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Protection of European Road Transport Networks

Authors:

Dr.-Ing. Georg Mayer (corresponding author)
PTV –Planung Transport Verkehr AG – NL Stuttgart
Kriegerstrasse 15
D-70191 Stuttgart
Federal Republic of Germany
Phone: 0049 (0) 711 16270 35
Fax: 0049 (0) 711 16270 70
E-mail: georg.mayer@ptv.de

Dipl.-Ing. **Ingo Kaundinya**
Federal Highway Research Institute of Germany (BASt)
Brüderstraße 53
D-51427 Bergisch Gladbach
Federal Republic of Germany
Phone: 0049 (0) 2204 43 831
Fax: 0049 (0) 2204 43 677
E-mail: kaundinya@bast.de

Abstract

An effective and secure road network is essential in order to guarantee mobility and supply for the European population. Particularly bridges and tunnels are key elements of the road network. Restrictions of the availability of these infrastructures may lead to intense traffic interferences on the surrounding road network resulting in negative effects on the road user, high economic follow-up costs and negative environmental impacts.

In order to improve the protection of transport infrastructure and the European road network security research projects have been launched on European and national level. The collaborative project "Security of Road Transport Networks (SeRoN)" has been initiated by PTV and BASt, bringing together seven partners from six European member states. The German project "Protection of critical bridges and tunnels in a road network (Schutz kritischer Brücken und Tunnel im Zuge von Straßen – SKRIBT)" started in 2008. Both projects will benefit from the results of the other project.

The main objective of the German SKRIBT project is to investigate and evaluate effective protection measures for critical bridges and tunnels in a road network. The focus of SKRIBT is on the different types of German bridges and tunnels, their structural and operational vulnerabilities but also on the user of these structures (investigations on object level). The SeRoN project deals with the impacts of possible terrorist attacks on the transport network, in particular the resulting regional and supra-regional impacts on transport links and their economic impacts (investigations on network level). Finally both projects will contribute to the identification of possible current and future threat situations and the corresponding most effective security measures which increase the security of road transport infrastructures and ensure a high availability of the European road network.

This paper gives an overview about the research approach and first results of current national and European projects dealing with road transport security.

Protection of European Road Transport Networks

1 INTRODUCTION AND MOTIVATION

The European road network is of major importance for the European economy and equally for the mobility of the European citizens. Especially roads of the Trans-European Transport Networks (TEN-T) and planned TEN-T road projects (like E55 Dresden – Prag - Linz, Elbe crossing A22 or Fehmarnbelt crossing) play an important role. Therefore, a major task of owners and operators of highways and roads in Europe is to ensure a high availability of all important links. Even smaller disruptions due to traffic restrictions or failure of some elements of the road network may lead to intense traffic interferences resulting in high economic follow-up costs and negative environmental impacts. Due to the interdependence of the road transport network with other traffic modes like rail, air and shipping traffic, a failure of important connections could have a domino effect.

Especially the German road network plays an important role for the Trans-European road network, caused by its central position in Europe (FIG. 1). The German road network must cope with the greatest share in goods and passenger transport of all transport modes already today. In 2005 about 70 % of goods transport and more than 88 % of the passenger transport was processed via the road network in Germany (1). The road network must take increasing traffic loads in the future because of the extended European market. Current forecasts predict an increase in goods transport on roads by 30 % until the year 2020 (2).

FIGURE 1: Trans-European road network in Germany (3).

Particularly bridges and tunnels are key elements of the road network due to their bottleneck function often based on the geographical constraints (FIG. 2). They may constitute attractive terrorist targets because of their accessibility and great potential impact on human lives and economic activity.

The damage to or even the complete loss of critical structures, for instance bridges crossing major rivers (FIG. 2) or important tunnel connections, by terrorist attacks, natural disasters or other incidents could lead to massive and considerable economic damages and can significantly affect the functioning of other important infrastructure elements.

FIGURE 2: Bridges are very important infrastructures with a high importance for the road network (Source: BASt).

The protection of these structures with regard to the current increasing threat situation caused by terrorism but also by aspects of climate change and other hazards is of central importance. In addition to the damage to structures themselves, a large number of users of these structures is exposed to a great danger during incidents or is concerned with required traffic diversions indirectly during the repair and maintenance activities resulting from incidents. Such events can also lead to negative psychological consequences, such as tunnel fear. In every case the security feeling of the users as well as of the society is considerably affected and this can possibly lead to a changed user behavior. The use of alternative routes for avoiding specific structures could result in traffic shifts in the road network. This could influence the flow of traffic on the remaining routes negatively and cause further considerable economic costs and negative environmental consequences.

2 CURRENT NATIONAL AND EUROPEAN RESEARCH PROJECTS

2.1 National projects

In **Germany** the German Federal Ministry of Education and Research (BMBF) has started an extensive security research initiative in 2007. In the context of the program “Research for Civil Security” which is part of the “High-Tech Strategy” of the German Federal Government there are more than 35 projects being currently funded in 3 different calls (34

more projects are “in the pipeline”). 2 projects deal with security of road transport infrastructure. One of these projects, dealing with the development of effective protection measures for road bridges and tunnels and their users, is the collaborative project “Protection of critical bridges and tunnels in a road network (Schutz kritischer Brücken und Tunnel im Zuge von Straßen – SKRIBT)”. The project, under the lead of the Federal Highway Research Institute (BASt), consists of 10 partners who come from Federal Institutions, Research Institutes and private companies. This paper will focus on the method and first results of SKRIBT in chapter 3. The other German security research project deals with sensor technology for tunnel linings.

Other national security research projects dealing with road transport were executed in different European countries. In **Austria** the new National Security Research Programme called KIRAS, issued by the Austrian Research Promotion Agency (FFG), is dedicated to enhance the research on safety and security issues at a national level. This research programme supports a wide field of research activities such as threat analyses, consulting and products for hazard prevention, hazard management and emergency response etc.. It focuses on long term, interdisciplinary and integrative activities able to support “comprehensive security”. The first phase of the programme is focussing on the protection of critical infrastructure, including beside other sectors traffic and transport (road, rail, air, water) as well. Results of research projects dealing with road transport security are not published so far. In **Switzerland** a recently finished research project deals with the vulnerability assessment of the Swiss road network (4). Other projects in the USA deal mainly with road transport network robustness and the calculation algorithms for alternative routes (5, 6).

2.2 European projects

Under the Seventh Framework Programme for Research (FP7), the European Commission supports currently 45 security research projects (security call 1 and joint ICT & security call). There is one project among these first security research initiatives dealing with road transport network security: the collaborative project “Security of Road Transport Networks (SERON)”. The aim of SERON is to improve the protection of transport infrastructure and the European road network. The project has been initiated by PTV and BASt, bringing together seven partners from six European member states. The project is scheduled to start in August 2009. This paper will focus on the approach of SERON in chapter 4.

Within the framework of the SERON the ongoing research projects on national and European level will be screened to identify possible synergy effects concerning the new SERON project.

3 INVESTIGATIONS ON OBJECT LEVEL

Comprehensive investigations on object level dealing with bridge and tunnel structures and user behavior are carried out in the research project SKRIBT. Some of the results of SKRIBT and of other national security research projects could be used as input for the project SERON. The research approach chosen for SKRIBT was presented on last year’s FUTURE SECURITY conference (7). Figure 3 shows again the work package structure of SKRIBT. In the following the current status of work is described.

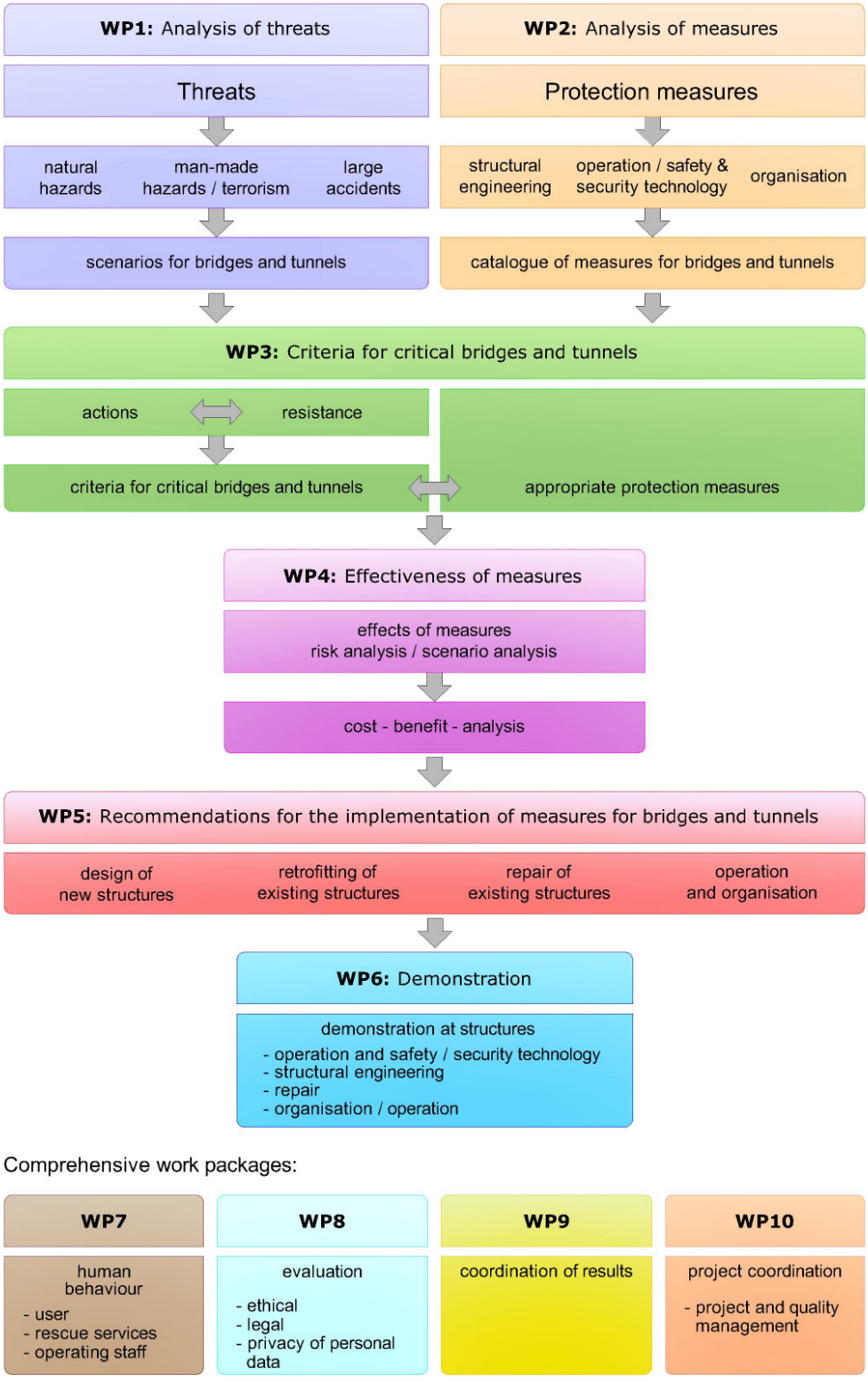

FIGURE 3: Structure of the project SKRIBT (Source: SKRIBT)

The work packages WP 1 and WP 2 have been finished. Within WP 1 a comprehensive scenario-catalogue has been developed in which the numerous scenarios are distinguished according to terrorism and criminal actions, natural incidents, human and technical failure, loss of critical infrastructure and incidents with a very low probability. Simultaneously to

WP 1 the second work package (WP 2) has been worked out. In the course of WP 2 protective measures have been collected with regard to construction technique, operation and organization. Thereby every presently potential protective measures as well as in future imaginable protective measures are considered and accumulated. Within the scope of WP 3, which started after the first two work packages in late 2008, a methodology to identify critical bridges and tunnels is currently developed. This methodology is taking all the different aspects of criticality into account and is one of the key elements of the SKRIBT project (FIG. 4). Therefore four sub-groups responsible for tunnel construction, bridge construction, user and rescue-services as well as traffic and environment are created. These sub-groups currently work out the relevant scenarios and parameters for their field. A current analysis of the weak points complemented by computer simulations concerning the critical construction and operation components as well as simulations related to human behavior in tunnels and in emergency situations are under progress (FIG. 5, 6).

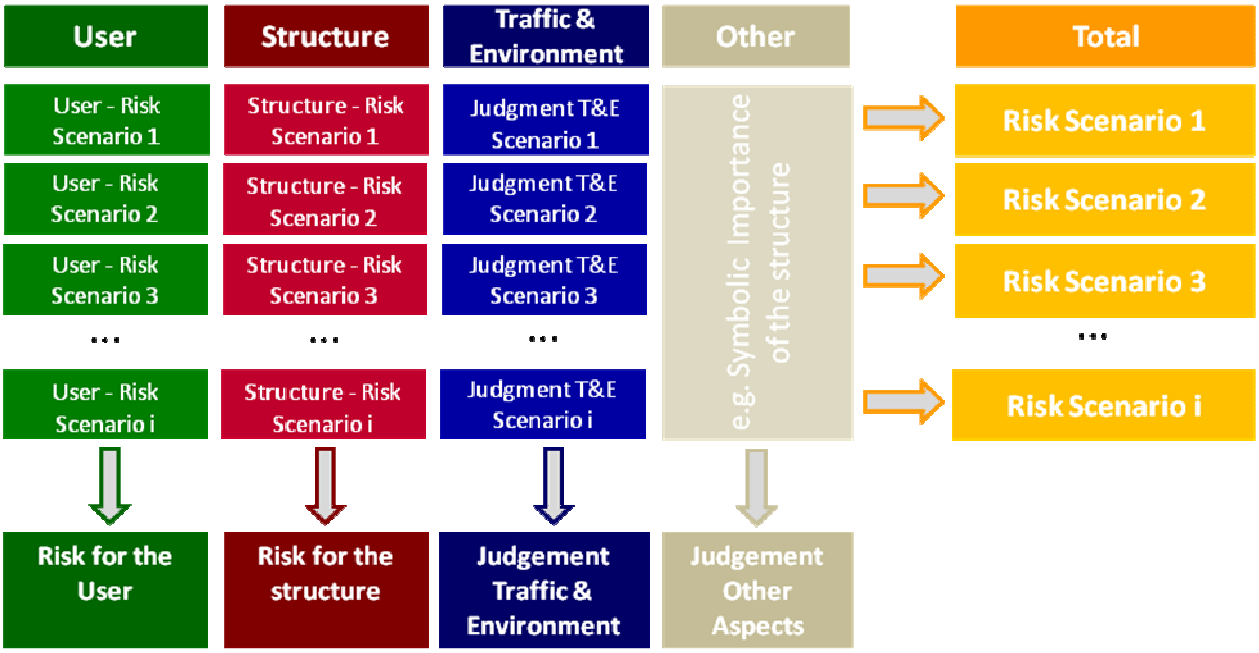

FIGURE 4: Methodology to identify critical infrastructures (Source: SKRIBT)

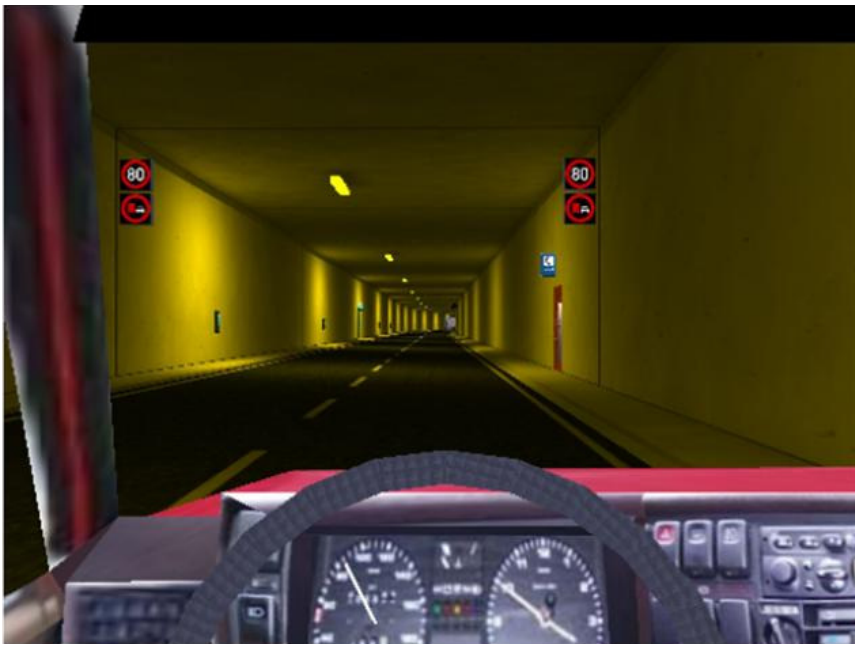

FIGURE 5: Simulation of a car ride through a tunnel for testing the human behaviour (Source: Chair for Psychology I, University of Würzburg)

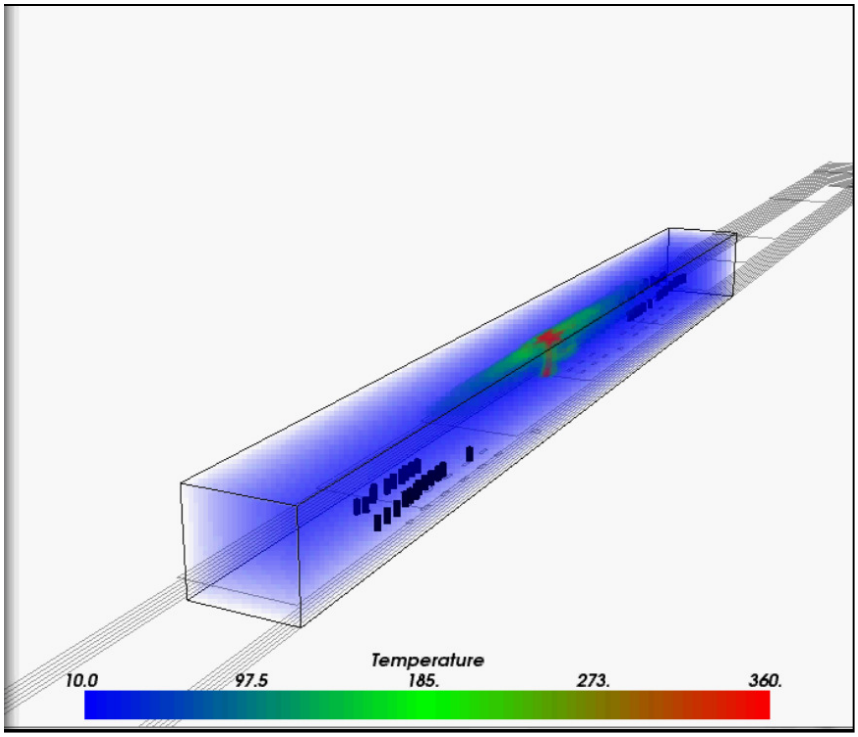

FIGURE 6: Simulation of physical effects and escape movements of persons in a tunnel (Source: PTV)

Finally the research results of SKRIBT should help owners and operators of road networks to identify critical infrastructures in their network and to determine the suitable effective protection measures for critical objects in order to make road tunnels and bridges more secure in the future.

Further information about SKRIBT is available on the Internet at www.skribt.org.

4 INVESTIGATIONS ON NETWORK LEVEL

The main objective of the SeRoN project is to investigate the impacts of possible terrorist attacks on the transport network, in particular the resulting regional and supra-regional impacts on transport links and their economic impacts. SeRoN has its focus on the development of a methodology which is to help owners and operators to analyze critical road transport networks or parts hereof with regard to possible terrorist attacks. SeRoN evaluates planned protection measures for critical road transport infrastructures concerning their impact on security and cost-effectiveness of the whole road network.

In order to reach this objective, an innovative and holistic approach will be applied. It brings together interdisciplinary expertise in order to derive the necessary innovations regarding object and network data handling, simulation methods, sensor technology, protection technology, quantitative risk assessment strategies and cost-benefit analyses, so that a functioning methodology will result from this project.

Eight work packages have been established to achieve the objectives of the SeRoN project. They are broken down into object and network level. The object level deals with specific infrastructure objects (bridges and tunnels). In WP 100, the possible threats are analyzed so that critical infrastructure objects can be identified in WP 200. The gathered knowledge is concentrated in WP 300, the knowledge database to be established, the structure of which is a main achievement of the SeRoN project. The knowledge database is the link to the network level. In case of an attack on one or several infrastructure object(s), its impacts and consequences on the transport network will be investigated. WP 400 analyzes the impacts of the destruction of an infrastructure object for the network. WP 500 assesses possible protection measures. The methodology is applied and validated in WP 600. Dissemination of project results, input of external advice and the formulation of project recommendations is done in WP 700. WP 800 consists of the overall project management. Figure 7 illustrates the work package structure.

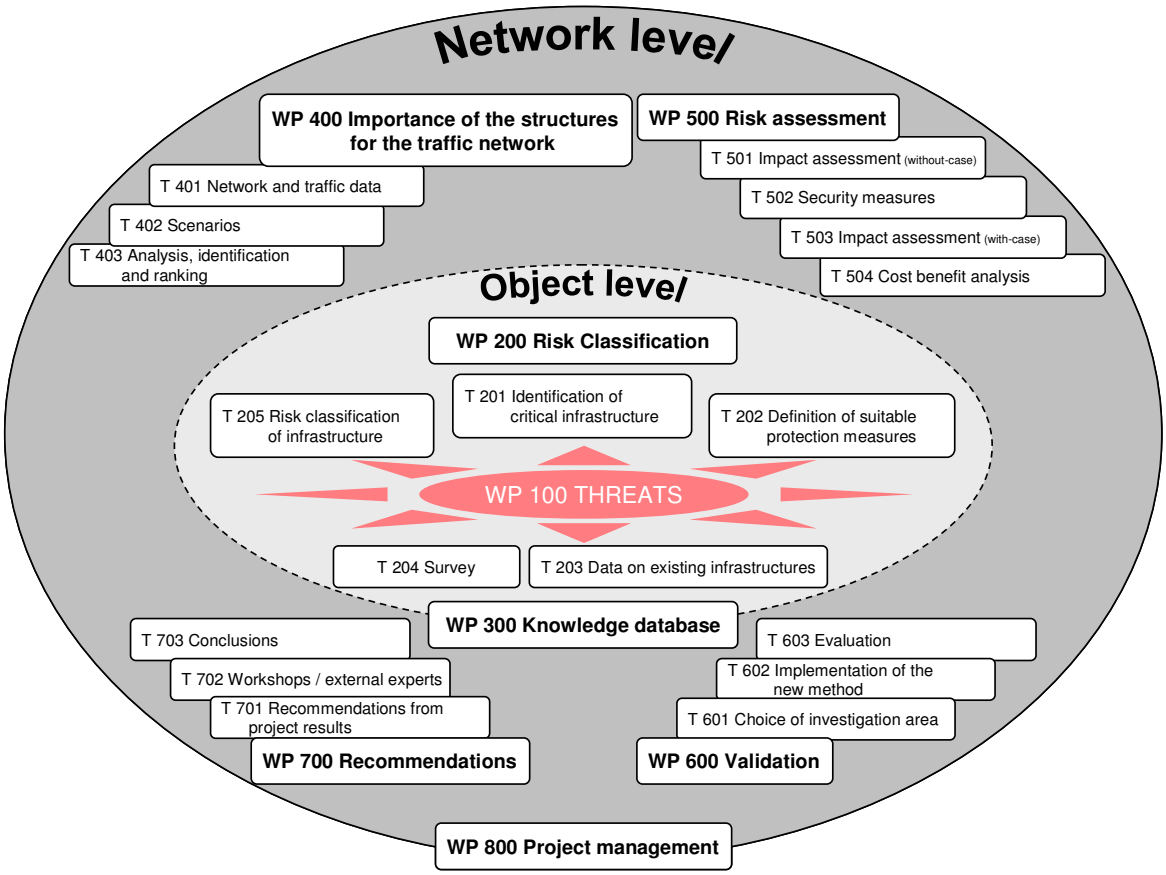

FIGURE 7: SERON structure and work packages (Source: PTV)

5 CONCLUSIONS AND OUTLOOK

Finally the two projects SKRIBT and SeRoN will give adequate recommendations concerning possible current and future threat situations and the corresponding most effective security measures which increase the security of road transport infrastructures and road transport networks and their users. The implementation of the measures will finally lead to a significant improvement of the levels of security, performance and resilience of the European road transport system.

The developed and validated innovative methodology of SeRoN will provide a common framework for the identification of critical road infrastructure objects with respect to their importance within the European transport network by means of an interdisciplinary interaction of expertise and innovative simulation methods. Furthermore, using this methodology, possible protection measures can be suitably chosen and be evaluated regarding their cost-effectiveness.

The newly developed methodology could later be applied to identify critical infrastructures and effective protection measures for road networks or parts hereof, for instance, main European traffic corridors which handle the most important traffic flows. The methodology could also be transferred to transport networks used by other traffic modes (e.g. railway links) and to natural disasters.

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