

Reducing Traffic Accidents in China: Strengthening the Use of Road Safety Audits

Fei Deng, Phillip Jordan, and Mike Goodge

World Bank, Washington, DC

China's road network is quickly expanding and the number of new drivers is growing rapidly, increasing the need to improve the road safety of new and existing road projects and traffic schemes. Road safety audits, when systematically implemented by a qualified and independent audit team, can drastically increase road safety and reduce the number and seriousness of car accidents at a low cost to benefit ratio. This note reviews the specific role of road safety audits, international experience and practices, and specific recommendations for improving the use of road safety audits in China. The establishment of a comprehensive national standard and provincial policies for road safety audits, training on road safety audits, along with an accreditation system for auditors are necessary for mainstreaming road safety audits in China.

INTRODUCTION

Road safety audits, a formal examination of the crash potential and safety performance of a future or existing road or traffic project, have been used by leading road authorities since the 1990s as an essential part of a set of tools to prevent crashes and protect road users. Implemented by independent and qualified audit teams, the audits ensure new road designs and traffic schemes are as safe as practical and prevent crashes, or at least minimize their effects.

In China, a 2004 *"Safety Assessment Manual for Highway Projects"* from the Ministry of Transport regulates and guides the use of safety audits. The manual recommends safety audits, but does not make it mandatory. While some provinces, such as Guangdong, Xinjiang, Henan, Hebei, Zhejiang, Sichuan, and Guizhou, already carry out more systematic safety audits, many opportunities exist to increase road safety in China by strengthening and mainstreaming the use of high-quality road safety audits.

It should be noted that audits will be an effective tool to manage road infrastructure safety only if they are carried out along with a comprehensive package of other tools, such as road safety

impact assessments, safety ranking of the road network in operation, regular safety inspections, accident data management, training and certification of safety personnel, and an exchange of best practices.

THE SPECIFIC ROLE OF ROAD SAFETY AUDITS

Roads and traffic schemes have always been designed with safety in mind. However, despite safety standards and good intentions, many new road projects quickly become crash "blackspots." A reason might be that the new road or traffic scheme—even though designed according to safety standards—increases motorist speeds. A new traffic scheme may also be biased towards motorized vehicles, often at the expense of pedestrians and other vulnerable road users. Moreover, the combination of different and possibly outdated or inappropriate standards, design team members working independently, or various design outputs inadvertently combining in a way that reduces road safety, can increase the number of crashes at a site.

In addition to problems in the design of a new project, changes during project construction can also lead to a degradation of safety when the effects of those changes are not fully analyzed. Finally, a new project may also inadvertently increase hazards on adjacent roads.

Road safety audits are designed to specifically address and prevent these kinds of unexpected increases in traffic accidents by providing an integrated assessment of a new (or existing) road project. By analyzing the situation—through a study of the design and a visit to the actual location—audits can identify problem areas and recommend improvements. Specific objectives are to:

- Minimize the risk of crashes on a new road project and minimize the severity of the crashes that do occur;
- Minimize the risk of crashes on adjacent roads (that is, to avoid the possibility that the project creates crashes elsewhere on the network);
- Ensure road safety for all road users, particularly slow moving traffic and pedestrians;
- Reduce the long-term costs of a new road project (considering that unsafe designs may be expensive or even impossible to correct at a later stage);
- Improve awareness of road safety engineering principles among all involved in road planning, design, construction, and maintenance.

By removing preventable crash producing elements (such as inappropriate intersection layouts) at the design stages and mitigating the effects of remaining problems by including suitable crash-reducing elements (such as anti-skid surfacing, crash barriers, and road signs), road safety audits provide a final and comprehensive safety check before a new road project or design scheme is built and put in use. Road safety audits will not necessarily make every new design completely safe, but they do help place safety higher on the decision making agenda and lead to deliberate decisions about safety aspects based on carefully considered advice.

INTERNATIONAL PRACTICE

Road safety audits are not a casual check, but vigorous and structured processes. The sound implementation of road safety audits by road

authorities requires addressing several key elements, including audit stages, project selection, audit steps, team qualifications, auditor accreditation, and the development and use of an audit manual. International experience suggests several approaches and good practices.

Audit Stages

Road safety audits can be undertaken at several or all six stages of a road development project:

- Planning (feasibility study)
- Preliminary design
- Detailed (final) design
- Construction (traffic management during road works)
- Pre-opening
- Post opening/existing road

Some countries (such as the United Kingdom) require audits at three or four of these stages, while others (such as Australia and New Zealand) require audits at all six. In addition to national requirements, the number of audit stages can also be decided by road authorities based on a road's planned level of service and available budget. In practice, audits at the preliminary and detailed (final) design stages yield best results. Audits during road works are necessary to protect road workers and road users. In both cases, audits are ideally performed early in the design or construction process.

Project Selection—Which Projects Should Be Audited?

While it would be best to audit every new road project or traffic scheme at each of its design and construction stages, road authorities around the world have to work with limited resources and use various approaches to decide on what projects and stages to audit. Countries may require audits for road projects above a certain monetary value, for certain classes of roads (such as expressways and highways), or for every stage of larger and more expensive road projects but at fewer stages (perhaps one or two) for lower-cost projects.

Steps in the Audit Process

In most countries, once an audit is agreed upon, the audit process itself consists of eight relatively straightforward steps:

- Selection of an independent audit team
- Provision of relevant project plans, drawings, and other documentation
- Commencement meeting¹
- Assessment through desktop study and site inspection
- Development of audit report and recommendations
- Report submission and completion meeting¹
- Project manager response to the report
- Actions to address safety concerns

It is important both the road agency and project manager understand and commit to the audit process. The road agency, through the project manager, is responsible for ensuring a high quality audit team is appointed. The same agency will also eventually need to resolve any outstanding safety issues in the project (especially those that rely on increased funding) and should closely follow project audits.

Audit Team Qualifications and Technical Capacity

The success of a road safety audit and its results in terms of reducing the number and impact of car accidents depends for a very large part on the qualifications and technical capacity of the audit team. The team also needs to be fully independent from the project design team. Only by exception (for example for a very small or low-volume and low-speed project) could a project be audited by a single auditor. Led by an experienced senior road safety auditor, the team should include members with a range of backgrounds related to road safety engineering,

¹ Commencement meetings and completion meetings tend to become unnecessary once a province or country becomes familiar with the audit process and after a number of audits have been carried out. Most times, the audit can be started and completed via emails and the electronic transfer of plans and reports.

blackspot investigation, traffic engineering, and civil engineering.

Auditor Accreditation

To ensure only qualified audit teams assess road projects, most countries take advantage of the Austroads² accreditation criteria for road safety auditors. Used by the Austroads network for more than 15 years, their set of criteria has become an internationally accepted system for auditor registration. To become and remain accredited, auditors are required to:

1. Have a minimum of five years of relevant experience in road design, traffic engineering, road safety engineering, or other closely related road safety discipline;
2. Successfully complete a road safety audit training course approved and recognized by a State Road Authority;
3. Participate in at least five road safety audits under the guidance and leadership of a senior auditor, of which at least three must be design stage audits and one a pre-opening or existing road audit; and
4. Participate in at least one audit per year to maintain practice and experience.

To become registered, a road safety auditor has to satisfy the first two criteria. After participating in five audits (the third criterion), an auditor can become a senior road safety auditor. The final criterion is a requirement for all registered auditors to maintain accreditation.

Use of a National Road Safety Audit Manual

Road safety audit manuals provide clear instructions and requirements for audit teams. Most countries have improved their audit processes after developing such a manual. A

² Austroads is the association of Australian and New Zealand road transport and traffic authorities, which consist of the six Australian state and two territory road transport and traffic authorities, the Department of Infrastructure and Transport, the Australian Local Government Association and the New Zealand Transport Agency.

manual cannot provide all the necessary technical knowledge for the auditors, but overviews, instructions, case studies, and photos or videos of common safety concerns can strengthen and promote consistency among road safety audits. The United Kingdom, Australia, Canada, and Dubai have well regarded manuals that have been prepared or revised in recent years. A number of other western European nations also have developed useful audit manuals recently.

Organizational Arrangements

Road authorities have made various arrangements to include audits and road safety specialists' advice, with specific arrangements usually depending on available resources. Possible arrangements are:

1. *Formal approval of a road design by a specialist audit team.* A qualified team of road safety experts audits and formally approves each design before a scheme can advance to the next stage.
2. *Specialist advice reported to an independent project manager.* A specialist safety team prepares an audit report and submits it to a third party (usually an independent senior manager) who decides on possible actions and also directs the design team as necessary.
3. *Specialist advice reported to the designer.* A specialist safety team submits its report to the original designer who determines what actions to take.
4. *Second design team audit.* The second design team audits the first design team's work and reports back to the first team. The first team decides whether to accept or reject the audit recommendations.
5. *Audit by second design team, reporting to an independent assessor.* A second design team audits the work of the first design team, with the audit report reviewed by an independent assessor who decides on actions to take.

6. *Own team audit.* An individual in the design team acts as auditor. (Independence may be difficult to show in such arrangements, but this is generally better than no road safety audit at all.)

Arrangements vary among road authorities, but in general larger road authorities are encouraged to develop and use specialist audit teams or have adequate numbers of specialist auditors in a private consultant pool.

ECONOMIC COSTS AND BENEFITS

A common perception is that road safety audits are costly, not produce any useful results, and only increase project costs (by requiring new work) and lengthen the project's overall design and approval process. Several studies, however, show the opposite and highlight the benefits of implementing road safety audits early on in the design process.

Indicative costs from Australia for example suggest that auditing a new large-scale project at four stages will add only 4-10 percent of the total costs of the road design, or about 0.5 percent of the total project cost. This percentage is even less for larger projects.

A British study, designed to quantify the benefits of road safety audits, compared before and after crash statistics for a sample of audited and non-audited traffic schemes and found that traffic schemes that had been audited achieved an average casualty saving per year of 1.25 person, compared to a saving of 0.26 person for non-audited schemes. A second British study estimated that the average saving from implementing changes at the design stage rather than after construction was approximately US\$20,000.

Another cost-benefit analysis in Denmark compared real audited projects to simulated models of the same roads without the implementation of audit recommendations. The analysis yielded a first year rate of return of 146 percent. A study in Jordan, which reviewed

projects that had not been audited but developed problems soon after construction, compared an estimation of crashes that would have likely been avoided by remedial safety audit recommendations to actual crash data. The study concluded that a road safety audit would have provided a first year rate of return of 120 percent. Finally, an Australian study indicated an average benefit/cost ratio of 36:1 for audits of road projects at the design stages, and of 6:1 for audits of existing roads.

In general, benefits of road safety audits range from specific benefits at the site to broader community and macro-level benefits, with those benefits quickly offsetting any costs. At the community level, the benefit of preventing even one casualty already far outweighs the cost of a full audit. Comparatively, the resources necessary for an audit are in fact quite small, and, over the whole life cycle of a road, will be more than recouped from savings, including crash cost and road furniture maintenance savings. On a macro level, road safety audits contribute to establishing a combination of crash reduction targets, generally fostering the importance of road safety engineering, raising awareness for the safety needs of all road users, and continually improving safety standards and procedures.

IMPROVING ROAD SAFETY AUDITING IN CHINA

Since its first introduction of road safety audits in the mid 1990s, China has gained limited experience using audits to strengthen road safety. Recently, new academic research is contributing to a programmatic approach to road safety, using both quantitative and qualitative methods to study key traffic safety topics. These research areas will likely improve the implementation of road safety audits and strengthen road safety culture in China.

Despite a general awareness among road administrators, road engineers, and researchers of the potential use of road safety audits, few road professionals in the public sector in China have been involved in road safety audits and most lack relevant knowledge and training.

When audits are performed, most project owners engage auditors from research institutes, consulting firms, or design institutes (sometimes also involving traffic police) to carry out the safety audit.

Specifically, China's system for road safety audits is weak in the following five key areas:

1. *Regulatory framework and sector mandates.* Few provincial road authorities have policies covering road safety audits and sector mandates are unclear.
2. *Technical Guidelines.* While a "Safety Assessment Manual for Highway Projects" exists, the robustness and practicality of the technical manual could be further improved.
3. *Follow-up to project recommendations.* Audits are not just intended to document issues, but must be followed by actions to improve safety. In many cases in China, however, audit completion is not followed by remedial actions. Legal enforcement to ensure a project owner responds in writing to each audit recommendation (to either confirm acceptance or justify rejection) is lacking.
4. *Process independence.* Audit teams must be fully independent of the project. At the moment, this does not seem to be the case for projects across China, with audit teams often mingled with design teams.
5. *Auditor qualifications and accreditation.* Addressing China's shortage of skilled road safety engineers and subsequent lack of experienced road safety auditors will take time but is important. The general skill level could be increased through formal training, professional development, and use of international experts. An accreditation system can regulate audit team qualifications.

Action Steps

To strengthen the use of road safety audits for reducing traffic accidents and impacts, China could take advantage of the experience of other countries with more mature audit systems. Specifically, China is encouraged to:

- *Develop a comprehensive national audit standard.* This Road Safety Audit Standard should not only include the technical aspects of audits, but more importantly also address institutional arrangements and procedures in the Chinese context.
- *Improve the technical guidelines for road safety audits.* A practical road safety audit manual (supported by resources on DVD) will strengthen and streamline audits. China should select a style of manual that suits its needs and proceed quickly to develop a local Chinese audit manual.
- *Develop provincial road safety audit policies.* Provincial road authorities without an audit policy should be encouraged to develop one. Policies can follow a basic template and reflect local resources and safety needs. In general, each province should consider the terms and conditions for the following three issues: making road safety mandatory, engaging fully independent audit teams, and legally enforcing proper actions to be taken in response to audit recommendations.
- *Provide training about road safety audits to project managers and auditors.* Widespread trainings and workshops across the country, combined with a mentoring program for auditors (with experienced, possibly international auditors guiding new auditors), will be necessary for several years to increase awareness and skills among project managers and auditors.
- *Establish an accreditation system.* A register of accredited auditors (either on a provincial or national basis) will provide reassurance to road authorities

about auditor qualifications and support the development of an “audit profession” in China, with status and professionalism.

The implementation of safety audits has helped integrate safety aspects into all levels of decision making for new road projects and traffic schemes by road authorities around the world. With China building new roads, highways, and expressways at a pace unmatched in the world, the time is right to adopt road safety audits for the benefit of all road users.

Fei Deng is a Senior Transport Specialist in the East Asia Sustainable Infrastructure Department at the Washington, DC Office of the World Bank. She is the road safety focal point for the East Asia and Pacific Region.

Phillip Jordan is the Managing Director/Principal Consultant of Road Safety International. He is well known for his work on road safety audits, blackspot investigations, and road safety engineering training.

Mike Goodge is a road safety audit specialist who lives and works in Asia. He is an Associate of Road Safety International.

Chengcheng Tang from Research Institute of Highways under MOT (China), Geoffrey Kurgan and Yi Yang, Transport Associates of the World Bank, also contributed to the note.

This note is part of the China Transport Note Series to share experience about the transformation of the Chinese transport sector. For comments, please contact Fei Deng (fdeng@worldbank.org).

Any findings, interpretations, and conclusions expressed herein are those of the authors and do not necessarily reflect the views of the World Bank. Neither the World Bank nor the authors guarantee the accuracy of any data or other information contained in this document and

*accept no responsibility whatsoever for any
consequence of their use.*