CEDR Transnational Road Research Programme
Call 2013: Ageing Infrastructure Management-Understanding Risk Factors

Funded by: Denmark, Germany, Ireland, Netherlands, UK, Slovenia

Re-Gen
Risk Assessment of Ageing Infrastructure

Reliable WIM traffic data information samples from partner countries collected

Milestone No. M3.1
January, 2015

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Due date of milestone: 31/12/2014
Actual submission date: 21/01/2015
Revised with PM Comments: 30/01/2015

Start date of project: 01/04/2014 End date of project: 31/03/2016

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Executive summary

This report is a precursor to the deliverable D3.1, the Guidelines on collecting Weigh-in-Motion (WIM) data and forecasting of traffic load effects on bridges. It describes the work performed so far on collecting information about the WIM data available for bridge assessment in the partner countries.

Surveys revealed that all partner countries (also all funding countries) collect WIM data but not all countries use it for bridge applications. Samples of WIM data have been acquired from all five partner countries. Their quality with respect to bridge applications is not equivalent but this will be described in more detail in the deliverable D3.1.

1 Introduction

Freight traffic volume and traffic volume, in general, is constantly increasing in Europe. At the same time, in most European countries, the proportion of bridges that were designed and built in times when traffic loading was considerably lower, exceeds 50% of the bridge stock (source FP5 project SAMARIS (2006)). Many of these bridges will need to be strengthened to carry greater load or posted (i.e. load restrictions). However, the system can be optimised if the true safety of the bridge is known through better understanding of the true loading situation and risks associated with overloading.

The recent Heroad report (Žnidarič & Kreslin, 2012) from the 2010 CEDR “Effective Asset Management meeting Future Challenges” call revealed that only a few European NRAs exploit the benefits of realistic traffic loading in bridge safety assessment. Even countries with well-developed and regulated bridge assessment procedures, like the UK, rely on traffic counting rather than on WIM data, which can be extremely misleading. Partners from Denmark, France, Netherlands and Slovenia are all intensively collecting WIM data and Ireland has just completed the first year of systematic WIM data collection. This data will be used in Re-Gen and elaborated in the D3.1 to suggest the optimal way to use it for bridge assessment applications and to feed the appropriate tasks of the Re-Gen project with relevant information.

2 The Project Scope

2.1 Overview

Across, Europe there is a need to build an understanding of the external factors that will influence the management of national road networks over the coming 20-30 years. These will include the predicted performance of the asset, projected traffic forecasts, potential impact of climate change and how all of this may be impacted by limited funding. Equally, with demand for a single interlinked European road network, the ability to provide optimised planning and maintenance strategies is likely to become even more important.

The Re-Gen hypothesis is that adopting a network-wide probabilistic risk based approach will provide a scientific structure to (i) ensure safe lifecycle analysis of road assets consisting of bridges, retaining walls and steep embankments and (ii) to inform key decisions regarding prioritised maintenance expenditure. The risk based approach will ensure optimised lifecycle performance of the infrastructure, within the context of *evolving traffic demands* and *climate change effects*. The proposed framework will consider the different types of risk faced by national road administrations – for example, safety risk, such as structural safety, financial risk, such as that arising from a maintenance backlog, or by managing the increasing demand for emergency repairs, operational risk, commercial risk and reputational risk. This risk methodology can then be used by national road administrations for the development of asset management policies, to communicate with stakeholders and to support funding submissions

The risk will be assessed considering not only the probability of failure of an element/network but also based upon the consequences of that failure. As a result the prioritisation of these structures for repair should be planned based upon the associated risk, where risk is defined as the product of the (probability of failure) x (consequence) of that failure. Such a risk based approach will provide Owners/Managers with the facility to optimise budgets/resources from the perspectives of minimisation of cost, i.e. considering alternative rehabilitation strategies including the do-nothing option, for maximised service life performance, Figure 1.

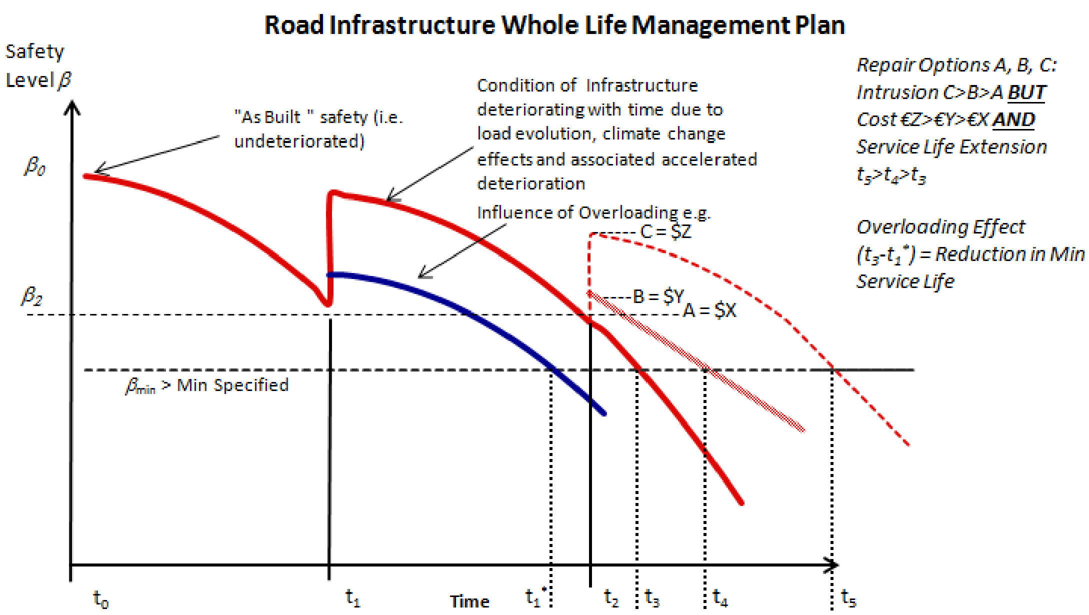

Figure 1: Life Cycle Performance Optimisation

2.2 Objectives

The Re-Gen objective is to provide Road Owners/Managers with best practice tools and methodologies for risk assessment of critical infrastructure elements, such as bridges, retaining structures and steep embankments, considering the effects of climate change and increased traffic and loads.

To achieve these objectives Re-Gen will:

1. Produce a State of the Art Report focused on consideration of:

   (a) asset performance and deterioration;
   (b) prediction of traffic growth;
   (c) fore sighting work on developing scenarios for the future;
   (d) climate change prediction.

2. Detail the development of a risk based methodology for prioritisation of maintenance actions from the perspectives of:

   (a) safety;
   (b) operation;
   (c) finance;
   (d) commercial;
   (e) reputation;

   and to demonstrate its use in a Web based tool.

3 WIM data collected

The objective of the work is to provide a state-of-the-art report on the availability of WIM data in partners' countries (and wider in Europe) that will feed the following project tasks. In this respect the goal of this milestone was to check with all partners' countries weather:

- they do collect WIM data;
- if yes, do they use it for bridge applications;
- if not, would the data collected be appropriate for bridge applications.

3.1 Surveys

Some partners are well involved in bridge loading activities in their countries and had this information available. Others, like Ramboll from Denmark, have contacted their national traffic data collection authorities and ask them to provide samples of WIM data. What has been looked in particular was if:

- data is available in vehicle-by-vehicle format; this is typically stored in a file where each line describes a vehicle with at least the following information:
    - time,
    - speed,
    - axle spacings,
    - axle loads,
- precision of the reported time stamp, i.e. weather the time is recorded at the nearest full second or in more detail or better; time records at at least 0.1s precision are deemed appropriate.

Typically the records contain additional information, such as vehicle category, axle configurations, gross weight, length of the vehicle, temperature, error codes, etc.

An example of the French WIM data imported in Excel is given in **Figure 2**.

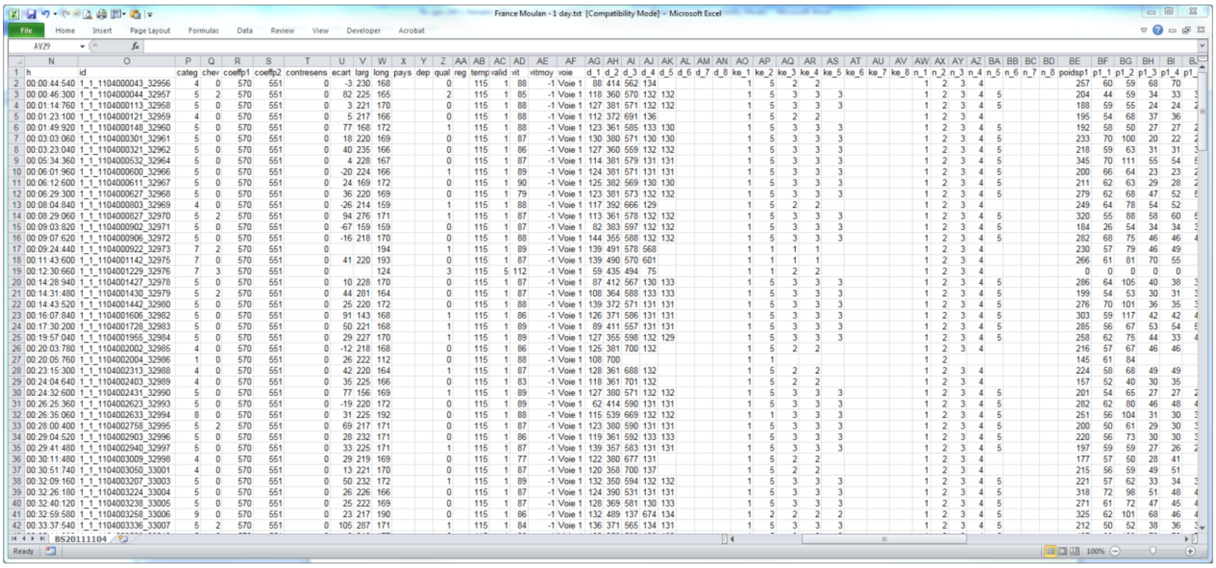

Figure 2: An example of vehicle-by-vehicle WIM data

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IN the deliverable D3.1 this data will be evaluated with respect to bridge applications (according to technologies, quantity of data and accuracy of results). It will also:

i) provide examples of good practice of using WIM data for bridge assessment and guidelines on how NRAs can collect and use it,
ii) demonstrate with case studies the importance of using WIM data with respect to bridge safety (risks).

3.2 Data collected

The following paragraphs provide a brief overview of the information collected in relation to WIM data collection policies in the partner countries, which was the subject of this milestone.

3.2.1 Slovenia

Slovenia is collecting WIM data on the entire national road network (Cestel, 2013). Only the portable bridge WIM systems are used which collect 1-week to 1-month data samples at roughly 100 locations. In addition, a few long-term (permanent) locations have been installed.

WIM data has been collected for the last 15 years for a number of applications, including bridge assessment. Vehicle-by-vehicle data, with precise time stamps (time differences between the vehicles with at least 0.1s precision) and detailed information about axle loads and axle spacings of individual vehicles that are necessary for bridge load modelling are available and are used for bridge load modelling applications. Bridge response measurements provided by the Bridge-WIM systems are also used to calibrate the structural models of the bridges.

3.2.2 France

France has a long tradition in collecting WIM data. In recent years they have replaced the old network of around 200 WIM systems with a new generation of more accurate WIM systems. Today a national WIM network is in operation, with approximately 20 permanent WIM stations built around piezo-quartz technology that feed data into a central database. Vehicle-by-vehicle data, with precise time stamps and detailed information about axle loads and axle spacings of individual vehicles are available and are used for bridge load modelling applications.

3.2.3 Ireland

Ireland got its first operational WIM network in 2013. It consists of 6 permanent piezo WIM systems that generate around 20 million vehicle records (including cars) in each quarter. Vehicle-by-vehicle data, with precise time stamps and detailed information about axle loads and axle spacings of individual vehicles are available and will be in the future used for bridge load modelling applications.

3.2.4 Denmark

Denmark has a network of 8 permanent WIM sites built around piezo-quartz technology on different types of roads. However, the data is primarily used for traffic and pavement loading studies. As such, they are lacking the precise time stamps in the vehicle-by-vehicle data records. As this is a reporting and not a measurement issue, the Re-Gen partner Ramboll is investigating whether it would be possible to store data in a more appropriate file format for bridge applications.

3.2.5 Netherlands

Netherlands has been, for the last 10 years, operating a network of 12 permanent WIM stations built around piezo-quartz technology that shortly will be upgraded with around 8 new stations. Although bridges are not the primary reason for collecting WIM data in the Netherlands this data has been in the past used for bridge applications.

3.2.6 Non-partner countries

Some countries, who are not partners in Re-Gen were also considered in the survey.

Data samples have been acquired from Germany, which also has a relatively comprehensive network of permanent WIM sites. Information in their vehicle-by-vehicle files is adequate for bridge applications.

Some other countries, like Austria, Sweden and Croatia, are collecting data with bridge-WIM systems and are consequently capable of using this data for bridge applications. Austria, in fact, uses this data on a regular basis for bridge applications.

4 Conclusions

This report gives a short overview on activities accomplished so far on collection of WIM data, a precursor to the deliverable D3.1, the *Guidelines on collecting WIM data and forecasting of traffic load effects on bridges*. Data samples were received from all five partner countries, which yield the conclusion that the Milestone M3.1 was successfully completed.

5 Acknowledgement

The research presented in this report/paper/deliverable was carried out as part of the CEDR Transnational Road Research Programme Call 2013. The funding for the research was provided by the national road administrations of Denmark, Germany, Ireland, Netherlands UK and Slovenia.

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