

Risk assessment of Road Tunnels using Bayesian Networks

Abstract

This paper introduces a methodology for the assessment of risks due to traffic in roadway tunnels. The proposed methodology utilizes Bayesian Probabilistic Networks for the risk assessment. The methodology is based on two hypotheses, i.e. that the roadway tunnel can be represented by a number of homogeneous segments and that the risks associated with a given segment can be represented through a set of Key Performance Indicators (KPI).

The KPIs are the observable characteristics of the tunnel and the traffic such as the annual average daily traffic, the number of lanes, possible traffic separation, width, curvature and gradients. The risk is calculated in terms of expected number of accidents, injuries, fatalities and tunnel fires over the entire tunnel length for both, normal traffic events and dangerous goods events. The dependencies and the conditional probabilities in the Bayesian Probabilistic Networks are based on three general pillars, i.e. data, models published in literature and expert opinion.

This new approach allows taking into account different specific characteristics of the tunnel and thus the risk of a complex tunnel system can easily be calculated. The Bayesian Probabilistic Networks are embedded into a Microsoft Excel Environment, so that the risk analysis can easily be performed. The methodology is generic, represents the best practice in the field of risk assessment and tunnel research, is realizable and easy to use, is transparent, supports the decision making process, and is modular so that it can be adopted to future findings.