

UMTRI-2012-1

JANUARY 2012

ROAD-SAFETY MANAGEMENT IN BRAZIL, RUSSIA, INDIA, AND CHINA

**JUHA LUOMA
MICHAEL SIVAK**



ROAD-SAFETY MANAGMENT
IN BRAZIL, RUSSIA, INDIA, AND CHINA

Juha Luoma
Michael Sivak

The University of Michigan
Transportation Research Institute
Ann Arbor, Michigan 48109-2150
U.S.A.

Report No. UMTRI-2012-1
January 2012

Technical Report Documentation Page

1. Report No. UMTRI-2012-1		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Road-Safety Management in Brazil, Russia, India, and China				5. Report Date January 2012	
				6. Performing Organization Code 383818	
7. Author(s) Juha Luoma and Michael Sivak				8. Performing Organization Report No. UMTRI-2012-1	
9. Performing Organization Name and Address The University of Michigan Transportation Research Institute 2901 Baxter Road Ann Arbor, Michigan 48109-2150 U.S.A.				10. Work Unit no. (TRAIS)	
				11. Contract or Grant No.	
12. Sponsoring Agency Name and Address The University of Michigan Sustainable Worldwide Transportation				13. Type of Report and Period Covered	
				14. Sponsoring Agency Code	
15. Supplementary Notes The current members of Sustainable Worldwide Transportation include Autoliv Electronics, China FAW Group, FIA Foundation for the Automobile and Society, General Motors, Honda R&D Americas, Meritor WABCO, Michelin Americas Research, Nissan Technical Center North America, Renault, Saudi Aramco, and Toyota Motor Engineering and Manufacturing North America. Information about Sustainable Worldwide Transportation is available at http://www.umich.edu/~umtriswt .					
16. Abstract This study examined road-safety management in Brazil, Russia, India, and China (the BRIC countries). The main topics reviewed were recent crash statistics, key governmental agencies in charge of road safety, road-safety programs, influential organizations outside of the government, key research institutes, and major barriers to improvement. The main findings are as follows: (1) Each BRIC country has governmental organizations with responsibilities for road safety. However, none of these countries has a single lead governmental unit responsible for national road safety. (2) The Russian Federation has a strategic road-safety plan, including a specific target for reduction of road fatalities. The strategic safety plan of China is limited to certain types of roads, and it aims to reduce fatality rates per vehicle. In Brazil and India, there is not yet any road-safety plan or road-safety targets. (3) There are several non-governmental organizations involved in road-safety work in Brazil, the Russian Federation, and India, but not in China. (4) Road-safety research is conducted in each of the four countries. (5) All four countries have recently introduced several new road-safety interventions. However, the introduced interventions are not based on a systems approach that would involve comprehensive measures supporting each other, or they are not applied uniformly throughout the country.					
17. Key Words road safety, management, Brazil, Russia, India, China				18. Distribution Statement Unlimited	
19. Security Classification (of this report) None		20. Security Classification (of this page) None		21. No. of Pages 35	22. Price

Acknowledgments

This research was supported by Sustainable Worldwide Transportation (<http://www.umich.edu/~umtriswt>). The current members of Sustainable Worldwide Transportation include Autoliv Electronics, China FAW Group, FIA Foundation for the Automobile and Society, General Motors, Honda R&D Americas, Meritor WABCO, Michelin Americas Research, Nissan Technical Center North America, Renault, Saudi Aramco, and Toyota Motor Engineering and Manufacturing North America.

Juha Luoma's contribution was prepared while he was a visiting research scientist at UMTRI from the VTT Technical Research Centre of Finland (<http://www.vtt.fi>).

The authors wish to thank the following individuals for their assistance in gathering the information: Philip Gold, Dinesh Mohan, and Wei Zhang. However, the authors are responsible for the final content and organization of this report.

Contents

Acknowledgments.....	ii
Introduction.....	1
Approach.....	5
Brazil.....	6
Russian Federation.....	12
India	17
China	23
Summary	27
References.....	30

Introduction

Brazil, Russia, India, and China (the BRIC countries) are both the fastest growing and largest emerging market economies (Wilson and Purushothaman, 2003; EconomyWatch, 2010). The population of these countries is almost three billion people, or over 40% of the total population of the world. Lately, the BRIC countries have also contributed to most of the growth in the world's GDP. By 2020, all four BRIC countries are expected to be in the top 10 largest economies of the world.

Rapid economic growth is usually connected to a rapid expansion of road transportation. Unfortunately, this also leads to an increase of road crashes, injuries, and fatalities. As has been recognized by many international organizations, such as the United Nations and the World Health Organization, this development calls for effective road-safety measures (e.g., Peden, Scurfield, Sleet, Mohan, Hyder, Jarawan, and Mathers, 2004; WHO, 2009). It is not enough to implement measures that improve legislation, roads, vehicles, road-user behavior, and postcrash response; one of the key activities is to organize effective and efficient road-safety management (United Nations, 2011). According to TRB (2011), "management is the direction of resources to attain defined objectives. The senior managers of transportation, public safety, and health agencies are expected to define traffic-safety-program objectives and strategies, budget and allocate resources to interventions, coordinate programs across agencies and jurisdictions, monitor the effectiveness of interventions and progress towards objectives, and interact with elected officials and the public to maintain support and justify the commitment of the required resources."

Peden et al. (2004) called for a "systems approach" to road safety that examines the components of the system (infrastructure, vehicle, and road user) in developing strategies for prevention. Furthermore, six general recommendations were provided: (1) identify a lead agency in government to guide the national road-safety effort; (2) assess the problem, policies, and institutional settings relating to road-traffic injury and the capacity for road-traffic-injury prevention in each country; (3) prepare a national road-safety strategy and plan of action; (4) allocate financial and human resources to address the problem; (5) implement specific actions to prevent road crashes, minimize injuries

and their consequences, and evaluate the impact of these actions; and (6) support the development of national capacity and international cooperation.

Based on many earlier studies, Bliss and Breen (2009) posited that a successful road-safety management system includes three interrelated elements: institutional management functions, interventions, and results (see Figure 1).

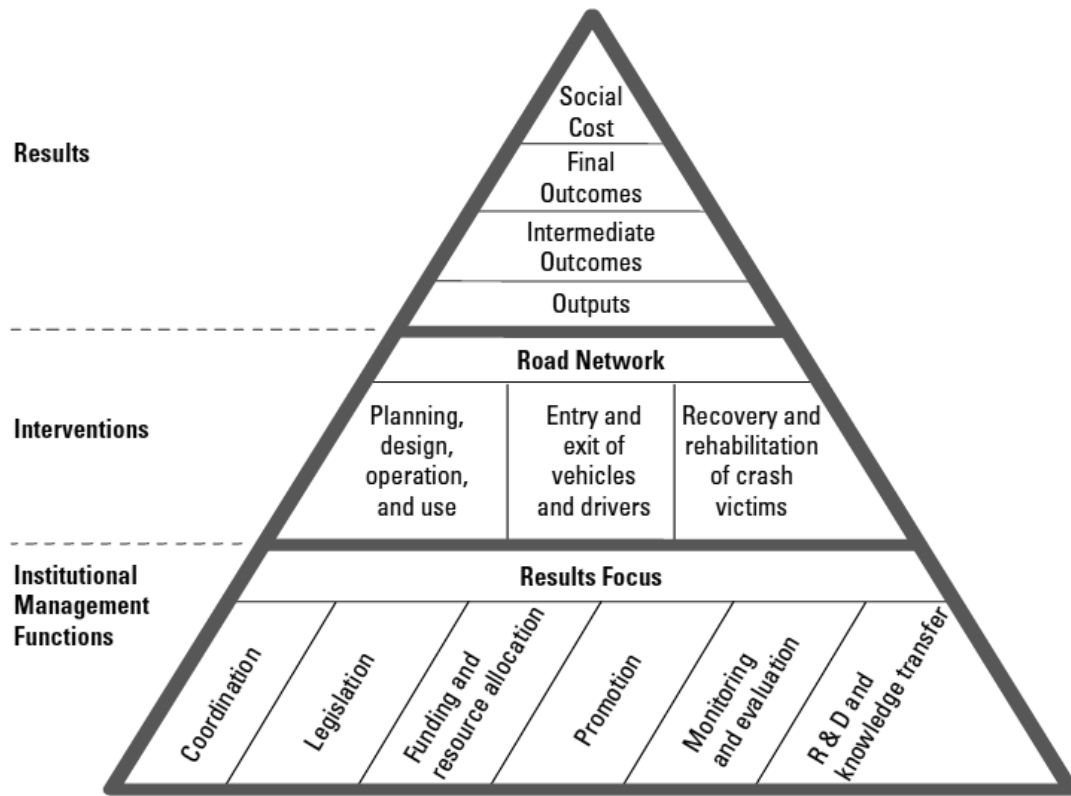


Figure 1. Road-safety management system (Bliss and Breen, 2009). (Reprinted with copyright permission of The International Bank for Reconstruction and Development / The World Bank.)

The elements of the first level (*institutional management functions*) include seven functions that provide the foundation on which road-safety management systems are built (Bliss and Breen, 2009):

1. *Results focus* is the most important function (the strategic orientation) and sets out a performance-management framework for the delivery of interventions and their intermediate and final outcomes. It defines the level

of safety that a country wishes to achieve presented in terms of a vision, goals, objectives, and related targets.

2. *Coordination* concerns the organization of the interventions and other related institutional management functions (horizontally, vertically, between government and nongovernment, etc.).
3. *Legislation* concerns the legal instruments necessary for governance purposes to specify the legitimate bounds of institutions, in terms of their responsibilities, accountabilities, interventions, and related institutional management functions.
4. *Funding and resource allocation* involves the financing of interventions and related institutional management functions on a sustainable basis using a rational evaluation and programming framework to allocate resources in order to achieve the desired focus on results.
5. *Promotion* concerns the sustained communication of road safety as a core business for government and society, and it emphasizes the shared societal responsibility to support the delivery of the interventions required to achieve the desired focus on results.
6. *Monitoring and evaluation* concerns the systematic and continuous measurement of road-safety outputs and outcomes (intermediate and final), and the evaluation of interventions. Driver and vehicle registers, crash injury databases, and periodic surveys are typical examples.
7. *Research and development, and knowledge transfer* concerns the systematic and continuous development and application of knowledge that contributes to the improved efficiency and effectiveness of road-safety management system.

The second level in Figure 1 concerns *interventions* that are designed to achieve the desired results. They address the safe planning, design, operation, and use of the road network; the conditions under which vehicles and road users can safely use it; and the safe recovery and rehabilitation of crash victims.

The third level of the road-safety management system deals with the *desired results* that can be final outcomes (e.g., vision and longer-term targets in terms of social costs, fatalities, serious injuries, etc.), intermediate outcomes (e.g., behavioral changes),

and outputs (e.g., evaluations of improvements in intermediate and final outcomes). Countries with good practices set quantitative-outcome and intermediate-outcome targets to achieve their desired results.

This framework postulates that successful road-safety management requires a number of integrated activities and links between them. Importantly, this framework can be applied to any country, regardless of its safety performance. For example, a recent road-safety review based on this framework (Breen, Howard, and Bliss, 2008) recommended several improvements for Sweden—one of the best-performing countries.

This study examined road-safety management in the BRIC countries. Although the framework shown in Figure 1 was not explicitly used, the main elements of that framework were included.

Approach

We contacted several road-safety experts in the BRIC countries with requests for the following information:

- (1) Most recent crash statistics.
- (2) What are the key governmental agencies in charge of road safety in your country? Are there any ongoing road-safety programs, and, if so, what are the main aspects of these programs?
- (3) What are the most influential organizations (outside of the government) and their agendas? Are there any specific ongoing programs?
- (4) What are the key research institutes? What are the main areas of their research?
- (5) What are the major barriers to improvement?

We received usable information for Brazil, India, and China, but not for the Russian Federation. Therefore, the presented Russian information is based on recent reports of ECMT (2006), Marquez and Bliss (2010), and OECD/ITF (2011). In addition, information on crash statistics for all countries was supplemented from various national and international sources.

Brazil

Recent crash statistics

Table 1 lists the key statistics for Brazil. Figure 2 shows the number of road fatalities for 2005 through 2010.

Table 1
Key statistics for Brazil (WHO, 2009).

Population	191,790,929
Gross national income per capita, US\$	5,910
Number of registered vehicles (2007)	49,644,025
Reported road traffic fatalities (2006)	35,155
Road fatalities per 100,000 of population	18.3
Road fatalities per 100,000 of registered vehicles	70.8

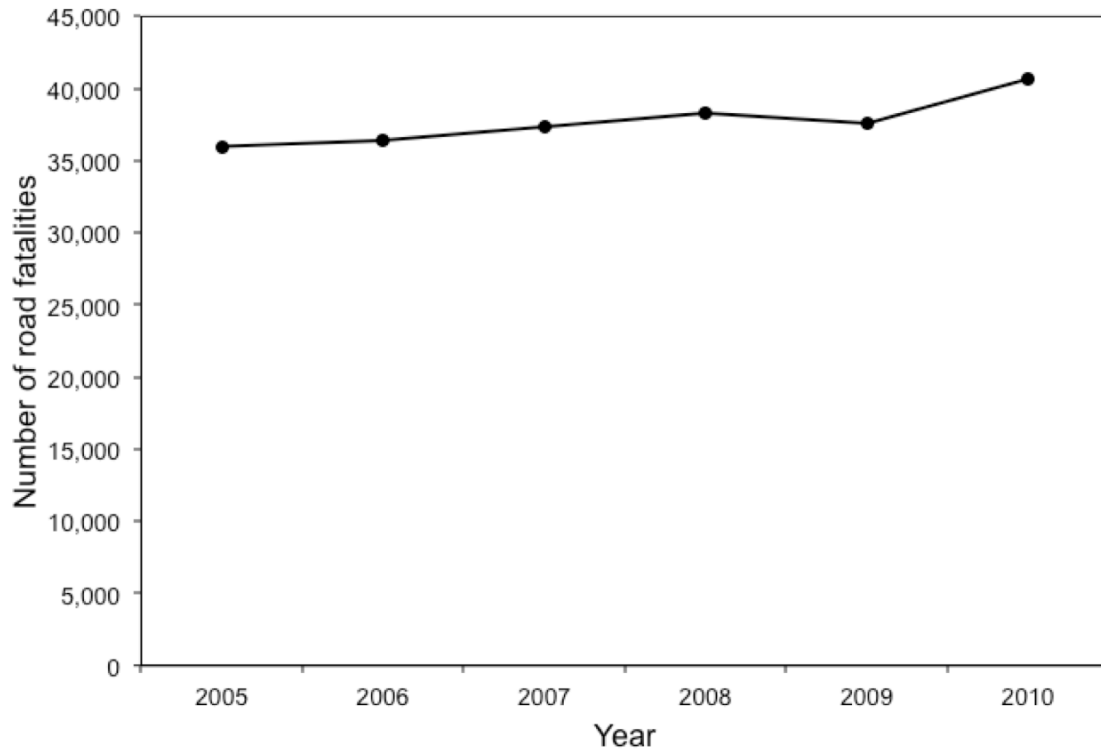


Figure 2. Number of road fatalities in Brazil from 2005 through 2010 (Ministry of Health, 2011).

The largest categories of fatalities among road users in 2006 were pedestrians (28%), riders of motorized two- and three-wheelers (20%), drivers of four-wheelers (5%), passengers (5%), and cyclists (5%) (Mortality Information System of the Ministry of Health, cited by WHO, 2009). However, the data by road-user category should be viewed with caution, because the category “other” includes 37% of road fatalities.

From 1998 to 2008, the number of vehicles increased by 76%. Although the number of both fatalities and vehicles increased, the fatality rate per vehicle stayed approximately unchanged. However, the fatality rate per population did increase.

Key governmental agencies in charge of road safety

The National Traffic Department (DENATRAN) is in charge of road safety in Brazil. However, it is a small unit, within the Ministry for Cities, and does not have a dedicated department for road safety. DENATRAN sometimes promotes road-safety publicity campaigns and traffic-education projects, but usually not on a continuous, long-term basis. In addition, frequent political changes in leadership limit the sustainability of DENATRAN actions.

The Ministry of Health devotes resources to promotion of road safety and to research into health questions associated with road safety.

Various independent police forces are involved in enforcement and, to a certain extent, educational campaigns. Federal Highway Police (PRF) is responsible for road safety on interurban federal highways throughout Brazil. Most Brazilian states have a State Traffic Department (DETRAN) and a State Highway Police force (PRE). These agencies are responsible for road safety on interurban state highways. In the cities, the situation depends on whether or not the city has “municipalized” its traffic. A total of 1,106 (approximately 15%) of all Brazilian municipal areas have municipalized traffic. In such areas, road-safety policing is carried out by a municipal traffic department, through a group of civilian traffic “operators” and/or a section of the state police.

Some of the largest Brazilian cities, such as São Paulo, Rio de Janeiro, Belo Horizonte, Curitiba, and Porto Alegre have “traffic engineering companies” that are municipal departments that operate the traffic system, and have responsibility for road safety within their mandates. Some of these include a specific road-safety education

department that deals with activities such as traffic education in schools, and defensive driving courses for bus and taxi drivers, and motorcyclists.

Interurban highway design, construction and maintenance and operation, including road-safety aspects, are carried out directly by various government agencies, or indirectly through contracts with private highway-construction companies. Usually, such contracts include specific, annual, safety targets (in terms of crash, death, and injury reductions). The federal (national) interurban highway network is the responsibility of DNIT (National Transport Infrastructure Department, formerly DNER). State interurban highways are administered by state highway departments (usually called DER, but with a different name in some states).

The United Nations 2011-2020 Decade of Road Safety Actions has been adopted in Brazil, initially by DENATRAN, but there is no substantial nationwide coordinated program of action. There are no specific official federal, state, or municipal targets for road death and injury reduction in Brazil. However, some cities have adopted their own specific targets.

Throughout Brazil, at federal, state, and municipal levels, there are many ongoing educational and training campaigns at any time. However, these actions are usually not coordinated as parts of a larger program. The *Lei Seca* (i.e., “dry law” campaign), which aims to combat drunken driving, is an example. This is a widely advertised publicity campaign, but it is not adequately supported by systematic law enforcement. Furthermore, there is resistance to the use of breathalyzers, based on arguments of civilian rights. On the other hand, the use of some technology-based road-safety measures is being widely disseminated, and their use is expanding. The best example is radar and other types of speed control on urban and interurban highways.

Most influential organizations (outside of the government)

There are a few influential organizations outside the government in Brazil. Some long-term road-safety campaigns are conducted and financed by private companies. Some of the best examples include the following:

The VOLVO campaign has been in action for many years and includes annual prizes for projects in various areas of road safety, including seminars held throughout the country.

PERKONS (a producer of electronic traffic control equipment, especially speed detection, measurement, and control devices and services) has a website devoted to disseminating and discussing various aspects of road safety.

CESVI Brazil, Road Safety Centre (an organization within Mapfre Insurance) is primarily concerned with vehicle-safety promotion, but more recently became involved in road-user behavior as well.

In addition, several highway-construction companies that operate the 400-km highway between São Paulo and Rio de Janeiro maintain ongoing road-safety campaigns that target their toll customers and the communities living alongside the highway.

ABRAMET (The Brazilian Association of Traffic Medicine) brings together a large number of physicians and psychologists interested in road-safety matters. This association organizes an annual international conference on road safety. It has some influence in promoting information distribution, research, and positive measures for aspects such as driving under the influence of alcohol and drugs, and sleepiness while driving.

ABRASPE (The Brazilian Association of Pedestrians) promotes discussion related to pedestrian safety.

Several non-Brazilian organizations are present in Brazil promoting road safety. The Inter-American Development Bank (IADB) and the World Bank include road safety as an aspect of all road-transport projects that they finance. Global Road Safety Partnership (GRSP) participates in projects in some cities. Washington-based EMBARQ has a unit with offices in Porto Alegre (CTS-Brazil), devoted to offering free consulting services to cities and other organizations to improve the quality of (primarily) public transport projects. Recently, CTS-Brazil started to include road-safety auditing of bus-corridor projects in several cities in projects financed by the Bloomberg Foundation.

SAFE KIDS (a Washington-based organization that promotes child safety, including road safety) has a unit in Brazil, known as Criança Segura. This organization promotes the use of appropriate child-safety seats, seat belts, and cycling helmets.

Key research institutes

There are no broad-based road-safety research institutes in Brazil. However, some Brazilian universities have transport engineering departments, some of which include road safety as a topic of study and research. Among them are Universidade de São Paulo, Universidade Presbiteriana Mackenzie, Universidade Federal do Rio de Janeiro, and Universidade Federal do Rio Grande do Sul.

Major barriers to improvement

At the institutional level, there is a lack of effective road-safety administration. This concerns national, state, and local levels. DENATRAN, the federal government organization responsible for road safety, is a relatively small entity. With some exceptions, most DETRANs (the state traffic departments) do not have enough qualified road-safety staff. Also, with some notable exceptions in the largest cities, many of the Brazilian cities lack qualified manpower to adequately deal with traffic-safety matters.

In addition, it appears that government and society do not consider road safety to be a high priority. There is an absence of a specific governmental department devoted to road safety, no national program, and no comprehensive research institutes. Furthermore, a systems approach to road-safety activities is not employed. Consequently, employed actions are not well integrated.

At the intervention level, very few measures appear to be effectively implemented nationally to achieve desired improvements. For example, Vasconcellos and Sivak (2009) identified the following four promising areas for intervention in Brazil: (1) pedestrian crashes (pedestrians currently account for about 36% of all road fatalities if “unknowns” are excluded), (2) motorcycle crashes (motorcyclists account for 26% of all road fatalities), (3) nighttime crashes (the likelihood of a crash per volume of traffic on federal roads is greatest during that time), and (4) crashes on two-lane roads (with a high frequency and a high severity of crashes). In addition, there are opportunities for interventions in the areas of low-quality sections of the road network (e.g., many crashes occur on the network not operated by private companies and which have no systematic

auditing of the quality of the road network), insufficient quality of driver training, and driving under the influence (despite recent efforts to reduce it).

There are no specific road-safety targets in Brazil. Furthermore, while road fatalities are recorded, many other safety indicators are lacking.

Russian Federation

Recent crash statistics

Table 2 lists the key statistics for the Russian Federation. Figure 3 shows the number of road fatalities for 2005 through 2010.

Table 2
Key statistics for the Russian Federation (WHO, 2009).

Population	142,498,532
Gross national income per capita, US\$	7,560
Number of registered vehicles (2007)	38,695,996
Reported road traffic fatalities (2006)	33,308
Road fatalities per 100,000 of population	23.4
Road fatalities per 100,000 of registered vehicles	86.1

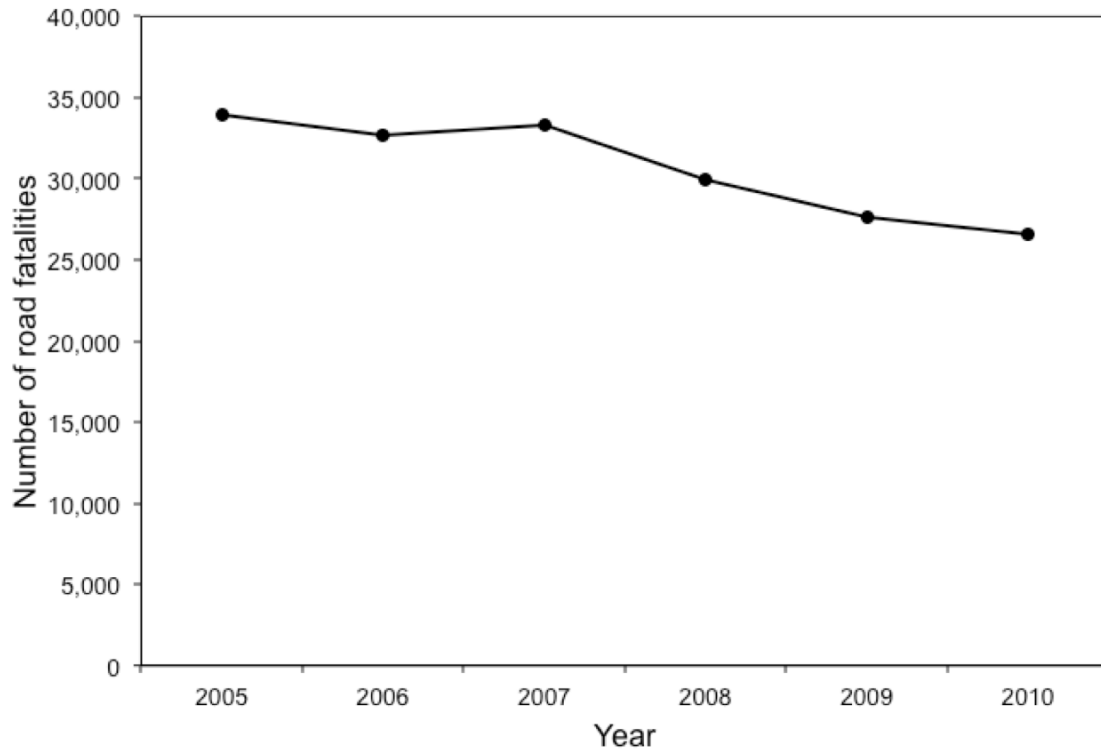


Figure 3. Number of fatalities from 2005 through 2010 (Government Road-Safety Monitoring Unit, the Russian Ministry of Internal Affairs, 2011).

The largest categories of fatalities among road users in 2007 were pedestrians (36%), followed by drivers (34%), passengers (28%), and riders of motorized two- and three-wheelers (2%) (The Road Safety Department of the Ministry of Internal Affairs, cited by WHO, 2009).

Safety performance in the Russian Federation has recently improved substantially (OECD/ITF, 2011). While from 2005 through 2010 the number of vehicles increased by 33.7%, the number of road fatalities decreased by 18.5%, (Government Road-Safety Monitoring Unit, the Russian Ministry of Internal Affairs, 2011; National Bureau of Statistics of China, 2011). The main improvement involved a reduction in pedestrian fatalities (OECD/ITF, 2011). Nevertheless, when compared with the best-performing countries in road safety, the road-fatality rate per population is still approximately five times higher (World Health Organization Regional Office for Europe, 2011).

Key governmental agencies in charge of road safety

In 2004, a governmental decree authorized the Ministry of Internal Affairs to coordinate the activity of all federal executive authorities concerned with road safety. Road safety was identified as one of the priority tasks of the Russian Ministry of Internal Affairs and its territorial bodies (OECD/ITF, 2011). However, no lead department was established.

In 2006, the government began implementation of the Federal Target Road Safety Program for 2006-2012, which included a target to reduce the number of road fatalities by 33% compared with 2004 levels (Marquez and Bliss, 2010; OECD/ITF, 2011). Later in 2006, a legal multisectorial Government Commission for Road Safety was established. Membership of the Commission includes high-ranking officials from the Russian Ministry of the Interior, the Russian Transport Ministry, the Russian Ministry for Emergency Situations, the Ministry of Public Health and Social Development, the Ministry of Education and Science, and other stakeholders. The main tasks of the Commission are as follows (OECD/ITF, 2011):

- Ensure coordinated action between the federal executive authorities in the development and implementation of state policy in the field of road safety.

- Identify the main priorities for regulatory improvements in the field of road safety.
- Coordinate actions of the federal executive authorities in developing safety projects and implement federal programs on road safety.
- Improve the coordination between the federal and local/regional levels of the federal executive authorities, and increase the efficiency of interaction with all other stakeholders in the field of road safety.

The Commission reports to Parliament on progress in road safety. To facilitate delivery of the Road Safety Program and targets, a Federal Target Program Coordination Council has also been established, supported by multisectorial, intergovernmental safety commissions in all regional entities of the Russian Federation.

In support of the goals set by the Russian Federation's road-safety program, a more comprehensive framework of legislation has been established with a strengthened penalty system (Marquez and Bliss, 2010; OECD/ITF, 2011). For example, new legal alcohol-content limits for blood (0.3 g/l) and breath (0.15 g/l) were introduced in 2007. The penalty for failure to submit to BAC testing was increased (withdrawal of driver license for 18 to 24 months). Other new penalties address causing death as a result of excess alcohol, substantially exceeding the speed limit, driving without a seat belt, and driving on the wrong side of a divided highway, for example.

There have been improvements in the safety of the vehicle fleet (decrease in age, seat-belt reminders, daytime running lights, and heavy-goods vehicle-safety provisions) with measures for further improvement planned (OECD/ITF, 2011). Enforcement targeting unsafe behaviors has also been increased recently, including enforcement of seat-belt use (a five-fold increase in penalties), excess alcohol, and automated speed enforcement. In addition, many speed-management applications have been introduced, including low-speed zones, pedestrian zones, and speed humps. New draft legislative proposals have recently been submitted to reduce general speed limits in cities from 60 km/h to 50 km/h, and to introduce lower limits in commercial areas (30 km/h) and in residential areas (20 km/h). New speed limits are strengthened with traffic calming measures, intelligent transport systems, and stronger requirements for drivers to give way to pedestrians.

These developments represent a substantial improvement in road-safety work (OECD/ITF, 2011). It is likely that many of these measures have contributed to improved safety performance. However, no scientific safety evaluation of specific interventions has been conducted. Consequently, there has been no analysis of how factors such as reductions in exposure to risk because of economic recession and lower speeds resulting from substantial congestion in large cities have contributed to the reduction in fatalities.

Most influential organizations (outside of the government)

There are no non-governmental organizations in Russia that have road safety as their sole focus (ECMT, 2006). However, organizations, such as the Russian Automobilist Society, Inter-regional Association of Driving Schools, and Russian Association of Professional Transport Education have activities related to road safety.

Key research institutes

There are several governmental and non-governmental research organizations in the Russian Federation that contribute to road-safety work (ECMT, 2006):

- The Scientific and Research Institute of Road Transport (NIIAT) is involved in the development of certification and licensing of the road-transport system, technical requirements including environmental and vehicle inspection standards; and road-safety issues, particularly in the field of road passenger and freight-transport safety.
- RosdorNII is involved in the preparation of standards, and in basic and applied research work related primarily to the federal road network.
- The State Road Research and Design Institute (Soyuzdornii) also works in the area of standards design, as well as in development and testing of safety devices such as road barriers.
- The State Technical University (MADI) is the center for education, infrastructure, and transport telematics in roads and transport. It contributed to the preparation of the first national plan for road safety, carried out work to

estimate crash costs, the preparation of regional road-safety programs, and the development of motor-vehicle insurance policies.

- The Scientific Research Centre on Road Safety Problems of the Ministry of Internal Affairs (NIC BDD) plays a leading role as a scientific and research institute within the Ministry of Internal Affairs. It coordinates and performs studies on factors contributing to road crashes, the development of preventive measures, providing legislative and regulatory, as well as analytical and informative background for activities of the State Inspection of Traffic Safety.

Major barriers to improvement

At the institutional level, there has recently been substantial progress as several road-safety functions have improved. These measures include institutional developments and the establishment of a road-safety program including a national target to reduce fatalities (OECD/ITF, 2011). Also, there are several research institutes that can support effective road-safety management. However, OECD/ITF (2011) points out that the Russian Federation needs to further improve the functioning of road-safety management at both the federal and local government level. In addition, no lead governmental department with clearly defined road-safety management functions has been established. Finally, adopting a systems approach for long-term improvement would likely enhance the ongoing progress.

At the intervention level, a number of road-safety measures have recently been implemented (OECD/ITF, 2011). The measures include development of legislation and improvement in vehicle safety, and increased enforcement. Although no scientific evaluation of the factors that led to this encouraging progress is available, it is reasonable to assume that many implemented road-safety measures (with known positive effects elsewhere in the world) had positive effects in the Russian Federation.

At the results level, road safety in the Russian Federation has substantially improved in recent years in terms of fatalities (OECD/ITF, 2011). However, the monitoring of many other safety outcomes is lacking.

India

Recent crash statistics

Table 3 lists the key statistics for India. Figure 4 shows the number of road fatalities for 2004 through 2009. Reliable fatality data by road-user category are not available for India.

Table 3
Key statistics for India (WHO, 2009).

Population	1,169,015,509
Gross national income per capita, US\$	950
Number of registered vehicles (2007)	72,718,000
Reported road traffic fatalities (2006)	105,725
Road fatalities per 100,000 of population	9.0
Road fatalities per 100,000 of registered vehicles	145.4

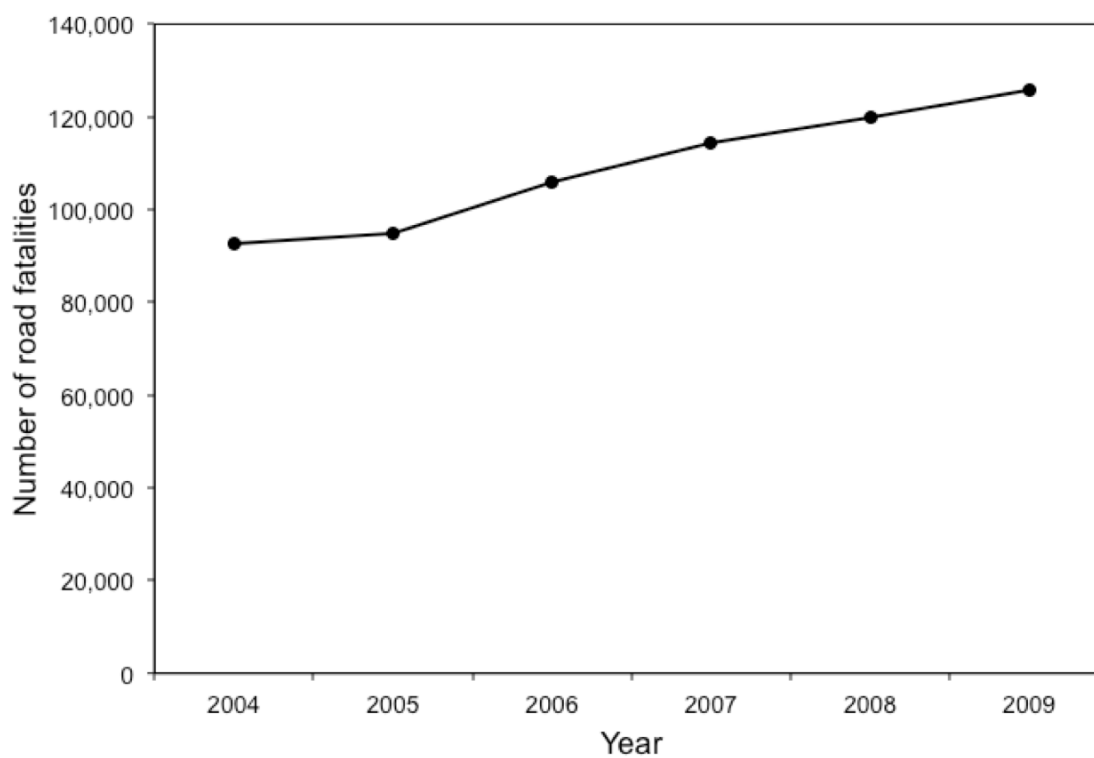


Figure 4. Number of fatalities from 2004 through 2009 (Government of India, Ministry of Road Transport and Highways, 2011).

Mohan, Tsimhoni, Sivak, and Flannagan (2009) reported that road fatalities in India increased by approximately 5% per year from 1980 to 2000, and by approximately 8% per year from 2001 to 2004. From 2004 to 2009, the average increase has been approximately 6% annually.

Key governmental agencies in charge of road safety

Safety regulations covering the management of traffic are issued by the Ministry of Road Transport and Highways, Government of India and are codified in the Motor Vehicle Act of India. The Act is currently being amended with numerous new regulations that deal with several factors that are known to increase risk of crashes, such as exceeding speed limits, failing to use seat belts, improper seating of a child in vehicle, use of a mobile phone while driving, and failing to wear a helmet while driving or riding a motorcycle (Report of the Expert Committee, 2011). Motor-vehicle-safety standards are set by the CMVR Technical Standard Committee established by the Ministry. These standards are based on corresponding ECE regulations, EEC directives, or other relevant international references. Car and motorcycle standards are in conformity with most of the ECE regulations (except crash-impact regulations). However, most new models manufactured in India already conform to these standards as well.

The Indian Roads Congress is the main technical body of highway engineers in the country. Highway-safety standards are set by committees of the Congress. They provide a national forum for subjects dealing with the construction and maintenance of roads and bridges, including technology, equipment, research, planning, finance, taxation, organisation, and related policy issues.

The National Crime Records Bureau collates records of all traffic crashes as recorded by police departments throughout the country, and publishes annual reports.

The local police departments are responsible for implementing traffic-safety regulations as specified in the Motor Vehicle Act of India. However, the Central Government has no enforcement authority unless a state specifies the details of the particular traffic regulation. For example, it has been mandatory since 1988 for all riders of motorized two-wheelers to wear a helmet; installation of seat belts in cars became

mandatory in 1994, and all front-seat occupants must now use seat belts. However, many states are not yet enforcing these laws. On the other hand, vehicle-safety standards are enforced by the Central Government, and therefore vehicles sold throughout the country conform to the same standards.

Ministry of Health Government of India is involved in improving trauma care facilities in hospitals, especially in major cities and in cities along major highways.

India is one of the countries included in the WHO “*Road Safety in 10 Countries*” project that will be conducted over five years by a consortium of six international partners. The project is being implemented in two states, Punjab and Andhra Pradesh. The focus is on reducing drunk driving through capacity building among law enforcement officials and social-marketing campaigns. The project is being coordinated through a multisectorial working group, chaired by the state Department of Health and Family Welfare.

The current state of Indian road-safety management includes no single road-safety agency, and there are no specific targets for the reduction of fatalities or other safety indicators. However, the Committee on Road Safety and Traffic Management (2007) has proposed to enact the National Road Safety and Traffic Management Board. Based on international review and WHO recommendations, the committee recognizes the need to prepare and implement a national road-safety strategy, to establish government leadership in road safety, to facilitate multisectorial collaboration, and to explore the possibilities to increase funding for road safety. The Committee recommended that a national road-safety agency be established in India through a specific enabling legislation on road safety. Such an agency would be responsible for (1) road-related measures, (2) vehicle-related measures, (3) road-safety research, (4) traffic laws, operations, and management, (5) capacity building, (6) road-user behavior strategies, public awareness, and education, and (7) medical care and rehabilitation (guidelines for establishing and upgrading trauma care systems).

Most influential organizations (outside of the government)

There are several non-governmental organizations in India that are involved in road-safety activities, involving the following:

Institute for Road Traffic Education is a nonprofit organization that aims to make Indian roads safer by development of infrastructure in the fields of traffic engineering, traffic enforcement, collision investigation and analysis, driver training and testing systems, public participation, and road-safety education.

IRF India is the Indian Chapter of the International Road Federation (IRF). It is managed by ICT, a New Delhi-based construction company. IRF India organizes annual conferences, and its officials participate in several policy-making committees.

Society of Indian Automobile Manufacturers (SIAM) has incorporated an independent body called Society for Automotive Fitness & Environment (SAFE) to advance vehicle inspection and certification. SAFE aims to generate awareness among the various stakeholders regarding inspection and certification of in-use vehicles that would lead to safer traffic and a cleaner environment.

Key research institutes

The Transportation Research and Injury Prevention Program (TRIPP) at the Indian Institute of Technology Delhi (IIT) is an interdisciplinary program focusing on the reduction of adverse health effects of road transportation. 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 intercity transportation systems, and in 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 performed in collaboration with associated departments and centers at IIT Delhi, government departments, industry, and international agencies. Areas of research include epidemiology, traffic-safety modeling, safer road design, crash modeling, biomechanics, and prehospital care. TRIPP is a Volvo Center for Excellence for Future Urban Transport, a Government of India Ministry of Urban Development

Center of Excellence, and a WHO Collaborating Center for Research and Training in Safety.

The Central Road Research Institute (CRRI), a national laboratory, is a part of the Council of Scientific and Industrial Research (CSIR). Studies in the Safety Division focus mostly on road-safety audits and road-user behavior.

The mission of the WHO collaborating center at National Institute of Mental Health and Neuro Sciences (NIMHANS) is to develop, support, facilitate, and employ a public-health approach for injury prevention and safety promotion. The center involves multidisciplinary academic and community collaborations.

The Indian Institute of Science (IISc) has two centers with research on traffic safety: (1) the Centre for Product Design and Manufacturing (CPDM), with the Transportation System Design and Product Safety Lab focusing on crashworthiness of transportation systems and occupant safety, and (2) a recently established Centre for Infrastructure, Sustainable Transportation and Urban Planning (CiSTUP), which includes traffic safety as one of its objectives.

The Automotive Research Association of India (ARAI) provides technical expertise in R&D, testing, certification, homologation, and framing of vehicle regulations. ARAI is a cooperative industrial research association established by the automotive industry and the Ministry of Industries.

The mission of Vehicle Research & Development Establishment (VRDE) is to carry out roadworthiness, fuel-efficiency, and pollution tests on vehicles, and type testing of automotive engines on behalf of governmental, semigovernmental, and other agencies, and to issue certificates of compliance. The testing and evaluation of vehicles and their systems is performed for design validation, performance evaluation, and homologation.

The Government of India, a number of state governments, and the Indian automotive industry are in the process of creating a state-of-the-art testing, validation, and R&D infrastructure in the country. The National Automotive Testing and R&D Infrastructure Project (NATRiP) aims at creating core global competencies in the automotive sector in India and facilitating seamless integration of the Indian automotive industry with the world. As part of NATRIP, several test centers have been authorized, including testing of powertrains, passive safety, vehicle dynamics, inspection, and

maintenance. All the centers are at various stages of completion and are expected to be fully commissioned in the next three to four years.

Engineering and medical units at universities occasionally produce theses (mostly at the master's level). However, generally there is no continuity in these efforts.

Major barriers to improvement

Indian road-safety management is rather advanced in terms of motor-vehicle standards, and there are positive developments in planning new road-traffic regulations. However, there has been a delay in establishing the National Road Safety and Traffic Management Board. Such an organization, if given sufficient power to design and implement road-safety strategy and action plans with appropriate tools for coordination and monitoring road safety, could substantially strengthen road-safety activities. Research centers dedicated to road safety at universities could support monitoring, research, and development of road safety.

At the intervention level, there are many areas that could benefit from effective road-safety measures. Specifically, Mohan et al. (2009) recently identified the following six promising areas for intervention in India: (1) pedestrians, bicyclists, and other nonmotorists in urban areas that account for about 60% of all fatalities in urban areas, (2) pedestrians, other nonmotorists, and slow vehicles on national highways that represent approximately 20-40% of fatalities on highways, (3) motorcycles and small cars in urban areas (motorcyclists represent approximately 25% of urban fatalities), (4) overinvolvement of trucks and buses in fatal crashes, (5) nighttime driving (visibility, alcohol, and fatigue), and (6) wrong-way drivers on divided highways (involving 19% of all fatalities on four-lane, divided highways). In addition, strengthened enforcement of existing road-safety measures (e.g., speed control, drinking and driving law, use of seat belts, motorcycle helmets) would be beneficial.

At the results level, there are no specific road-safety targets. In addition, collection of safety-indicator data is limited.

China

Recent crash statistics

Table 4 lists the key statistics for China. Figure 5 shows the number of road fatalities for 2005 through 2010.

Table 4
Key statistics for China (WHO, 2009).

Population	1,336,317,116
Gross national income per capita, US\$	2,360
Number of registered vehicles (2007)	145,228,994
Reported road traffic fatalities (2006)	89,455
Road fatalities per 100,000 of population	6.7
Road fatalities per 100,000 of registered vehicles	61.6

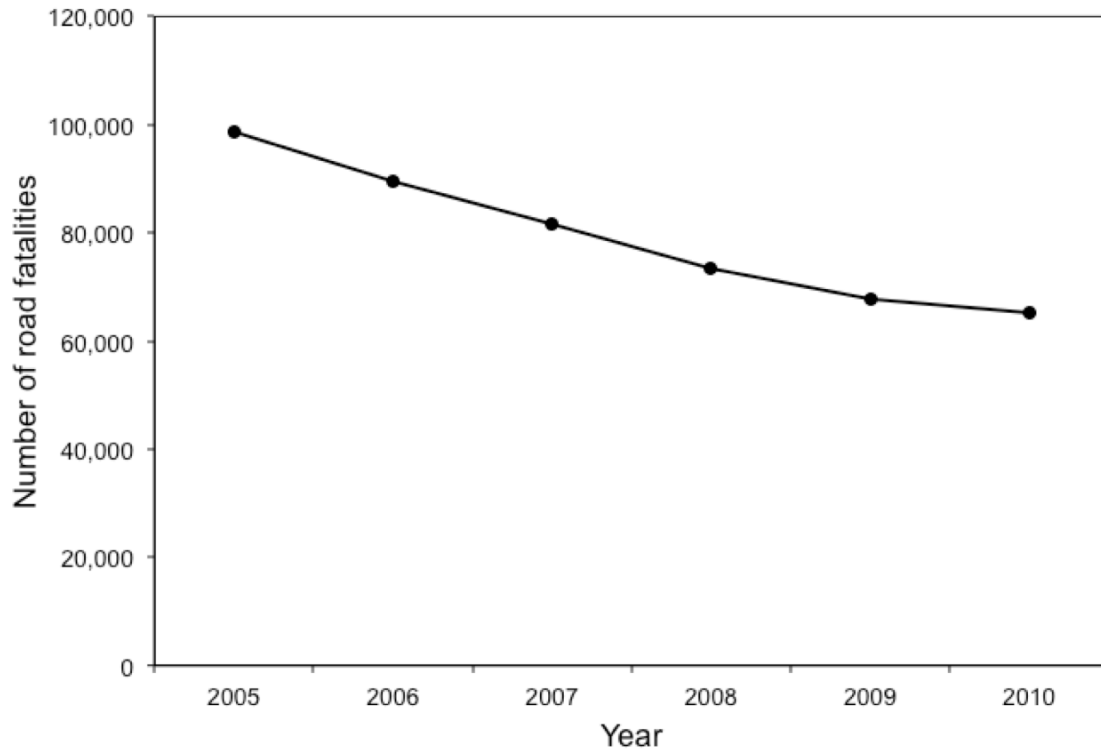


Figure 5. Number of fatalities from 2005 through 2010 (Traffic Administration Bureau, Ministry of Public Security of PRC, annual).

The largest categories of fatalities among road users in 2010 were motorcyclists (27%), followed by pedestrians (25%), passengers (17%), bicyclists (14%), car and truck drivers (10%), and drivers of minivans, SUVs, and buses (7%) (Traffic Administration Bureau, Ministry of Public Security of PRC, annual). From 2005 to 2010, the number of fatalities in each road-user category decreased, with the largest reductions for passengers (-47%) and drivers of minivans, SUVs, and buses (-45%).

In recent years, the number of motorized vehicles has substantially increased. For example, from 2005 to 2010, the number of cars increased by 190%, and the number of minivans, SUVs, and buses by 184% (Traffic Administration Bureau, Ministry of Public Security of PRC, annual).

Key governmental agencies in charge of road safety

The key government agency in charge of road safety in China is Traffic Administrative Bureau, Ministry of Public Security. Under the central government, each province and county has a corresponding branch department. These departments are responsible for traffic enforcement and driver licensing.

The Ministry of Transportation is responsible for road building and driver training. Each level of local government has a transportation administration committee to make long-term policies to plan transportation systems. However, the committees usually do not get involved in the management of specific aspects of road safety.

The State Administration of Work Safety (SAWS) and its local branches are responsible for monitoring transportation safety, with particular emphasis on major crashes involving several fatalities.

There is an ongoing national program called National Road Transportation Safety Science & Technology Action Program or National Road Safety Action Plan (Wang, 2011). The program was launched in 2008 and it is sponsored by the Ministry of Science and Technology, Ministry of Public Security, and Ministry of Transport. The goal is to develop key supporting technologies and promote typical applications for road-transportation safety, and to generate a series of scientific and technical outcomes that are practical and widely applicable. Emphasis is on technology as an aid in preventing crashes, minimizing the consequences of crashes, and providing emergency assistance in

serious crashes. The program focuses on arterial highways, expressways, and rural low-volume roads (Wang, 2011); urban roads and streets are not included.

The goals of this plan are to achieve continuous decreases in fatalities, to reduce serious crashes and to attain fatality rates per vehicle that would be comparable to moderately developed countries. Specific targets of Phase I (2009-2011) include fatality-rate reduction for demonstration road sections, improvement of emergency rescue efficiency, and a high inspection rate of commercial vehicles (Wang, 2011). Specific topics of interest include transportation-user intervention, vehicle safety, road-infrastructure safety, and supporting resources for road-transportation management and safety.

The involved major institutions are ministry-affiliated research institutions, such as the Research Institute of Highway Ministry of Transport and Traffic Management Research Institute of the Ministry of Public Security. In addition, some universities are involved in these activities.

Most influential organizations (outside of the government)

There are no influential organizations outside of the government.

Key research institutes

Traffic Management Research Institute (under the Ministry of Public Security) focuses on the following areas: research in traffic-safety theory, methods of preventing traffic crashes, techniques of managing traffic information, techniques of controlling traffic, rules for managing traffic, licensing techniques for traffic management, quality inspection of traffic-safety products, training of traffic-management officers, development of intelligent-transportation technical products, collection of national road-crash data, publishing of monthly review and annual statistics, developing vehicle standards, and enforcement.

Research Institute of Highway Ministry of Transport (under the Ministry of Transport) studies road-system planning and design, technologies for transportation management, intelligent transportation, road and bridge construction techniques, standards, and logistics.

Major barriers to improvement

At the institutional level, there is a lack of a specific government organization with sufficient authority and resources to promote road safety. The actual responsible organization at each level of administration is the general government. Development and Research Center of State Council (2007) indicated that institutional functions are divided, and different functions are located in different departments, lacking a unified and authoritative general management organization. Furthermore, certain functions are under the administration of different departments, which leads to overlapping responsibilities of departments and adds to difficulty in coordination. In addition, it seems that no systems approach has been adopted.

At the intervention level, there are several safety measures dealing with alcohol that have recently been introduced, including specific limits defining drunk driving, and increased enforcement. However, there is still room for additional safety measures. For example, Zhang, Tsimhoni, Sivak, and Flannagan (2008) identified the following four promising areas for intervention in China: (1) pedestrians and other nonmotorists (accounting for 40% of all fatalities), (2) nighttime driving, which is substantially riskier than daytime driving (in part because Chinese drivers tend to delay turning on their headlamps), (3) vehicle passengers (accounting for over twice as many fatalities as do drivers), and (4) motorcyclists (representing 22% of all road fatalities).

Furthermore, Development and Research Center of State Council (2007) also listed several safety problems that call for effective safety measures: (1) many traffic rules are frequently not adhered to by drivers of motor vehicles and nonmotor vehicles as well as pedestrians; (2) safety level of vehicles is poor as motorcycles and tractors comprise a large proportion of vehicles, and motor-vehicle safety standards and management are relatively weak; (3) many roads are not properly designed, and no safety audits are carried out; and (4) road-traffic-safety laws, promotion, and education need improvement.

At the results level, there is no complete and reliable road-traffic-safety database and no overall safety targets in China.

Summary

Table 5 summarizes the main findings presented above by country.

Table 5
Summary of findings.

Item	Brazil	Russia	India	China
Safety level (fatalities per 10 ⁵ population)	18.3	23.4	9.0	6.7
Recent change in road safety (increase or decrease in road fatalities)	Increase	Decrease	Increase	Decrease
Governmental organization	No effective unit to promote road safety	Effective to some degree, but no single responsible unit	No effective unit to promote road safety; promising plans	No effective unit to promote road safety
Strategic safety plan	No	Yes	No	Limited
Systems approach to road safety	Not applied	Not applied	Not applied	Not applied
Road-safety organizations outside of the government	Several; influence unknown	Some; influence unknown	Several; influence unknown	No
Road safety research	At many universities, but no dedicated road-safety research institutes	At many research institutes and universities	At many research institutes, but no dedicated road-safety research institutes	At a limited number of research institutes
Interventions	Limited; many opportunities not yet utilized	Several new measures implemented recently	Limited; many opportunities not yet utilized	Limited; many opportunities not yet utilized
Road safety targets and safety-performance indicators	No road safety target; insufficient set of indicators	Road safety target exists; insufficient set of indicators	No road safety target; insufficient set of indicators	Limited road safety target; insufficient set of indicators

There are substantial differences among the BRIC countries in terms of fatalities per population. Specifically, the rates for Brazil and the Russian Federation are two-to-three times higher than those for India and China, reflecting, in part, the different degrees of motorization. On the other hand, the recent road-safety progress in terms of fatalities (which is comparable to the progress in fatalities per population) in the Russian Federation and China has been promising, but not so in Brazil and India. However, the cited fatality rates are based on official statistics, and it is a well-known fact that underreporting is a frequent problem, particularly in low- and middle-income countries (e.g., Jacobs, Aeron-Thomas, and Astrop, 2000).

Each BRIC country has governmental organizations with responsibilities for road safety. However, the degree of effectiveness of each organization is unclear, and none of these countries has a single lead in the government that is responsible for national road safety, as recommended by the World Bank (Bliss and Breen, 2009). India has explicit plans to implement such a unit, but no specific implementation schedule is yet available.

The Russian Federation has a strategic road-safety plan, including a specific and relatively ambiguous target to reduce the number of road fatalities. There is a strategic safety plan also in China, but it is limited to certain types of roads. In Brazil and India, there is not yet any road-safety plan.

The experience from the best-performing countries shows that the successful road-safety plans are based on a comprehensive systems approach (OECD/ITF, 2008). None of the BRIC countries seems to apply this approach. This suggests that the interventions introduced in these countries might prove to be less effective than expected.

Although the main responsibility for road safety belongs to the government, road-safety work in several countries is supported by organizations outside of the government. In Brazil, India, and (to a lesser degree) the Russian Federation, there are several non-governmental organizations involved in road-safety work. However, the obtained information did not reveal how influential the non-governmental organizations are in these three countries. China does not have any non-governmental organizations that are involved in road-safety work.

Road-safety research is conducted in each of the four countries. However, it appears that there are no dedicated road-safety research institutes, or the number of such institutes is limited.

All four countries have recently introduced several new road-safety interventions. These interventions deal with some of the behaviors that are known to reduce road crashes and/or fatalities and injuries (e.g., failure to use seat belts, speeding, and drunk driving), as well as vehicles and infrastructure that support safe behavior. The general problem of the introduced interventions appears to be that they are not based on a systems approach involving many broad-based measures that support each other, or they are not applied uniformly throughout the country. For example, seat-belt laws or speed limits cannot be effective if the violations are not sufficiently enforced and penalized.

The Russian Federation is the only BRIC country with a road-safety target specified in terms of a total reduction in fatalities. This type of target is analogous to the target in terms of the reduction of fatalities per population that is used in several best-performing countries. Both types of targets provide a valid basis for road-safety work. The road-safety target in China aims to reduce fatality rates per vehicle in order to be comparable to moderately developed countries. This target is less ambiguous, because the fatality rate per vehicle typically decreases with increased motorization, even if no new effective safety measures are introduced (Evans, 2004). Both the Russian and Chinese targets are limited to the number of fatalities, and the number of (seriously) injured people is not included (although the Chinese road-safety plan includes a decrease of crashes involving serious injuries in general). Furthermore, no other safety-performance indicators are systematically monitored or targeted, such as the level of speed-limit compliance, use of seat belts, extent of drunk driving, or safety ratings of vehicles and infrastructure. There are no road-safety targets in Brazil and India.

References

- Bliss, A. and Breen, J.M. (2009). *Implementing the recommendations of the world report on road traffic injury prevention. Country guidelines for the conduct of road safety management capacity review and the specification of lead agency reforms, investment strategies and safe system projects.* Washington, D.C.: The International Bank for Reconstruction and Development / The World Bank. Retrieved on November 8, 2011 from: http://siteresources.worldbank.org/EXTTOPGLOROASAF/Resources/traffic_injury_prevention.pdf
- Breen, J., Howard, E. and Bliss, T. (2008). *An independent review of road safety in Sweden* (Publication 2008:109). Swedish Road Administration. Retrieved on November 8, 2011 from: http://publikationswebbutik.vv.se/shopping/ShowItem_3734.aspx.
- The Committee on Road Safety and Traffic Management. (2007). *Report of the Committee on Road Safety and Traffic Management.* Retrieved on November 18, 2011 from: http://morth.nic.in/writereaddata/sublinkimages/Road_Safety_sundar_report4006852610.pdf
- Development and Research Center of State Council. (2007). *Research on road traffic safety in China.* Beijing, China: Development and Research Center of State Council, Industrial Economic Research Department.
- ECMT (European Conference of Ministers of Transport). (2006). *Road Safety Performance. National Peer Review: Russian Federation.* Paris: OECD.
- EconomyWatch. (2010). *The BRIC countries: Brazil, Russia, India, China.* Retrieved on November 8, 2011 from: <http://www.economywatch.com/international-organizations/bric.html>.
- Evans, L. (2004). *Traffic safety.* Bloomfield Hills, MI: Science Serving Society.
- Government Road-Safety Monitoring Unit, the Russian Ministry of Internal Affairs. (2011). *Information on traffic safety parameters.* Retrieved on November 11, 2011 from: <http://www.gibdd.ru/info/stat/>.

- Government of India, Ministry of Road Transport and Highways. (2011). *Road accidents in India 2009*. Retrieved on November 15, 2011 from:
<http://morth.nic.in/writereaddata/mainlinkFile/File419.pdf>.
- Jacobs, G., Aeron-Thomas, A., and Astrop, A. (2000). *Estimating global road fatalities* (TRL Report 445). Crowthorne: Transport Research Laboratory.
- Marquez, P.V. and Bliss, T. (2010). *The goal is zero: Making roads safe in Russia to reduce injuries and premature deaths*. Retrieved on November 28, 2011 from:
<http://siteresources.worldbank.org/INTECA/Resources/KBonroadsafetyinRussiapmarquezandtonybliss.pdf>.
- Ministry of Health. (2011). *Mortality Information System* (unpublished data). Brazil.
- Mohan, D., Tsimhoni, O., Sivak, M., and Flannagan, M.J. (2009). *Road safety in India: challenges and opportunities* (Report No. UMTRI-2009-1). Ann Arbor: The University of Michigan Transportation Research Institute.
- National Bureau of Statistics of China. (2011). *BRICS joint statistical publication 2011*. Retrieved on November 11, 2011 from:
<http://www.stats.gov.cn/english/statisticaldata/otherdata/brics2011/>.
- OECD/ITF. (2008). *Towards zero: Ambitious road safety targets and the safe system approach*. Retrieved on November 28, 2011 from:
<http://www.internationaltransportforum.org/Pub/pdf/08TowardsZeroE.pdf>.
- OECD/ITF. (2011). *Road safety performance – National peer review: Russian Federation. Update 2010*. The International Transport Forum/OECD. Retrieved on November 8, 2011 from:
<http://www.internationaltransportforum.org/Pub/pdf/11Russia.pdf>.
- Peden, M., Scurfield, R., Sleet, D., Mohan, D., Hyder, A.A., Jarawan, E. and Mathers, C. (eds.) (2004). *World report on road traffic injury prevention*. Geneva: World Health Organization. Retrieved on November 10, 2011 from:
http://www.who.int/violence_injury_prevention/publications/road_traffic/world_report/en/.
- Report of the Expert Committee. (2011). *Review of the Motor Vehicle Act, 1988*. Retrieved on November 18, 2011 from: <http://morth.nic.in/showfile.asp?lid=377>.

- Traffic Administration Bureau, Ministry of Public Security of PRC. (annual). *China road traffic accidents statistics*. Beijing: Author.
- TRB. (2011). *Achieving traffic safety goals in the United States* (Special Report 300). Washington, D.C.: Transportation Research Board of the National Academies.
- United Nations. (2011). *Improving global road safety* (Note by the Secretary-General). Sixty-sixth session, Agenda item 12, Global road safety crisis. Retrieved on November 10, 2011 from:
http://www.who.int/roadsafety/about/resolutions/sept_2011_sg_report_en.pdf.
- Vasconcellos, E.A. and Sivak, M. (2009). *Road safety in Brazil: challenges and opportunities* (Report No. UMTRI-2009-29). Ann Arbor: The University of Michigan Transportation Research Institute.
- Wang, Y. (2011). *National road safety action plan in China*. Paper presented at the Sixth SHRP 2 Safety Research Symposium. Washington, D.C.: Transportation Research Board. Retrieved on November 15, 2011 from:
<http://onlinepubs.trb.org/onlinepubs/shrp2/2011SafetySymposiumWang.pdf>.
- WHO (2009). *Global status report on road safety: time for action*. Geneva: World Health Organization. Retrieved on November 8, 2011 from:
www.who.int/violence_injury_prevention/road_safety_status/2009.
- Wilson, D. and Purushothaman, R. (2003). *Dreaming with BRICs: The path to 2050* (Global Economics, Paper No. 99). Goldman Sachs. Retrieved on November 16, 2011 from: <http://www2.goldmansachs.com/our-thinking/brics/brics-reports-pdfs/brics-dream.pdf>
- World Bank. (2009). *Confronting "Death on Wheels": Making Roads Safe in Europe and Central Asia* (Report No. 51667-ECA). Washington, D.C.: Author. Retrieved on November 10, 2011 from:
<http://siteresources.worldbank.org/INTECA/Resources/DeathonWheelsWeb.pdf>.
- World Health Organization Regional Office for Europe (2011). *European health for all database*. Retrieved on November 28, 2011 from: <http://data.euro.who.int/hfad/>.
- Zhang, W., Tsimhoni, O., Sivak, M., and Flannagan, M.J. (2008). *Road safety in China: challenges and opportunities* (Report No. UMTRI-2008-1). Ann Arbor: The University of Michigan Transportation Research Institute.