Decision Support System (DSS) for road weather conditions -trial in the Czech Republic

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T. Gustavsson & J. Bogren
Klimator and Road Climate Centre
GVC, Göteborg University
Sweden

T. Jurik & T. Pospisek
Cross
Zlin,
Republic of Czech

Introduction

Road weather Information Systems (RWIS) is used for helping maintenance personal to take the right decision regarding salting and ploughing activities. These types of systems have been in use for many years and have been shown to be a very good help for the maintenance people. However, the system was originally designed and build for a maintenance system consisting of small surveillance areas, well trained personal who also had good local knowledge both of field station environments as well as the local road network. Today most National Road Administrations need to lower costs associated with winter maintenance and therefore small surveillance areas are lumped together forming bigger ones. In doing so the local knowledge of roads and field stations among other things are often lost and forgotten.

RWIS-systems normally forms a very good tool for taking decisions regarding maintenance activities but to be used in its full potential it is very important that the user are well trained and experienced to interpret all the data that are produced by the system. An interview study among maintenance personal performed in Sweden by Ljungberg (2002) clearly showed that the personal experienced their work to be very stress full and they where often afraid to take the wrong decision as the consequences could be so fatal. What the personal asked for was some help to make better use of the system and also to help taking the right decision regarding type and timing of activities.

In order to meet these demands research and development regarding a decision support system has been conducted at the University of Göteborg, Sweden, for several years. The aim of these studies have been to develop the present RWIS into a system which gives INFORMATION not only data regarding the present and upcoming need for winter maintenance activities, i.e, a tool for taking the right decision regarding:

- when to perform activity
- where to perform activity
- type of activity

Background

At the university of Göteborg research regarding the relationship between weather, topography and road slipperiness has been a main focus since the beginning of the 1980-ies. In figure 1 an early example is shown. The timing of hoar frost formation was studied in relation to weather and station network. In the figure the dots indicating the timing of slipperiness in relation to frontal movements, local topography among other things. These early studies gave the background knowledge regarding controlling factors for slipperiness distribution and what kind of tools that where needed to be able to predict the spatial variation, see Gustavsson & Bogren (1990). Based on this research a “Road Slipperiness Distribution Model, (**RSDM**)” was developed.

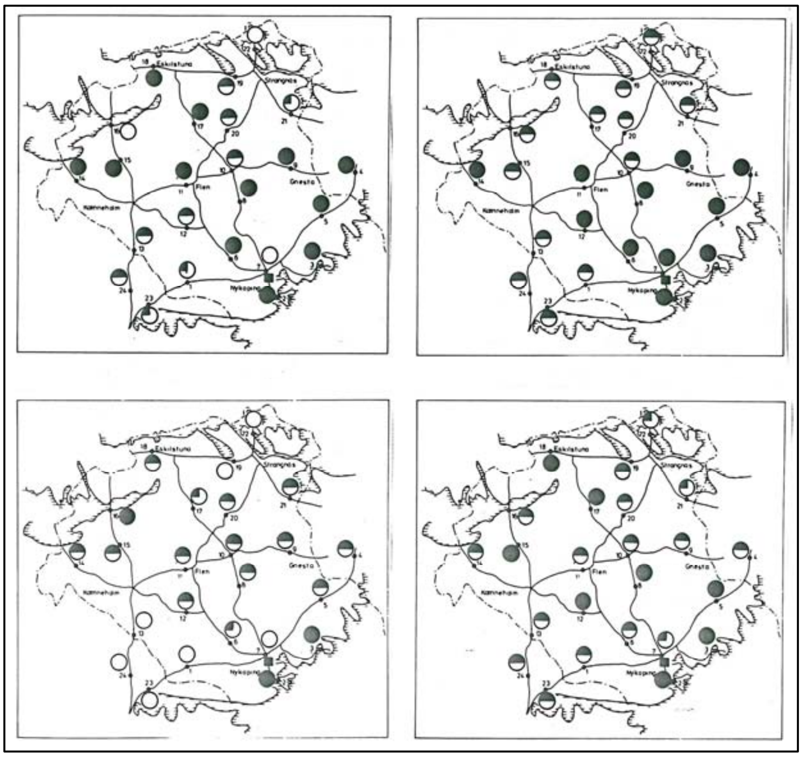

Figure 1. Variation in timing of slipperiness during 4 different warm frontal passages in the county of Södermanland, Sweden during the winter 1983 – 1984.

Another important tool for being able to predict the variation in road slipperiness is a model that can calculate the variation in road surface temperature and road conditions along roads. A Local Climate Model (**LCM**) was developed in Göteborg which made it possible to calculate these variations based on input information from thermal mapping, road segmentation and RWIS-data, Gustavsson & Bogren (1993) and Bogren et al. (1992).

Since the mid 1990-ies trials with variable speed limits are conducted in Sweden. In these systems a **Weather Model** is used for calculating the severity of the prevailing road weather conditions in relation to stopping distances for cars. This model classifies the weather conditions into alarm levels that correspond to specific speed limits. This model has been further developed to be used in a decision support model by linking the severity to needs for different types and intensity of maintenance activities.

Forecast of the upcoming weather and road conditions are a very important part of a DSS. Several different forecast models have been developed during the past years, Gustavsson & Bogren (2000) and Bogren et al (2000). The **RoadCast**-model that we have developed differs from previous models as it includes a neural network part. This model also contains a combination of an energy balance part and a statistical part and has been shown to be very successful for producing good forecasts of both road surface temperatures and road conditions.

The models that are used in the DSS can be summarized as follows:

- LCM: model for calculation of road surface temperature and road conditions along roads
- RSDM: a model for calculation of the spatial variation of slipperiness
- Weather model: a model that calculate the severity of a specific weather situation in respect of risk for road slipperiness
- RoadCast: a road condition forecast model

In figure 2 the DSS-model is outlined. It consists of several different parts giving different type of inputs. A weather prognosis for the coming 12 hours is the base for the weather development and the RWIS-data for the actual road weather conditions. These inputs are processed in the different models previously described giving as a result the prevailing and upcoming road conditions.

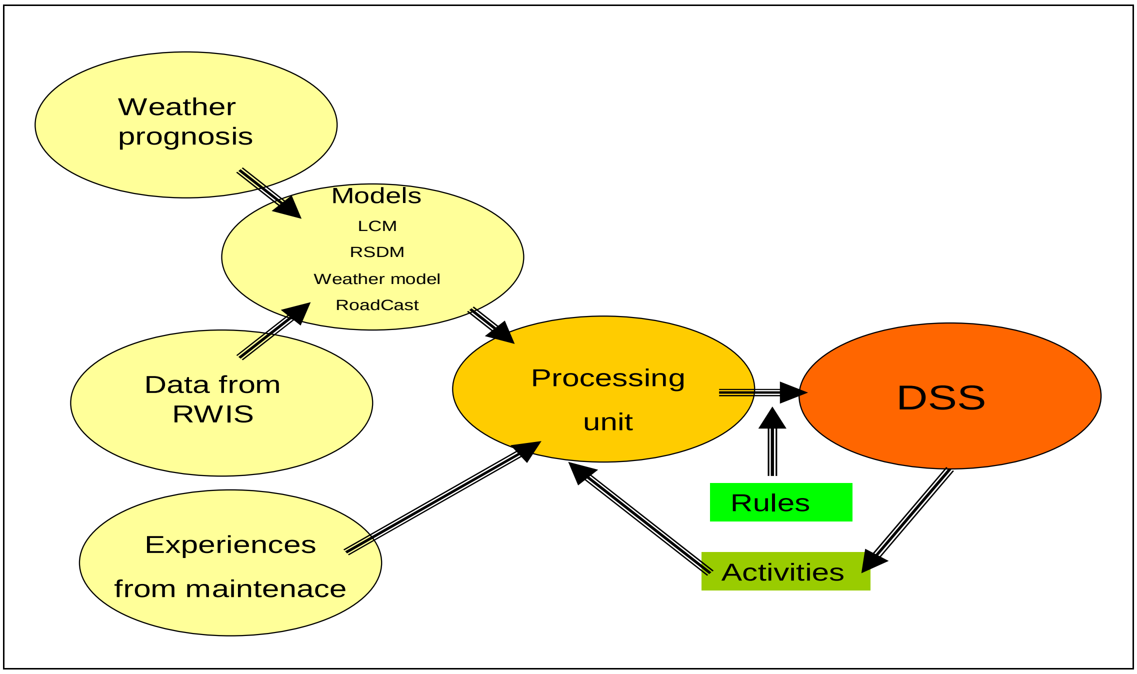

Figure 2. Parts in the support system for decision regarding need for maintenance activities.

Another important input comes from the maintenance personal where their experiences and knowledge are taking into account for the actual area covered by the DSS. Rules regarding when to perform activities in respect of road standards and “allowed” road conditions forms an important link between the processing unit and the output from the DSS. Performed activities in the form of salting and ploughing are another important link between the two parts in the model.

Trials in the Czech republic

During the winter 2007/2008 the DSS-model is tested in the republic of Czech in the county of Pardubický kraj. In figure 3 an output from the DSS is shown for the trial area. All first and second class roads are included in the model and each model is divided into segments according to factors controlling different type of slipperiness conditions.

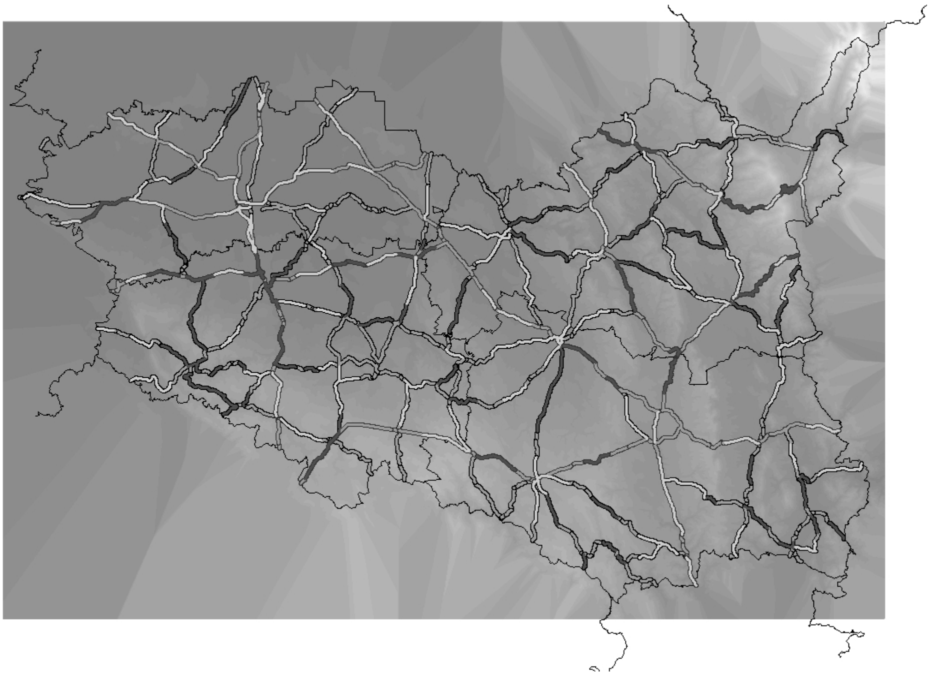

Figure 3. Map of the test area with roads divided into segments indicating different levels of slipperiness exposure.

The model differs between 6 different classes of road conditions and these are further divided depending on risk level. For each road segment the actual condition can be seen as well as the predicted development of the road conditions.

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