EXPERIENCES WITH ROAD SAFETY AUDITS AND INSPECTIONS

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ABSTRACT

The instruments of Road Safety Audits (RSA) and Road Safety Inspections (RSI) are part of the Road infrastructure safety management. With the official recommendations for Road safety audits this method was introduced in Germany in the year 2002. Following the European Directive 2008/96/EC and taking into account the experiences from more than 13 years of auditing the German recommendations are actualized and upgraded at the moment to a mandatory standard including RSA and RSI requirements.

While the first road safety auditors in Germany were trained for motorways and rural roads the author developed together with other institutions the certification course and the RSA process for urban roads and residential roads. Germany might be the only state, where Road Safety Auditors are certified for different road categories and especially are divided into interurban and urban auditors. More than 130 auditors were certified and are now working as auditors for the urban road categories. Certificates are awarded with three years validity. Requirements for extensions are the verification of three audits and the participation in two courses. Yearly the „Symposia for road safety with auditor forums“ take part at the University of Wuppertal where actual research outputs in the field of Urban Road Safety are presented and critical audits like those for complex intersections, cycling and walking infrastructure or great residential zones are discussed.

The outcome of a RSA and RSI process is a report, which identifies any road safety deficiency. Analyzing the safety deficiencies in Germany it appears that the most deficits are based upon a breach of standards and rules. The reasons for safety deficits are mostly to be found in missing coordination and in particular when the requirements from several person and institutions concerned reduce safety. For example there could be the requirement for parking facilities which are expressed by tradespeople and politicians although it hinders the visibility of an intersection. Another reason is that the sensibility of planners concerning safety is still not as high as the interest for capacity.

The training of 30 engineers from the Egyptian road administration was one of the key elements of the Twinning project “Enhancing Road Safety in Egypt”. The methodology of the training combines theoretical aspects and presentations with practical case studies. The official starting point for obligatory audit reports is still to be set – however hopefully soon. In Egypt the structure of a clear hierarchy of road network is missed very often.

The long term experiences with RSA and RSI courses and reports figure out that a consequent implementation and use of the benefits of these instruments can help to improve road safety and to avoid accidents.
1. INTRODUCTION

The goal of the Decade of Action for Road Safety is to stabilize and then reduce the forecast level of road deaths worldwide by 2020 by increasing road safety activities at national, regional and global levels. The resolution invites all member states to set their own national road traffic casualty reduction targets for the decade and calls for the implementation of road safety activities, particularly in the areas of road safety management, road infrastructure, vehicle safety, road user behavior, road safety education and post-crash response.

Besides, in September 2015, the United Nations General Assembly adopted a series of Sustainable Development Goals as part of the 2030 Agenda for Sustainable Development. The Sustainable Development Goals including the following specific targets related to road safety:

- by 2020, to halve the number of global deaths and injuries from road traffic accidents,
- by 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities, and older persons.

Road infrastructure is an important contributing factor in many severe accidents and managing its safety offers a wide scope for improvement. In that respect, the European Parliament published the Directive 2008/96/EC (European Parliament and the Council of The European Union 2008), which introduces a comprehensive system of road infrastructure safety management. Latest in the year 2010 the European member states implemented the system approach in their law and operate more or less with the specifications of the Directive. In other countries like the United States similar instruments still exist.

All over the world this new development is recognized and the whole system or parts of it influence the decisions for improving the road infrastructure with the aim of increasing road safety for all road users. However, the Directive is related to the trans-European road network only, Member States may and do also apply the provisions to the whole national, regional and local road infrastructure. Keeping in mind that severe accidents happen on interurban and rural roads and the most risks can be seen in urban roads, the development should be used by planning and maintaining the whole network.

The infrastructure safety management focuses on the following four procedures (Figure 1: The four instruments of the Road Infrastructure Safety Management):

- Road Safety Impact Assessment
- Road Safety Audit (RSA)
- Network Safety Management (Ranking of high accident concentration sections and network safety ranking)
- Road Safety Inspections (RSI)
This article describes the background of Road Safety Audits and Inspections (RSA and RSI) and gives examples and experiences from the implementation and application in Germany. In addition experiences of first trials of the implementation in Egypt are mentioned.

2. DEFINITION OF RSA AND RSI

The Road safety audit (RSA) is an independent detailed systematic and technical safety check relating to the design characteristics of a road infrastructure project and covering all stages from planning to early operation as to identify, in a detailed way, unsafe features of a road infrastructure project. The RSA is still used in some countries for several years, e.g. PIARC published a well-known RSA guideline (PIARC 2007a).

Audits are carried out by independent Auditors from private firms or road administrations, not involved in the project design team. Auditors have to be trained and fully qualified. The outcome of a RSA is a Report, which identifies any road safety deficiency and if appropriate, makes recommendations aimed at removing or reducing the deficiencies. The RSA process is divided into distinct stages, which are similar in most countries where it is undertaken. This allows the client to take corrective action in a timely manner and prevents the designer from abortive effort. The key stages which should be audited are the feasibility study, the preliminary design, the detailed design and the pre-and post-opening.

The plans to be checked have to be submitted of the customer to the auditor. Then the independent check of the documents follows on the part of the road safety auditor. After that a walk-through is necessary to judge the safety deficiencies which were found in the plan. The audit report contents project information, background information, all listed deficiencies and if necessary recommendations. The customer should comment every single deficit in writing and judge whether the recommendations of the road safety audit should be implemented or, where it is decided otherwise, to give reasons for the decision. After that the audit phase is completed.

Road safety inspections (RSI) are an ordinary periodical verification of the characteristics and defects that require maintenance work for reasons of safety as a preventive tool. RSI’s aim is to identify potential problems so countermeasures can be applied to remove or minimise the chance of an
The RSI process is systematic and can but need not to be focused on black spots or sections and junctions with a high accident cost reduction potential identified by accident data. Therefore an inspection should on the one hand at latest be carried out when the network safety management identified those network elements with high accident rates or high risks – on the other hand it can be a regularly assessment on the whole network system.

An inspection is comprehensive, with extensive preliminary work, on site appraisal including detailed check lists, analysis of the problems and suggested countermeasures. Inspections can identify safety deficiencies that are a result of poor maintenance, for example poor signing and line marking or visibility issues caused by vegetation. In addition the deficiencies could have other reasons like insufficient sight distances or design elements which surprise the road users. All inspections should take into account a range of human factors which relate to driver errors that are induced by the road.

Comparable to Road safety audits the main output of inspections is an RSI Report. A typical inspection report should be structured into (PIARC 2007b)

- an Introduction describing the road being inspected,
- a part A with Project data (road function, traffic situation, road standards, surroundings),
- a part B with Investigation form listing all deficiencies,
- a part C with proposals and options for counter measures – short term (e.g. signage, enforcement), medium term (e.g. speed reductions using traffic calming measures, refuge islands for pedestrians etc.) and long term (larger investment may be required) and
- an appendix with maps and illustrations (in order to clarify the results, different kinds of illustrations may be used including photos and sketches of countermeasures, locations need to be specified).

Depending on the complexity of the work, an inspection should be done by a group of inspectors. The qualifications should be the same as for auditors and the police should be involved.

3. IMPLEMENTATION OF RSA AND RSI IN GERMANY

With the "Empfehlungen für das Sicherheitsaudit von Straßen" (FGSV 2002) - recommendations for road safety audits - published by the FGSV (research company for traffic and transport in Germany) the road safety audit was introduced in Germany. An official letter of the Ministry of Roads (ARS Straßenbau 26/2010) addressed to the ministries of roads to the 16 Federal States of Germany the EU Directive 2008/96/EC which is covering the Trans European Road Network (TERN) is implemented as a binding national regulation (BMVBS 2010). To ensure that the application of the Directive is effective, the mentioned official letter demands to use the appropriate procedures as well as the appropriate use of available budget resources not only for the TERN, but for all federal roads. The ministry recommended further on the implementation for all state roads and for all roads, which are in the responsibility of the more than 11,000 municipalities in Germany. At least since then RSA have a nationwide application on all federal and most state roads and a more seldom application on urban roads, where audits are optional so far.

Road safety auditors must attain an additional qualification besides a basic qualification. The additional qualifications are specialized and standardized training courses for auditors. These courses
are offered for five road categories: motorways, interurban highways, through-roads, urban main roads and residential roads. Planners who would like to be certificated as auditors have to choose modules of minimum two road categories. Normally there is a division in interurban auditors (motorways, interurban highways, through-roads) and urban auditors (urban main roads and residential roads). This circumstance considers that there is a big difference in designing interurban roads with e.g. regarding consistent alignment in opposition to urban roads with e.g. regarding vulnerable road users or traffic calming.

At the moment more than 270 certified road safety auditors are listed in an official auditor list, which is in addition to a list of trainers published from the BASt Bundesanstalt für Straßenwesen (Federal Highway Research Institute). The training is officially ruled by a manual (FGSV 2009) and it includes for each part (interurban or urban roads) seven days at the university and minimum 10 days of homework. At the beginning of the training actual road design plans are called in from the participants. Audit reports of these plans and of additional planning in all design stages have to be done during the trainings and in house exercises. Certificates are awarded with 3 years validity. Requirements for extensions are the verification of three audits and the participation on two courses like the annually from the FGSV and BASt offered two-days „Symposia for road safety with auditor forums“ at the two Universities.

At the moment (year 2015) around 130 auditors are working on audits for urban roads and residential roads in municipalities. Most of them are employees of the communal administrations, some are consultants. While audits for these road categories are optional, the implementation of the RSA instrument is still in progress. Figure 2: No. of Audit Reports for Urban and Residential Roads in municipalities shows that the most audits are set up in cities and villages in the middle western and eastern parts of Germany while there are still lacks in the northern and southern parts.

Figure 2: No. of Audit Reports for Urban and Residential Roads in municipalities (assessment done in the year 2012)
Regularly and obligatory inspections in Germany related to the RSI procedure were in the past restricted to maintenance issues and these kind of inspections are still a part of RSI. According to § 45, 3 of the StVO (General Administrative Regulations for Road Traffic Regulations) (BMVBS 2009) traffic authorities have to conduct these inspections regularly and in co-operation with the road authorities and the police, but they are normally concentrated at traffic signs, traffic signals, marking and lighting. Regular traffic investigations contain the audit of all for safety relevant signs, including the road markings. Despite the condition of the traffic signs it has to be analyzed whether they are complete, useful and essential. In addition the condition, the equipment and the use of the road environment are to be analyzed.
New rules for obligatory and systematically inspections which are related to possible infrastructural deficiencies leading potentially to accidents are discussed at the moment and they will be implemented by a new standard “RSAS Richtlinien für das Sicherheitsaudit von Straßen (Guidelines for Road Safety Audits and Inspections) in 2016. Therefore, a distinction will be made between those inspections which are implemented at fixed intervals as “regular traffic investigations” and “thematic traffic investigations” and in addition “traffic investigations for special reasons”. These special reasons can be for example

- high accident rates at sections or intersections pointed out by a Network Safety Management procedure,
- safety related striking features pointed out at special assessments e.g. for motorcyclists or elderly pedestrians,
- changes in road functions or road categories or
- planned maintenance measures.

In these cases a RSI should focus not only on signage or marking like the regular ones, but on all road safety deficiencies including e.g. cross section, sight distances, crossings or cycle paths. To do this in obligatory cycles for the whole road network might increase road safety, but it is far away from being operably and feasible, because the existing road network especially in urban areas has so many safety deficiencies that investigations can’t be achieved totally and should be concentrated on that situations, where hot spots, high accident rates or striking features occur.

4. TYPICAL HAZARDS AND DEFICIENCIES IN URBAN ROADS

Analyzing the safety deficiencies in German design plans it appears that the most deficits are based upon a breach of standards and rules. Some more are referred to the failing realization of new outcomes of research or they are the result of the inadequate use of the area of discretion in aid of road safety.

In general it has to be mentioned, that the education and training of German planners is of course quite good – the reasons for safety deficits are more to be found in missing coordination between various parts of authorities and in particular when the requirements from several person and institutions concerned reduce safety. For example there could be the requirement for parking facilities which are expressed by tradespeople and politicians although it hinders the visibility of an intersection. Another reason is that the sensibility of planners concerning safety is not as high as the interest for capacity. Planners are trained in capacity calculation models for a long time while measuring and forecasting road safety is very often not a detailed part of education and advanced training.

One typical hazard especially in urban roads is the line-of-sight obstruction between vulnerable road users and car drivers caused by parking cars (examples see Figure 3 and 4: Sight obstructions between waiting pedestrian at a zebra-crossing and car drivers caused by parking lots). For road safety at main roads it is very important to consider sight distance between motorized and non-motorized traffic. Especially when choosing the number and character of the parking areas, the intervisibility between vehicles and pedestrians/bicyclists is to guarantee at crossroads, T junctions, access roads and pedestrians crossings. Obstructions of sight prevent the cognition of conflict situations in sufficient time.
A further circumstance that is to be mentioned is the frequent use of segregated right turning lanes at urban intersections, although they often are black spots of urban main roads. Segregated right turning lanes are characterized by accumulations of rear-end collision accidents, to some extent with involved bicyclists and pedestrians. This circumstance is shown in the collision diagram in Figure 5: Collision diagram – accidents in one year at segregated right turning lanes. Nevertheless segregated right turning lanes are popular to reduce time of waiting at highly frequented junctions by the account of road safety.
In many projects a not continuous and inconsistent bicyclist routing could be noticed. For cyclists using routes not regularly, an often changing bicycle routing is difficult to detect and abstract. This can lead to false use which is in part even deliberately done (such as using the pavement). Other road users do not count on this behavior so conflicts and accidents may follow.

According to the reduced spatial resources in German towns and villages it is not easy to choose a safe cross section. Very often the lane widths and the dimensions of parking lots are satisfying while walking and cycling paths are not even at minimum standards. Combining minimum sizes for walking and cycling (example see Figure 6: Detailed Design and picture from a new design of a road with a combination of minimum sizes for cycling path and sidewalk) raise the risk of using other, not assigned areas by road users. This involves a certain amount of conflict, especially for pedestrians and cyclists.

Figure 5: Collision diagram – accidents in one year at segregated right turning lanes

Figure 6: Detailed Design and picture from a new design of a road with a combination of minimum sizes for cycling path and sidewalk
In addition illegal parked cars often lead to line-of-sight obstruction and lacking sight distance to pedestrians or cyclists (example see Figure 7: Detailed Design and picture from a new design of a road with lacking and inadequate measures to prevent illegal parked cars). In areas with a high parking demand it is important to make arrangements to avoid illegal parked cars, especially near junctions and gateways.

Figure 7: Detailed Design and picture from a new design of a road with lacking and inadequate measures to prevent illegal parked cars

One of the main problems in urban areas is the complexity of the road infrastructure and the road equipment. The example of Figure 8: Hot Spot – collision diagram and pictures of a complex intersection where especially accidents involving children and elderly pedestrians occur is a very common situation especially in inner cities where four- or six-lane urban main roads have to be crossed by pedestrian or cyclists. In this case an underground station is reachable by the middle island and so there is a high demand of crossing the road while entering and turning traffic don’t respect the right of way of pedestrians. Traffic signals are missed here like it is the existing and too complex situation in many urban main roads.

Figure 8: Hot Spot – collision diagram and pictures of a complex intersection where especially accidents involving children and elderly pedestrians occur
Currently a state-wide data bank of deficiencies brought up in audits is developed and in progress so that this upcoming knowledge can spread out with the aim to enhance design plans with fewer deficiencies.

5. EXPERIENCES WITH RSA AND RSI IN EGYPT

In developing countries and in countries in transition the knowledge of safety effects of different road infrastructure elements and even the mentality can be very different from e.g. the European or American state of the art. While training and certifying Road Safety Auditors in Egypt as part of a Twinning Project (Twinning Project EG08/AA/TP13 2008) the author had to overcome the conviction and the belief that an accident is a destiny which cannot be avoided. Not an easy task – in that case it wouldn’t matter which kind of road elements are chosen in planning stages. “Accidents happen and that’s how it is”. And driver’s behavior is a fact that cannot be influenced – in contrary: drivers would like to go fast through towns so intersections and roundabouts should be designed in a way that fast driving is possible. It might be that this opinion encountered to the author is a little bit overdrawn but it has to be dealt with and education and training should first focus on the basic knowledge of safety impact before going into detail.

In addition a detailed knowledge about accidents, accident costs and accident rates related to the special situation in a country is very often not available. Accidents are mostly underreported or not reported in an appropriate way. A review on the existing accident data base for example for the year 2008 in Egypt came to the result that three different accident data sources exist:

- Ministry of Health (4,500 fatalities per year),
- Ministry of Interior (6,800 fatalities per year) and
- World Health Organization (12,300 fatalities per year).

In addition the accidents cannot be located in that detail as it would be necessary for the calculation of accident rates in different types of road sections and junctions. Given the discrepancies in statistics and not knowing about accident rates for different types of road elements, it is even difficult to come up with recommendations which might be successful in increasing road safety in Egypt. Therefore in several countries there is a need for reliable accident data and for the implementation of a statistical system as a first step towards an implementation of Road Infrastructure Safety Management instruments.

However, the training of 30 engineers from the Egyptian road administration was one of the key elements of the Twinning project. The aim was to implement Road Safety Audits as a regular instrument for all design projects in Egypt. Although this project was set up very detailed with duration of more than three years and with an involvement of around 40 safety experts the mission failed so far. The reason is not only to be seen in the Arabic Spring which happened in between the project’s time – the intention and support of the decision makers, politicians and administrational leaders was not as well as it should be for implementing this new instrument as a standard process. Hopefully the trainees have learned to develop safer road infrastructure and hopefully they have the chance to use their new knowledge in their daily business life. An evaluation of the real outcomes of the Twinning Project after a few years would be good but it is still not planned.

This circumstance makes really sad - the need for safer roads in Egypt is extremely high. Functions of roads are not properly separated so that there is a dangerous mixture of Connectors and Access Roads
along most of the roads in urban areas. One of such dangerous examples is the Cairo - Alexandria Agriculture Road, which is designed as a motorway with high speed, but going through many villages and towns (Figure 9: Motorway with access to settlements in Egypt). Mixed functions can be found on motorways and especially on express roads without special paths for pedestrians and agricultural vehicles and accesses to private and public roads. In linear settlements people are settling very narrow to the carriageway of high speed roads. A structure of a clear hierarchy of the road network, following the objectives of land use is missed very often. The lack of usable sidewalks and safe crossing facilities for vulnerable road users (Figure 10: Pedestrians and Cyclists on Egyptian motorways) comes up with high speed of traffic along the urban roads in Egyptian cities and villages.

Figure 9: Motorway with access to settlements in Egypt

Figure 10: Pedestrians and Cyclists on Egyptian motorways

6. CONCLUSIONS

Summing up the road infrastructure safety management with RSA and RSI instruments should be integrated in all phases of planning, design and operation of road infrastructure. It can help to avoid
several accidents all over the world. With implementing the safety management, an improvement and a significant reduction of accidents can be expected.

A comparison of the experiences in Germany and Egypt points out that top-down and bottom-up processes are both necessary to implement RSA and RSI as a standardized procedure. In Germany RSA is obligatory for all state roads and with the positive experiences for those road categories many municipalities have already implemented the safety audit compulsive.

An ongoing significant step is the documentation, analysis and publication of experiences with safety audits and inspections. Although RSA and RSI are implemented in many countries so far it is still a fact that new design plan always include safety deficits. That is why an obligatory implementation as a top-down process might be necessary. In addition it is very important that the knowledge and experience is collected and spread out with the aim to develop self-explaining and forgiving roads.

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