ROAD SAFETY DEMONSTRATION

A. Introduction

1. The Shaanxi Mountain Road Safety Demonstration Project (the project) is located in two prefecture-level cities, Ankang and Shangluo, in southeastern Shaanxi province in the People’s Republic of China (PRC). The project will rehabilitate 187 kilometer (km) of trunk roads (G316, S224 and S102) and 139.6 km of rural roads and provide road safety improvements on an additional 569.6 km of rural roads. The project includes a $50 million road safety program to demonstrate innovative approaches to improve road safety outcomes involving design, education and institutional improvements.

2. The China Road Assessment Program (ChinaRAP)—a collaboration between Ministry of Transport Research Institute of Highway (RIOH) and the International Road Assessment Programme (iRAP)—and the Asian Injury Prevention (AIP) Foundation contributed to the development of the road safety demonstration for the project.

B. Background

3. An estimated 1.2-1.3 million people are killed, and up to 50 million injured, on the world’s roads every year, costing the global economy hundreds of billion dollars annually. Without decisive intervention, annual fatalities will exceed 1.8 million by 2020. Over 90% of the world’s road fatalities occur in low and middle income countries where fatality rates average 21.5 and 19.5 per 100,000 of population, respectively. In comparison, fatality rates in high income countries average 10.3 per 100,000. The World Health Organization (WHO) predicts that road injuries will become the fifth leading cause of death globally by 2030. With the burden of road crashes falling disproportionately on the poor, and two-thirds of victims’ families taking loans to cover lost income, road traffic fatalities and injuries are contributing to persisting poverty worldwide.

4. It is reported that 65,225 people were in killed in road crashes in the PRC in 2010 though the WHO estimates that as many as 275,983 people were killed—more than any other country—at a rate of 20.5 deaths per 100,000 population. In recent years, the number of reported crashes has declined while the proportion of reported crashes resulting in fatalities had increased—29% in 2012 compared to 22% in 2005—indicating a trend towards fewer but more serious crashes on the PRC’s roads. Most crash victims are male vulnerable road users between 21 and 65 years of age living in rural areas. It is estimated that road deaths and serious injuries cost PRC $300 billion per year (CNY 1,880 billion), equivalent to 5% of gross domestic product (GDP).

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1 The definition of a road fatality varies by country but generally will include any crash victims who die from their injuries up to 7—30 days following the crash.
4 WHO. 2013.
6 Vulnerable road users include pedestrians, cyclists or motorcyclists.
5. The PRC government recognizes that concerted action on road safety is required to address this emerging public health threat. The PRC is a signatory of the ‘United Nations Decade of Action for Road Safety, 2011—2020’ and has introduced laws on seat belt use for front seat occupants, blood alcohol content limits, and speed restrictions. As well, the State Council of the PRC issued the ‘Safety Plan in the Twelfth Five-Year Plan’ (the plan) in 2011 which established quantitative national level road safety planning objectives. The plan acknowledges the importance of drawing on international best practices to accelerate progress towards safer roads.

6. In terms of infrastructure, the Ministry of Transport introduced the Highway Safety Enhancement Project (HSEP). In the ten years since 2004, the HSEP resulted in investment of CNY30 billion ($5 billion) worth of safety facilities on 366,000 km roads. The second phase of HSEP will include ChinaRAP risk assessments based in part on experience of the road safety design improvements under the project.

7. However, with more than 20% of the world’s road deaths occurring in the PRC the success of the PRC’s road safety effort is critical to success of the UN Decade of Action and the proposed UN Sustainable Development Goal to halve road deaths. Provincial and local governments are keen to achieve major reductions in road crashes and the resulting injuries and fatalities. The importance of drawing on international best practices to accelerate progress towards safer roads and additional (human and financial) resources is recognized.

C. Road Safety in the Project Area

8. In Shaanxi province, where road fatalities mirror the national rates, it is estimated that the reported road fatalities and injuries from 2008 to 2012 (9,831 and 30,021 respectively) cost the local economy CNY31 billion ($5 billion). In the project area, the mountainous southeastern region of Shaanxi, the provincial and national rates are far exceeded; in Ankang and Shanglou 50% and 59%, respectively, of reported crashes in 2012 resulted in fatalities.

9. It is estimated that deaths and injuries on roads in the project area cost CNY517 million ($84 million; 0.3% of Shaanxi’s GDP) per year from 2007-2011. The three project trunk roads, carrying almost half of the total traffic of the project roads, have the highest crash costs and are among the deadliest in the PRC:
   (i) G316. The per kilometer fatality and injury rates are 11 and 24 times higher than the national average for Class III roads, respectively, costing CNY109 million annually;
   (ii) S224. The per kilometer fatality and injury rates are 2 and 31 times higher than the national average for Class III roads, respectively, costing CNY54 million annually; and
   (iii) S102. The per kilometer fatality and injury rates are 134 and 257 times higher than the national average for Class IV roads, respectively, costing CNY75 million annually.

10. The rural roads have lower crash costs (CNY20—CNY37 million annually) but exhibit similarly high per km fatality and injury rates compared to the national averages with fatalities 20 times and injuries at least 100 times higher.

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9 WHO. 2013.
11. Crashes in the project area are largely the result of: (i) run-off crashes due to sharp curves, unforgiving roadsides such as cliffs, deep drains, and aggressive vertical rock faces (around 42%); (ii) head-on crashes due to sharp curves and poor sight distance (around 40%); (iii) pedestrian crashes (around 9%); and (iv) rear-end crashes (around 9%).

D. Proposed Road Safety Demonstration

12. The project aims to address the project area’s severe road safety problem through a $50 million road safety demonstration which includes: (i) road safety design improvements (i.e. additional to the design standard) on the project roads; (ii) improved capacity of road safety unit in Shaanxi Provincial Transport Department (SPTD) and local traffic bureaus; and (iii) a road safety education and community awareness campaign. Of the total estimated budget for the project of $399.96 million, $50 million is committed to road safety-specific activities. These are discussed in the sections that follow. A summary of the road safety demonstration is in Table 1, and the components are discussed in more detail in the following sections.

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<th>Table 1: Road Safety Demonstration Summary</th>
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<td>• Civil works involving various road safety improvements including roadside safety barriers, paved shoulders, realignments, enhanced skid resistance, traffic calming and pedestrian crossings. The designs also include trials of countermeasure types not commonly used in PRC, such as: vehicle activated signs, flexible delineator posts, and colored pavement treatments at the entry to villages and raised pedestrian crossings at schools.</td>
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<td>Capacity Development</td>
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<td>• Training</td>
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<td>o Safe road design training in PRC for 80 people</td>
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<td>o International safe road design training for 30 people</td>
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<td>o International safety leadership, strategy and planning training for leaders, department heads and managers from SPTD</td>
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<tr>
<td>o Road safety and transport management integration for leaders, department heads and managers from SPTD</td>
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<td>• Road network safety and traffic management system</td>
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<td>• Monitoring of road safety during the construction period</td>
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<td>• Evaluation of the road safety impact of the new roads overall, and of specific countermeasure types</td>
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<td>Road Safety Education and Community Awareness Campaign</td>
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<td>• School-based education, comprising: delivery of primary school curriculum for students; use of interactive e-learning modules; training for teachers; and information workshops for parents.</td>
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<td>• Community education, including public events that introduce communities to the project and communicate the importance of safe, high-quality roads in their communities; and development of materials such as videos, banners and posters.</td>
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<td>• Ownership and capacity building, comprising the creation of a road safety working group that supports and promotes the pilot project.</td>
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1. **Road Safety Design Improvements**

13. During project preparation, iRAP assessment methodology was introduced to guide the road safety design and monitoring processes (Box 1). ChinaRAP generated road safety star ratings and economic analyses for baseline road conditions and for various iterations of designs for project road rehabilitation as they were developed by local design institutes. This is the first time that the ChinaRAP process has been applied on this scale in PRC, and resulted in road safety provisions that exceed the requirements of the PRC highway design standards.

<table>
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<tr>
<th>Actions</th>
<th>Agencies</th>
<th>Resources</th>
<th>Timeframe</th>
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<tr>
<td>Monitoring and evaluation of the pilot project, including a mid-term review with key stakeholders which may influence the way in which the project proceeds and a final evaluation which provides recommendations about how the pilot might be extended in Shaanxi and emulated in other provinces.</td>
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**Box 1: What is ChinaRAP?**

The China Road Assessment Program (ChinaRAP)—a collaboration between Ministry of Transport Research Institute of Highway (RIÖH) and the International Road Assessment Programme (iRAP)—assesses baseline conditions and designs of roads to determine cost-effective road safety improvements. In particular, ChinaRAP:

- Inspects high-risk roads and producing Star Ratings, which are a simple and objective measure of risk for vehicle occupants, motorcyclists, bicyclists and pedestrians. One-star roads have the highest risk and five-star roads have the lowest risk.
- Develops investment plans that identify affordable and economically-sound road improvements that will improve a road's Star Ratings and save lives.
- Provides training, technology and support that will build and sustain national, regional and local road safety capability.
- Tracks road safety performance so that funding agencies and donors can assess the benefits of their investments in safer roads.

**Box 2: What are star ratings and what does a 3 star rating mean?**

iRAP Star Ratings are based on road inspection data and provide a simple and objective measure of the level of safety which is ‘built-in’ to the road for vehicle occupants, motorcyclists, bicyclists and pedestrians. Five-star roads are the safest while one-star roads are the least safe.

The 3-star band represents a reasonable balance between providing a safe environment and requiring a standard of design that, while challenging, is also achievable and represents a positive return of investment in the majority of cases. For example, it is virtually impossible for a typical undivided road that carries 5,000 vehicles per day to achieve 3-stars for pedestrians if the speeds are above 60km/h, unless there are footpaths in place. More information on how the Star Rating bands were set is contained in the iRAP Methodology Fact Sheet 7: Star Rating Bands (http://irap.org/en/about-irap-3/methodology).

14. Design features that improve road safety outcomes include: roadside safety barriers, paved shoulders, realignments, enhanced skid resistance, traffic calming and pedestrian crossings. The project road designs include trials of countermeasure types not commonly used in PRC, such as: vehicle activated signs, flexible delineator posts, colored pavement treatments at the entry to villages, and raised pedestrian crossings at schools. The assessments show that the improved designs will result in modest improvements in the star ratings for all road users.
These improvements will occur despite an expected increase in operating speeds—which increases risk of death and serious injury—on the trunk and rural roads. The designs will result in the length of road rated 3-stars or better for vehicle occupants increasing from 16% to 41%. The roads rated 3-stars or better will carry a relatively high share of traffic (59% of vehicle kilometers travelled), indicating that safety investments have been well-targeted to busier sections of road where exposure to risk is higher. A similar pattern is apparent for motorcyclists, pedestrians and bicyclists (Table 2).

Table 2: Existing and Design Roads Rated 3-stars or Better by Road Length and by Vehicle Kilometers Travelled

<table>
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<tr>
<th>Road user</th>
<th>Length (km)</th>
<th>Vehicle kilometers travelled (vkt)</th>
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<tbody>
<tr>
<td></td>
<td>Existing roads (baseline)</td>
<td>Final road designs</td>
</tr>
<tr>
<td>Vehicle occupants</td>
<td>16%</td>
<td>41%</td>
</tr>
<tr>
<td>Motorcyclists</td>
<td>7%</td>
<td>22%</td>
</tr>
<tr>
<td>Pedestrians</td>
<td>43%</td>
<td>52%</td>
</tr>
<tr>
<td>Bicyclists</td>
<td>55%</td>
<td>80%</td>
</tr>
</tbody>
</table>

Note: Only sections of road where pedestrians and bicyclists are likely to be present were rated.

15. Overall, it is estimated that 26,985 fatalities and serious injuries would occur on the project roads over a 20 year period. However, the additional road safety design improvements will result in an estimated 5,407 fewer fatalities and serious injuries (a reduction of 25% compared to the baseline estimates). This investment would generate a road safety benefit cost ratio of 6.7:1.

2. Capacity Development

16. The Project will involve training that lays a foundation for a road safety management model that results in significant reductions in deaths and serious injuries in Shaanxi. The training will expose participants to each of the five pillars of the ‘United Nations Road Safety Collaboration Global Plan for the Decade of Action for Road Safety 2011-2020’. However, given the nature of the project, the training will focus in particular on building capacity in road safety management (pillar one) and improving the safety of road infrastructure (pillar two) within the project stakeholder organizations. At the completion of the training, participants will have a comprehensive understanding of: best practices in safe road design; and best practice road safety strategy, planning and management and the science that underpins it.

17. The training will involve four components:
   (i) Safe road design training in PRC for 80 people. At the end of this component, participants will be familiar with and master ChinaRAP safety assessment methods and be familiar with advanced road engineering safety measures used in China that can be adopted to strengthen safety on roads in Shaanxi. During project preparation, 30 designers were trained in the ChinaRAP software and assessment methodology.
   (ii) International safe road design training for 30 people. At the end of this component, participants will be familiar with and master new road safety audit approaches, and be familiar with international road design processes that use

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12 The five pillars are: (i) building road safety management capacity; (ii) upgrading the safety of road infrastructure; (iii) further developing the safety of vehicles; (iv) enhancing the behavior of road users; and (v) improving emergency services.
advanced safety measures that can be adopted to improve road safety in Shaanxi. This component will include visits to a country(ies) leading in road safety, and may, for example, involve participation in the International Road Federation Safer Roads By Design: Across Six Continents Certified training course.

(iii) International safety leadership, strategy and planning training for leaders, department heads and managers from SPTD. At the end of this component, participants will be familiar with and understand international approaches to the development and implementation of sustainable road safety strategies and plans that significantly reduce road trauma and can be adopted in Shaanxi. The component will include visits to a country(ies) leading in road safety, and may, for example, involve participation in the MUARC-CASR Road Safety Management Leadership Program in Melbourne, Australia (which was developed with the World Bank Global Road Safety Facility).

(iv) Road safety and transport management integration for leaders, department heads and managers from SPTD. At the end of this component, participants will be familiar with and understand the laws, standards and rules that are used by countries leading in road transport (especially road safety), and can underpin the development of integrated transport policies and practices that will enhance transport sustainability in Shaanxi. The component will include visits to a country(ies) leading in transport sustainability and road safety.

18. The development and implementation of a road network safety and traffic management system will address a problem of poor data and planning integration. The database system will combine ChinaRAP risk assessment, crash, traffic and asset / maintenance data, and will assist the SPTD in long term road safety planning. By linking road safety data with road maintenance data, the new road network safety and traffic management system will provide an opportunity to leverage road maintenance works for targeted road safety improvements in the future. For example, maintenance staff will be able to use the system to prioritize works at locations where there is both a need for maintenance and a road safety problem that could be addressed through the use of low-cost countermeasures such as signs and road markings.

19. Monitoring of road safety during construction will be undertaken to ensure that traffic is able to flow safely through construction zones and that demonstration safety facilities are implemented effectively. Opportunities to supplement the scheme with additional low-cost high-return improvements, such as adjustments to sign and line marking types and locations may also be identified. Throughout this task, training will be provided to SPTD staff.

20. Risk assessment data and crash data will be used to evaluate the road safety impact of the new roads overall, and of specific countermeasure types. This will provide an important opportunity to build the body of evidence about the relative effectiveness of safety countermeasures in PRC. The resultant ‘crash modification factors’ will be particularly valuable in developing future road safety designs in Shaanxi and will be helpful for the Ministry of Transport’s HSEP. Throughout this task, training will be provided to SPTD staff.

3. Road Safety Education and Community Awareness

21. The project will include a school road safety education pilot project, based on a program developed by AIP Foundation for application in PRC. The Walk Wise program was developed to prevent road traffic injuries and fatalities in vulnerable communities through a focus on road safety education and awareness and has been implemented in 36 primary schools in Chongqing province. By 2016, the program will reach approximately 80,000 students at 80
primary schools in neighboring Chongqing and Sichuan provinces. Leveraging on this model and its resources, Walk Wise will be the first road safety education and community awareness program of its type in Shaanxi. The education program will strengthen the project outcome as it plays an important role in influencing road user behaviors.

22. The Walk Wise pilot will be delivered in three schools and will address key shortcomings in road safety in Shaanxi. The pilot will:
   (i) Improve the skills and confidence of primary school teachers to train their students in road safety.
   (ii) Provide schools with the quality curricula and teaching materials that are necessary to promote safe behavior. These materials have undergone extensive development and revision in PRC.
   (iii) Emphasize building a supportive network among local stakeholders, promoting community-wide awareness, and encouraging community ownership to ensure long-term sustainability and impact. In this respect, the project will also provide SPTD with an important mechanism to engage with the community on road safety and the significance of the investments being made in the trunk and rural road network.

23. The pilot Walk Wise pilot will include four main components.
   (i) School-based education, comprising: delivery of primary school curriculum for students; use of interactive e-learning modules; training for teachers; and information workshops for parents.
   (ii) Community education, including public events that introduce communities to the Shaanxi Mountain Road Safety Demonstration Project and communicate the importance of safe, high-quality roads in their communities; and development of materials such as videos, banners and posters.
   (iii) Ownership and capacity building, comprising the creation of a road safety working group that supports and promotes the pilot project.
   (iv) Monitoring and evaluation of the pilot project, including a mid-term review with key stakeholders which may influence the way in which the project proceeds and a final evaluation which provides recommendations about how the pilot might be extended in Shaanxi and emulated in other provinces.

24. **Project Road Safety Working Group.** The Foreign Finance Project Office of SPTD will provide high level project leadership to ensure efficient and effective program implementation. The road safety working group will also comprise representatives from SPTD, county government, education department, the traffic police department, NGOs, schools and various community groups and individuals. The working group will meet regularly and formulate a strategic plan to support the program beyond the pilot stage. The working group will have clearly defined roles and responsibilities for each stakeholder to ensure strong coordination and a successful long-term partnership.