for the operation of the buses, including supplies of tickets, passes, etc. The drivers of the buses are appointed by the private operator and the conductors by PMPML. The buses use shared infrastructure like bus stops, bus terminuses and parking depots owned by PMPML.

Responsibility for the operation and maintenance of the buses lies with the private operators, to whom PMPML pays a lease charge on a per kilometre basis. The lease charge is subject to change if there is an increase in the price of fuel or other consumables like tyres, engine oil, etc. PMPML sells advertising rights on the buses to generate additional revenues, and is also responsible for the development and implementation of systems for improving operational efficiency. The bidding parameter is the number of buses the private operator shall lease to PMPML.

Example 2:

Jaipur City Transport Services Limited (JCTSL) planned to operate a Bus Rapid Transit System on a buy-own-

operate and maintain (BOOM) basis. The company initially invited bids for 60 buses from private operators. The bus operators were required to procure, own and maintain the buses and operate them at own cost for a period of seven years on routes, and as per schedules, directed by JCTSL. The private operators are expected to deploy properly trained and duly authorised staff for the operation of the buses, and are paid back on a per-kilometre basis, determined by the operational costs decided in the agreement.

Example 3:

Indore Municipal Corporation has formed a Special Purpose Vehicle (SPV), Indore City Transport Services Limited (ICTSL), for the purpose of providing bus transport services in the city. The main objective of ICTSL is to act as an agency for monitoring and providing an intra-city bus transport system. The fleet currently operated under the aegis of ICTSL consists of 84 buses, which transport on average about 75,000 passengers per day, over 24 routes. ICTSL provides the bus services on a PPP basis. Under the contract, the buses are procured, owned and run by private operators. The private operators collect fare revenues, which they retain, and receive additional sums from the authority in the form of shares in the income derived from bus passes and advertising. In return, the operators make a fixed monthly payment to ICTSL. The bidding parameter is the payment quoted by the private operator.



Conclusion

There is huge potential for PPP in public transport in Indian cities, and consequently excellent prospects for the future. However, careful planning, procurement and financing are vitally important for ensuring effective and successful implementation. Successful projects could guide the path forward.



INTELLIGENT TRANSPORT SYSTEMS

Video Incident Detection for Advanced Traffic Management Systems under Indian Traffic Conditions

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Introduction

The New Delhi based Central Road Research Institute (CRR) has successfully demonstrated two ITS pilot projects forming part of an Advanced Traffic Management System, namely a Video Incident Detection System (VIDS) and an Advanced Parking Management System (APMS). This study focuses on the efficacy of VIDS for advanced traffic management under Indian conditions in locations where lane discipline is seldom adhered to. The principal objective of the study is to apply video image processing for incident detection (using Citilog software) on a typical urban section of the country's NH-2 Highway to assess effectiveness of incident detection and accuracy in evaluating traffic flow parameters. The study further elaborates on the various VIDS parameters as well as the reliability and adaptability of the system.

VIDS parameters

The Video Incident Detection System (VIDS) parameters can be adjusted, and it is always possible to revert to the default settings. This flexibility is important as the settings directly affect the processing and image analysis programme for the lane in question. Any incorrect adjustments can generate problems such as false alarms, or cause incidents to go undetected. The following is the list of parameters for VIDS I:

- Traffic slow-down alarm
- Slow vehicle alarm
- Wrong way alarm
- Stop in fluid traffic alarm
- Stop in congested traffic alarm
- Speeding alarm

The abovementioned operations are shown in Figures 1 and 2.



Figure 1: Lane configuration of the Video Incident Detection System

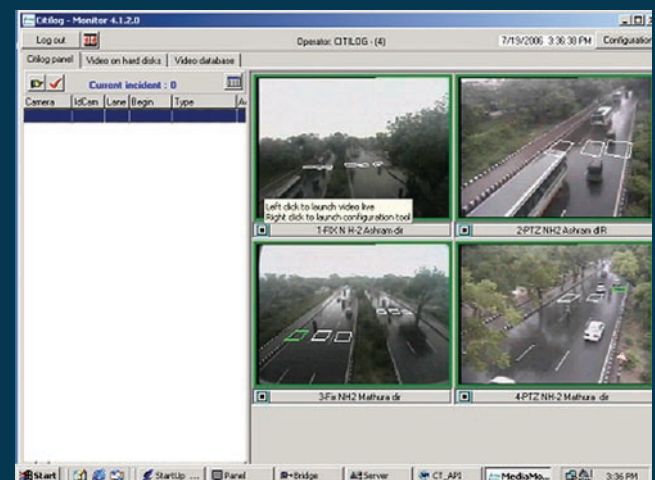


Figure 2: Operation of four cameras, comprising two PTZ and two fixed

Installation strategy and field study

A typical urban, six lane, divided carriageway on NH-2 was selected for the study. Two locations, a mid block and a signalised T intersection, were selected for the installation of cameras. At each location, two video cameras – one fixed and one Pan-Tilt and Zoom (PTZ) – were set up. The fixed cameras covered six lanes of the carriageway while the PTZ cameras covered three. Incident detection and traffic flow data from all four cameras was collected over an entire day, from 9 am to 5 pm.



The project was implemented through funds made available by the Government of India's Planning Commission and a small Traffic Management Centre (TMC) was established in the Traffic Engineering Safety Division of CTRI. This took the form of an ITS control room housing the instrumentation set up, which enabled the online transfer of raw video images from the four cameras through 2 Mbps dedicated data circuit lines. Other equipment included the converters, server and analyser for processing the data, using Citilog software. In practice, the TMC verifies the processed data obtained from the images transmitted by the cameras and flashes corresponding messages to Variable Message Signs (VMS) installed at strategic locations. A typical demonstration of the instrumentation set up is shown in Figure 3.

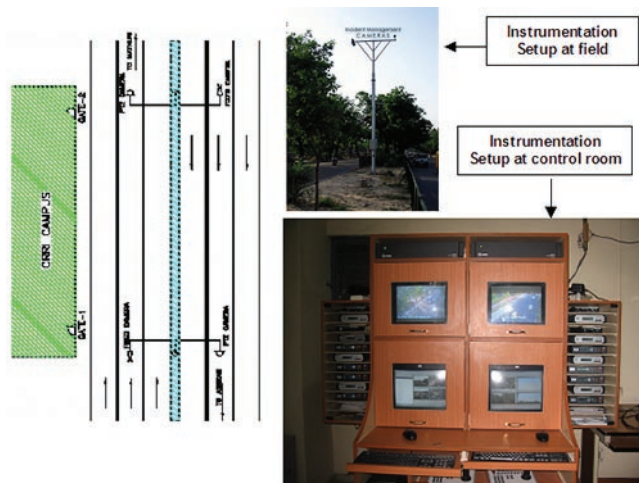


Figure 3: Instrumentation Setup of the Video Incident Detection System (VIDS) for Advanced Traffic Management System (ATMS)

Reliability analysis

The enumeration of traffic flow on the study stretch was first arrived at by manual counting from the CCTV footage. The types of incidents occurring on the study stretch were similarly observed manually.

The CCTV observed traffic flow and incidents (by reference to peak and off-peak hours) were then compared with the system data. By applying statistical approaches like chi-square tests to compare the observed and system data, the effectiveness of VIDS for automatic enumeration of traffic data and incident data collection under Indian traffic conditions could be determined. Figure 5 shows the Goodness-of-Fit plot for data collected respectively from

CCTV observation and the system deployed on the NH-2 using Fixed Camera 1. From the plot, it can be observed that the system is capable of counting vehicles to up to ninety five percent accuracy.



Figure 4: Glimpse of the incidents detected using Video Based System on NH-2 **Top:** detection of congested condition due to slow down. **Bottom:** detection of vehicle travelling in wrong direction.

As alluded above, the incident information was collected separately for peak and off-peak hours. To gauge the effectiveness of the system, the total number of field observed incidents was compared with those detected by the system. The number of false alarms (i.e. incidents which were reported by the system but which were not observed on CCTV) was recorded. Using this approach, the performance level of the video based incident detection system was then assessed by measuring the following parameters:

- Mean detection time
- Incident detection rate
- False alarm frequency

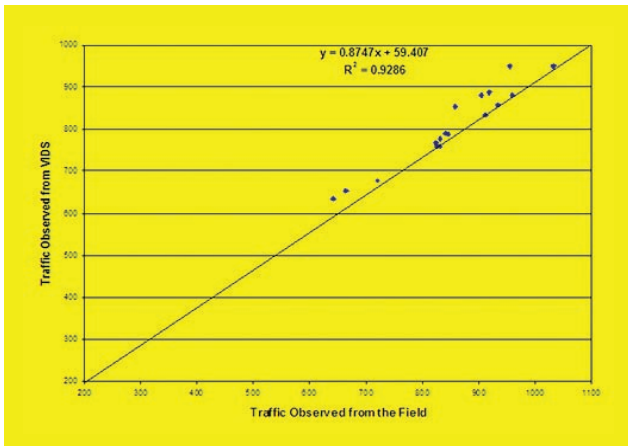


Figure 5: Goodness-of-Fit Plot for data collected from field and system on NH-2 (in Ashram Direction) using Fixed Camera 1

Table 1: Statistical summary for traffic flow data comparing the data collected from field and VIDS

Type of Camera and lane details	Average percentage error	Regression value
Camera 1 (Lanes 1,2,3)	13.281	0.843
Camera1 (Lanes 4,5,6)	12.892	0.761
Camera 2 (Lanes 1,2,3)	13.897	0.898
Camera 3 (Lanes 1,2,3)	12.280	0.840
Camera 3 (Lanes 4,5,6)	10.110	0.825
Camera 4 (Lanes 1,2,3)	8.920	0.960

Table 2: Statistical summary for incident data collection comparing the data collected from field and VIDS

Camera No	Incident Detection Rate	False Alarm Rate
Camera 1	85.68	16.11
Camera 2	85.47	15.43
Camera 3	86.00	10.87
Camera 4	88.06	08.67

Tables 1 and 2 provide a statistical summary of the performance of VIDS by reference to the above parameters.

Conclusions

Based on the above analysis, the following inferences can be drawn:

- The comparative figures for observed data and system data are reasonably close to each other, signifying the reliability of the system.
- The volume count obtained using the Citylog software was less than that recorded on the basis of manual observation. This may be attributed to a basic condition in the software which means it only accounts for vehicles that follow lane discipline. This is seldom respected on Indian roads! A basic limitation in the Citilog software lies in its ability to generate classified traffic volume.
- Automatic incident detection performed through Citilog software exhibits accuracy to a level of up to 85 %.
- Error in traffic data collection is greater during peak hours and there is less difference in traffic volume during non peak hours. This may be due to extreme congestion and non-adherence to lane discipline.



ENVIRONMENT

Low Emission Zones: Experience and Future Options

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Introduction

Calls from citizens for healthy and liveable city centres, coupled with legal imperatives like the EU Ambient Air Quality Directive (1), compel municipalities to take action in order to reduce immissions of air pollutants. The Directive fixes the threshold values for important pollutants like Sulphur Dioxide (SO₂), Nitrogen Oxide (NO_x), and particle matter, etc. In addition to the existing threshold values for PM₁₀ (particle matter of less than 10 millionths of a metre), new and more rigorous regulations have come into force, like the threshold level for PM_{2.5} (air pollutants with a diameter of 2.5 micrometres or less). Any European citizen can call on his or her regional government to take appropriate compliance measures. In addition, the Kyoto Protocol has been ratified by most countries internationally, and in the European Union there is an obligation on Member States to cap greenhouse gas emissions.

Municipalities are reacting. In Europe alone, more than 60 Low Emission Zones have been set up already, and many more are in the pipeline.

Introducing Low Emission Zones

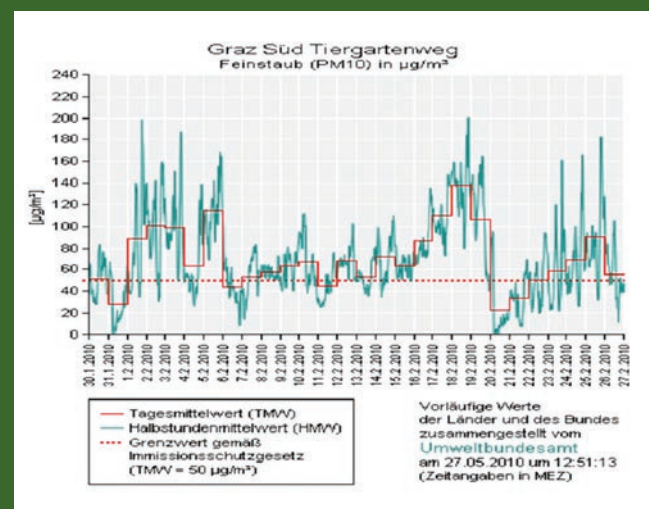
Low Emission Zones (LEZs) are areas where polluting vehicles are restricted from entering (2). To date, the main emissions targeted by LEZs have been particle matter and Nitrogen Dioxide (NO₂). Zones specifically targeting Carbon Dioxide have not yet been set up. A vehicle's pollution level is established by reference to classification criteria, including, for example, "Euro Standards"(3). Such criteria may take into consideration whether a vehicle is equipped with a

particle filter. Sometimes the restriction is only aimed at the particle matter category, as is the case in many German cities, and in the Italian city of Milan. Frequently, in countries like Norway and the UK, the vehicle weight constitutes an additional criterion (particularly if heavy goods vehicles are affected). In the Italian province of Alto Adige (4), vehicle access is scaled on a seasonal basis, according to the vehicle type and pollution class – a reaction to weather specific immissions.

Drive bans

Vehicles that do not comply with the pollution requirements are either banned from entering the LEZ or required to pay a charge. Drive bans are immediately effective from the day they come into force. It follows that they constitute the fastest way of reducing traffic pollution – provided drivers' compliance is enforced. However, drive bans precipitate sudden behavioural changes, like compelling people to adopt public transport or invest in more modern and greener cars. This entails a financial burden that may be prohibitive to certain sectors of the population. Exemptions from the drive ban, as well as long transitional periods, are therefore frequently applied to smooth deployment.

Nevertheless, such bans provoke regular debate about government overriding individual rights. The controversy generated tends to completely obscure and outweigh the ecological justifications, and the necessity to encourage behavioural changes for a more sustainable future. As a consequence, driving bans often miss the target when it comes to changing mindsets and mobility habits.



Measuring Site: Graz Süd Tiergartenweg
Particulate matter (PM₁₀) in µg/m³

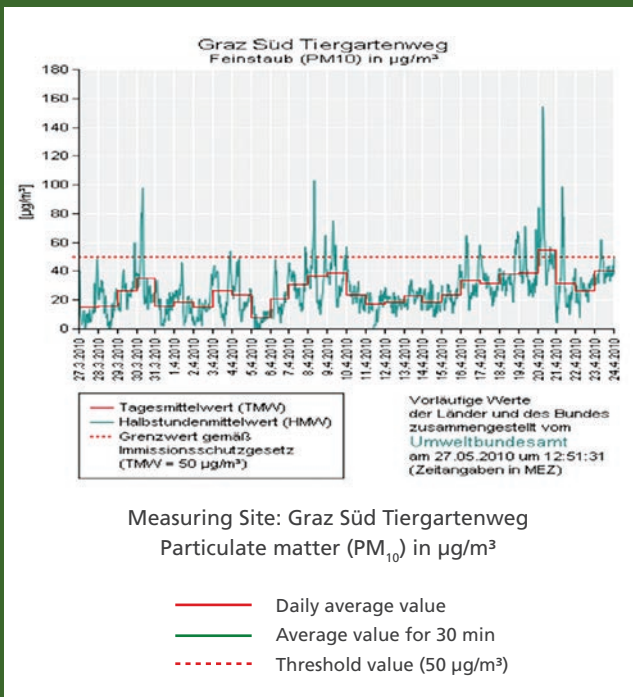


Fig. 1: Time series of particulate matter immissions in February 2010 (left) and April 2010 (right) in the city of Graz, Austria. Due to the weather situation, the threshold of 50 µg/m³ was significantly exceeded several times during February; a situation that occurred only once in April (5).

In addition, driving bans tend to be in force 7 x 24, even though particle matter immissions are largely a function of the weather situation (see Fig. 1), and there are other traffic related emissions, like CO₂, that are not covered.

Environmental charging

The most important target is to achieve a sustainable, and hence voluntary, behavioural change in car drivers. Such behavioural change can be stimulated, and a generally accepted stimulus is the pay-as-you-use principle. The London LEZ, for instance, with its daily payment option, has significantly accelerated the natural renewal and modernisation of vehicles in the city, with consequential reduction of pollution, and is set shortly to achieve near 100% compliance with the prevailing minimum Euro emissions standard (6). By assigning a monetary value to a scarce good – clean air is simply scarce – a new value pattern slowly emerges in drivers. Such changed value patterns may not only be influenced by pollution but also by other urban traffic issues like travel times and parking pressure. After introducing the Milan Ecopass system in January 2008 – under which vehicles are charged according to their pollution class (similar to the classes used for the Euro emission standards) – the number of polluter cars

was dramatically reduced, though they were not excluded altogether from accessing the zone. Indeed, the polluter cars were reduced by 56.7% in the first year of operation (see Fig. 2) and the natural renewal of the fleet has been maintained and confirmed following the initial ‘swing-in’ (7).

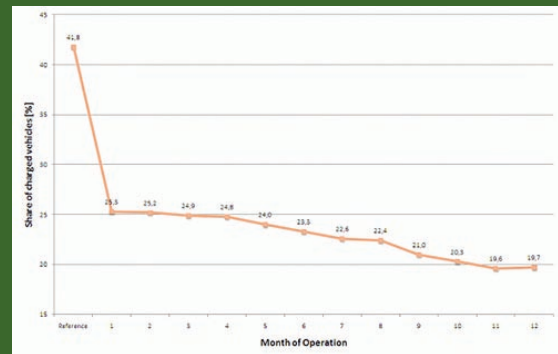


Fig. 2: Share of charged vehicles in the first 12 months of operation of the Milan Ecopass system; the charge is according to the pollution class of the vehicle (7).

A charge that is scaled according to the pollution propensity of the vehicle has the advantage of persuasively drawing the driver’s attention to the one aspect that really matters – his own behaviour in the context of sustainable mobility – without abruptly forcing him to change his lifestyle and circumstances.

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The NOxer® Process: from Developments to In-Situ Depollution Measurements

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Nitrogen oxides in urban environments

Nitrogen oxide (NO_x) emissions appear in all forms of high-temperature combustion of fossil fuels (coal, fuel oil, petroleum, etc.). The transport sector is responsible for nearly 60% of these emissions, which are harmful to human beings and the environment (even in very small concentrations) ⁽¹⁾.

European governments have pledged to halve nitrogen dioxide emissions by 2010, in the framework of international agreements (Gothenburg Protocol of 1999 and the European Directive on National Emission Ceilings of 23 October 2001).

NOxer® technology: elimination of nitrogen oxides via photocatalysis

Eurovia has developed a special depollution process that neutralises part of the exhaust gases by eliminating the NO_x . The principle is based upon the use of a special anatase-based form of titanium dioxide (T_iO_2), which is specially optimised for photocatalytic applications. When exposed to ultraviolet light, the T_iO_2 triggers the production of extremely reactive zones which interact with molecules of oxygen in a gaseous state on the surface. The

combination of oxygen in the air, light (solar or artificial) and the pollutant promotes the oxidation of the nitrogen oxides, eliminating them from the gaseous phase. The T_iO_2 operates as a chemical catalyser, i.e. it facilitates reactions in which nitrogen oxides are eliminated, but it is never consumed itself. This technology is used, and is most effective, where the highest NO_x concentrations are found, i.e. close to traffic. Laboratory test results reveal elimination rates of more than 75% of the nitrogen oxides that come into contact with the pollution-reducing surface

NOxer® pollution-reducing noise barriers ⁽²⁾

By incorporating this technology into wood fibre concrete, which is a commonly used material for noise barriers built alongside traffic routes, NOxer® offers an environmentally-friendly solution.

The excellent sound absorption performances, measured according to European standards ⁽³⁾, allow for an 8 to 11 dBA (adjusted decibels) reduction in sound intensity in relation to the initial noise level. By incorporating NOxer® technology, these structures are capable of simultaneously controlling noise and air pollution (see Figure 1).

NOxer® pollution-reducing pavements

In order to implement the NOxer® process as close as possible to the sources of pollution, Eurovia has also developed a pollution-reducing pavement. This consists of an open-textured asphalt (with a high percentage of voids) over which a slurry, containing a form of T_iO_2 that has been specially developed for photocatalysis, is poured. The slurry mainly consists of cement, mineral fillers, water and T_iO_2 .

The characteristics of the surfacing are identical to those of a traditional, semi-coarse asphaltic concrete type of bituminous layer, in terms of both its texture and skid resistance (mean texture depth > 0.6 according to the standards ⁽⁴⁾) as well as its behaviour. The NOxer® pavement



Figure 1: NOxer® pollution-reducing road infrastructures (noise barrier)



Figure 2: Examples of NOxer® projects:
a. Madrid; b. Cagnes-sur-Mer

is suitable for urban and peri-urban applications. From its launch at the end of 2006 up until 2009, more than 40,000m² of the product had been applied by Eurovia's specialised teams on French, UK and Spanish sites (see examples in Figure 2).

Depollution measurements at the pavement level

Comparing nitrogen oxide concentrations solely by using an analyser on two different parts of a site (with pollution-reducing and traditional surfaces) gives results that are dependent on numerous parameters (traffic, weather, lighting, configuration of the site, intersections, etc.). To compensate for these difficulties associated with open air measurements, depollution efficiency has been monitored on all our sites. An initial online system for monitoring the NO_x elimination capacity of materials has been developed. Inspired by the laboratory qualification test for NO_x, the principle applied is to reconstitute air containing a similar level of pollution to that measured on sites and to measure the output concentrations (see Figure 3a).

This polluted air is passed over the actual surface of the NOxer® layer. Additional lighting is provided by a lamp, thus making the experiment independent of the lighting conditions found at any given moment on site. It is then relatively simple to monitor the evolution of nitrogen oxides by using standardised analysers (chemiluminescence analysis). The difference between the input and output

concentrations shows the effectiveness of the surfacing materials chosen for the site, and thus confirms the correct application of the surfacing. The reduction is immediate, without start-up kinetics (see Figure 3b).

Averaged pollution-reducing efficiency of pavements

Different sites were also fully instrumented and monitored using passive diffusion tubes. These tubes, measure the mean NO₂ concentration over a given period (e.g. one day or one week). The samples are independently analysed by an external laboratory. The results reveal the reduction in the occurrence and concentration of peaks of pollution in the presence of the NOxer® surfacing (for example, 50% reduction in concentration peaks of above 120 µg/m³ in Cagnes-sur-Mer).

Impact of the NOxer® process shown by numerical simulation

Measurements in open environments still remain difficult to implement and depend on numerous external factors. Modelling makes it possible to use the known performances of the surfacing while dispensing with the

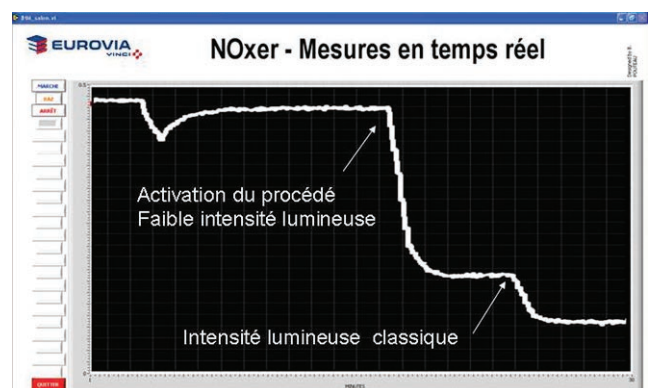
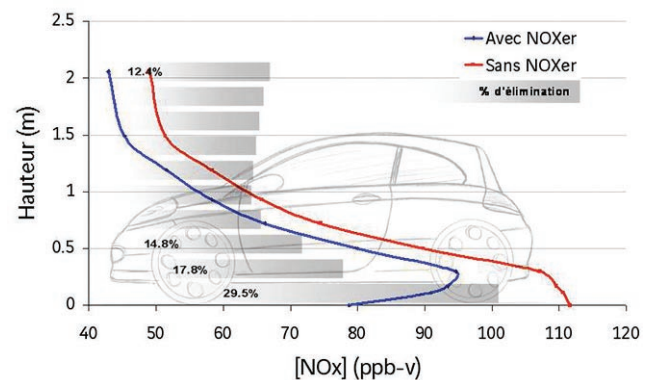


Figure 3: Operating principle for the acceptance test for NOxer® pavements



problems associated with studies in open environments. For demonstration purposes, an existing site was fully modelled by incorporating all parameters (3D geometry, weather conditions, traffic levels, etc.). The methodology consisted of using three-dimensional numerical simulation to compare the NO_x concentrations obtained with and without the NOxer® surfacing under given conditions. Thus, several series of “virtual sensors” were installed throughout the entire site from ground level up to a height of 2.0 m. Figure 3 lists the average reductions measured according to height, based on 28 different profiles. The results reveal a reduction in NO_x concentrations of more than 30% locally at vehicle height. Over a height of 20 metres, there is an overall reduction in pollution of more than 10% of the NO_x generated by traffic. This depollution effect, which is locally effective from the user’s perspective, reduces the pollution drawn in by vehicle air intakes, thus improving the air quality in passenger compartments as well as the mean air quality throughout the entire site.

Conclusion

With these different applications, the NOxer® process combats peaks of pollution and clearly improves air quality. The different monitoring operations carried out on the sites have revealed the major tendencies in the efficiency of the process, bearing in mind that each site is different and has its own characteristics. The modelling confirms the accuracy of the measurements and validates the model used.

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Attica Tollway: the “Green” Ring Road of Athens

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The Attica Tollway is a 65km long motorway that forms the ring road of Athens. Designed and constructed on a concession basis, it constitutes one of the largest co-financed projects in Europe.

The provision of high levels of service, aimed at increasing safety and reducing travel times, combined with an improvement in the environmental conditions in Attica, has been a top priority since the inception of the project.

The urban section of the Attica Tollway is designed and constructed in open cut shape, and the main carriageway is situated 13m below the ground level, to minimise visual effects and nuisance. Fifteen kilometres of cut-and-covers and tunnels were constructed in order to protect the





surroundings from traffic-related noise, and enhance the integration of the urban environment. However, on the basis of regularly conducted measurements, it became apparent that additional measures were desirable. As a result, noise barriers have been installed, over a total length of 18km, along the urban sections of the motorway. Furthermore, a series of supplementary noise-protection procedures have been instigated, including the construction of buffer zones and the planting of slopes and embankments. A monitoring system has been implemented through the installation of eight permanent noise measurement stations at key locations along the motorway.

In 2003, in recognition of these efforts, the Attica Tollway was awarded the prestigious *Décibel d'Or* (Golden Decibel), discerned by the *Conseil National de Bruit* (CNB – the French National Noise Abatement Council), for its programme *Management and Reduction of Road Noise Pollution from the Operation of Attica Tollway*.

The same noise measurement stations are also appropriately equipped to monitor air quality on a 24/7 basis, in conformity with the latest EU legislation.

Another important aspect of environmental mitigation has been the protection of local fauna. Biodiversity is continuously protected through the construction of cut-and-cover animal crossings, protective fencing and other special measures designed to deter animals from entering the motorway. Similarly, stickers have been applied to the glass screens of the transparent sound barriers so as to prevent birds from crashing into them.

More than a million plants have been planted, partially irrigated with water from wastewater treatment facilities, and extensive efforts undertaken to increase the total green areas and help achieve a reduction in the thermal load of the motorway.

The Tollway strives to keep traffic flowing, through the implementation of an Integrated Traffic Management System (electronic tolling and constant patrolling) thus contributing to significant reductions in traffic congestion, and consequent improvements in air quality.

Finally, on the impact assessment front, considerable care has been taken in rendering and maintaining the motorway "climate-proof". Since the Attica Tollway crosses three large basins, and interrupts the surface runoff of the surrounding mountains towards the sea, it was necessary to incorporate 67km of sewerage and flood protection works into the construction of the motorway, so as to channel storm water to the transverse structures and direct it to the sea receptors.

As a result of all the aforementioned measures, the operator of the Attica Tollway was the winner of IRF's 2008 Global Road Achievement Award, in the category of Environmental Mitigation, for its efforts in the field of environmental management – for which the company also received ISO 14001:2004 certification in the same year.



BUS RAPID TRANSIT

Bus Rapid Transit is What Happens if you Believe the Bus Can Deliver

Colin Brader

Director of Integrated Transport Planning Ltd. (ITP), Birmingham, UK



Holding up the bus as the panacea for urban mobility, as recent policy has done, without ensuring the support needed for design to be undertaken comprehensively and properly is a mistake; one which policy makers and experts worldwide are learning fast not to repeat.

Most public transport practitioners will not need reminding that the highest capacity line of the TransMilenio Bus Rapid Transit (BRT) scheme in Bogota, Colombia, happily swallows up 45,000 people during the peak hour. Similarly, the South East Busway in Brisbane, Australia, accommodates 150,000 per day. On the whole, these passengers have smiling faces as they are presented with a public transport system that is designed around their needs, fits comfortably into the public realm and is dependable and reliable.

What lessons do such systems hold for the rest of the world; both developed and developing? TransMilenio was an excellent example of a visionary Mayor taking the city by the scruff of the neck. Transport was viewed as a piece in a complex jigsaw that would see the city develop with a bright economic future. Reducing crime rates, producing happier people and enhancing visual attractiveness were included as objectives. Rather than transport being isolated, it was part of a wider, integrated strategy that saw no boundaries. This approach recognises the facilitation role that transport plays, and its contextualisation in a wider vision for the city. The problems of BRT insertion may disappear if connected to a bigger goal of realising a vibrant and successful city.

BRT has never been more popular across the world. It is criss-crossing cultural and income differences, and proving itself as a universal urban facilitator of well being. Major donor agencies that have been nurturing urban transport strategies are identifying BRT as central to supporting mobility; part of institutional restructuring and achieving some form of control

over public transport to ensure it meets the overarching aims of economic development and poverty alleviation.

Over the last three years, Integrated Transport Planning Ltd. (ITP) has been working in Lagos, Nigeria, where a stripped down version of BRT, referred to as "BRT-Lite", has been developed and implemented within a 15 month time frame, to become Africa's first BRT scheme. Whereas TransMilenio is grand in its approach to infrastructure, Lagos is 'Lite', consisting of low cost but targeted infrastructure focusing upon the satisfaction of key user needs such as run time reliability, safety and a reasonable level of quality.



Kampala – a city in need of BRT

BRT is a flexible concept that must be adapted to the local context, whilst driven by user needs and taking into account local constraints. A good example is that of the Nantes Busway in France. Rather than add a further tramway to the existing tram network, a fourth line was built as a busway. Insertion required reducing the capacity of the city's radial motorway but resulted in significant increases in the overall carrying capacity of the corridor. Currently transporting over 25,000 people per day, user surveys have shown that the busway is now viewed as a popular and integral part of the network.

Could the experience of TransMilenio, Lagos BRT Lite and the Nantes Busway be transferred to other areas? If there is a genuine belief in the bus as a quality means of transport that can deliver high capacity urban access then why not? If urban mobility is truly valued, then increasing the ability of public transport modes to compete with and complement each other is an obvious course of action. The fact that this would involve according the same priority for the bus as for a rail-based system should be a matter of course. Involving local stakeholders will prove decisive and identifying transport within wider socio-economic objectives should be an inherent precondition. At a time when governments are tightening their belts, this is not just what citizens deserve, it is what they expect!



Bus Rapid Transit and Mobility in Lagos Mega City

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Introduction

The Lagos metropolitan area, which has attained the status of a mega city, is by far the largest and most complex urban area in Nigeria. During the last two decades, levels of efficiency and productivity in the metropolitan area have been adversely affected by a serious and growing congestion problem. The increasing population of the metropolis has engendered an urban sprawl mostly made up of low-income workers who live at the periphery of the city. The situation is exacerbated by the poor condition of the road network, and the absence of a functional traffic system architecture and infrastructure.

As part of ongoing efforts to improve the mobility of commuters and decongest the metropolis, therefore, the Lagos State Government selected some major arteries to be considered for the establishment of the first Bus Rapid Transit scheme in Africa. This became operational on 17 March 2008.

The Lagos BRT

As seen in the preceding article, the Lagos BRT project is termed 'Lite' in so far as it does not seek to attain the highest specifications for such schemes, as found for example in the TransMilenio in Bogota. It is implemented under the auspices of the Lagos Metropolitan Area Transport Authority (LAMATA) and has two principal partners, the National Union of Road Transport Workers (NURTW), which owns the Blue Buses, and the Lagos Asset Management Company (LAGBUS), which operates the Red Buses. These two bodies were instrumental in contributing to the initial launch fleet of 180 high-capacity buses. These were used for the implementation of the first phase of the project, which covered the city's Mile 12 to CMS traffic corridor, with the Red Buses running the route non-stop and the Blue Buses stopping at designated intermediary bus stops. Currently, the Blue and Red buses together make up a fleet of more than 1,200 vehicles.

The BRT is 65% physically segregated and 20% delineated by road markings and distinctive pavement treatment. Lanes are typically 3.3m wide and are separated from other traffic by



Figure 1: The BRT Network (Courtesy: LAMATA)



Plate 1: Segregated route way (Courtesy: LAMATA)

concrete kerbs that are 400mm high. Gaps of approximately 0.2m have been left in the kerbs to allow storm water to drain, thereby negating the need to reposition road drainage.

Other features include well-built, distinctively marked stations, designed to enable level boarding and alighting (see Plate 2), as well as high-quality, attractive and functional amenities. The buses operate 16 hours daily (6am - 10pm).

Impact indicators of BRT on mobility in Lagos Metropolis:

- **Low fares:** The introduction of the BRT on the Mile12/ CMS traffic corridor has reduced the cost of transport for low-income earners. Where they would have spent NGN 300 (USD 2) previously, they now spend just NGN 100 (USD 0.66).
- **Reduced travel time:** The BRT has reduced commuting time drastically for those who use the service, especially during the morning and evening peak periods.
- **Increased comfort:** With the BRT each passenger has a seat, unlike the *molues* (big yellow buses run by private operators) where four adults are often squeezed on a seat.
- **Orderliness:** The BRT has introduced some order in passenger boarding, compared to the chaos and riots that frequently characterise the boarding of *molues*. In contrast, the average waiting time at bus stops for the yellow buses is 6 minutes, while waiting time at the BRT stations can be as high as 30 minutes (see Plate 3).



Plate 2: Comfortable Bus Shelter (Courtesy: LAMATA)



Plate 3: Long waiting times characterise BRT usage (LAMATA)

Negative impacts associated with the BRT-Lite

- Increased congestion at some intersections. Also, during reconstruction of some sections, BRT drivers often park along lanes reserved for the yellow buses, thereby causing delays.
- Some accidents have been recorded on the BRT when pedestrians, motorists and cart pushers veer into the segregated right of way.
- Reckless driving by some of the BRT personnel has cast a few doubts on safety, and has actively discouraged some people from using the service.
- Lagos, which already has one of the highest noise levels in the country, has been thrown even deeper into the abyss of noise pollution due to the incessant way BRT drivers blare their horns.
- At all the BRT stations, used tickets litter the environment.

Table 1: BRT-Lite ridership in 2008/2009 (Source: LAMATA)

Months	No. of passengers carried
March 17 – end March 2008	800,254
April 2008	2,908,134
May 2008	3,465,276
June 2008	3,545,196
July 2008	4,506,286
August 2008	4,639,876
September 2008	4,701,847
October 2008	4,608,254
November 2008	5,096,426
December 2008	5,186,413
January 2009	5,427,776
February 2009	5,429,663
March 2009	5,938,250
April 2009	5,904,332
TOTAL	62,157, 983

Prospects

Overall, the BRT has been a success. Ridership, for instance, has exceeded the projected figures by 233% since inception

(LAMATA, 2009 - see Table 1). The BRT-Lite carries almost 200,000 people per day and, given the prevailing acceptance of the BRT scheme by Lagosians, it is on course to helping Lagos reduce its congestion problems and enhance quality of life.

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Motorways and Urban Mobility: the Example of the A14 Motorway in Paris

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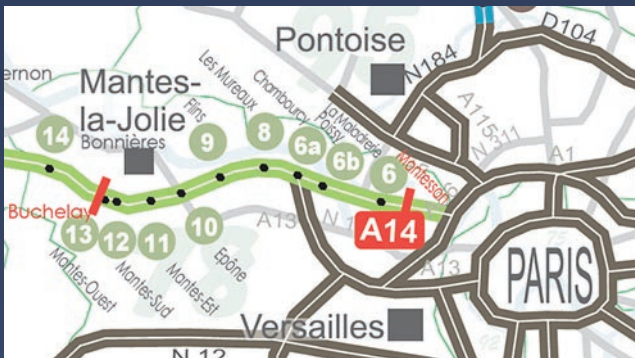


The impact of urban motorways can be greatly enhanced – notably in terms of achieving socio-economic and environmental benefits – if they are conceived as part of an integrated transport system, better designed to serve diverse mobility needs.

A good example is the A14 Motorway in the Paris area.

A14: an integrated urban motorway

The A14 Motorway, which covers a total length of 15.6 km, is an urban motorway located in the west of Paris, linking the business district of La Défense to the western suburbs. It is the first urban toll motorway in France. It features two tunnels – 2.8 km and 1.7 km long respectively – and crosses the river Seine by means of two viaducts.



It was conceived as a public-private partnership (PPP) project, an approach that is particularly well suited to ensuring infrastructure that is well integrated, efficient and innovative.

The contract was signed by **sanef's** subsidiary, Société des Autoroutes Paris-Normandie (**sapn – the Paris-Normandy Motorway Company**) in December 1991 and the motorway opened in November 1996, after only 5 years of studies and construction. The investment of approximately EUR 900 million was financed by sapn without any public subsidy.

Particular attention was given to the integration and acceptability of the infrastructure. For example, in order to minimise noise and visual impacts, the A14 runs below ground level for 13.4 km, which represents 86% of its total length.

An assessment of the project carried out after 10 years of operations has estimated the long-term socio-economic return at 15.8%.

Better utilisation of the infrastructure through variable tolls

The A14 Motorway is clearly a commuter facility, with few goods vehicles and very specific traffic patterns. These correspond to the massive commuter pressures of a major city and business hub during weekday peaks, coupled with mass exodus from the capital on Friday evenings, with the same intense traffic returning on Sunday afternoon/evening.

Given this, a variable tolling policy, with peak and off-peak rates, has been implemented, and this policy has proved very effective for ensuring fluid traffic and reduced travel times. Currently more than a third of users take advantage of the various discount subscription packages available for commuters and other regular clients.

Integration in a transport system: Bus Rapid Transit (BRT)

A dedicated Bus Rapid Transit (BRT) system has also been created. This is managed by private operators and connects the residential areas around the Seine valley to the La Défense business district. 210 commercial trips are scheduled daily, offering a theoretical capacity of more than 10,000 passengers per working day, the equivalent of about 30,000 car trips!

More than 15% of people on the A14 are travelling by regular mass transit bus!

The Express A14 BRT demonstrates how an urban motorway infrastructure can perfectly complement and integrate into the complex mass transit systems of large cities by providing solutions that are efficient, flexible and cost effective. In this same spirit, **sapn** has further instigated a system whereby toll free access is given to drivers practising registered carpooling!

An evolving infrastructure: new interchange at Chambourcy

Transport needs and patterns change over time and the challenge is for the infrastructure to evolve accordingly.

By way of example, ten years after the inception of the A14 project **sapn** agreed to build an additional full interchange giving access to the motorway to residents in the Chambourcy area.

Other potential developments and improvements to the A14 are in the pipeline. They include dedicated lanes and car parks for carpooling; more sophisticated and efficient pricing policies; as well as solutions for congestion in the La Défense area and on the RN13 between La Défense and the périphérique (the inner ring road of Paris).

The A14 is a good example of a well-integrated urban infrastructure, demonstrating how an urban toll motorway can constitute an essential component of a global mass transit system.





ROAD SAFETY

Road Safety in Indian Cities

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More than 240 people get killed every week in India's metropolitan cities (cities with populations of a million or more). There are 34 fatalities per week on the roads of Delhi alone! But, Delhi is not the riskiest city in the country. No less than 16 other metropolitan cities present a higher risk than Delhi. The level of risk in the cities of Uttar Pradesh, the most populous state of India, is more than twice that of the other cities in the country (see Figure).

Why then is the road safety situation so bad in so many cities of India? The main reason appears to be the prevailing imbalance in modal split coupled with inadequate transport infrastructure and its sub-optimal use. Very few cities have an adequate public transport system. People rely primarily on personalised modes such as cars and two-wheelers and para-transit modes such as auto-rickshaws and tempos. In most of the cities, two-wheelers and cars account for over 90% of the vehicle population, whereas the share of buses is negligible. In general, the road space in cities is grossly insufficient and the problem of traffic accidents is further aggravated by the mixed nature of traffic composition. Experience shows that fatalities tend to be concentrated around roads that are dysfunctional in the sense that they are not fit for carrying such mixed streams of intense fast and slow moving traffic safely. Typical features aggravating injuries and fatalities include traffic volumes and speeds that the roads were simply not designed for, high proportions of young and inexperienced drivers and high levels of non-motorised transport users, such as cyclists and pedestrians, vying for the same road space.

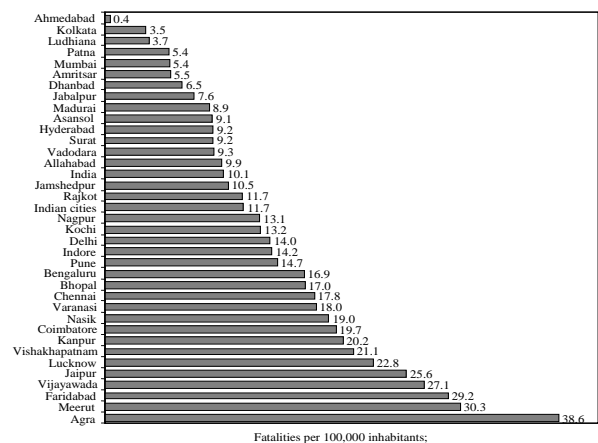
Most of the traffic accidents are attributed to human error. For this reason, road safety initiatives traditionally focus on 'fixing' the driver in order to prevent crashes. While there can be no doubt that approaches involving road safety education and enforcement are essential in curtailing traffic accidents, there is an equal and parallel need for more focus on mitigating the outcome of accidents by designing safer vehicles and safer roads.

Roads should be designed in such a way that they are not only self-explaining but also 'forgiving'. Accidents are less likely to occur on self-explaining roads and injuries will tend to be fewer and less severe on forgiving roads. A self-explaining road shows road users precisely where they should be at any given moment and guides them on how to proceed safely. For example, a simple cost effective pedestrian refuge (a small raised and protected island) in the middle of a busy road, where pedestrians can pause before continuing to cross, not only clearly indicates where to cross, but also makes crossing much easier and safer.

Forgiving roads protect road users in the event of an accident. Road design must recognise that accidents can occur and ensure that injuries and fatalities are minimised. For example, simple engineering features like safety barriers can be used to separate fast moving vehicles from people. Similarly, crash cushions can be used to reduce the consequences of an accident.

While increased mobility is essential for economic development and the relief of poverty, it should not be at the cost of escalating fatality rates among the poorer and most vulnerable sections of society. Appropriate action needs to be taken that simultaneously addresses vehicles, user behaviour and the design of the roads themselves. A key part of the solution lies in assessing the networks of metropolitan cities and identifying those dysfunctional roads on which large numbers of road users are being killed or seriously injured. These roads should then be targeted for safety upgrading through affordable, cost effective measures.

Figure: Road accident fatality risk in Indian metropolitan cities



Source: Accidental deaths & suicides in India, 2007; Published by the National Crime Records Bureau, Ministry of Home Affairs, Government of India, New Delhi.



CYCLING

Cycling to improve Quality of Life in Africa

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Urban roads in Africa are used by a high number of people on foot, but only very narrow areas are available for pedestrians. Meanwhile, a small minority of people are taking up the lion's share of road space – in their vehicles.

A number of civil society organisations are promoting non-motorised transport and advocating bicycle use in African countries. In August 2009, these organisations founded the African Bicycle Network (ABN). Most of the founding members have histories going back over many years and have earned a solid reputation for effective grassroots work on promoting non-motorised transport.



The network's aim is to provide a platform for harnessing the wealth of knowledge, experience and expertise already available from such organisations by way of targeted contribution to improving the quality of life of people in Africa. In this respect, the network serves as a focal point for regional integration aimed at advocating and lobbying for sustainable development, with an emphasis

on non-motorised transport. By identifying, organising and managing existing resources, we can enormously strengthen the technical, organisational and advocacy capacities of existing groups, as well as ensure that knowledge available from any one organisation flows throughout the regions of Africa to benefit other groups in similar need.

Our goal is that more and more African citizens will turn to bicycles, and that their numerous advantages will be increasingly realised and promoted by interest and social groups throughout the continent by way of simple but decisive response to many of the key development challenges facing Africa today.

More information: www.africanbicyclenetwork.org

Tanzanian Grassroots Organisation Develops Strategy to Improve Urban Mobility for Cyclists

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Imagine biking along a dirt road riddled with potholes, rocks and open drainage tunnels. On certain stretches, these roads are in fact paved but in poor repair with hazards at every turn. Pedestrians amble all around you as they pass in and out of vendors' stalls along the road or rush to catch a bus, suddenly moving out in front of your bike. However, the most dangerous obstacles are the ever-present cars and motorbikes that have decided to use the service road as a parking lot or, worse yet, an additional road lane.

As a cyclist, you have the option of actually moving out onto a dual carriageway, but motorised vehicles rarely recognise the right of cyclists to share the road. Giving up cycling is not viable, as you cannot afford a car or daily bus fare. Maybe, your livelihood depends on your bicycle or, because of a disability, it is the only mode of transport accessible to you.

The above scenarios are not merely a hypothetical exercise. Rather, they are based on the day-to-day reality of the average cyclist in Dar es Salaam, Tanzania. A single cyclist



would have trouble pressuring government institutions to improve road conditions for non-motorised vehicles, especially if that cyclist comes from a lower-income bracket. For this reason, around 278 cyclists have decided to join the local grassroots organisation, Umma wa Wapanda Baiskeli (UWABA).

UWABA was founded in January 2006 with a mission to advocate for the safety of bicyclists in Dar es Salaam. The only condition for membership is that an individual must use a bicycle or tricycle as his or her mode of transport around the city. After four years of lobbying Tanzanian government and transport officials for improvements in cycling conditions, safety and infrastructure - coupled with a series of cycle safety education campaigns - the organisation's members have developed a successful five-pronged strategy based around "The Five 'E's'", namely

Engineering, Enforcement, Education, Encouragement, and Environment.

This strategy has been instrumental in developing relationships with the Dar es Salaam Rapid Transport project (DART) and the Tanzania National Roads Agency (TANROADS) that have enabled UWABA to submit recommendations regarding the rehabilitation of a major road in the city. UWABA has also been in regular contact with the local traffic police to ensure that existing traffic laws are enforced to protect cyclists. Bicycle safety does not end with engineering and enforcement, however, so UWABA has, for example, run a series of two-day cycle safety training courses in local schools and in the community. Furthermore, for the past four years, UWABA has been organising annual Cycling Caravans that both encourage citizens to cycle and highlight the lack of safe, pleasant streets suitable for this purpose in Dar es Salaam. Finally, UWABA has taken part in campaigns such as 'Ride Planet Earth', which highlight the fact that cycles and other non-motorised vehicles contribute to efforts to mitigate climate change.

UWABA's future plans

While UWABA has enjoyed many achievements, the organisation's members recognise that there are still many more obstacles to overcome, mainly connected with the improvement of roads and the promotion of cycle-focused policymaking. UWABA plans to continue lobbying for the establishment of a regular forum so that non-motorised transport policy creation can be more coordinated and efficient. This would notably bring together all Tanzanian government institutions involved in issues relating to cycle transport in Dar es Salaam. Furthermore, UWABA will capitalise on future and existing partners by lobbying national parliamentary candidates in the lead up to the





Tanzanian General Election in October 2010, and by reaching out to other concerned organisations in Dar es Salaam.

Finally, UWABA is reaching out to potential donors in order to fund its FASTA bicycle cooperative. This cooperative will serve the dual purpose of initiating an efficient cycle courier service in Dar es Salaam and of giving poorer members of UWABA a welcome and much-needed opportunity to increase their incomes.

More information on this programme and the grassroots work of UWABA can be found on the organisation's website at www.uwaba.or.tz/index-en.htm.

Sharing the Road: Shared Bicycle Programme

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INTERNATIONAL ROAD FEDERATION
FEDERATION ROUTIERE INTERNATIONALE

For municipalities facing the huge problems of smog, congestion, and noise pollution that escalating motorised traffic brings in its wake, bicycles offer a solid and viable policy alternative. A scheme that is growing in popularity worldwide is the Shared Bike system, centred on the deployment of Public-Use Bicycles (PUBs) to create 'cycle-friendly cities' that promote bicycles as a prominent and integral part of their urban transport strategies. There are two main categories for bike sharing schemes: Community Bike Programmes, organised mostly by local community groups or non-profit organisations; and Smart Bike Programmes, implemented by municipalities or through Public-Private Partnerships (PPPs). Both systems commonly enable bikes to be rented at one location and left at another.

Already a number of major cities, from both the developed and developing worlds, have adopted shared bike schemes. A good recent example is Mexico City, Mexico, where the Ecobici Programme was launched in February 2010, and is paving the way for other Latin American cities to follow. The Ecobici model will be the country's cheapest mode of transport at MXN 0.82 (less than USD 0.10) per day, and already has 1,000 bikes accessible from 85 stations in



5 districts. The scheme is part of ongoing efforts by the city, once infamous for its pollution and poor air quality, to improve the environment, diminish traffic congestion, and recover public spaces. Legislation is underway to secure greater respect for cyclists and pedestrians, as well as ensure that the necessary infrastructure is in place to support this objective. Already, the city has committed to implementing 100 miles of bike paths by 2012.

Although Bike Sharing Schemes make sense for many cities, there are a number of issues impeding progress, such as theft, vandalism, topography and climate. Increasingly, however, these are being resolved by new and smart technologies (such as electric bikes), holding client credit card information, penalties and incentive schemes to encourage users to return the bikes. Nevertheless, planning a successful bike sharing scheme still calls on policy makers to pay careful prior attention to key factors and challenges such as city size, implementation times, infrastructure development and costs. In Europe, the New and Innovative Concepts for Helping European Transport Sustainability (NICHES) Project has developed a helpful checklist to guide this task.

For more details, please visit the Urban Mobility section of the global Transport Knowledge Partnership (gTKP) website www.gtkp.com.

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