SWOV Fact sheet

The Road Safety Audit and Road Safety Inspection

Summary
A road safety audit (RSA) and a road safety inspection (RSI) are used to test the safety level of the road infrastructure. The RSA tests the design of new roads or the reconstruction of existing roads, whereas the RSI is used for testing existing roads. An RSA, therefore, aims to 'improve' the road safety before the road is built or reconstructed. At present, not many RSAs are carried out in the Netherlands, but the few experiences gained predict positive effects on road safety. The RSA has also shown its road safety value in other countries.

An RSI can also contribute to road safety. An RSI can be carried out periodically on an entire network, but also on road sections that have an above average number of crashes. Various assessment methods are used in RSIs, none of which have standardized procedures. For a more systematic use of RSIs such standardization is desirable. Little is known about the effects of an RSI.

Background
One of the accompanying measures in the Start-up Programme Sustainable Safety (1997) concerned the development and introduction of the road safety audit instrument in the Netherlands. In 2000, SWOV developed a provisional audit protocol for this purpose which was tested over an 18-month period (Van Schagen, 2000). The experiences during this trial period resulted in a number of changes and simplifications, which were incorporated in a road safety audit manual published by the Info-Point Sustainable Safety (Feijen & Van Schagen, 2001). The Dutch company DTV Consultants offers courses to become a certified auditor for roads managed by the national road authority (since 2012) and for other roads (since 2001). The road safety audit (RSA) is not applied on a large scale in the Netherlands. The closely related road safety inspection (RSI) isn't used much either. EU Directive 2008/96/EG (EP & R, 2008) makes the RSA and the RSI compulsory for roads that are part of the Trans-European road network. In the Netherlands, the Directorate-General for Public Works and Water Management has introduced the Directive for all national trunk roads, including non-motorways.

This fact sheet will discuss both the RSA and RSI and the road safety effect they may have.

What are RSAs and RSIs?
Both an RSA and an RSI test the road infrastructure exclusively for its road safety. When the design of new roads or of the reconstruction of existing roads is tested, an RSA is carried out. The test of an existing road is called an RSI. Van Schagen (2000) completes this definition of an RSA as follows: it is a formal, standardized procedure in order to reach an independent assessment of the possible road safety consequences of the design. An RSA has a preventive character and aims to signal any potential road safety problems before the infrastructure is actually built, and to make suggestions for improvements. Therefore an RSA fits perfectly within the Sustainable Safety vision.

The RSI involves experts visually inspecting the existing road network for all sorts of faults regularly and systematically. This is usually done using checklists that are similar to those used in the RSA. The European Directive 2008/96/EG defines an RSI as "an ordinary periodic assessment of a road's features and deficiencies which from a road safety perspective make maintenance necessary" (EP & R, 2008).

Both instruments are intended to be used by road authorities. An RSA involves the designers of the traffic plans and an independent audit team carrying out the RSA. In addition to the road authority, an RSI involves one or more road safety experts who carry out the inspection.

How do RSA and RSI work?

RSA

At present, an RSA is compulsory in the Netherlands only for national roads, according to European Directive 2008/96/EG. For other roads a road authority decides if and in which phase(s) a road will be subjected to an RSA. This decision is sometimes taken on request of other parties like residents' associations and interest groups. The road authority approaches a suitable auditor with a written and signed request for an 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 an RSA was carried out in an earlier phase. The auditor is an expert on road design, behaviour, 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 have the RSA carried out by an audit team of at least two auditors. This audit team studies the information, may visit the location, and assesses the road safety of the design 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 that the RSA is carried out in a structured manner, prevents important aspects being forgotten, and checks whether all relevant groups of road users have been taken into account.

The findings of the audit team are laid down in an audit report (Feijen & Van Schagen, 2001). 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

Like the RSA, the RSI will also be compulsory for all national roads in the Netherlands from late 2012. For all other roads the road authorities can decide whether or not an RSI needs to be carried out. 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 based on the current numbers of crashes. Road sections with a higher than average crash rate then receive priority for an RSI. This approach closely resembles the so-called *black spot analyses*.

In an RSI experts, usually with the aid of a checklist, investigate whether the condition of the road and the traffic situation will lead to problems. In the Netherlands, the Directorate-General for Public Works and Water Management has already applied this method making use of so-called 'traffic auditors' from the Netherlands Traffic Management Centre (VCNL) who, among other things, also use the RSA checklists. On the basis of these results, priorities are set and reconstruction designs drawn up to be carried on the short or the longer term. These measures may or may not be combined with small or large road maintenance. As yet, there are no standardized procedures for carrying out an RSI. The Directorate-General for Public Works and Water Management will decide on such a procedure in the course of 2012.

Different countries regard different activities as part of an RSI. An inventory in 11 European countries (Lutschounig et al., 2005) shows that an RSI can include the following activities: an analysis of crashes, an analysis of traffic conditions, 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 an RSI has been carried out, 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. The European RIPCoRD-ISEREST project has drawn up 'best-practice guidelines' (Cardoso et al., 2007) which are based on the experiences in different European countries. These guidelines are a directive for the procedures and the content of an RSI, as well as an approach for the introduction of an RSI.

Which roads qualify for an RSA or RSI?

All projects in which new infrastructure is constructed or where the existing infrastructure is being radically changed are, in principle, candidates for an RSA. These projects may involve municipal as well as provincial roads, water board roads, and national roads. The size of the project and the extent

to which a road safety problem is expected determine the necessity of an RSA. Preferably, RSAs are carried out in all five phases of a project:
1. the overall planning (feasibility study, road scheme appraisal, categorization plan);
2. the preliminary design;
3. the detailed design (specifications and drawings);
4. after completion but before opening or reopening;
5. 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 the construction of new motorways and trunk roads, should undergo an RSA in each of the phases. For less extensive projects such as reconstruction or widening of existing roads, an RSA is recommended in phases 1 or 2 as well as in the phases 3, 4, and 5. Smaller projects, such as laying out bicycle 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.

RSIs can also be carried out on existing municipal as well as existing provincial roads, water board roads, and national roads. Experience has taught us that road authorities subject main roads to an RSI sooner than local roads.

What are the experiences with RSA and RSI?

RSA

The RSA was first used in England in the 1980s and was readily adopted in Australia and New Zealand and in Europe by Denmark, France, and Norway (Belcher et al., 2008). The RSA is generally considered a valuable instrument to guarantee road safety in design plans, and to help designers gain affinity with road safety create affinity. However, disadvantages are also mentioned (Van Hout & Kemperman, 2004): in addition to the costs of carrying out an RSA, it may also delay the design process or the implementation process, depending on the phase in which the audit takes place.

In the Netherlands the first experiences with the RSA were gained in seven trial projects with municipalities, provinces, and the state as commissioning road authorities; the RSA was carried out in different project phases. These trial projects indicate that the RSA is an instrument that may function well and that a positive road safety contribution is to be expected (Van Schagen, 2000). After initial scepticism among road authorities about 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 much 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. The experiences during the trial period resulted in recommendations to improve the RSA's contents and procedure, and to increase the demand for the RSA.

In 2002, the Provincial Road Traffic Safety Authority (POV) Zuid Holland started a project to stimulate the use of the RSA (POV Zuid-Holland, 2004). Road authorities received a subsidy to carry out an audit on one of their current road projects. In this way the POV enabled a total of five municipal road authorities to gain experience with an RSA. In 2004 the POV once more offered the road authorities in Zuid Holland subsidies for carrying out an RSA. The project resulted in a number of possibilities for improvement of the RSA and possibilities for stimulating its use.

RSI

A recent European study (Lutschounig et al., 2005) investigated the present use of RSIs in the EU. The study showed that countries use different definitions of an RSI: mostly a mix of RSA, RSI, and black spot analysis. It is often decided to carry out an RSI if a road section has a high crash rate. In Germany, Hungary, Norway, and Portugal the national road authorities often carry out an RSI during maintenance inspections. Furthermore, there is no legal basis for RSIs, which means that no urgency is felt to carry them out.

What are the costs and benefits of an RSA and an RSI?

RSA

The benefits of an RSA are mainly the costs saved on crashes that have been prevented by following the audit's recommendations. In addition, Gadd (1997) mentions 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 an 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 costs of a project. In Australia the direct costs vary between € 600 and € 6,000, an average of only 0.2% of the total project costs (Van Hout & Kemperman, 2004). According to Van Schagen (2000) the direct costs during the trial audits in the Netherlands were between € 3,200 and € 4,600; at the present price level this would be between € 4,300 and € 6,600. The earlier in the process an initial RSA is carried out, the lower the relative costs in proportion to the total costs.

The indirect costs are the extra costs of construction and reconstruction activities that result from the auditors' recommendations. Estimates based on international experiences are between 1% and 2% of the total project costs. In smaller projects the direct and indirect costs of an RSA are relatively higher than in large projects.

Based on a literature study, Macaulay & McInerney (2002) maintain that an RSA is generally cost-effective. In four studies, they found that the economic advantages of an RSA had in fact been quantified.

Surrey County Council (1994) compared 38 reconstruction plans half of which had been subjected to an 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 an 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 an RSA was carried out was exclusively attributable to the RSA: the reconstruction activities on roads with an RSA and those on roads without an RSA were not really comparable.

The UK Highways Administration was in charge of a study of 22 projects on the main road network in which an RSA had been carried out during the design phase and the recommendations were implemented (Wells, 1999). 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 needed to be corrected at a later phase. At that time, the average benefit of making changes in the design phase was more than € 17,000, which would have been € 23,000 at the 2009 price level.

A 1995 study in Denmark focussed on 13 projects that had undergone an RSA (DRD, 1995). The number of crashes if no RSA had taken place was estimated. The savings on crash costs resulted in a cost-benefit ratio of 1:1.46.

A study in Jordan focussed on projects in which no RSA had taken place and where road safety problems occurred a short time after the projects had been completed (Al-Masaeid, 1998). The study assumed that the repair works that were necessary after the crashes occurred would have been included in the initial design if an RSA had been carried out. The number of crashes that could have been prevented was estimated, resulting in a cost-benefit ratio of 1:1.2.

In addition to their literature study, Macaulay & McInerney (2002) studied another nine Australian RSAs carried out in the design phase. The cost-benefit ratios of the implementation of audit recommendations were all positive and amounted to between 1:3 and 1:242 per project. Individual recommendations in these RSAs have cost-benefit ratios between 1:0.06 and 1:2,600;. 90% of these have a positive cost-benefit ratio and for 75% of the recommendations the benefits were at least ten

times higher than the costs. However, for 65% of the recommendations the implementation costs were less than € 1,000. It is difficult to believe that such small alterations have large road safety effects.

RSI
As there is not yet any standardized approach for RSIs, it is difficult to compare the costs and benefits of different RSI approaches. Macaulay & McInerney (2002) not only studied the effects of RSAs, but also those of RSIs. More than 78% of all implemented recommendations had a positive cost-benefit ratio and for about 47% the benefits were twice the costs.

Which hindrances and possibilities are there for the introduction of RSAs and RSIs?
At present, audits and inspections are not yet structural parts of an infrastructure project. The potential commissioners have little or no demand for such an instrument as the RSA; this was also observed in Van Schagen (2000). Especially those without any direct experience with an audit have considerable doubts about its value, and these are reinforced by the costs and extra work that accompany an RSA. What is more, the purpose of explicitly considering road safety separately from other aspects that determine a plan, such as urban development starting points, economic motives, and environmental demands, is often unclear. However, the analysis by Van Schagen (2000) indicated that generally the trial audits were carried out to everyone's satisfaction, including to that of the clients. However, the large majority of road authorities do not yet have any concrete experience of an audit and doubt 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.

SWOV aims at a system of quality assurance in designing the road traffic system (Wegman & Aarts, 2006). Instruments such as the RSA, the RSI, as well as EuroRAP and the Sustainable Safety Indicator, can fulfil a role in this as test instruments. As mentioned earlier, the European Directive 2008/96/EG (EP & R, 2008) makes the RSA and the RSI obligatory for the Trans-European road network. In the Netherlands, the Directorate-General for Public Works and Water Management applies the Directive to all national roads (including non-motorways). In 2012, the first road safety auditors for national roads were trained (Moning, 2012).

Conclusion
The RSA has internationally proven its road safety value and, based on the trial audits and the small number of 'real' audits in the Netherlands, 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 an 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 an RSA and the process phases in which an RSA is desirable, and second, by creating a demand for RSAs 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. An RSI can also contribute to road safety. It is necessary to draw up a standard procedure for RSIs, 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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(SWOV reports in Dutch have a summary in English)

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