

Elements of Road Safety Engineering

Workshop Report

Hohhot, Inner Mongolia Autonomous Region
The People's Republic of China

2-5 September 2019



The Central Asia Regional Economic Cooperation (CAREC) Institute has been closely collaborating with the Asian Development Bank (ADB) and CAREC Program to design and deliver capacity building workshops in line with objectives of the CAREC Road Safety Strategy. The workshops are a joint effort to build understanding of best practice practices in road safety, particularly in the four essential components of road safety engineering:

- ✓ treating hazardous road locations
- ✓ road safety audits
- ✓ roadside hazard management
- ✓ safety at road work sites

In light of the above, a 4-day workshop program was developed which follows the contents of the three new CAREC/ADB Road Safety Engineering Manuals on Road Safety Audit, Safer Road Works, and Roadside Hazard Management.

In March and April 2019, five 4-day technical workshops title “Elements of Road Engineering” were conducted for more than 120 participants (traffic police and engineers) in Bishkek (Kyrgyzstan), Dushanbe (Tajikistan), Baku (Azerbaijan), Tbilisi (Georgia), and Tashkent (Uzbekistan). The ADB/CAREC Road Safety Engineering Consultant Mr Phillip Jordan was the resource person to deliver all these workshops.

The CAREC Institute, in association with the ADB, then took the lead in facilitating the sixth workshop in this series. Originally scheduled to be held in Urumqi, the People’s Republic of China (PRC) in early May 2019, the workshop was postponed and subsequently re-scheduled and conducted in Hohhot, Inner Mongolia, the PRC, in early September 2019.

Presentations were in English, with simultaneous interpretation into Chinese. The three CAREC road safety engineering manuals were distributed to all participants as workshop notes. Various techniques of interactive workshop delivery were used to entice constructive discussions involving all participants.

The case study on inspection of the expressway blackspots was a highlight. The inspection went smoothly thanks to generous assistance of the Traffic Police Department of the Inner Mongolia, who closed one carriageway of the westbound expressway to traffic during the inspection. The following day, participants reported back on suitable remedial measures. They gave insightful findings and recommendations to reduce accidents at this curve.

This report was prepared by Phillip Jordan, ADB/CAREC Road Safety Engineering Consultant, and edited by Eisa Khan Ayoob Ayoobi, CAREC Institute’s Senior Knowledge Services Officer.

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1. Introduction

CAREC countries have made road safety a collective regional priority within the CAREC Program's framework. Consequently, with the support of the Asian Development Bank (ADB), CAREC adopted the "Safely Connected: A Regional Road Safety Strategy for CAREC Countries 2017–2030" at the 15th CAREC Ministerial Conference on 26 October 2016. The aim of this strategy is to reduce fatalities on CAREC road corridors by 50% by 2030, as compared with 2010. The strategy aims to save 23,000 lives and avoid 250,000 serious injuries each year, yielding estimated savings of \$16 billion per year.¹

Every day, more than 3,500 people are killed in road crashes around the world which is about 1.35 million people each year.² Although road crash is listed as the eighth deadliest cause of fatalities globally, it is ranked the sixth deadliest cause in Central Asia. The same report quotes that "road traffic injuries are currently the leading cause of death for children and young adults aged 5–29 years, signaling a need for a shift in the current child and adolescent health agenda which, to date, has largely neglected road safety." Pedestrians, in general, are overly represented in road deaths; they typically make up a third of all road deaths in Central Asia.

The CAREC region is mainly mountainous and landlocked with only three CAREC countries (the PRC, Georgia, Pakistan) out of eleven members having access to maritime routes. The region is heavily dependent on roads and railways for transportation. Roads require safety measures to keep road users safe, and special measures are required to ensure the safety of road users in mountainous and landlocked regions such as CAREC.

To support the objectives of the UN Decade for Action in Road Safety,³ the ADB in association with the CAREC Institute has been delivering road safety engineering workshops across the CAREC Region with the aim of improving the capacity of road safety engineering professionals in CAREC countries.

The CAREC Institute has been collaborating closely with the ADB to design and deliver capacity building workshops in line with the CAREC Road Safety Strategy goals and objectives. It delivered its first road safety workshop – Designing Safer Roads: Accelerating the Implementation of the CAREC Road Safety Strategy – in Dushanbe, Tajikistan, during 30-31 August 2017 with the following objectives:

- 1) Build understanding of best practice principles in road safety engineering and of the four essential components of road safety engineering:
 - a. treating hazardous road locations (blackspots)
 - b. road safety audits
 - c. roadside hazard management
 - d. safety at road work sites

¹ Safely Connected: A Regional Road Safety Strategy for CAREC Countries 2017–2030. ADB. Retrieved October 20, 2019, from <https://www.adb.org/sites/default/files/institutional-document/228011/carec-road-safety-2017-2013.pdf>

² Global Status Report on Road Safety 2018. World Health Organization. Retrieved October 20, 2019, from <https://apps.who.int/iris/bitstream/handle/10665/276462/9789241565684-eng.pdf?ua=1>

³ UN Decade for Action in Road Safety. World Health Organization. Retrieved October 20, 2019, from http://siteresources.worldbank.org/EXTTOPGLOOASAF/Resources/2582212-1265307800361/decade_of_action_2011.pdf

- 2) Develop an action plan with priority actions for changes in policies and/or practices that may be required at the national level
- 3) Provide an opportunity for experience sharing and developing collaboration on road safety engineering among countries within the region

In March and April 2019, five 4-day technical training workshops were conducted for more than 120 participants (traffic police and engineers from national Ministries of Transport) in Bishkek (Kyrgyzstan), Dushanbe (Tajikistan), Baku (Azerbaijan), Tbilisi (Georgia), and Tashkent (Uzbekistan).

The sixth workshop in this series was, originally, scheduled to be held in Urumqi, the PRC, in early May 2019. Nonetheless, the workshop was postponed and subsequently re-scheduled and conducted in Hohhot, Inner Mongolia, the PRC, in early September 2019.

These workshops support actions highlighted in the 2017-2030 CAREC Regional Road Safety Strategy, especially the need for capacity building in road safety engineering and road safety audit for engineers.

Picture 1: Road Safety Workshop Participants in Hohhot



2. Elements of Road Safety Engineering

2.1. Workshop Outline

The Hohhot workshop was the sixth workshop in the series. It was held in Hohhot, Inner Mongolia, the PRC, during 2-5 September 2019. The venue was equipped with audio and video facilities for simultaneous interpretation from English into Chinese and vice-versa.

The workshop focused on Pillar Two in the UN Decade of Action for Road Safety – Safer Roads. It followed the CAREC Road Safety Engineering manuals (three volumes of 2018), and covered two main road safety engineering processes:

- The reactive process of blackspot investigations. The workshop showed how “high crash frequency” locations can be investigated and treated with low cost

countermeasures. The importance of access to good data and close cooperation between police and engineers was emphasized.

- The proactive process of road safety audit. The workshop showed engineers how they can prevent crashes on new roads by applying the road safety audit process during planning, design, and construction of new road projects.

Picture 2: Road Safety Workshop Participants in Hohhot



Mr Phillip Jordan, an experienced road safety engineer and workshop presenter from Australia, delivered the workshop. Mr. Jordan has many years of experience in road safety engineering in the public and private sectors. He has worked in most parts of Central Asia, China, Mongolia, the Caucasus, Middle East, and South East Asia, as well as Australia, Canada, Great Britain, and the USA. Hence, he was able to provide a holistic perspective on trending international road safety issues and help the PRC participants broaden their expertise and knowledge of the field.

The workshop objectives were:

- 1) To introduce professionals from national highway authorities, provincial road agencies, national traffic police, consultants, NGO's and others to the key elements of the road safety engineering
- 2) To provide guidance, advice and knowledge to assist road authorities in CAREC countries to ensure safer roads for all
- 3) To update knowledge and skills of CAREC member countries on road safety engineering

A rural blackspot case study was used to provide the participants with experiential learning opportunities through practical blackspot investigations on Day Two of the workshop. A road

safety audit case study was not available, thus a case study from another CAREC country was used as a “desktop” audit example.

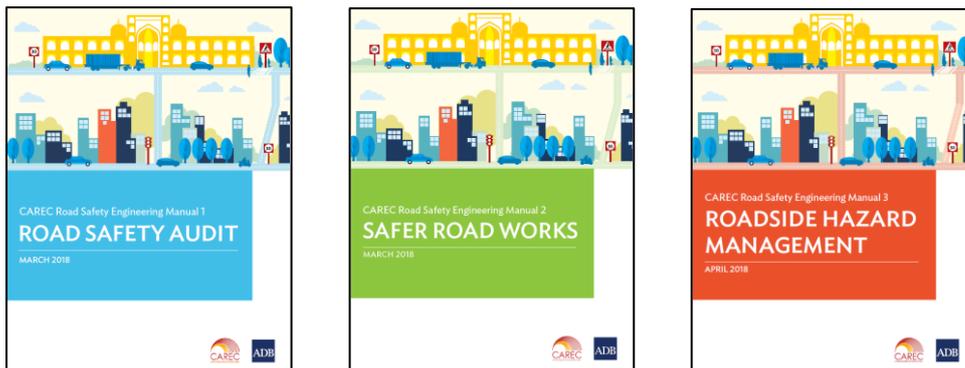
2.2. Participants

There were 25 participants in this workshop. They were from the Ministry of Interior (traffic police), the local design institute, and the Ministry of Transport of the PRC.

Picture 3: Road Safety Workshop Participants in Hohhot



2.3. CAREC Road Safety Engineering Manuals



Picture 4: The first three CAREC road safety engineering manuals (2018)

The new CAREC Road Safety Engineering manuals were used as the workshop notes. Being available in four languages (English, Russian, Mongolian, and Chinese), the new manuals are comprehensive resources for use in the CAREC region. The manuals were well received in the Hohhot workshop and they will open opportunities for further workshops and trainings in coming years.

Day One of the workshop gave an overview of the road safety situation around the world, in China and in Inner Mongolia. The morning session also provided a general introduction to road safety engineering. Crash causation was discussed to introduce delegates to blackspot investigation techniques and the importance of collection and use of good crash data.

Throughout the workshop, the presenter emphasized the benefits to be gained from traffic police and engineers working in close cooperation, sharing resources and information. Participants were encouraged to treat road safety as a business that requires investment to deliver significant returns.

The workshop then focused on several specific technical topics within the field of road safety engineering. Roadside hazard management was detailed, which included the concept of clear zones and how fixed objects and street furniture in the vicinity of the road can be hazardous.

Discussions took place on hazard management as requested by participants given that the Hohhot is building/maintaining a long range of highways throughout the city. Good practice in intersection design was then explained, followed by a session on road signs and road markings. A presentation on vulnerable road user safety followed, in which the challenges of vehicle flows were discussed in ways that would not be detrimental to the safety of Inner Mongolia's many pedestrians and vulnerable residents.

Day Two of the workshop addressed blackspot investigation techniques and ways to reduce crashes at hazardous locations. Topics included crash reduction factors, how to find patterns in crashes, and the economic savings possible through blackspot programs. In the afternoon of Day Two, participants travelled by bus along the G6 expressway to inspect a blackspot on a sweeping left-hand curve on the carriageway leading towards Hohhot.

2.4. Blackspot Investigation

The workshop was designed to be a practical workshop in which participants would “learn by seeing and doing.” The blackspot investigation was an important case study in this workshop. Participants were assigned to small teams and briefed about the blackspot process before travelling to undertake a site visit to a blackspot on the G6 expressway, approximately 100km east of Hohhot. The local police provided great safety support for participants by closing the expressway for half an hour to allow the inspection to take place without live traffic.

The Police also gave verbal information about the crashes on the curve and explained the known pattern of crashes while on-site. The teams were asked to develop appropriate and low-cost crash countermeasures based on their findings from the site inspection. Each team was invited to report back to their workshop colleagues on their recommendations when they returned to the workshop venue for the next session.

Picture 5: Police closed one carriageway during the blackspot inspection on the G6 expressway



Picture 6: Blackspot location, the G6 expressway curve



2.5. Road Safety Audit

On Day Three and Day Four, participants were introduced to the process of road safety audit, including its costs and benefits, the different stages of audit and types of road projects that can benefit from an audit. Some example audits from across CAREC were presented showing how positive safety measures can be achieved through the audit process.

The CAREC Road Safety Audit manual (2018) defines a road safety audit as a formal examination of an existing road or future road or traffic project in which independent, qualified auditors report on the project's crash potential and safety performance. A road safety audit considers the road safety needs of all road users who may use a new road/highway once it is rehabilitated and upgraded. It seeks to identify potential risks during the design stage, and make practical recommendations for changes to reduce or eliminate these prior to construction. An audit is not a compliance check with national standards or norms. Some of the safety concerns identified in an audit may be due to national practices and/or standards that are no longer recognized as “safe” by international criteria. Emphasis was given to the concept that “prevention is better than cure” and that auditors are problem “finders” as opposed to problem “solvers.”

Drawings for a local road project were not available to permit a local audit case study and inspection to take place. The participants were therefore briefed and assigned to teams for the audit exercise and provided with sets of drawings for a planned road project (the Northern Bishkek Bypass) in a neighboring CAREC country (Kyrgyzstan). The teams were informed that the audit would be a detailed design stage audit, and that each team would be required to present their findings verbally to their workshop colleagues. A short presentation was given to assist the teams on how to write a good audit report.

Participants were encouraged to “put themselves in the shoes of the future road users” and to look for the road safety challenges that may face people once the new bypass is completed. The participants found the desktop audit challenging, as the standards used for roads in the neighboring country differ markedly from those of China. This made the case study more difficult for participants than if they were auditing a local proposal. Still, some significant safety concerns were identified by the teams, and recommendations were made by each team to address these concerns. The workshop closed at the end of the fourth day with the completion of workshop evaluation forms.

3. Lessons Learnt

Several key lessons were learnt from this technical workshop, and they are outlined here for consideration in future workshops.

- 1) Local stakeholder cooperation. There is a need to have an agreed program for the workshop by all stakeholders at least three months before the workshop. A 3-month minimum period allows for planning, invitations, preparation of PowerPoints, translations, and travel arrangements. This period would not be enough if cooperation with local stakeholders were not timely.
- 2) Ensure the local organizers understand that the program involves case studies which require the participants to go out to sites. The blackspot case study(ies) require crash

- data (from police) while the audit case study(ies) require design drawings (from the road authority).
- 3) Translation and questions (which were encouraged) take up time. The 4-day program that was prepared for these workshops was full of technical topics; some of these went overtime, causing some other sessions to be put aside, and some days going overtime. A lesson for future workshops is to review the time schedule for each session. It may be more effective overall to give shorter sessions on all topics rather than longer sessions on fewer topics.
 - 4) The blackspot case study was well received. It provided an excellent opportunity for “learning by seeing and doing.” Future workshops should plan for more case studies.
 - 5) There was keen interest from participants on how to assist pedestrians the best possible way. As pedestrians are one of the main victims of road fatalities in CAREC countries, there is merit in providing more time and more case studies about pedestrian safety in future workshops.

The evaluation forms show that most of the delegates were very satisfied with all aspects of this technical workshop.

Sincere thanks are due to the following people for the success of this workshop:

- Mr Eisa Khan Ayoob Ayoobi, CAREC Institute
- Mr Steven Liu, CAREC Institute
- Ms Dildar Zakir, CAREC Institute
- Mr Wang Youyou and Ms Zhang Wenyu – interpreters
- Staff of the Juva Jia Xi Hotel, Hohhot
- The bus driver for the blackspot site inspection
- All participants

4. Recommended Next Steps

This workshop was successful in presenting important road safety engineering topics. The workshop highlighted that there is a real opportunity to assist the next generation of engineers to broaden their thinking on matters of road safety and avoid simply following “design standard.” It is important to note the requests from participants for future similar workshops. They see the need for more road safety engineers in their country and they appreciate the support to train and mentor future professionals. Consequently, the following recommendations are made for inclusion in future knowledge exchange on road safety:

- 1) Continue presenting as many 4-day technical workshops on road safety engineering as resources permit.
- 2) Commence, or strengthen connections with national technical universities to assist the teaching staff to be better equipped to teach road safety engineering to their engineering students. It is strongly recommended that the CAREC Institute and the ADB take up this idea and take this workshop program into universities across the CAREC region to assist professors improve understanding of road safety engineering. This way, they will be better placed to teach this important topic to their engineering

students, thus increasing awareness and knowledge among the future generations of CAREC highway engineers.

- 3) Create a network of national technical universities which can participate in these workshops and enhance sharing of road safety experience across the region. In time, this network may be able to present the required national training workshops for accreditation of auditors. Also, in time, the network may become a platform for sharing knowledge and mentoring in road safety audits (including cross-border audits) for national road authorities.
- 4) Certificates should be available to those who attend and participate in all sessions of the workshop. The certificates may be accredited and might confer qualification. This issue needs further and broader discussion, along with the topic of better implementation of the road safety audit process. There is a widespread interest in the audit process, but no CAREC country has yet implemented it in a comprehensive way. There is a need to assist countries to implement the audit process. Key steps towards this could be more technical workshops, establishment of the national auditor registration schemes, and enactment of national audit policies.
- 5) The CAREC manuals are valuable workshop notes. They should continue to be used as the notes for future workshops. The fourth manual (Pedestrians) is desirable as there is a lot of interest in trying to improve pedestrian safety but most of that interest is focused on ways to further restrict and segregate pedestrians from traffic. Many more options are available and a new CAREC manual on this topic will be well received, and it will add value to future workshops.
- 6) The case studies (blackspot investigations and road safety audits) were well received by all participants, but they do need more preparation time and effort. In Hohhot, the local stakeholders did not agree that local crash data and design drawings for a local road project were needed for use in case studies. While a blackspot case study was arranged during the workshop, it was not possible to get drawings for a local audit case study. A foreign example was used instead, which meant that participants had to look at photographs of the site instead of inspecting the site. The participants therefore missed the opportunity to “practice” a real audit. Therefore, it is recommended that further discussions take place with local stakeholders in extending their support to provide essential means for practical learning.

Appendix A: List of Workshop Participants

Provincial Transportation Department of the Inner Mongolia Autonomous Region

1. Mr. Ma Yupeng, Division Head
2. Mr. Zhang Yaodong, Principal Staff Member
3. Mr. Liu Jianwei, Senior Staff Member
4. Mr. Zhang Hongwei, leading group member of Bureau
5. Mr. Pan Yongjie, Deputy Chief
6. Ms. Hu Yaqin, Deputy Chief
7. Mr. Liu Xuecheng, Senior Engineer, Traffic design and research institute
8. Ms. Wan Fang, Deputy Chief, High-grade highway construction and development co. Ltd
9. Mr. Zhang Dawei, Deputy Chief, High-grade highway construction and development co. Ltd
10. Mr. Nan Yuxin, Deputy Chief, High-grade highway construction and development co. Ltd
11. Mr. Guo Hao, Senior Staff Member, Highway administration law enforcement supervision general team
12. Mr. Xue Yufeng, Deputy Chief, Transportation investment and development LLC
13. Mr. Gao Yu, Senior Staff Member, Transportation investment and development LLC

Provincial Public Security Department of the Inner Mongolia Autonomous Region

14. Mr. Zhang Jianwei, Division Head, Accident department
15. Mr. Li Yichen, Staff Member, Accident department
16. Mr. Qi Biao, Senior Staff Member, Traffic order department
17. Mr. Cao Zhuobin, Staff Member, Traffic order department
18. Mr. Huang He, Chief, Highway management detachment
19. Mr. Shi Qiang, Senior Staff Member, Highway management detachment
20. Mr. Jia Hanchuan, Accident disposal squadron leader, Highway management detachment
21. Mr. Sun Jianguo, Deputy Chief, Accident department of Hohhot City
22. Mr. Qiao Haijun, Senior Staff Member, Accident department of Hohhot City
23. Mr. Liu Jiangtao, Chief, Accident department of Baotou City
24. Mr. Wang Yonghe, Chief, Accident department of Wulanchabu City
25. Mr. Liu Yongfei, Chief, Accident department of Ordos City

Resource Person

26. Mr. Phillip Jordan, Consultant, ADB

CAREC Institute

27. Mr. Eisa Khan Ayoob Ayoobi, Senior Knowledge Services Officer
28. Mr. Steven Liu, Training Officer
29. Ms. Dildar Zakir, Training Officer

Interpreters

30. Mr. Wang Youyou
31. Ms. Zhang Wenyu

Appendix B: Workshop Program

Day 1 ROAD SAFETY ENGINEERING		
0900	Welcome – outlining the objectives of the workshop. Setting the scene, including introduction of participants.	National highway authority official
0930	Road Safety Engineering – the Essentials. Detailing what engineers can do to reduce road trauma. The extent of the global and national road safety problem and emphasizing “the road” in road safety.	Phillip Jordan
1030	BREAK	
1045	Technical knowledge for road safety engineers and auditors - Roadside hazard management – fundamentals to keep in mind during an audit or when treating a run-off-road problem. Understanding the clear zone concept and the 5-part roadside hazard management strategy.	Phillip Jordan
1230	LUNCH	
1330	Technical knowledge for road safety engineers and auditors - Signs, lines and delineation.	Phillip Jordan
1500	BREAK	
1515	Technical knowledge for auditors - Pedestrian safety. Remembering safety for the largest group of road users.	Phillip Jordan
1630	Workshop close - Day 1	National highway authority official

Day 2 INVESTIGATING BLACKSPOTS		
0900	Review of Day 1 – comments, questions, discussions.	Participants
0910	Investigating “high crash frequency” sites – taking crash data and turning it into useful information to assist with crash investigations. How to find crash patterns by using collision diagrams and crash factor grids.	Phillip Jordan
1030	BREAK	
1045	Recent examples of treating hazardous locations. This session will include several case studies for participants (using photographs and local crash data) to practise their blackspot investigations.	Phillip Jordan
1200	LUNCH	
1300	Travel to inspect local “blackspots”, investigate possible reasons for the crashes, and develop practical countermeasures.	All participants
1500	Return to the workshop venue and work in teams to prepare a short presentation of the key findings and recommendations.	All participants
1530	Case study presentations of blackspots by each team – 10 minutes each.	All participants
1630	Workshop close - Day 2	National highway authority official

Day 3 ROAD SAFETY AUDIT		
0900	Review of Day 2 – comments, questions, discussions.	Participants
0910	Introduction to Road Safety Audit – how, what, when, where, why.	Phillip Jordan
1030	BREAK	
1045	A “desktop” audit (drawings required). Participants will examine a set of drawings, “audit” them (<u>without</u> a site inspection) and will report their 2 or 3 main safety concerns to their colleagues.	All participants
1230	LUNCH	
1330	Technical knowledge for road safety engineers and auditors – road safety at road works.	Phillip Jordan
1500	BREAK	
1515	Technical knowledge for road safety engineers and auditors – principles of safe intersection design and control.	Phillip Jordan
1630	Workshop close - Day 3	National highway authority official

Day 4 ROAD SAFETY AUDIT		
0900	Review of Day 3 – comments, questions, discussions.	Participants
0910	Road safety audit case study. The session begins with a safety briefing and a description of the project(s). Participants are placed into teams of 3-4 before undertaking their audit inspection of the site by bus.	Participants in teams
1200	Return to workshop; begin preparing team RSA reports over lunch.	Participants
	LUNCH	
1330	Case study presentations by each team – 10 minutes each.	All participants
1515	BREAK	
1530	Managing the audit process – a national RSA policy, accreditation of auditors, terms of reference for audits, what to do with an audit report. Opportunities for discussions, local ideas and inputs from all participants.	Phillip Jordan, and inputs from all participants
1600	Workshop summary	National highway authority official Phillip Jordan