DeTECToR: Decision-support Tools for Embedding Climate Change Thinking on Roads

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Decision-support Tools for Embedding Climate Change Thinking on Roads: DeTECToR

Climate change challenges

Climate change presents a significant challenge for road authorities, both in dealing with its impacts on their network, and in finding ways to reduce their greenhouse gas (GHG) contribution. Changes in climate mean that road authorities are dealing with more frequent extreme weather, greater sea level rise and increased stress on infrastructure leading to higher deterioration rates. In addition, they must meet targets aimed at reducing GHG emissions from their organisational and supply chain activities.

The DeTECToR (Decision-support Tools for Embedding Climate Change Thinking on Roads) project was commissioned through the Conference of European Directors of Roads (CEDR) Transnational Research Programme to help road authorities address these challenges.

The project objectives were to produce decision support tools and guidance to enable road authorities to implement the latest climate change research and thinking. By applying a robust methodology for determining the most cost-effective adaptation measures they will be able to develop the business case for adaptation action, and by reviewing their operations and procurement processes, they will be able to implement their climate change policy consistently and effectively across their network to reduce GHG emissions. In this way, consideration of appropriate climate change measures, following a robust assessment process, will become a routine part of the management of the road network.

DeTECToR focused on two key areas;

1. Developing the business case for climate change adaptation

2. Embedding consideration of climate change mitigation and adaptation into road authority operations and procurement.

A decision-support tool and accompanying guidance was developed for both these areas.

The method used to produce the tools and guidance consisted of three phases:

1. Review of climate change research and good practice: A review of the latest research and good practice was carried out in order to inform the development of the tools and guidance. This involved a comprehensive literature review and a survey of road authorities on their current practices and future priorities (see Figure 1).
2. Development of the tools and guidance: Initial findings and plans on the functionality and format of the tools were presented to road authorities at a workshop. These findings were used to shape the specification for the tools. The tools and guidance were developed collaboratively involving expertise from climate scientists, civil engineers, specialists in climate risk assessment, cost-benefit analysis and asset management.
3. Pilot studies: The two tools were trialled with selected road authorities in order to ensure they met user needs in terms of functionality, ease of use and producing useful information in the most appropriate format. The risk assessment and CBA tool was piloted in Scotland, Germany and Austria and the procurement collaboration platform was piloted with Norway, Sweden and the Netherlands.

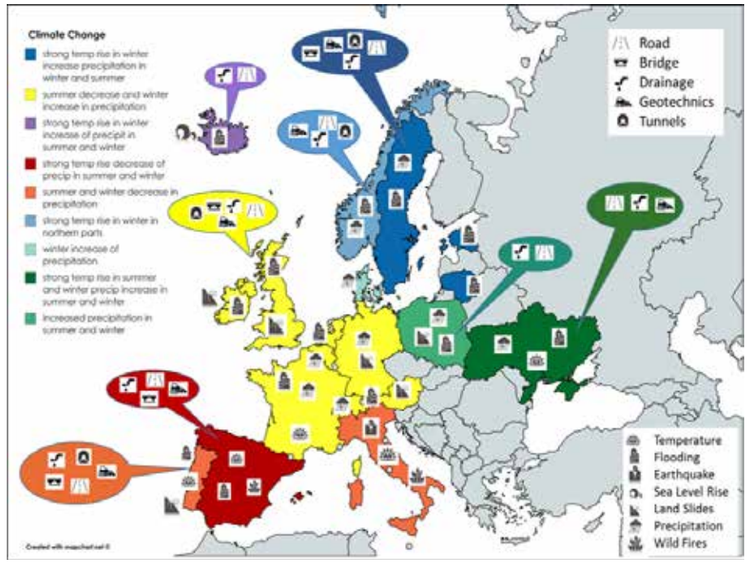

Figure 1. Assets and hazards of most concern to European road authorities (based on DeTECToR survey results). This can be viewed in reference to the type of climate the country experiences.

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The project aimed to produce two sets of tools and guidance aligned with its two main goals:

To support road authorities in developing the business case for climate change adaptation:

- A risk assessment and cost-benefit analysis (CBA) tool incorporating future climate change to enable the comparison of the cost-effectiveness of potential adaptation options.
- A guidance document on the inclusion of climate change in economic appraisal and use of the CBA tool.

To help road authorities embed consideration of climate change mitigation and adaptation into their operations and procurement:

- An online collaboration tool providing a platform to exchange information and lessons learned and case studies on the inclusion of climate change in procurement processes.
- A guidance document on the embedment of climate change mitigation and adaptation into road operations and procurement processes and use of the procurement tool.

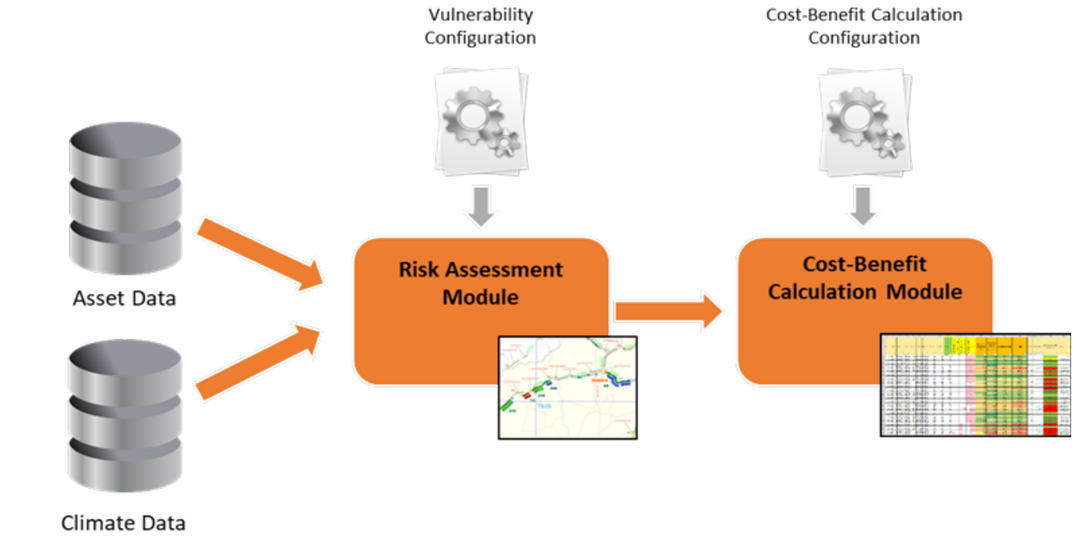

Figure 2. Schematic of the risk assessment and cost-benefit analysis tool showing the two modules and user inputs.

Risk Assessment and Cost Benefit Online Tool

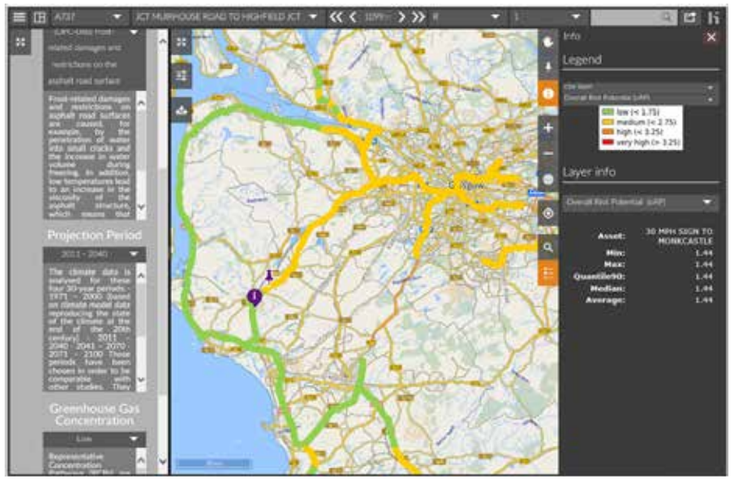

Figure 3. Screenshot from the DeTECToR risk assessment and cost benefit tool. The map shows risk assessment results from the Scotland pilot study for frost-related damages and restrictions on asphalt pavements for the period 2011 to 2040, with a low GHG concentration.

The risk assessment and cost-benefit tool developed is an online tool consisting of two modules. The risk assessment module enables users to identify the areas of their network with the highest risk for different types of failure referred to as damage pattern categories (DPC), for example heat related damages and restrictions on asphalt pavement. Climate, asset and effect indicators and indicator´s thresholds are defined for each DPC and are assigned a score (low, medium, high, very high) depending on data uploaded into the tool. These are then combined to provide each section of road or asset an overall risk score of 1(low), 2(medium), 3 (high) or 4 (very high).

The second module enables the costs of different adaptation strategies to be compared over an appraisal period. It uses information produced by the risk module to determine how likely a failure event is to occur and the lifespan of the asset and calculates the direct and indirect costs. The costs associated with three adaptation options are compared to the no adaptation scenario to enable the lowest cost option to be identified. Climate data and asset data from the pilot study road authorities was uploaded into the tool to test the functionality and usability of the tool. Figure3 shows a screenshot of this tool. The tool is a flexible framework which is configured by the users to tailor it to their network and priorities. It designed to be adaptable, so that the indicators can be modified according to the data available and new DPCs can be added to reflect the hazards experienced by the road authority.

Procurement Collaboration Platform

The procurement collaboration platform is a website with wiki functionality. Information and good practice examples have been uploaded into the tool as part of the DeTECToR project, but the aim is for this to be added to by road authorities. The platform enables road authorities to share approaches and experiences with each other; expanding the resource and keeping it up-to-date. The platform is divided in topic sections with pages of information containing good practice, case studies and links to additional information. Interviews were held with three pilot study road authorities and information on their sustainable procurement approaches were uploaded into the tool. Figure 4 shows a screenshot of a page from the platform.

Figure 4. Screenshot of the DeTECToR procurement collaboration platform. It shows one of a number of different pages of information which include a summary of good practice, case studies and links to further information. These can be edited by registered users.

Scotland pilot study

The risk assessment and CBA tool was trialled with road authorities in three countries; Germany, Austria and Scotland. Each pilot study focused on different types of hazard and asset types. The Scotland pilot study was carried out by TRL in conjunction with Transport Scotland, who provided data and advice to help trial the tool. The South West Unit was selected as the area for the pilot study and three types of climate hazards which regularly cause problems in this part of the country were chosen:

- Damage and restrictions due to the impact of coastal flooding on asphalt pavements (see Figure 5)
- Damage and restrictions due to the impact of strong wind on bridges
- Damage and restrictions due to the impact of frost on asphalt pavement

Data on climate, pavements and bridge characteristics and condition, topography etc. was obtained and uploaded into the tool. Modifications were made to some indicators to tailor the tool to the Scottish network and data available.

Figure 5. Coastal flooding on the A78 South West Scotland, 3rd Jan 2014 (photo from Scotland TranServ)

The results

The risk level for the three DPCs was calculated for climate projection periods 2011–2040, 2041 – 2070 and 2071 - 2100 and the reference period 1971 to 2000. Also for low and high GHG concentrations. The tool displays the results on a map of the road network allowing the sections of the network at higher risk to be easily identified (see Figure 6 for an example of this).

It also enables the user to understand the change in risk with time and GHG concentration. A sense check of this shows that as would be expected the frost damage risk is lower in the future and with high GHG emissions as the temperature is projected to be higher. However, the risk of coastal flooding increases with time and GHG emissions as sea level rises. The risk of storm damage to bridges changes very little over time.

The CBA module enables the cost associated with different adaptation actions to be viewed. It is calculated over a 30-year appraisal period and includes both direct and indirect costs.

In the example shown in Figure 6 assessing options for addressing the impacts of frost, for most of the pilot network no action is most cost-effective approach.

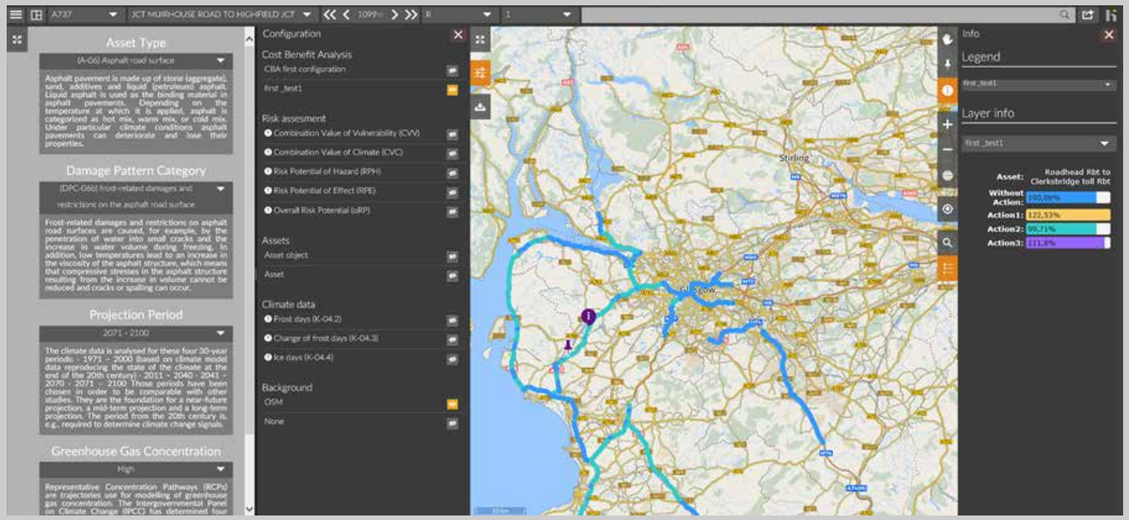

Figure 6. Screenshot from the DeTECToR risk assessment and cost benefit tool. The map shows cost-benefit analysis results from the Scotland pilot study for frost-related damages and restrictions on asphalt pavements for the period 2071 to 2040, with a high GHG concentration. For most of the pilot network 'No Action' is the most cost-effective strategy, however for some parts of the network 'Action 2' provides the lowest cost over the appraisal period.

DeTECToR partners

TRL were the project Coordinator. The other partners in the consortium were Alfen Consult GmbH (from Germany), Heller Ingenieurgesellschaft mbH (Germany), Climate and Environment Consulting Potsdam GmbH (Germany), The Road and Bridge Research Institute (IBDiM) (Poland), AIT Austrian Institute of Technology GmbH (AIT) (Austria) plus two third parties UBIMET (Austria) and The German Weather Service (DWD) (Germany).

The project team consisted of specialists in software development, climate science, road engineering, climate change impacts on roads, risk assessment, procurement and sustainability.

This project was commissioned through the CEDR Transnational Research Programme.

The funding countries were Germany, the Netherlands, Ireland, Norway, Sweden and Austria.

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