ROAD SAFETY INSPECTIONS -
THE AUDIT OF ROADS IN OPERATION AS AN ADDITION FOR
MORE DETAILED REVIEW OF THE TRAFFIC SITUATION AT ROAD NETWORK

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ABSTRACT
The directive of the European Parliament and of the European Council on road infrastructure safety management was transposed to the 19.12.2010 into German regulations which are compulsory for roads of the Trans European Network. It provides descriptions and regulations for preventive methods like safety impact assessments, road safety audits and road safety inspections as well as for reactive methods to rank and manage the road network in operation from a traffic safety point of view. In order to support the ambitious road safety target set by the European Commission to reduce the number of traffic fatalities within the next 10 years the actual methods and regulations shall particularly be developed further. Road safety inspection aims to detect obvious defects of the condition of the roads in operation. In order to support those responsible for road safety inspections the method and the process have to be optimized. Thus to further establish the set of rules for road safety inspections the Scientific Committee AK 2.7.1 “Recommendations for the Execution of a Road Safety Inspection" at the German Road and Transportation Research Association (FGSV) was set up. The work of this Committee is supported by the research and development project "Tools for the execution of the road safety inspection and extended form regular control of the road administration" financed and managed by the German Federal Highway Research Institute BASt). A proposal how this method could be adapted for an application in China is the subject of this presentation.
1 PRESENT STATUS

The European Commission has prescribed mandatory in the Directive of the European Parliament and the European Council a safety management system for the road infrastructure of the Member States. This enfolded Road Inspections for roads of the Trans European Road Network (TERN) The TERN in Germany comprises basically the motorways and a few kilometers of federal roads. In Germany, the application of this method is recommended for roads of a lower category by the federal ministry of transportation. One motivation for this recommendation might be the current fatal accident occurrence in Germany especially on the rural roads classified below the TERN.

As a result of 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 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.

Already in 2009 by the German Road and Transportation Research Association (FGSV) the need for a holistic, systematic, standardized and formal procedure was realized and consequently an executive working group (AK 2.7.1) was established a compliment to the already existing instruments. The task of this working group is to elaborate a code of practice for safety audits to be used for roads in operation. Initial proposals for the structure of this code are already available. In order to support the further development of these proposals a research and development project (FE 01.0178/2011/LRB) is conducted by two Universities of Applied Sciences (Bark, Follmann et al. 2012), financed and managed by the Federal Highway Research Institute. Furthermore this project aims to establish tools (technical aids, checklists, lists of deficits, photo examples etc.) and instructions for the implementation and conduction of these audits with a focus on the applicability on state roads.

The European Commission has prescribed mandatory in the Directive of the European Parliament and the European Council a safety management system for road infrastructure for the Member States. This enfolded Road Safety Impact Assessment for expansion projects as well as for existing roads in the Trans European Road Network (TERN). And they recommended it to other roads. The TERN in Germany comprises basically the motorways and few federal roads. The current accident occurrence in Germany with serious accidents, especially at state roads has a lot to commend it, to adopt the directive of the European Parliament also to types of roads classified below the TERN.

With a circular of the Federal Ministry of Roads (ARS Straßenbau 26/2010) resulted the implementation of the EU Directive 2008/96/EC in national law (BMVBS 2010). As a condition for an effective application of the Directive, the Circular demands to use appropriate procedures as well as the appropriate use if available budget resources.

Already in 2009 by the Research Association for Road and Transportation (FGSV) was the need for a holistic, systematic, standardized and formal procedure realized and established an executive working group (AK 2.7.1). There is a code for a safety audit in the existing network, will be developed as a compliment to the already existing instruments.

Initial proposals for the structure of the code are already available. They are currently further developed in a research and development project (FE 01.0178/2011/LRB) by the Federal Highway Research Institute (Bark, Follmann et al. 2012). Especially for state roads should be
developed some tools (technical aids, checklists, lists of deficits, photo examples etc.) and instructions for the implementation of appropriate security checks of the road network.

2 CURRENT PROCEDURE
The already existing methods for the road infrastructure safety management of the road network in Germany are appropriate beyond the TERN, too. These methods can be divided into proactive and reactive methods (Figure 1).

The reactive methods includes safety analysis (ESN – FGSV 2003) and local accident investigation (BMVBS 2009). The Federal Highway Research Institute (BASt) uses the instrument of ESN in order to conduct a classification of the level of safety of the TERN. The results are published in form of maps and lists with significant accident clusters. These can be used as a basis for more detailed observations, as well as for the derivation of concrete arrangements and statistic planning by the responsible road authorities.

Local accident investigations are to be perceived by accident commissions (committee of public administration, traffic authority and police). They are based on the fact sheet for local accident investigation into accident commissions (FGSV 2012).

<table>
<thead>
<tr>
<th>General</th>
<th>Operation</th>
<th>Safety Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning of safe roads and routes, e.g. safe pathes to School</td>
<td>Visual inspections of road conditions</td>
<td>Road Safety Committee</td>
</tr>
<tr>
<td>Road safety impact assessment</td>
<td>Safety inspections</td>
<td>Safety analysis in the road network (ESN)</td>
</tr>
<tr>
<td>Audits of road designs</td>
<td>Analysis of road network condition (ZEB)</td>
<td></td>
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<tr>
<td></td>
<td>Special traffic investigations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Traffic check</td>
<td></td>
</tr>
<tr>
<td>Preventive</td>
<td>reactive</td>
<td></td>
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</tbody>
</table>

*Figure 1: Contributions for increase of road safety*
A part of the preventive procedures are inter alia regularly road control of the public administration by the catalog of measures road maintenance in operation (MK 6d – LBV-SH 1997), as well as the traffic display as it is required by its fact sheet (MDV – FGSV 2007a).

The road control respectively road attendance are elements of road maintenance expense. They are used to monitor the apparent defects during construction of a road. Its legal basis is the Federal Highway Act and the road laws of the federal states. The road attendance has the task of ensuring the safety of the roads, to monitor them as far as it is immediately possible to restore or perform assuring measures. The inspection trips are in accordance with the MK 6d at streets with over regional traffic at least once a week with a speed of not more than 40 km/h through the road maintenance staff. The MK 6d is currently under the auspices of the Supreme Building Authority in the Bavarian Ministry of the Interior in revision. In this draft, effective 09.12.2009 (STMI 2009) for the first time specific requirements for the type and the extent of the documentation of controls are described. Furthermore, this draft stipulates an adoption of a “task list of road maintenance”.

Special traffic investigations are used to check e.g. the status and visibility of road signs as well as to eliminate potential obstacles close to the roads. 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. Regular and cause related traffic investigations have to be distinguished (Table 1). Therefore, a distinction is made between those to be implemented at fixed intervals “regular traffic investigations” and “thematic traffic investigations” and in addition “traffic investigations for special reasons”. 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.

Table 1: Tasks and cycle of road inspections (FGSV 2007a)

<table>
<thead>
<tr>
<th>Type of road inspection</th>
<th>Content of investigation</th>
<th>Road category</th>
<th>Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard inspection</td>
<td>Traffic signs relevant for safety including markings and equipment, hazards in the road environment</td>
<td>Main streets (urban), Federal, State and County Roads / motorways</td>
<td>every 2 years</td>
</tr>
<tr>
<td>Inspection at night / darkness</td>
<td>Traffic signs relevant for safety including markings and equipment, alignment, lighting of crossings</td>
<td>Main streets (urban), Federal, State and County Roads / motorways</td>
<td>every 4 years</td>
</tr>
<tr>
<td>Inspection of railroad crossings</td>
<td>Traffic signs and equipment at the level crossing</td>
<td>all roads</td>
<td>every 4 years</td>
</tr>
<tr>
<td>Tunnel inspection</td>
<td>Traffic signs relevant for safety including markings and equipment, lighting</td>
<td>all roads</td>
<td>every 4 years</td>
</tr>
<tr>
<td>Signage inspection</td>
<td>Signage</td>
<td>all roads</td>
<td>every 4 years</td>
</tr>
</tbody>
</table>
Despite all these efforts, examples of roads in operation show that there is potential for further improvements of these procedures (Figure 2). One reason might be the isolated analysis of the respective areas. In addition, the fact that no specific education and training courses for the responsible personal is established might be a reason.

For road safety audits ESAS (FGSV 2002) a guideline was established in 2002 describing a formal procedure in order to ensure that for new roads safety aspects are fully taken into consideration. For roads in operation a holistic method for the detection of safety deficits, which is particularly suitable for the preventive detection of defects, is not available. All prevent methods already introduced in Germany deals with various safety issues only. In one thesis from the University of Applied Sciences Darmstadt, which was awarded by the German traffic safety council, first experiences of a holistic approach along 140 km of county roads were made with a focus on the approach, the practicality and the effectiveness of a first proposal of such a method (Biederbick 2009).

Based on a practical comparison of traffic investigation and safety inspection (Baumann et al. 2011) note that significant safety relevant defects can only be described based on a holistic analyses of the road and the surrounding. According to the authors traffic investigation fulfill...
the requirements for regular inspections of the road network. For the investigation of road sections with a high safety potential according to the ESN, traffic investigations are only partially suitable.

Until now, no uniform methods for the auditing of existing roads or road inspections in the European countries exist (Figure 3). An ERA-NET Road Project report conducted by Nadler et al. (2011) contents a summary of reported findings. For this purpose the methodical approaches of Road Safety Inspections (RSI) has been compiled for 25 European countries as well as Australia and New Zealand. As defined by the World Road Association (PIARC 2007), based on RSI safety deficits should be determined without taking accident reports into consideration. This is inter alia the case in France and Norway. In contrast, in Austria and the Czech Republic, RSI will be linked to the accident reports. In the UK and Portugal, RSI are affiliated with the instruments of the maintenance.

The Federal Ministry of Transport, Innovation and Technology in Austria (BMVIT 2010) published a manual for standardized conduction of “Road Safety Inspections”. This manual contents aspects of the application, the approach, the conduction and the tools.

Figure 3: Approach for the implementation of Road Safety Inspections (RSI) in Europe

In the EU-project PILOT4SAFETY (2011) standardized guidelines for training and certification of Road Safety Inspectors were developed for implementation of EU-Directive 2008/96/EG. Partners in this project are the road authorities of Denmark, Greece, Italy, Spain and Czech Republic. In addition the Federal Highway Research Institute of Germany is partner of this consortium. The project comprises methods for accident investigations, Road Safety Audit (RSA) and Road Safety Inspection (RSI). Basis for the chapter RSI was the elaboration of the World Road Congress (PIARC 2007). Furthermore a „New Curriculum for Road Safety Experts“ for the training of RSA- and RSI-Inspectors is in preparation.
For Germany the fact is to record that for the purpose of evaluation of the safety of the existing road infrastructure preventive as well as reactive measures are applied. Nevertheless, these measures do not enable an overall evaluation of road safety as demanded by ESAS (FGSV 2002) for the design steps. At the same time in other European countries remarkable methodic approaches are created.

3 DEVELOPMENT OF TECHNICAL FRAMEWORK

It is the task of the working group 2.7.1 “Recommendations for the implementation of an inventory audit of roads” of the FGSV to develop the basic rules for inventory audits to be applied in Germany. This working group was created in March 2009 and is composed of members of Federal Highway Research Institute (Bundesanstalt für Straßenwesen, BASt), German Road Safety Council (Deutscher Verkehrssicherheitsrat, DVR), Association of the German Insurances (Gesamtverband der Deutschen Versicherungswirtschaft, GDV), road authorities of several federal states such as Baden-Württemberg, Bavaria and North Rhine Westphalia, universities, consultants and the BMVBS (correspondent). From the experience with safety inspection (Pfeiffer, Klepel et al. 2010) and experimentally carried out audits on demand (Spahn 2011, Straßen.NRW 2008) initial suggestions and structures for basic rules have been developed. Basic approaches are:

- Differentiation in an audit on demand (in longer intervals) as well as regular, as possible annual safety inspections (enlarged road maintenance).
- Following the recommendations for the safety audits of roads (ESAS 2002) respectively the currently ongoing work on its update.
- Support of the analysis by lists with deficits and/or questions.
- Differentiation by urban roads, rural roads and motorways.
- Consideration of the needs of all road user groups.
- Development of an education and advanced training program.

These approaches get deepened especially for rural roads in the research and development project FE 01.0178/2011/LRB “tools to carry out audits of inventory and an extended distance control” of the Federal Road Research Institute (Bundesanstalt für Straßenwesen, BASt) (Bark, Follmann et al. 2012).

First of all it is important to close gaps in knowledge regarding the actual use of the currently available instruments for detecting typical safety deficits of the existing road infrastructure. For this purpose the existing and successful used methods get analyzed and developed considering the requirements of the stakeholders.

Due to the effort needed per kilometer of road it is not possible to conduct inventory audit for all roads all over the country. And at best it can be repeated in long intervals. Primarily such an inventory audit will therefore be on an ad-hoc-basis. From the previous discussion the following points have to be considered:

- special investigations as to motorcycle routes according to MVMot (FGSV 2007b),
routes with a high safety potential according to ESN (FGSV 2003),
routes with upcoming conservation measures and
routes with changing significantly traffic-related conditions.

The list is not yet completed and will be extended by the incorporation of the top road authorities. In addition to the audit on demand there is a significant need to systematize and improve the preventive safety checks. Here the knowledge of road maintenance in the sense of responsibility of the road authorities has intensively to be taken into consideration, especially with traffic compulsory insurance in mind. With a link of road control and traffic safety work it could be possible to arrange an intensive control with a special focus of road safety for example once a year.

To obtain a comprehensive knowledge of the current implementation and evaluation of road control, process-specific components of the road control from the local staff of the road authority are needed. Similarly track logs have to be evaluated to that effect which security deficits get previously recorded. With executing persons the results have to be discussed and problems of implementation and possible suggestions for improvement will be addressed in depth.

The acceptance of new equipment is also influenced by the acceptance of the road workers to their tasks, which steps are considered as being important, how instructions for work to be performed are estimated or how amenable possible changes in the existing procedures are seen. It is important to clarify which additional work road maintenance is able to achieve within the limit of its activities and which further qualifications are necessary for this purpose. The regulatory framework has to include coordinated tools such as checklists, deficit lists and introductions for the implementation of the procedures. As the basis for the standardized examination and auditing of the existing network it is possible to use the checklists of ESAS for the opening of roads to traffic (FGSV 2002) in the first approach. It is necessary to check whether in the process of planning and on that date available information (for example route planning in position and elevation plan) is existent for the existing network. In that case it is possible to evaluate the relevant deficits. First experiences with the application of the worked out checklists from PIARC (PIARC 2007) are already summarized in a master thesis at the University of Applied Sciences Darmstadt (Jacobs, 2012). There were also existing checklists of further regulations concerning the use for auditing included in this master thesis. Basically, however it is important to work out in further studies what is affordable in the particular procedures.

In data bases merged security deficits, particular from the auditing of planning (Straße.NRW, database of the Centre for Traffic Safety of the Highways Agency Bavaria – Datenbank der Zentralstelle für Verkehrssicherheit der Straßenbauverwaltung Bayern) provide another basis. With the comparison to safety deficits from this process it is possible to develop understanding for the introduction of an additional procedure. For the new rules it produces new approaches which aspects are important for the development of the rules. Especially in relation to documentation, implementation, prioritization and impact monitoring.

Taking into account the future developments in terms of personnel and cost structures a rapid economic and easy transfer and control of the recorded data is recommended. The
framework should therefore show an automatic operating under observance of administrative structures. The aim is to collect data of regular route control and event-related inventory audits and to accelerate processes for detection and implementation of arrangements. For this purpose structures like shown in figure 4 need to be developed.

Besides the ease of use and the regard of the effort it is important to consider that the data has to be added to existing data bases like Road Authority (Straße.NRW) or the Central Agency for Traffic Safety of the Highways Agency Bavaria (Zentralstelle für Verkehrssicherheit der Straßenbauverwaltung Bayern). It is to discuss whether the data has to be checked and who can access the data and to which extent.

To establish the relationship to the practical experience and for a close collaboration with the executive staff it is necessary to arrange further expert workshops in addition to the discussions in AK 2.7.1. These workshops should also be on a regional level. Furthermore based on the results of exemplary safety checks the need for such a method will be found. When selecting a route issues such as settlement patterns, topography, geographical location as well as type of road, traffic load and profile have to be considered. The selected road maintenance workers for the implementation of the exemplary safety inspection have to be trained for the extended road control. The aim is to teach the road maintenance workers the central content of the instrument, the developed check- and deficit-lists, the exact procedure for the extended route control and the following data processing. The outcome of this is the knowledge for processes und possible training content related to later implementation.

Compulsory introduction events including exchange of experience ensure a high quality standard, an increasing awareness for the importance of such a new task and also serve as a regular exchange of the latest developments and problems in the course of implementation. In this context it is important to establish concepts and curriculum of training programs contemporary. Therefore, qualification requirements and required training and continuing education of all stakeholders will be developed for the rules.

From the education and training of safety auditors as well as by accident commissions extensive experience of the necessary requirements are available. The regulatory framework is complemented by proposals for the necessary training and advanced training modules based on the MAZS (FGSV, 2009).

4 OUTLOOK

For the acceptance and understanding for the introduction of a new process according to the rules "Recommendations for the Execution of an Audit of Roads in Operation" the involvement of all relevant road authorities and stakeholders is of great importance. Therefore it is necessary to include the top road authorities of all federal states as well as the road maintenance workers in the entire developing process. This evaluation will also assess which routes and because of which occasion from the perspective of federal states an additional safety audit should be conducted and what content might be of importance.

For the process of a regular inspection the aspect of the enlarged distance control should be checked. Based on the experience of structural analysis and the exchange of experiences with the participants a separate checklist for the extended route maintenance could be developed, according to the given draft checklist of MK 6d (draft, 12/2009). It is important to ensure that the scope of the checklist will be realizable. Furthermore future personnel and cost structures
but also administrative structures of the responsible authorities have to be taken into account. A possible categorization on the severity of the defects should be considered. Via the evaluation of the detected defects a connection to the proceeding of the audit could be made. Thereby conspicuity has to be checked as a possible reason for the implementation of an audit. For example, by weighting the categories of deficiencies and deficits it could be necessary to implement an audit when reaching a certain limit.

Due to the personnel structure in the road maintenance it is important to set value on practical suitability of the developed method. A stronger link of the existing methods with traffic safety work has to be considered. In addition to the legal framework, country-specific deviations and developments relating to the updating of the regulations have to be kept in mind.

Besides the practicality of the checklists the data acquisition method will be a crucial aspect. It is to examine whether the selection of the admissions process in accordance with the basic conditions differ by type of road, traffic congestion and street furnishings or rather to what extent they have to differ under consideration of the future personnel and cost structures.

The link to the existing methods such as the condition detection and condition assessment of surfaces of the roads (ZEB) has to be checked as well. The aim is to receive information which parts of the sometimes very extensive technical resources are significant and should be included.

As a result the developed methods have to be tested and further developed on existing routes. In this way it is possible to gain knowledge regarding the practicability. Likewise, this allows an overview of existing safety deficiencies in the road network from different angles. It results in qualification requirements and the required training and education of all stakeholders. The fields of application of this new instrument can be established.

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