Application of Methodology of Road Safety Audit & Road Safety Inspection

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Abstract

In a Road Safety Audit (RSA) and a Road Safety Inspection (RSI) the road infrastructure's safety level is tested. RSA tests the design of new roads or the reconstruction of existing roads, whereas RSI tests existing roads. RSA, therefore, aims to 'improve' the road safety before the road has been built or reconstructed. At present, not many RSA are carried out in Iran, but the few experiences that there are promise positive effects on road safety. The RSA has also shown its value in other countries. Making use of the RSA should therefore be encouraged. The RSA should become a quality brand name and should be anchored in a road authority's policy by means of subsidy, precondition, or obligation. RSI not only can be carried out periodically on an entire network, but also incidentally on road sections that have an above average number of crashes. Various judging methods are used in RSI, none of which have standardized procedures. For a more systematic use of RSI such standardization is desirable. One of the accompanying measures in the Start-up Program Sustainable Safety concerned the development and introduction of the road safety audit instrument in Iran. For this purpose Transportation Research Institute in 2004 developed Road Safety Audit Manual that was tested during the 2005/2006 period the experiences during this trial period have led to a number of RSA workshop RSA projects and have been incorporated in the final edition of Road Safety Audit Manual. The RSA is not yet fully applied on a large scale in the Iran. The RSI and RSA have many similarities. However, the RSI involves experts regularly and systematically visually inspecting the existing road network for all sorts of faults. In this paper both protocols have been fully discussed and due to the gap created in the understanding of RSA and RSI the author have suggested a methodology which would be most suitable for Iran and discusses the RSA and RSI and the road safety influence they can have.

Keywords: Road Safety Audit, Road Safety Inspection, Safety Improvements, RSA Guideline

Introduction

One of the accompanying measures in the Start-up Program Sustainable Safety concerned the development and introduction of the road safety audit instrument in Iran. For this purpose SWOV developed a provisional audit protocol [1] that was tested during an 18-month period [2]. The experiences during this trial period have led to a number of changes and simplifications, and have been incorporated in a road safety audit manual of the Info-Point Sustainable Safety [3]. The RSA is not yet applied on a large scale in the Netherlands. The closely related RSI isn't used much either. The fact sheet published will discuss both the RSA and RSI and the road safety influence they can have [4].

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What are RSA and RSI?

In both RSA and RSI the road infrastructure is only tested for its road safety. When the design of new roads or of the reconstruction of existing roads is tested, it is called RSA. The test of an existing road is called RSI [2] completes this definition of RSA as follows: it is a formal, standardized procedure in order to reach an independent judgment of the possible road safety consequences of the design. RSA has a preventative character and aims to signal any potential road safety problems before the infrastructure is actually built, and to make suggestions for improvements. RSA thus fits perfectly in Sustainable Safety.

The RSI and RSA have many similarities. However, the RSI involves experts regularly and systematically visually inspecting the existing road network for all sorts of faults. Checklists are usually used to this end. No formal definition of RSI has yet been made.

Who are RSA and RSI meant for?

Both instruments are intended to be used by road authorities. In RSA, the designers who make traffic plans and an audit team carrying out the RSA are involved. In RSI, besides the road authority, one or more inspectors are involved who carry out the inspection.

How does RSA and RSI work?

RSA

RSA is not obligatory in the Iran. It is the road authority's responsibility whether or not to have RSA carried out. The road authority also decides in which phase or phases the RSA is carried out. The road authority itself can decide to have RSA carried out, but it is also possible that a third party, a citizen group or special interest group for example, submits a request to the road authority. The road authority approaches a suitable auditor with a written and signed request for RSA. This request contains a short description of the project, which phase it is in, which information is available (e.g. overall design, categorization plan, specifications, and drawings), and whether RSA was carried out in an earlier phase. The auditor is an expert on road design, behavior, and road safety who is not, or has in no way been, involved in the project, and has successfully completed a course in auditing. Depending on the size of the project, its complexity, and the required expertise, it can be decided to carry out the RSA with an audit team of at least two auditors. This audit team studies the information, possibly visits the location, and tests the design for its road safety. The knowledge and expertise of the auditor or auditors are of the utmost importance. The auditor can use checklists to support him. A checklist ensures the structure in the RSA, examines whether important aspects have been forgotten, and whether all relevant groups of road users have been taken into account. The findings of the audit team are put down in an audit report [3]. This audit report contains an overview of the documentation used, the circumstances during the visit to the location, the design's potential safety problems, and

suggestions for improvements. The audit report is presented to the client who then decides which of the recommendations are to be followed and implemented. This decision is then communicated in writing to the audit team. If certain recommendations are not followed, the motivation must be given.

RSI

Two types of RSI can be distinguished. The first one inspects the entire network periodically, irrespective of the number of registered road crashes. The second approach selects road sections by current numbers of crashes. Road sections with a greater than average crash rate then receive priority in RSI. This approach closely resembles what are known as black spot analyses. RSI involves a visual inspection of the road surface condition, and special equipment is used to measure the underground situation of the road. With these results, priorities are set and reconstruction designs drawn up that can be carried out in the more or less short term. These measures can but need not be combined with small or large road maintenance. There are no standardized procedures for carrying out, RSI various countries regard different activities as being part of RSI. According to research [5] in Austria these include, for example, an analysis of crashes, an analysis of traffic conditions, and an analysis of constructive road elements, an inspection on location, meetings and interviews with maintenance departments and traffic police, and analyses of the road surface (texture, evenness, composition, skidding resistance, etc.) and its environment (edge strip, shoulder, etc.). After RSI has taken place, the following measures, for example, can be taken: installation of speed cameras at specific road sections, improving the visibility of road markings, applying speed warning systems, correction of side slopes, etc.

Which roads qualify for RSA or RSI?

In principle, all projects in which new infrastructure is constructed, or where the existing infrastructure is being radically changed, are candidates for RSA. They can involve municipal as well as provincial roads, water board roads, and state roads. The size of the project and the extent to which a road safety problem is expected determines the necessity of RSA. Preferably, RSA are carried out in all five project phases:

- The overall planning (feasibility study, road scheme appraisal)
- The preliminary design
- The detailed design (specifications and drawings)
- After completion but before opening or reopening
- Some months after opening or reopening

During each phase the question is answered whether all possibilities of optimizing road safety have been sufficiently utilized and if this applies to all categories of road users and under all weather conditions. The phase in which an audit is the most effective differs per project. The most important and largest projects, such as constructing new motorways and trunk roads, should undergo RSA during all phases. For less extensive projects such as reconstructing or widening existing roads, the RSA is recommended in the phases 1 or 2 as well as in the

phases 3, 4, and 5. Smaller projects, such as laying out cycle paths, should preferably have at least one audit in phases 1, 2, or 3 and one audit in phase 4 or 5. For spatial development plans, only an audit in phase 1 is recommended. RSI can also be carried out on existing municipal as well as existing provincial roads, water board roads, and national roads. Experience has shown [4] that road authorities subject higher order roads to RSI sooner than lower order roads.

RSA

The RSA was first used in England in 1980 and was quickly adopted in Australia and New Zealand and in Europe by Denmark, France, Norway and Iran [6]. The RSA is generally considered a valuable instrument to guarantee road safety in design plans, and to create support from designers. However, disadvantages are also mentioned [7] besides the costs of carrying out RSA, it also results in a delay of the design process or implementation process, depending on the phase in which the audit takes place. The Netherlands has gained experience with the RSA in seven trial projects with municipalities, provinces, and the state as commissioning road authorities; the RSA was carried out in various project phases. The result of trial projects is that the RSA can function well and that a positive road safety contribution is to be expected [2]. After initial skepticism among road authorities on the RSA's value in proportion to the effort involved, they were ultimately satisfied with the results. They found the audit particularly useful as a second opinion, especially if the plans had been made externally. The audit was also found useful because it made clear how far the ultimate plans deviated from the original starting points. Most of the parties involved indicated that they would consider an audit in future projects, although the costs could be a problem. As a result of the experiences during the trial period it was recommended to improve the RSA's contents and procedure, and to increase the demand for it. In 2002 the Provincial Road Safety Board (POV) Zuid Holland started a project to stimulate the use of the RSA [7]. Road authorities received a subsidy to carry out an audit on one of the current road projects. In this way the POV enabled a total of five municipal road authorities to gain experience with RSA. In 2004 the POV once more offered the road authorities in Zuid Holland subsidies for carrying out RSA. The project resulted in a number of possibilities for improvement in the RSA and possibilities for stimulating its use.

RSI

A recent European study [8] studied the present application of RSI in the EU. Countries apparently use different definitions of RSI: mostly a mix of RSA, RSI, and black spot analysis. It is often decided to carry out RSI if a road section has a high crash rate. In Germany, Hungary, Norway, and Portugal the national road authorities often carry out RSI during maintenance inspections. RSI have no legal basis, meaning that there is no large necessity of carrying out. That is why the EU project is attempting to come to a standardized approach of RSI in Europe, to develop an implementation plan and checklists, and will carry out a number of trial projects.

Alternatives for RSA or RSI

Besides the RSA and RSI there are other methods of testing the safety level of the road infrastructure, such as the European Road Assessment Programme (EuroRAP) and the Sustainable Safety Indicator (DV-meter). The opinion of experts is central to the RSA and RSI, whereas EuroRAP and the DVmeter work with quantitative scores. These scores indicate the extent to which the characteristics of existing or planned roads correspond with safety guidelines. Using road characteristics and numbers of crashes EuroRAP has different ways of objectively judging roads. One of the methods is the Road Protection Score (RPS) which awards a number of stars to show the extent to which safety measures have been taken. Measures can then be taken on roads with a low score to improve road safety.

The Sustainable Safety Indicator was developed to test to what extent infrastructural plans meet the Sustainable Safety requirements. This testing can take place in various design phases; therefore there is no need to wait until after completion. The Sustainable Safety Indicator examines the various measurable aspects of the design (indicators) that are closely related to the Sustainable Safety requirements. The indicators chosen for each requirement were specified by [17].

Results of RSA and RSI

RSA

RSA produces a list of bottlenecks in the design that have a negative road safety effect. For these bottlenecks suggestions are made for improvements which could prevent crashes. Furthermore, experience of RSA emphasizes the importance of having safety as an explicit criterion in road design. RSA also provides the certainty that all measures to eliminate or reduce any design problems have been considered. The earlier in the process that possible problems are traced the easier and cheaper it is to correct them. The further the plans have been elaborated or even implemented, the more difficult it is to reverse previously made decisions.

RSI

RSI leads to insight in the road safety aspect of infrastructure. Partly based on this it is possible to draw up a maintenance program, road safety measures can be taken, or essential reconstruction can take place.

Costs & benefits of RSA and RSI

RSA

The benefits of RSA are mainly the costs saved on crashes that have been prevented by following the audit's recommendations. In addition [9] a series of qualitative benefits: after completion a diminished risk of crashes and the repair works resulting from them, a reduction of the total project costs, a greater awareness of road safety and

quality in design processes, better facilities for vulnerable road users, and a contribution towards achieving road safety targets, better standards, and design guidelines. The costs of RSA can vary greatly depending on the size of the project and the phase in which the audit takes place. A distinction can be made between direct and indirect costs. The direct costs are the time spent by auditors and the extra time that designers need to include the recommendations in the design. Experiences in Denmark estimate the direct costs to be an average of 1% of the total project costs. In Australia they vary between €600 and €6,000, an average of only 0.2% of the total project costs [10]. In the Netherlands the direct costs during the trial audits were between €3,200 and €4,600 [2]. The earlier in the process an initial RSA is carried out, the lower the relative costs. The indirect costs are the extra costs of construction and reconstruction activities recommended by the auditors. Estimates of experiences abroad are between 1% and 2% of the total project costs. In smaller projects the direct and indirect costs of RSA are relatively greater than in large projects. Based on a literature study RSA is generally cost effective. In four studies, they found that the economic advantages of RSA had actually been quantified [11].

In a Study by Surrey County Council [12] compared 38 reconstruction plans of which half had been subjected to RSA and the other half had not. The annual average numbers of casualties saved declined by 1.25, from 2.08 to 0.83 on the reconstructed roads where RSA had been carried out. On roads where no RSA had been carried out, the annual average number of casualties declined by 0.26, from 2.60 to 2.34. However, it is by no means clear if the large decline on roads where RSA was carried out was exclusively attributable to the RSA: the reconstruction activities, those with RSA and those without RSA were not really comparable.

The UK Highways Administration carried out a study of 22 projects on the main road network in which RSA had been carried out and implemented during the design phase [13]. The project weighed the implementation costs of the audit recommendations against the costs if the necessary Changes had not been implemented in the design phase, but had to be corrected at a later phase. The average benefit of making changes in the design phase was about €17,000. A 1995 study in Denmark was aimed at 13 projects that had undergone RSA [14]. The number of crashes if no RSA had taken place was estimated. The savings of crash costs resulted in a profitable cost-benefit ratio of 1.46, or 1:1.5.

A study in Jordan focused on projects in which no RSA had taken place and where, shortly after the projects were completed, road safety problems occurred [15]. The study assumes that the necessary repair works after the crashes would have been included in the initial design if RSA had been carried out. The number of crashes that could have been prevented was estimated, resulting in a cost-benefit ratio of 1.2. Besides their literature study [11] another nine Australia RSA carried out in the design phase. The cost-benefit ratios of the implementation of audit recommendations were all positive and amounted to between 2 and 242 per project. Individual recommendations in these RSA have cost-benefit ratios between 0.06 and 2,600. 90% of these have a positive cost-benefit ratio (>1) and for 75% of the recommendations the benefits were more than ten with due acknowledgement times as large as the costs; i.e. a cost-benefit ratio of >10. However, for 65% of the recommendations the implementation costs were less than €800. It is difficult to believe that such small alterations have large road safety effects.

RSI

As there is not yet any standardized approach to RSI, it is difficult to compare the costs and benefits of the various RSI approaches. [11]. not only studied the effects of RSA, but also those of RSI. More than 78% of all implemented recommendations had a positive cost-benefit ratio (>1) and about 47% even had a very positive one (> 5). Which hindrances and possibilities are there for the introduction of RSA and RSI? At this moment in time audits and inspections are not structural parts of an infrastructure project. The potential commissioners have little or no demand for such an instrument as the RSA; this was also the case [2]. Especially those without any direct experience with an audit have reasonable doubts about its value, which are reinforced by the costs and extra work that accompany RSA. What is more, it the purpose of explicitly separating road safety from the other aspects that determine a plan and a design is often unclear; the other aspects being urban development starting points, economic motives, and environmental demands. However, the analysis of showed [2] in general in the trial audits were successfully carried out, the clients also being satisfied.

However, the large majority of road authorities does not have any concrete experience of an audit and doubts its value. This negative attitude is strongest among municipal road authorities, but provinces, water boards, and the national authorities are also critical. This is partly due to a lack of practical examples. As is the case with the RSA, carrying out RSI costs extra money and there is no legal obligation for such an inspection. What also plays a role is that there is no standardized RSI procedure. Recently, the European Commission has proposed a guideline which involves that each EU country has to draw up procedures for the RSA and the RSI and apply them to, in any Road Network. For the Netherlands this guideline means that RSI procedure must be agreed upon. Roads in the Netherlands consist mainly of motorways, for which only the state is the road authority and, as such, is responsible for guideline implementation. SWOV is striving for a system of quality assurance in designing the road traffic system [16] Instruments such as the RSA, the RSI, as well as EuroRAP and the Sustainable Safety Indicator, can fulfill a role in this as test instruments.

Conclusions

The RSA has proven its road safety value abroad and, based on the trial audits and the small number of 'real' audits in the world, it can be concluded that the RSA can contribute to road safety. However, large contributions are not to be expected because usually small alterations of the design are concerned. The demand for RSA needs to be stimulated. For one, this can be done by clearer communication with the road authorities involved about the purpose and status of RSA and the process phases in which RSA is desirable, and second, by creating a demand for RSA in management, politicians, and special interest groups. To do this, the RSA needs to be a quality brand name and be given a management anchorage in the form of subsidy, precondition, or obligation. RSI can also contribute to road safety. It is necessary to draw up a standard procedure for RSI, after which a number of trial projects can be initiated and carried out which can serve as a basis for improvements.

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