



International Lessons for Road Safety  
in the People's Republic of China

---

Yuji Ono, David Silcock, and Gloria Gerilla-Teknomo  
No. 1 | June 2013



ADB East Asia Working Paper Series

## International Lessons for Road Safety in the People's Republic of China

Yuji Ono, David Silcock, and Gloria Gerilla-Teknomo

No. 1 | June 2013

Yuji Ono is a former transport specialist and Gloria Gerilla-Teknomo is a senior transport sector officer in the Transport and Communications Division (EATC), East Asia Department (EARD), Asian Development Bank. David Silcock is a consultant for a technical assistance project on Improving Road Safety through the Application of ITS.

Asian Development Bank

Asian Development Bank  
6 ADB Avenue, Mandaluyong City  
1550 Metro Manila, Philippines  
www.adb.org

© 2013 by Asian Development Bank  
June 2013  
Publication Stock No. WPS135538

The views expressed in this paper are those of the author/s and do not necessarily reflect the views and policies of the Asian Development Bank (ADB) or its Board of Governors or the governments they represent.

ADB does not guarantee the accuracy of the data included in this publication and accepts no responsibility for any consequence of their use.

By making any designation of or reference to a particular territory or geographic area, or by using the term "country" in this document, ADB does not intend to make any judgments as to the legal or other status of any territory or area.

Unless otherwise noted, \$ refers to US dollars.

This EARD working paper series is a medium for stimulating discussion and eliciting feedback on research and studies undertaken by Asian Development Bank (ADB) staff, consultants, or resource persons. It deals with issues, and development problems in East Asia, particularly those facing the People's Republic of China and Mongolia. It aims to enhance knowledge on East Asia's development and policy challenges, and strengthen dialogue between ADB and its member countries.

## Contents

Contents.....	i
Figures.....	i
Abstract.....	ii
I. Introduction.....	1
A. Global Scale and Costs of Road Trauma.....	1
B. Contrast between High and Low Income Countries.....	1
C. Objectives.....	2
II. Road Safety in the PRC.....	2
A. Trends and Characteristics.....	2
B. Key Issues and Challenges.....	5
III. International Lessons.....	8
A. Global Commitment.....	8
B. Political Leadership.....	9
C. Road Crash Data Collection and Reporting.....	9
D. Evolution of Road Safety Management.....	10
E. Responsibilities and Target setting.....	11
F. Application of New Technology to Support the Safe System Approach.....	12
IV. Considerations for Road Safety Improvements in the People's Republic of China ..	14
A. Institutions.....	14
B. Strategic Planning and Targets.....	15
C. Data Collection and Sharing.....	15
D. Passive and Preventive Safety Measures of Vehicles.....	16
E. Education and Enforcement Supported by a Safe Transport System.....	18
F. Infrastructure in a Safe Transport System.....	19
G. Using Intelligent Transportation Systems for Support.....	20
V. Conclusions.....	21
Appendix: ADB's role in Road Safety.....	24
Introduction.....	24
Road Safety Action Plan.....	25
Endnotes.....	26

## Figures

Figure 1 Road traffic collision trend in the PRC (1995–2010).....	4
Figure 2 Road deaths per 100,000 people, 2007.....	4
Figure 3 Road deaths by mode in the PRC, 2008.....	6
Figure 4 Causes of fatal collisions in the PRC, 2010.....	6
Figure 5 Collisions attributed to different types of motor vehicles by use, 2010.....	7
Figure 6 Human, vehicles and road coordination in a closed-loop system through ITS ....	13

## **Abstract**

The World Health Organization estimates that each year around 1.2 million deaths and between 20 and 50 million injuries occur on the world's roads. These road traffic collisions are a serious constraint to development and a burden to many low and middle income countries. Acknowledging the global importance of road safety as a development issue, this staff working paper considers approaches and good practices for road safety which have been adopted in the best performing countries during recent decades, drawing in part on the findings of a technical assistance project on Improving Road Safety through the Application of Intelligent Transport Systems in the People's Republic of China (PRC), it suggests how these can be useful for reducing road traffic deaths and injuries in the PRC.

JEL Classification: R4, R41

Keywords: human-road-vehicle interaction, intelligent transport systems, road crash statistics, road fatalities, road traffic collisions, road safety, road safety management, road traffic injuries, safe system approach, safety-conscious road design

## I. Introduction

### A. Global Scale and Costs of Road Trauma<sup>1</sup>

1. Road traffic collisions and their consequences are major externalities of road transport. Each year, there are around 1.2 million deaths, and between 20 and 50 million injuries on the world's roads. To put these deaths in context, the numbers are similar to deaths from tuberculosis, and more than the number of deaths from malaria. Overall, road traffic deaths rank tenth as a leading cause of death. For people aged between 5 and 44, road traffic collisions are amongst the top three causes of death.

2. Not only is this problem bad, it is getting worse. World Health Organization (WHO) estimates that by 2030, if nothing is done, road traffic deaths will rise from tenth to fifth position among the leading causes of death.

**Road traffic crashes are one of the leading causes of death among people aged between 5 and 44**

**World Health Organization**

3. In addition to the human grief and misery caused by death or injury of a loved one, there are substantial economic costs which result from road

traffic collisions. WHO (2009) estimates the annual global costs due to traffic injuries to be \$518 billion, more than the total amount of international development assistance. For a single country these costs are typically between one and three percent of gross national product (GNP).

### B. Contrast between High and Low Income Countries

4. Over 90 per cent of the world's road fatalities occur in low- and middle-income countries (LMICs), despite their having only 48 per cent of the world's registered vehicles. The problem is particularly acute among developing countries in the Asia Pacific region. About 44% of global road fatalities happen in this region even though it is home to only 16% of the world's motorized vehicles.

5. Road fatality rates per capita in high income countries (HICs) are typically half of those in poorer countries, whilst road fatality rates per registered vehicles are often 10 and in some extreme cases 100 times higher in LMICs than in HICs. In many HICs,



Photo credit: Nana Soetantri

death rates have been declining over the last four to five decades. In contrast, in most LMICs the situation is getting worse.

6. The burden of road trauma falls disproportionately on poor people, particularly in LMICs. Almost half of those who die on the roads are pedestrians, cyclists or users of powered two-wheelers, collectively known as vulnerable road users (VRUs). This proportion is higher in poorer countries. According to WHO, in the HICs of the Americas region, 65% of road deaths are vehicle occupants; while in the LMICs of the Western Pacific region, 70% of road deaths are VRUs.

7. As well as being at increased risk, poor families are less likely to be insured or able to pay the costs associated with death, disability or injury. A poor family is liable to be driven into debt or destitution by the costs associated with the loss or disability of a bread winner.<sup>2</sup>

### **C. Objectives**

8. Road traffic collisions are therefore not only an unfortunate side effect of a transport system, but a serious constraint on development and a large social and economic cost to many LMICs. The People's Republic of China (PRC) is among these countries. The per capita road collision fatality rate in the PRC is around 4 times higher than in the United Kingdom (UK) and Sweden. Such HICs previously had a long history of endemic road crashes but were able to tackle this serious issue over several decades. It is valuable to learn from road safety good practices in successful countries and consider their application to the PRC and other LMICs.

**Road traffic collisions are a serious constraint on development and a large economic and social loss to low- and middle-income countries**

9. This paper focuses on drawing attention to successful approaches and good practices that have been adopted in the best performing countries during recent decades.

## **II. Road Safety in the PRC**

### **A. Trends and Characteristics<sup>3</sup>**

10. Road safety in the PRC should be understood in the context of the country's rapid economic and social development since the 1980s. One aspect of this development has been the rapid expansion of the national highway network, together with massive growth in the vehicle fleet. The length of the highway network has increased fourfold since 1990, and by 2011 about 85,000 kilometers (km) of expressway have been built.

11. Between 1978 and 2009, the vehicle fleet grew at an annual rate of 17.9% and the number of licensed drivers grew at an annual rate of 15.9%. Motorization, in terms of vehicles per capita, grew at an annual rate of 14.5%, closely following the annual per capita GDP growth rate of 16.9%.

12. Not only has there been substantial growth in the vehicle fleet and numbers of drivers, but their structure has changed. In the 1990s, the majority of vehicles were trucks and buses, driven by professional drivers. Today, the majority of drivers are not professionals and most drivers are relatively inexperienced. About 10% of drivers have been licensed for only one year, and just over one third of drivers have less than three years driving experience.



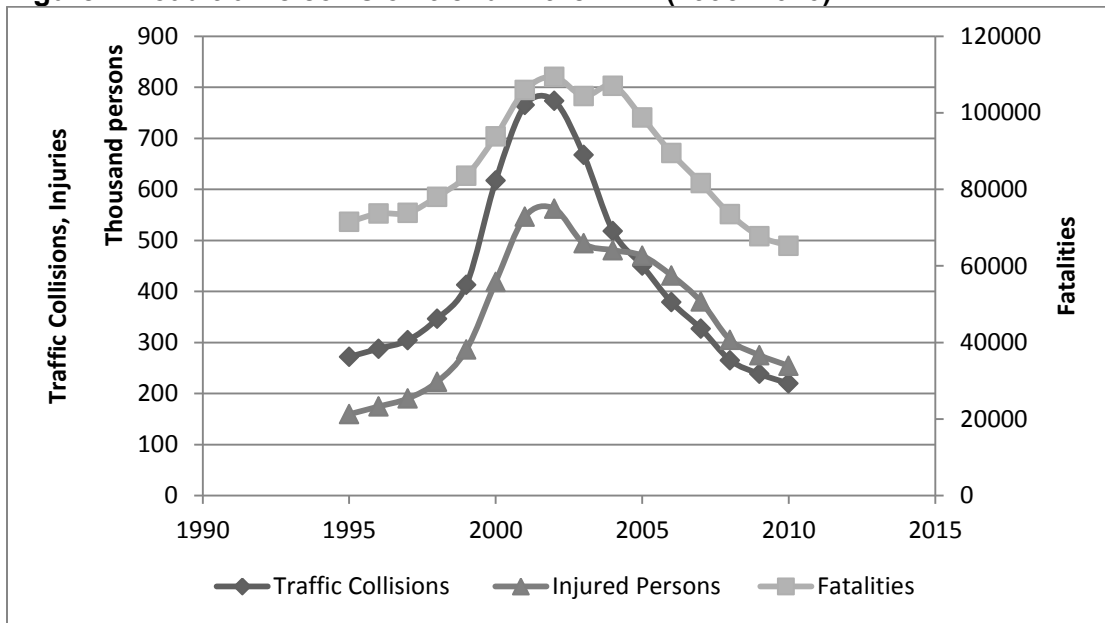
Photo credit: ADB

13. Road deaths in the PRC peaked in 2002 with 109,381 reported deaths. This followed rapid growth in the preceding decade, but since 2002 the annual number of road deaths has reduced – see Figure 1. The government attaches great importance to road safety, and has adopted policies to contain the high frequency of traffic collisions. These policies and actions cover most aspects of the traffic system, including promulgation of laws and related legislation, education, management, road infrastructure, setting of vehicle standards, and technology development. The National Inter-ministerial Joint Conference on Road Safety was established in 2003, to improve coordination of ministries and government agencies. Through concerted efforts, the number of road crashes has been decreasing steadily. In 2011, the PRC had 62,387 deaths and 237,421 injuries on the roads. Despite this welcome reduction, road deaths and injuries are still high relative to population and the number of registered vehicles when compared with the best performing countries.

14. The road traffic collision data for the PRC presented in Figure 1 and used generally in this paper is drawn from the Ministry of Public Security (MPS) traffic police records. In common with most countries, road traffic collisions involving death and injury in the PRC should be reported to the traffic police and summary statistical documents are prepared from the reported collisions. The strength of this process is that it provides consistent time series data, but like all such procedures it is dependent on accurate and complete reporting of crashes.



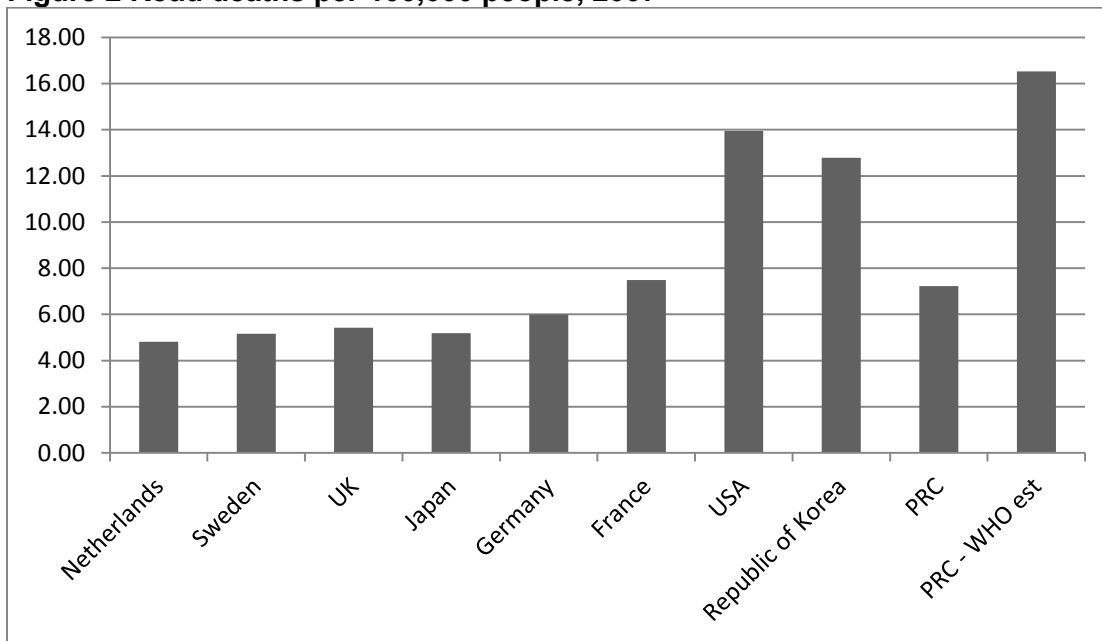
**Figure 1 Road traffic collision trend in the PRC (1995–2010)<sup>4</sup>**



Source: National Bureau of Statistics of China. 1996-2011. *China Statistical Yearbook 1996-2011*. Beijing.

15. Figure 2 presents a comparison of road deaths per 100,000 people for a number of countries.<sup>5</sup> The data for the PRC are (i) based on official statistics adjusted by WHO to be equivalent to a definition of death within 30 days of the crash, and (ii) WHO's estimate of road deaths, modeled by making use of the expected relationships between economic indicators, vehicle fleets, development status and road safety indicators such as helmet laws and speed limits from countries which have reasonably complete crash reporting systems and good hospital records.

**Figure 2 Road deaths per 100,000 people, 2007**



Source: WHO. 2009. *Global Status Report on Road Safety*. Geneva

16. As can be seen, the PRC's official and modeled rates are substantially different. It is generally the case, in almost all countries, that some crashes are not reported to the police. Also, countries vary in the road types covered and the vehicles included in the national reporting system. To some extent, therefore, police records underestimate the complete picture. This is believed to be the case in the PRC<sup>6</sup> and is illustrated by the difference between PRC's reported and estimated death rates in Figure 2.

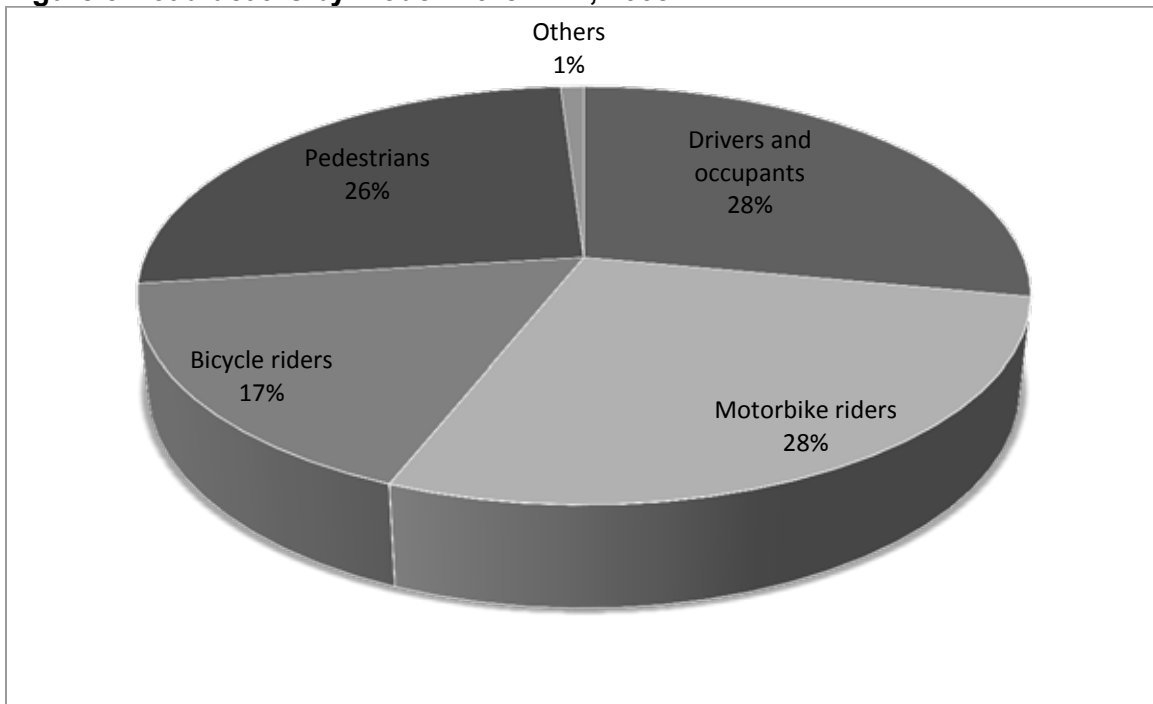
17. From a research perspective there are often other problems with police crash records, particularly when the causes of crashes are being studied. From a police perspective there is usually a focus on infringements of traffic laws and on identifying a person to blame for the crash. Thus, police reports commonly list 'driver error' as the cause of a crash. Other potential factors contributing to the crash or the 'error' are not identified. Even where errors are subdivided into a list of offences, it is principally the judgment of the police officer at the scene which provides this data. He/she has many other tasks to carry out at a crash scene and rarely has time to study the factors leading up to the crash in any detail. These concerns apply to the data presented in the next section.

## **B. Key Issues and Challenges**

**18. The majority of victims of road crashes are vulnerable road users.** Vulnerable road users (VRUs), which include pedestrians, bicycle and motorcycle riders, account for 71% of all fatalities in the PRC (Figure 3). The share is much higher than in the United States (24%) and Sweden (34%), principally due to lower car ownership and the high use of two-wheeled transport. In Japan, VRUs were 66.5% of total fatalities in 2008. Higher percentages of vulnerable road user victims are a common Asian transport characteristic, especially in economies where motorized two wheeled vehicles are widely used, resulting from roads which are often not designed to separate motor vehicle transport from vulnerable users, and facilities for VRUs such as dedicated footpaths, cycle lanes and safe crossing points are limited.

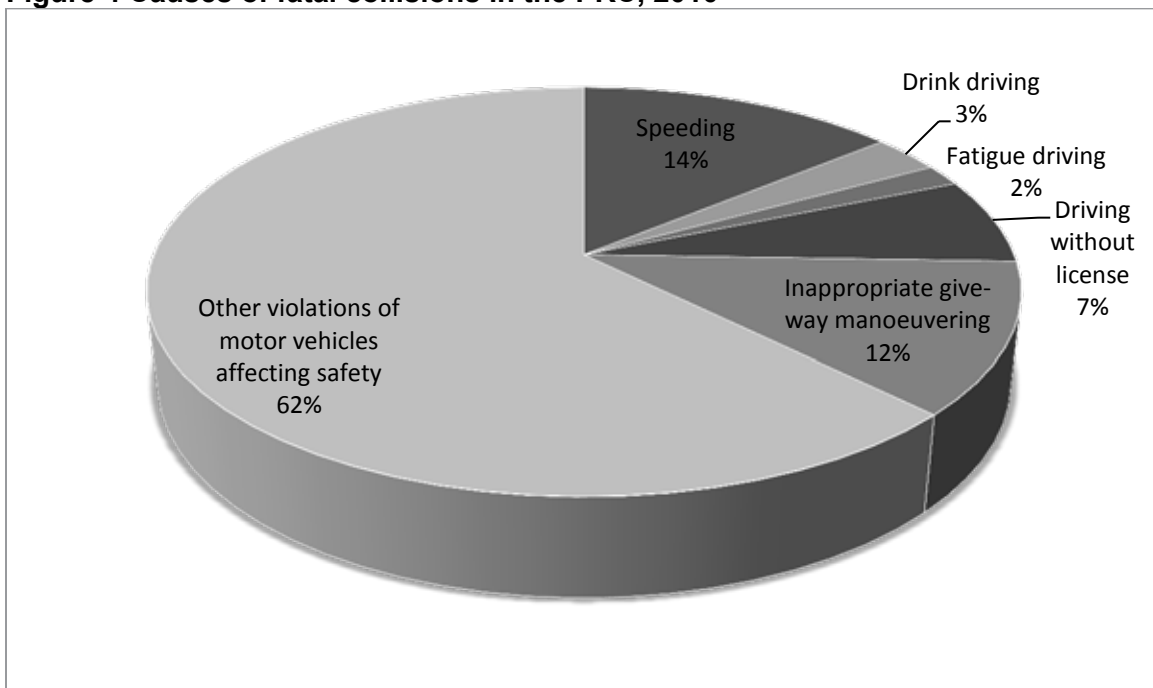
**19. Illegal driving activities are a major cause of collisions.** According to the *Annual Statistics of Road Accidents in [the People's Republic of] China*, released by the MPS, illegal activities of motor vehicle drivers dominate as the cause of collisions. From 1998 to 2008, road traffic collisions caused by the illegal activities of drivers accounted for 87.4% of the total crashes, 81.3% of the total fatalities and 86.7% of the total casualties. In 2010, among illegal activities of drivers, inappropriate give-way maneuvering, speeding, and driving without a license were cited as the largest single reasons for crashes. Figure 4 shows the causes of fatal collisions. However, the general nature of these categories, and the absence of other information about circumstances surrounding the traffic collision, mean that identifying potential countermeasures from the police reports is difficult. Also, the police reports typically list 'driver error' as the cause of a crash to identify a person to blame for the crash, although there are more underlying reasons for such crashes.

**Figure 3 Road deaths by mode in the PRC, 2008**



Source: Ministry of Public Security. 2008. *Annual Statistical Report on Road Traffic Accidents*. Traffic Management Bureau. Beijing.

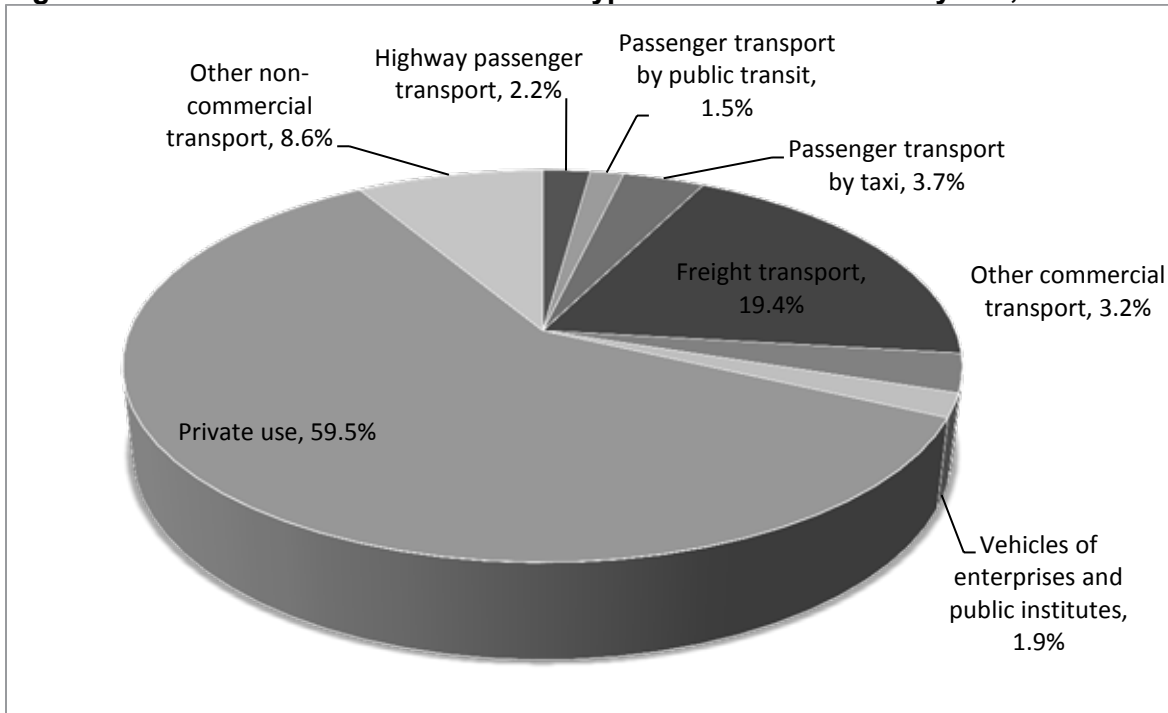
**Figure 4 Causes of fatal collisions in the PRC, 2010**



Source: [People's Republic of] China Ministry of Public Security. 2010. *Annual Statistics of Road Collisions of the People's Republic of China*. Beijing.

**20. High involvement of commercial vehicles.** Collisions involving commercial vehicles accounted for 32% of the total collisions in 2010; fatalities were 41% of the total and injuries were 29.2%. Figure 5 shows that among commercial vehicles, freight vehicles were most often involved (19.4%), much higher than any other single type of vehicle. This can be compared to the UK,<sup>7</sup> for example, where in 2009 16.4% of fatalities involved a commercial vehicle and 13.1% involved a freight vehicle.

**Figure 5 Collisions attributed to different types of motor vehicles by use, 2010**



Source: [People's Republic of] China Ministry of Public Security. 2010. *Annual Statistics of Road Collisions of the People's Republic of China*. Beijing.

**21. Safety of infrastructure is deficient.** The PRC has made great progress in building expressways. By the end of 2011, expressway length was 85,000 kilometers,<sup>8</sup> ranking as the longest expressway network in the world. However, there are many deficiencies in the remainder of the road network, especially in terms of safety features and facilities for vulnerable road users. Whilst the new expressways largely follow international good practice in terms of design standards, and signs and markings, inter-urban and rural roads often lack adequate signs and markings to guide drivers, and facilities for vulnerable road users, such as footpaths, cycle lanes and safe crossings are minimal. With a few exceptions in the major cities, urban traffic management is often poor. There is a lack of signs and road markings. Junction layouts are not well designed and vulnerable road users are often ignored. Sidewalks, if existent, are often restricted by frontage development and commercial activities. Crossing points are neither well defined nor protected. Many wide roads do not have median islands, especially at junctions, to guide traffic and to shelter pedestrians.



Photo credit: Yuji Ono

#### **Lack of facilities for vulnerable road users**

### **III. International Lessons**

#### **A. Global Commitment**

22. There is now a global consensus that road deaths and injuries are a major health and social problem, acting as a constraint on development. WHO has taken the lead in this, and chairs the United Nations Road Safety Collaboration (UNRSC),<sup>9</sup> supported by a series of United Nations General Assembly resolutions. On 2 March 2010, the UN General Assembly adopted resolution 64/255, proclaiming the period 2011-2020 as the Decade of Action for Road Safety, with a goal to stabilize and then reduce the level of road traffic fatalities around the world.

23. Through the Decade of Action, the UN has called on member states to <sup>10</sup>

*.... develop action plans and strategies in road safety, noting that the programs should be seen to be cost-effective measures and profitable investments for Governments and other organizations to undertake, and to identify ambitious, measurable targets for those plans and strategies.....*

24. In preparing these action plans there are lessons to be learned from the countries that have been successful in road safety. These countries have made great efforts to collect accurate and comprehensive data about the epidemiology and potential causes of road crashes. This has provided attention to critical issues where large safety benefits can be achieved. Not all countries have such data available, but most of the underlying factors are similar in many countries. WHO<sup>11</sup> argues that targeting key risk factors can effectively reduce the numbers of crashes and the consequent trauma. To quote WHO

“...speed is at the core of the road injury problem”.<sup>12</sup> A number of other universal problems are listed by WHO as important risk factors, including alcohol, poor infrastructure, lack of use of motorcycle helmets and seat belts in vehicles, and fatigued driving.

25. A look at how the more successful countries have dealt with their road safety problems, and have achieved substantial reductions in road death and injury, offers valuable lessons for the PRC and other LMICs. The decade of action provides a global stimulus for actions on road safety and should encourage international cooperation in this regard.

## **B. Political Leadership**

26. Improving road safety demands the involvement of many parties in all sectors. To achieve this requires political leadership and commitment and the results of such leadership can be seen in a number of countries.

27. Japan in the 1970s offers a good example. Recognizing the serious and growing road safety problem, the Japanese Government introduced the Traffic Safety Policies Law in 1970. This law established the Traffic Safety Measures Conference, chaired by the Prime Minister, which is held every year. Action plans were developed and responsibilities for implementation of the plans shared among related ministries. These actions resulted in a substantial reduction in road deaths, from over 16,000 in 1970 to fewer than 8,000 in 1980 despite increases in car ownership during the same period.

28. France has achieved comparable improvements since 2002 when the President made reducing road deaths a policy priority in his ‘state of the nation’ address. Compared to 2001, fatalities fell 32% by 2004<sup>13</sup> and the downward trend has continued since then.

***“Eventually no one will  
be killed or seriously  
injured within the road  
transport system”***

**Vision Zero**

29. Sweden is often cited as a road safety leader for its ‘Vision Zero’ goal. In 1997, the Swedish Parliament decided on a long-term national goal for road safety: “nobody should be killed or seriously injured within the road transport system (Vision Zero), and the road transport system’s structure and function must be brought into line with the demands this goal entails.”<sup>14</sup> This case was a collective example of political leadership, through the parliament, which brought about policy changes. Vision Zero had reinvigorated road safety intervention and stimulated a high level of co-ordination and common purpose among all stakeholders.<sup>15</sup>

## **C. Road Crash Data Collection and Reporting**

30. Serious road crashes often attract media attention and most people have their own opinions on what could make the roads safer. The use of anecdotal information and its reporting in the media all too often lead to minor issues being given misplaced emphasis in efforts to improve traffic safety. On the contrary, policy decisions on effective road injury prevention need to be based on reliable data and objective information, not on anecdotal evidence.

31. Reliable data on the incidence and types of crashes are needed to provide a detailed understanding of the circumstances that lead to crashes. Knowledge of the type and cause of associated injuries is valuable for identifying interventions and for monitoring their effectiveness. In many LMICs, systematic efforts to collect road traffic data are not well developed and underreporting of deaths and serious injuries is common. It has been suggested that these are problems of this kind in the PRC.<sup>16</sup> Only by systematic and data-led management of the leading road injury problems will significant reductions be achieved in exposure to crash risk and in the severity of crashes.

#### **D. Evolution of Road Safety Management**

32. It is possible to identify four successive stages in the development of road safety management in those countries which have succeeded in reducing their road deaths.<sup>17</sup>

##### ***Stage 1 – focus on the driver***

33. In the 1950s and 1960s road safety management in many HICs was characterized by dispersed, uncoordinated, and poorly funded road safety units acting in isolation. They established legislative rules and penalties and expected subsequent changes in behavior, supported by information and publicity. It was argued that since human error contributed most to crash causation it could be addressed most effectively by educating and training the road user to behave better. Blaming the driver meant that authorities did not take their responsibility for designing and providing a safe road traffic system.

##### ***Stage 2 – focus on system-wide interventions***

34. In the 1970s and 1980s Dr. William Haddon, an American epidemiologist and the first director of the United States National Highway Traffic Safety Administration (NHTSA), developed a systematic framework for formulating road safety activities which encompassed infrastructure, vehicles and users in the pre-crash, in-crash and post-crash stages, now well known as the ‘Haddon matrix’.<sup>18</sup> The focus of policy widened from an emphasis on the driver in the pre-crash phase to include in-crash protection (both for roadsides and vehicles) and post-crash care. This broadened road safety analysis to a system-wide approach to intervention and took into account the complex interaction of factors which influence injury outcomes. However, the focus remained at the level of systematic intervention and did not directly address the institutional management functions or the results that were sought.

##### ***Stage 3 – focus on targeted results and institutional leadership***

35. By the early 1990s, the leading countries in terms of road safety introduced action-focused road safety plans with quantitative targets. Ongoing monitoring established that growing motorization need not inevitably lead to increases in death rates; the trend could be reversed by continuous and planned investment in improving the quality of the traffic system. The UK, for example, halved its death rate (per 100,000 head of population) between 1972 and 1998,<sup>19</sup> despite a doubling in the number of motorized vehicles. Key institutional management functions were also becoming more effective. Institutional leadership roles were identified, inter-governmental coordination processes were

established and funding and resource allocation mechanisms and processes were becoming better aligned with the results required.

#### ***Stage 4 – Safe systems and long term elimination of death and serious injury***

36. By the late 1990s, two of the world's best performing countries rethought their interventions and institutional arrangements.

37. The Dutch Sustainable Safety and Swedish Vision Zero strategies set a goal to make the road system intrinsically safe. The emphasis was on effectively managing the exchange of kinetic energy in a crash to ensure that the thresholds of human tolerance to injury were not exceeded. These strategies recognized that speed management is central and re-focused attention on road and vehicle design and related protective features. The 'blame the driver' culture had now been superseded by 'blaming the traffic system', throwing the spotlight on the shared responsibility and accountability for the delivery of a Safe System. This also provides a context for the role of Intelligent Transport Systems (ITS) that can be used to warn drivers when tolerances are being exceeded and, in limiting cases, take over control of some of the vehicle's systems. Examples already in use are automatic braking systems and electronic stability control. Research and development is well advanced with speed control systems.

38. The evolution summarized above illustrates the changes in road safety thinking that have taken place over the past 50 years, and reflects the paradigms used by road safety professionals in the most successful countries. In drawing lessons from this evolution it is possible for other countries, like the PRC, to accelerate the process of improving road safety compared with the period of more than 50 years taken in Western Europe, Japan and Australasia.

#### **E. Responsibilities and Target setting**

39. The Organization for Economic Co-operation and Development (OECD)<sup>20</sup> has concluded that the existence of targets and targeted road safety programs increases the likelihood that safety policies will be implemented. In countries with targeted road safety programs, institutions change their behavior once such a program is introduced. Targeted road safety programs can result in better integration of existing institutional efforts, generally involve greater co-ordination, and often produce a more focused allocation of resources. Road safety programs with quantified targets have a better probability of becoming successful than those without such targets, and target setting leads to better and more realistic programs.

40. The best performing countries all have well defined strategies and action plans, giving priority to critical problems and the actions needed to overcome them. These are defined at both national and local levels. As part of a systems approach, the best performing countries have also recognized that a systematic approach to road safety management is needed. Lead agencies have been defined with clearly specified responsibilities. There is close coordination of activities between the agencies aimed at achieving agreed goals and targets.

41. This coordination is horizontal, between ministries and agencies, and vertical, between different levels of central and local government. It is a feature of the best



performing countries that a substantial part of the responsibilities and actions for road safety are at the local level. In order to achieve this, skilled professional staffs need to be involved at all levels of government.

42. Road safety action plans, in the best performing countries, cover not only the traditional engineering, enforcement and education measures, but also now include development of new technologies to help meet the targets set by government. This acknowledges that ITS technologies have an important role to play in supporting traditional road safety measures, particularly in traffic law enforcement.

## **F. Application of New Technology to Support the Safe System Approach**

43. Among the three interacting components of the road transport system which influence the frequency and severity of road crashes—people, vehicles, and the road environment—people are the most important aspect, especially drivers who are the information processors and the decision makers in the system. They perform vehicle movements to complete the driving task by constantly collecting and processing information, and then make judgments and decisions in accordance with their perception of the situations they face, based on their attitudes, knowledge and experience.

44. However, differences or limitations in drivers' psychological and physiological abilities cause many mistakes or uncertainties in driving behavior, which lead to potential dangers, mainly because:

- Human behavior is not always rational. Some behaviors occur that can cause danger and lead to violating traffic regulations in some cases (such as perceived time pressure leading to speeding or dangerous overtaking, even though the driver knows he is taking a risk).
- People make mistakes. This is part of being human. As well as driver errors, mistakes may be made by road or vehicle designers, who may give wrong or misleading information to road users.
- Human abilities are not constant. For example, a long period of driving will produce fatigue and distraction due to continuous and tedious operation; or the increased reaction time after people drink alcohol can cause road crashes. Also, people themselves have certain physiological and psychological limitations which are not the same for all individuals. The speed of human decision-making and motion reaction time is limited, and people cannot be expected always to make proper allowance for unexpected events.

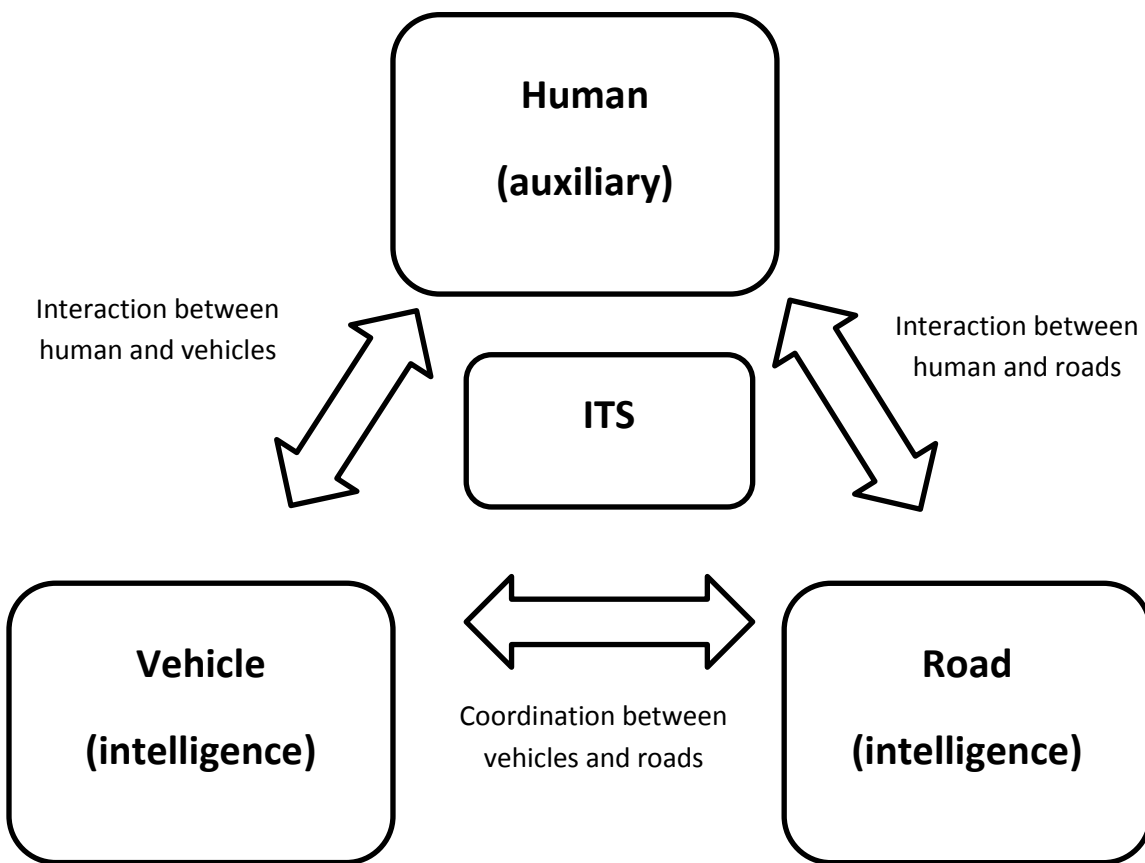
45. In addition, compared with a motor vehicle, the human body is frail. It cannot withstand the transfer of kinetic energy which occurs during a high speed impact. This is particularly important for those outside the vehicle—commonly pedestrians and cyclists—who are not protected as well as those inside the vehicle.

46. New technologies can help people adapt to their environment and overcome these deficiencies. New ITS technologies can aid drivers in their split-second decisions to avoid collisions. The traditional approach of addressing each element of road, vehicle and person as separate components has been overtaken by a systems approach which

treats the three components as an integrated whole. The interactions between the components, particularly how humans process and interpret information in a complex traffic environment, are taken into account in designing and managing the system as a whole. The system design takes account of human failings, both the physical weakness of the human body in terms of withstanding impacts, and the errors made in processing information and making decisions.

47. ITS has unique advantages and potential, such as for detecting potential dangers automatically, giving timely reminders and warnings to drivers, and assisting to control vehicles. ITS technologies integrate the people, vehicles and roads to form a stable closed-loop system by introducing more information collection, rapid data processing, and communication and display devices in the vehicles and on the roads, as shown in Figure 6.

**Figure 6 Human, vehicles and road coordination in a closed-loop system through ITS**



Source : ADB. 2012. *Improving Road Safety through the Application of Intelligent Transport Systems*. Consultant's report. Manila (TA 7308-PRC).

48. These advantages are now recognized in the road safety strategies and action plans of the leading countries. For example the European Commission's European Road Safety Action Program<sup>21</sup> gives a comprehensive list of actions on ITS for all road safety stakeholders, including the European Union, member states, regional level actors and

the private sector. This includes “using technical progress to make vehicles safer”, where the main focus is on ITS, especially crash prevention or active safety technologies, such as: eSafety,<sup>22</sup> electronic stability control system, collision warning system and emergency call system. The United States Department of Transportation has an ITS program which focuses on intelligent vehicles, intelligent infrastructure and the creation of an intelligent transportation system through integration with and between these two components. In Japan, goals on road safety are proposed in the “New IT Reform Strategy by IT Strategic Headquarters (January, 2006)”,<sup>23</sup> which aims to reduce the number of people killed or injured in traffic collisions by implementing systems for assisting safe driving through infrastructure-vehicle cooperation.

#### **IV. Considerations for Road Safety Improvements in the People’s Republic of China**

49. The PRC can accelerate the process of improving road safety by drawing upon international best practice in road safety.

##### **A. Institutions**

50. Under the State Council's division of responsibilities for road safety, the traffic police department of the MPS, is responsible for road safety enforcement, and the Ministry of Transport (MOT) is responsible for supervising road transport companies. As stipulated in the Road Traffic Safety Law, local governments shall meet the development needs of road traffic, formulate a road safety management plan, and organize implementation based on road safety laws, regulations and relevant state policies. The law makes the traffic police department the lead agency for road safety.

51. In 2003, the National Road Safety Inter-Ministerial Joint Meeting was set up to coordinate road safety activities. Joint Meeting members include MPS, MOT and 15 other departments and units. Similar coordination committees have been established in a number of provinces. However these mechanisms still have significant shortcomings. Many agencies operate in a largely independent manner. Road safety is often only a small part of a manager’s responsibilities and the number of professional staff actively engaged in road safety, particularly in local government, is insufficient. As a result, actions are not always well designed, and properly coordinated so their impact is small.



Photo credit: Gloria Teknomo  
**Traffic situation monitoring**

## **B. Strategic Planning and Targets**

52. The countries that have performed best in road safety all have well defined strategies and action plans, giving priority to critical problems and the actions needed to overcome them. These are defined at both national and local levels. Such direction for targeted actions is missing in the PRC, particularly at local government level.

53. Until recently the PRC did not have any quantified road safety targets. However in October 2011, the State Council issued the 'Safety Plan in the Twelfth Five-Year-Plan', which established the planning objective for road safety that deaths per 10,000 vehicles will decrease by at least 32% by 2015 compared with 2010.

54. It must be acknowledged that merely setting targets does not guarantee results. The OECD experience is based on countries with more mature road safety management systems and generally greater depth of road safety professional resources than currently exists in the PRC. The point remains, however, that setting targets concentrates attention, and forms a common goal for different departments and agencies to work towards.

## **C. Data Collection and Sharing**

55. The best performing countries, in terms of road safety, all have comprehensive crash databases. This allows policies to be defined and actions to be targeted on the basis of reliable information. Further, the databases facilitate regular monitoring of performance and evaluation of interventions, against specific targets that may be set.

56. Crash report forms used by the traffic police in these countries have evolved over many years, generally in consultation with potential users of the data. This has resulted in the collection of information which is of great value in epidemiological terms to describe the overall situation and to provide more detail with respect to high risk locations and specific interventions. The data bases can be used to identify, for example, types of road users most at risk, contributory factors associated with high risk, and road types and locations where crashes are most prevalent. This data has been used to make informed decisions about policies, laws, action programs and targeting of investment. The PRC still has a long way to go in these terms as the crash data collected is limited in extent, reliability and suitability for analysis.

57. Not only do the best performing countries collect and analyze extensive crash data, but the statistics are readily available to all those who need access to them. The initial crash reports are made by the police, but these records are quickly entered into computerized data bases. Subject to confidentiality about individuals' names, the databases can be accessed by other road safety professionals and researchers. This is in contrast with the PRC where access to the data collected by the traffic police is very restricted. This applies not only in the context of accessing information by the general public, but also by road safety professionals.

## D. Passive and Preventive Safety Measures of Vehicles

58. Part of developed countries' success in reducing fatalities has come from passive safety measures, to protect vehicle occupants during a crash. The introduction of passive technologies such as airbags and shock absorbing vehicle body structures brought enormous benefits in developed countries. Research in Japan indicates that 27% of all fatality reductions from 1994 and 2003 could be attributed to the improvement of crashworthiness, which refers to the ability of a vehicle structure to protect its occupants during a crash.<sup>24</sup> This is also supported by the fact, that in many developed countries, car occupant fatalities have steadily decreased compared with pedestrians and cyclists, during the past two decades. The introduction of passive technology is especially relevant for the PRC and other LMICs since the experience of many developed countries was that car occupant fatalities increased in the initial stages of motorization. In order to not repeat this in the PRC, the introduction of safer cars will be an important tool. The "China New Car Assessment Program" (C-NCAP) provides consumers in the PRC with safety information to assist their purchasing decisions. This is in line with good practices internationally where it is common for non-profit organizations to promote and conduct independent research and testing programs that assess the safety and environmental characteristics of motor vehicles and their comparative performance and to disseminate the results to the public.<sup>25</sup>

59. Motorcycle riders accounted for 28% of all fatalities in the PRC in 2008 (Figure 3). Wearing proper helmets is the most effective way of reducing fatalities of riders, since head injury is the major cause of death. Strong enforcement of helmet wearing combined with education and campaigns is proven to be effective. In Viet Nam, a mandatory helmet wearing law for adults was introduced in 2007. Following the successful enforcement of the law, coupled with publicity campaigns and the introduction of new technical standards for helmets, road crash fatalities decreased 12% in 2008.<sup>26</sup> In the PRC the law requires helmets to be worn, but casual observation suggests that the level of enforcement varies widely across the country.



Photo credit: ADB

### **Wearing proper helmets for motorcycle riders**

60. Wearing seat belts is a fundamentally important measure to protect vehicle occupants from injury. In Japan, non-use of seatbelts is associated with increased fatality rates by 39 times, 12 times, and 4 times for driver seats, front passenger seats, and rear passenger seats, respectively.<sup>27</sup> Rear seat belt wearing is effective not only to protect the wearer, but because non-use of rear seat belts increases the risk of fatalities for front seat occupants when the rear seat

passengers are thrown forward by an impact and strike the front seat occupants. Front seat use of seat belts is required by law in the PRC, but wearing rates vary with levels of enforcement. The “China Seatbelt Intervention” was piloted in Guangzhou in 2005 to increase seatbelt usage. The results of the campaigns, combined with enforcement and a police training program achieved an increase in front seat belt usage from 50% to 62% following the 12-month period.<sup>28</sup>

61. Child restraints are still not commonly used in developing countries. Children are often held by parents on their knees, but children will typically be thrown forward in a crash, and risk serious injury. Since the abdomen of a child is weak, seat belts for adults are not enough to sustain the bodies of children properly. Child restraints tailored to the child’s size are needed to provide proper protection. Their use is rare in the PRC.



Photo credit: Nana Soetantri

**Child restraint**

62. Many passive safety measures are cost effective, but it has gradually been recognized that there is a limitation to decreasing fatalities by passive safety measures only. Passive safety measures reduce the trauma caused by collisions, but do not prevent collisions from occurring. Thus, the governments of developed countries are gradually paying more attention to the introduction of preventive safety technology, which refers to technology assisting in the prevention of a crash.

63. The European Commission introduced the e-safety program in 2002 in order to improve crash prevention technology such as the electronic stability control system (ESC).<sup>29</sup> Research in Japan in 2005 identified that collisions decreased 36% from the introduction of ESC.<sup>30</sup> The United States Insurance Institute for Highway Safety estimated in 2006 that ESC could prevent one third of fatal crashes, and as many as 10,000 fatal crashes could be avoided each year in the United States if all vehicles were equipped with ESC.<sup>31</sup> The United States, Japan, and Australia have already announced compulsory inclusion of ESC in certain new vehicle models.

64. The focus of safety measures in HICs is thus shifting to the introduction of preventive safety technologies. The PRC could also enjoy the benefits of both passive and preventive technology advancement simultaneously. Large scale, worldwide introduction of advanced equipment will reduce the cost of these technologies as more and more cars become equipped in the factory. However it will take time for this to lead to substantial results. Since most passive and preventive technologies are fitted to new cars, it takes a decade before a majority of the vehicle fleet has such technologies. However, since it is a sustainable and reliable method, these technologies are certainly good investments in the PRC.

## E. Education and Enforcement Supported by a Safe Transport System

65. Based on early research in the United States and UK, road safety policies emphasized the driver, since research at that time found that most crashes were caused by driver error.<sup>32</sup> In parallel, enforcement was found to be an effective measure to make users keep the basic traffic rules. Hence, Japan, in the 1970's, strengthened enforcement, supported by road safety education, and this contributed to a significant reduction of fatalities. Road safety education in isolation had limited effects, but combining road user education with traffic law enforcement was an important approach to road safety.

66. Penalties for drink driving were increased step by step and permissible blood alcohol



Photo credit: Steven Lewis-Workman

### **Enforcing traffic rules**

concentration levels were made more stringent in many developed countries. The combination of more stringent enforcement for driving under the influence of alcohol, and campaigns organized to increase the awareness to stop drink driving, contributed to significant road crash reductions. In the PRC, increasing attention is now being paid to stop drink driving, and more stringent enforcement and awareness campaigns are likely.

67. However, in successful countries it was eventually recognized that there is a limit to what can be achieved by education and enforcement alone since everyone makes mistakes as human beings. This led to an emphasis on the safe systems approach, based on the premise that the road transport system must be designed assuming that people will make mistakes.<sup>33</sup>

68. Police crash reports in the PRC consistently identify drivers failing to observe traffic rules as the cause of the great majority of collisions. Whilst there is still a lot of opportunity for targeted education and enforcement campaigns to bring road safety benefits in the PRC, there is a growing case for moving towards the safe systems

approach. This should recognize the potential role of new technology in countering the effects of inevitable human errors.

69. The application of new technology has great potential for reducing collisions through a combination of driver behavior monitoring, providing better information more quickly to road users, giving warnings to drivers to change their behavior, training drivers using diagnosis of their driving behavior and crash videos, and—in the longer term—for controlling transport systems.

## **F. Infrastructure in a Safe Transport System**

70. The PRC has been rapidly expanding its road infrastructure in recent years. The focus of investment has been on expressways and major corridors, and there is an obvious contrast between these new roads and the remainder of the road network. The latter generally lack appropriate signs, markings and facilities for vulnerable road users. Even on new roads the principle of forgiving design, to minimize the risk of death or serious injury when crashes occur, is not universally applied. In HICs such facilities have developed over decades and are rooted in long experience of traffic and road safety management. This experience has not yet evolved sufficiently in the PRC, especially in terms of the professional expertise needed to implement these measures. Traffic management in the PRC remains largely in the hands of the police. A cadre of professional traffic engineers, employed by highway authorities and local government to deal with such issues, has yet to be fully developed.



Photo credit: Nana Soetantri

### **Alcohol Breath Analyzer**

71. Two measures that can be used to ensure a safe infrastructure system are black spot analysis and road safety audits (RSA).

72. A road safety audit (RSA) is the formal safety performance examination of an existing or future road by an independent team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users.<sup>34</sup> A key feature of the RSA is the use of a team of professionals with various expertise including highway safety engineering, highway design engineering, road maintenance, and road safety enforcement. This procedure is now in widespread use in



the best performing countries, but not commonly practiced in the PRC, except for a few highway projects funded by international finance institutions, such as ADB.

73. A black spot is a road location or road section with a high frequency of collisions. Black spots are often at intersections and places where road geometry changes unexpectedly. If collisions at black spots are investigated, certain patterns and probable causes can often be identified and treated to reduce the risk of further, similar collisions. There are many successful examples of a black spot approach. The important point is to identify black spot locations and causes of collisions scientifically, based on good crash data. However, the approach often faces difficulties in the PRC not only because of the problems with crash data described previously, but also due to poor coordination between road and police authorities. To facilitate coordination between the two and implement the approach effectively, joint initiatives will be useful. There are already some positive examples of this. In December 2003, the MPS and the State Administration of Work Safety for the first time jointly reviewed hazardous sections of highways, and identified twenty-nine hazardous sections to be refurbished under ministry supervision. Beginning in 2004, the MOT implemented a three-year highway safety guarantee project for national and provincial trunk highways with the theme of valuing life and eliminating potential hazards. In 2007, highways in counties and towns were also included in the highway safety guarantee project. Many hazardous sections of highway have been effectively refurbished and improved under this program. In the three years from 2004 to 2006, CNY9.01 billion was spent on the highway safety guarantee project. 278,000 hazardous sections have been refurbished for a total length of 83,000 kilometers. In 2007 and 2008, CNY4.85 billion was invested in the highway safety guarantee project that refurbished 163,000 hazardous sections with a total length of 55,000 kilometers.

## **G. Using Intelligent Transportation Systems for Support**

74. The operation of transport systems can be transformed by computers, sensors, and communications technology. ITS entails the application of these technologies to surface transportation. ITS provides the ability to gather, organize, analyze, use, and share information about transport systems; and to control the systems more efficiently and more safely. ITS is increasingly being used as an important component of road safety strategies in the best performing countries. In the Netherlands, for example, although a dramatic decrease in road deaths and injuries has already been achieved in the past two decades, in early 2009, the Dutch Ministry of Transport, Public Works and Water Management delivered the “Road Safety Strategic Plan 2008-2020”,<sup>35</sup> aiming at a further 25% reduction in the number of fatalities and injuries, through an integrated approach. Under the integrated approach, ITS measures are a key element of the strategy.

75. During the past two decades, Sweden has made substantial use of ITS which is considered an important tool for realizing Vision Zero. Sweden’s ITS strategy includes several ITS applications that have potential to address traffic safety problems, such as variable speed limits, automatic speed monitoring, intelligent speed adaptation, and driver assistance systems.<sup>36</sup>

76. In May 2011 the UK Government published a new strategic framework for road safety.<sup>37</sup> This acknowledges the growing role of technology and says:

*“In the longer term, with improvements in technology, e.g. collision avoidance – which will continue to transform the way we drive and use roads and the ability of the system to protect all road users when things go wrong – allied with safer and better driving, we will see a very different world”*



Photo credit: Research Institute of Highways  
**A speed camera in Shaanxi province**



**Event data recorder in Shandong province**

77. The PRC has begun the process of using ITS to support law enforcement, in particular with speed cameras to enforce speed limits and event data recorders linked to GPS in commercial vehicles to enforce limits on driving hours. These technologies have been found effective in reducing collisions and fatalities and there is a strong case for their wider use.<sup>38</sup>

## **V. Conclusions**

78. Road traffic collisions are a major global health problem, leading to similar numbers of worldwide deaths as malaria or tuberculosis. The great majority of these deaths occur in LMICs countries, where the problem is often getting worse due to increasing motorization. In contrast, many HICs, despite their high levels of vehicle ownership, demonstrate steady improvement. This paper has identified lessons from HICs that have been successful in road safety that are relevant for the PRC and other LMICs to draw upon and benchmark, in their efforts to reduce road traffic deaths and injuries. Key lessons are summarized below.

### **(i) Lessons regarding policies and institutions**

- **Political commitment and leadership** is essential to demonstrate support, provide necessary resources and ensure that appropriate policies are established and implemented.
- Because road safety is a multi-sectoral, multi-disciplinary issue, **coordination** of actions by all relevant agencies is critical. The most successful countries have a strong multi-stakeholder coordination mechanism, with a **lead agency** to oversee and ensure coordinated actions.

- An **action plan**, with quantified **targets** against which progress can be assessed and outcomes evaluated, helps to give focus and momentum to the implementation of road safety policies. Evaluation of the impact of projects and policies is important to inform future actions and for updating of the action plan.
- **Reliable crash data and analysis** should be used as a foundation for formulating road safety policy and actions. This requires full and accurate traffic crash reports to be collected by the police, and for the data to be shared with other professionals involved in road safety.
- Actions are needed at **national and local government** levels. **Professional staff**, with responsibilities for road safety, need to be trained and recruited for all levels of government.

(ii) **Lessons regarding drivers and road users**

- **Education and enforcement** should be linked. Road safety education in isolation has limited effects, but combining road user education with traffic law enforcement is a proven approach to road safety.
- The most successful countries have now adopted a **safe system approach**. This acknowledges that human error (mostly driver error) is inevitable. The road transport system as a whole must be designed to minimize the frequency, and in particular the consequences, of these errors.

(iii) **Lessons regarding vehicles**

- **Passive safety** measures for vehicles are important. Major reductions in traffic collision deaths and injuries are possible through high levels of helmet wearing for powered two-wheeler users (including passengers), seat belt wearing in all car seats, and properly designed child restraints. The introduction of passive technologies such as airbags and shock absorbing vehicle body structures will bring significant benefits in developing countries.
- **Preventive safety** measures for vehicles using ITS are already being adopted in the best performing countries. As the vehicle fleet develops and modernizes, technologies such as electronic stability control will offer further road safety benefits.

(iv) **Lessons regarding infrastructure and technology**

- **Safety-conscious road design** supports improved road safety by recognizing that drivers will make errors, and building roadside protection and facilities for vulnerable road users into the road design. **Road safety audit** of new road designs and existing roads is another proven technique. Similarly, reducing **traffic collision black spots** reduces the risk of further problems at locations with a history of road crashes.

- **Intelligent transport systems** have great promise for the future. They are already making an impact through the use of automated enforcement systems and safety systems in vehicles. As technologies improve and become cheaper to apply, they have the potential to make substantial improvements in road safety.

79. ADB is taking an active role to improve road safety in its developing member countries. It recently approved the ADB Road Safety Action Plan to mainstream road safety in its operations (Appendix A).

## Appendix: ADB's role in Road Safety

### Introduction

The Asian Development Bank (ADB) established the Sustainable Transport Initiative (STI) to align its transport operations with ADB's strategic framework, Strategy 2020. The STI seeks to scale up operations in four new areas: urban transport, climate change and energy efficiency, regional cooperation and integration, and road safety and social sustainability.

In the past, ADB's support for road safety was about 5% of the total ADB financing for transport projects in developing member countries (DMCs). This support was mainly engineering related interventions for localized road safety improvements, and technical assistance to increase the capacity of governments to address road safety problems. Box 1 shows the three main areas of past ADB support for road safety.

#### Box1. Past ADB Road Safety Support

There have been three main categories of past ADB support for road safety in developing member countries:

**1. Road safety component, engineering only (\$0.5–1 million)**

These have typically been included within road projects and focus on engineering-related road safety improvements, e.g., safety audits of hazardous locations, engineering design of safety improvement. They can lead to localized safety improvements and increase capacity in the executing agency but do little to strengthen overall capacity to address road safety problems.

**2. Road safety component, comprehensive (\$3–5 million)**

These have also been included within road projects and include a wider range of activities including some undertaken with other sectors. In Fiji, such support has included procurement of enforcement equipment and training for police, crash data system, traffic education of children, driver training/testing, vehicle roadworthiness testing, establishment of a national road safety council, training of a road safety unit within the public works department and safety engineering improvements on the major road network. Such projects help to develop local capability to address road safety and can lead to significant improvements in road safety (e.g. Fiji deaths and injuries were reduced by 50% over a 7 year period). They also help to build road safety capacity and address road safety in a more holistic manner.

**3. Regional and sub-regional technical assistance (RETA) (up to \$2 million)**

Such RETAs provide support for road safety in several countries and can benefit from synergies through countries sharing experience and working together. A RETA has assisted 10 ASEAN countries to develop individual road safety action plans and encouraged them to cooperate, coordinate and harmonize activities. These countries are now implementing the action plans and have a multi-sector, multi-country road safety working group that meets regularly. However, unless such RETAs are supported by subsequent road safety lending, they may not lead to lasting improvements.

*Source: ADB.2012. Implementation of Sustainable Transport Initiative: Mainstreaming Road Safety in ADB Operations Action Plan. Manila*

## Road Safety Action Plan

To further scale up road safety in Asia and the Pacific, ADB has adopted a Road Safety Action Plan (<http://www.adb.org/publications/road-safety-action-plan-overview>). The Road Safety Action Plan aims to improve the way that ADB addresses road safety in its operations, and expand ADB's portfolio of projects to support road safety. ADB will assist individual DMCs and sub-regional groupings in formulating country specific road safety action plans and specific road safety components/projects, including standalone road safety investment projects.



The Action Plan identifies seven areas for action critical for establishing a systematic, high quality and sustainable approach to addressing road safety in ADB operations, and for scaling up road safety work across the region. These key areas are listed in Box 2.

### Box 2. Key Areas for Action

#### ADB Operations

- 1 Strengthening ADB internal road safety capacities
- 2 Developing and operationalizing procedures, guidelines and related tools
- 3 Identifying opportunities for scaling up road safety in DMCs
- 4 Mainstreaming and strengthening road safety components
- 5 Establishing standalone road safety pipelines

#### Coordination and Partnerships

- 6 Collaborating and coordinating with MDBs, donors and UN agencies to support the UN Decade of Action on Road Safety
- 7 Mobilizing international organizations as partners in supporting road safety in Asia and Pacific region

*Source: ADB.2012. Implementation of Sustainable Transport Initiative: Mainstreaming Road Safety in ADB Operations Action Plan. Manila*

ADB is taking an active role to improve road safety in Asia and the Pacific. With these seven action areas, ADB intends to have a more proactive role to support the reduction of traffic deaths and injuries in its DMCs.

## Endnotes

---

- <sup>1</sup> This introduction draws heavily on World Health Organization. 2009. *Global Status Report on Road Safety: Time for Action*. Geneva.
- <sup>2</sup> Transport Research Laboratory. 2003. *Guidelines for estimating the cost of road crashes in developing countries*. Project Report 780.
- <sup>3</sup> Statistics in this section from: RIOH. ADB. 2012. *Improving Road Safety through the Application of Intelligent Transport Systems*. Consultant's report. Manila (TA 7308–PRC). ADB, Manila
- <sup>4</sup> National Bureau of Statistics of China. 1996-2011. *China Statistical Yearbook 1996-2011*. Beijing.
- <sup>5</sup> World Health Organization. 2009. *Global Status Report on Road Safety: Time for Action*. Geneva
- <sup>6</sup> T. Alcorn. 2011. Uncertainty clouds China's road traffic fatality data. *The Lancet*. 378, Issue 9788, pp. 305 - 306, 23 July 2011.
- <sup>7</sup> Reported Road Casualties Great Britain, 2009 – The Stationery Office, London.
- <sup>8</sup> Ministry of Transport, Peoples Republic of China, 2010. Annual Statistics of Highway and Waterway Development. Beijing.
- <sup>9</sup> See <http://www.who.int/roadsafety/en/> for more information
- <sup>10</sup> UN General Assembly Resolution A/64/266. August 2009. *Improving Global Road Safety*. New York.
- <sup>11</sup> World Health Organization and World Bank. 2004. *World Report on Road Traffic Injury Prevention*. Geneva.
- <sup>12</sup> UN General Assembly Resolution A/64/266. August 2009. *Improving Global Road Safety*. New York.
- <sup>13</sup> C. Gerondeau. 2005. *Road Safety in France*. FIA-Foundation, London.
- <sup>14</sup> Vägverket, Government of Sweden. 1998. *Road Traffic Safety Report*. Stockholm.
- <sup>15</sup> J. Whitelegg and G. Haq. 2006. *Vision Zero: Adopting a Target of Zero for Road Traffic Fatalities and Serious Injuries*. Stockholm Environment Institute. Stockholm. [http://www.sei-international.org/mediamanager/documents/Publications/Future/vision\\_zero\\_FinalReportMarch06.pdf](http://www.sei-international.org/mediamanager/documents/Publications/Future/vision_zero_FinalReportMarch06.pdf)
- <sup>16</sup> T. Alcorn. 2011. Uncertainty clouds China's road traffic fatality data. *The Lancet*. 378, Issue 9788, pp. 305 - 306, 23 July 2011.

- 
- <sup>17</sup> World Bank. 2009. *Country Guidelines for the conduct of road safety management capacity reviews and the specification of lead agency reforms, investment strategies and safe systems projects*. Washington.
- <sup>18</sup> W. Haddon Jr. 1968. The changing approach to the epidemiology, prevention and amelioration of trauma: the transition to approaches etiologically rather than descriptively. *American Journal of Public Health*. 58: 1431-1438.
- <sup>19</sup> Reported Road Casualties Great Britain, 2008. The Stationery Office, London
- <sup>20</sup> Organization for Economic Co-operation and Development. 2002. *Safety on Road: What's the vision?* OECD Publications. Paris.
- <sup>21</sup> European Road Safety Action Programme. 2003: *Halving the number of road accident victims by 2010. A shared responsibility (COM(2003) 311 final)*. Unpublished.
- <sup>22</sup> eSafety is a joint initiative of the European Commission and many industrial and other stakeholders having an interest in road safety. The initiative's aim is to increase road safety by deploying and developing safety systems based on modern information and communication technologies.
- <sup>23</sup> IT Strategic Headquarters of Japan. 2006. New IT Reform Strategy.
- <sup>24</sup> K. Takeuchi and Y. Ono. 2006. The Estimation of Fatality Reduction by Improvement of Crashworthiness. *International Association of Traffic and Safety Sciences*. Vol.31; No.2; pages.113-117(2006). Japan.
- <sup>25</sup> Global New Car Assessment Program.  
<http://www.globalncap.org/Pages/HomeMain.aspx>. accessed 20 December 2012.
- <sup>26</sup> Asia Injury Prevention Foundation.  
[http://www.helmetvaccine.org/target\\_countries/vietnam.html](http://www.helmetvaccine.org/target_countries/vietnam.html).
- <sup>27</sup> Police Agency. 2005. *Fiscal year 2005 Statistics*. Tokyo.
- <sup>28</sup> George Institute for International Health. <http://www.georgeinstitute.org>.
- <sup>29</sup> Electronic stability control system is a crash avoidance system to detect and minimize skids. It detects loss of steering control and automatically brakes the appropriate wheel to help the driver maintain control.
- <sup>30</sup> National Agency for Automotive Safety and Victims' Aid. 2005. *Benefits of Electronic Stability Control*.
- <sup>31</sup> Federal Highway Administration of the United States Department of Transport.  
<http://www.iihs.org/news/rss/pr061306.html>



- 
- <sup>32</sup> B.E. Sabey and H Taylor, 1980. *The known risks we run, the Highway*. TRL Supplementary Report 567. TRL, UK.
- <sup>33</sup> Swedish Road Administration. *Safe Traffic: Vision Zero on the Move*. <http://www.vv.se/>
- <sup>34</sup> Federal Highway Administration of the United States Department of Transport. <http://safety.fhwa.dot.gov/rsa/>
- <sup>35</sup> Road Safety Strategic Plan 2008-2020, Minister of Transport, Public Works and Water Management, Netherlands, June 2009.
- <sup>36</sup> Swedish Road Administration and SWECO. 2009. *The Road to ITS :A guide to the process of introducing road-based ITS solutions, with examples of implemented applications*.
- <sup>37</sup> Department of Transport. 2011 Strategic Framework for Road Safety. United Kingdom.
- <sup>38</sup> ADB. 2012. *Improving Road Safety through the Application of Intelligent Transport Systems*. Consultant's report. Manila (TA 7308–PRC).

## **International Lessons for Road Safety in the People's Republic of China**

Road traffic collisions are a serious constraint to development and a burden to many low- and middle-income countries. Acknowledging the global importance of road safety as a development issue, this staff working paper considers approaches and good practices for road safety that have been adopted in the best performing countries during recent decades. It suggests how these can be useful for reducing road traffic deaths and injuries in the PRC.

### **About the Asian Development Bank**

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to two-thirds of the world's poor: 1.7 billion people who live on less than \$2 a day, with 828 million struggling on less than \$1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.