



Advances in winter maintenance decision support in the Czech Republic

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ABSTRACT

For the winter season 2013/2014 the Czech Republic advanced to the higher level of winter road maintenance decision support. These improvements were connected with the standardization of winter maintenance operations, which is to be presented at PIARC winter road congress in Andorra 2014. The standardization was defined as the evolution of the existing state and focuses on specification of relation between road authority and contractors. Besides this, the effort was carried out in evolution of maintenance decision support.

For winter season 2013/2014, the fourth generation of nationwide road weather information system has been launched. It brings new features which partly react to users' demands. The RWIS contains also the latest version of maintenance decision support system, which provides dispatchers with detailed road surface forecast.

In 2013/2014 the MDSS system will expand to last three regions and so it'll cover the whole country. In this winter season it is also expected that the new MDSS module will be introduced, trying to provide dispatchers with the treatment recommendation.

Besides RWIS and MDSS the road authority put effort to prepare detailed winter maintenance manual which should help dispatchers to choose the best available technology. It extends the existing documents and legal conditions with further specification of different types of reaction to specific winter conditions and phenomena dangerous for road traffic. As the direct result, the decision diagram has been produced to be placed on every dispatcher's table.

Keywords: winter road maintenance decision support, road weather

1 INTRODUCTION

In last few years the road authority in the Czech Republic constantly make efforts to standardize winter road maintenance in order to support and optimize this important sector. Winter maintenance is traditionally floating between three facets. Safety on the roads is the primary goal. At the same time, however, there is a pressure to perform winter maintenance on a limited budget, while maintaining or even improving the quality and efficiency of maintenance.

There are several key players in the Czech Republic who take care of the standardization of winter maintenance and weather information services. The head road authority is the Ministry of Transport of the Czech Republic, it is the factual owner of the highways and class I roads. The secondary road authority is the Road and Motorway Directorate of the Czech Republic (RMD), a state-funded organization which is subordinate to the Ministry of Transport.

The RMD performs winter maintenance by its own departments on highways and some motorways (which are formally class I roads). Winter maintenance is ensured by the Centres of administration and maintenance of highways and the Centres of administration and maintenance of motorways. Maintenance of class I roads is performed by contractors. This means that under a contract with the Ministry of Transport, eventually with the RMD the maintenance is performed by contractual private companies – so far mainly region-funded organizations.



Czech Hydrometeorological Institute (CHMI), a national weather service, participates in the winter maintenance support already for years by providing general as well as specialized weather information and weather forecasts on high quality level. Based on years of experience CHMI has stabilized the set of weather products for winter maintenance. CHMI does not participate only in decision making process, but also in retrospective evaluation of winter severity and maintenance adequacy using so called Winter maintenance index which is a specialized product for this application.

Highways	Expressways	Class I roads	Class II roads	Class III roads
776	442	5,798	14,558	34,167

Table 1. Road length in the Czech Republic in kilometres by July 1, 2013. [1]

CROSS Zlín, a private company, participates in the maintenance decision support in the Czech Republic from 1995 when it started introducing road weather stations on Czech highways. CROSS is also providing software services, e.g. from 2003 CROSS develops its own technology independent road weather information system called METIS which is used extensively throughout Czech territory.

Last, but not least, the private company Klimator from Sweden is involved in the development of national road surface forecast system called SSWM. Klimator is responsible for preparation of the core microphysical model which is based on downscaling the national numerical weather prediction model called ALADIN, which is guaranteed by CHMI.

2 STANDARDIZATION OF WINTER MAINTENANCE

The standardization of winter road maintenance was deeply analyzed and prepared by the special working group of the Ministry of Transport in 2013 with focus on class I roads which form the backbone of internal road traffic. Since this issue is deeply presented within the paper 0123 “Standardization of winter maintenance operations on road network in the Czech Republic: Successful way to keep the relation between budget and quality” on PIARC, 14th International Winter Road Congress, Andorra, February 4th – 7th 2014 – we will shorten this issue in this paper. However, it is inevitable to achieve the goal which is defined as the balance between safety of the roads, maintenance quality and budget limitation.

Thanks to **Winter maintenance index** the long-term evaluation of local and national standard of winter maintenance is possible. The primary finding which can be seen in results year by year is that the individual approach of different contractors to specific winter conditions can be much different, even if we take into account different climate and local (altitude) conditions. And so we know that **the standardization** is the way which is necessary to optimize the maintenance in all regions.

Speaking about regional and national roads, there are **97** maintenance centres for class I roads operated by contractors and **18** maintenance centres for highways operated by RMD.

The legislative framework for winter road maintenance is stipulated in Act No. 13/1997 Coll., on roads, and the Ministry of Transport Decree No. 104/1997 Coll., implementing above stated Act on roads. In addition to these legal documents the working group and CROSS has prepared detailed **winter maintenance manual** and **dispatcher’s decision diagram**.

The purpose of the manual is mainly to standardize the technologies and procedures of winter maintenance. The purpose of decision diagram is to guide the dispatcher through the decision process in reaction to specific winter weather and road conditions. By intent, it is simplified and covers the reactions to frost formation, freezing rain occurrence, and snowing and icing events. Before winter season 2013/2014 both documents were handed over to dispatchers so this season will be testing.

The standardization also supported further utilization of GPS tracking of maintenance vehicles, weekly operational adequacy check (deviations from standard level of maintenance) and occasional local inspections in maintenance centres. These control measures are still needed to better know how the winter maintenance is done and who/where/when/why generates the deviations from standard.



Further, the new financial model of winter maintenance was prepared for testing in several chosen maintenance areas, but this is out of the scope of this paper; even if it has noticeable influence on contractors' motivation to perform the maintenance. We are speaking specifically about the monthly fee for winter maintenance.

3 WINTER MAINTENANCE DECISION SUPPORT

Winter maintenance decision support can be generally divided into hardware and software systems. Over past 20 years the Czech Republic has built up a functional set of systems supporting the decision making of winter maintenance operators. From road weather stations, through comprehensive web-based road weather information system, to road surface forecast system. The last thing which is currently in testing phase should help dispatchers with decision on when a specific road needs to be salted or ploughed – the system should provide clear indications of maintenance needs, actually treatment recommendation.

3.1 Road weather stations

From 1990's when the road weather stations started to spread in the Czech Republic hundreds of sites were equipped with atmospheric and road sensors from different producers. In 2014 there are **420** locations equipped with road weather sensing technology giving its users valuable information.

Most of the stations are equipped with the basic set of sensors for measuring air temperature, dew point / relative humidity, precipitation intensity, road status, road surface temperature, freezing point and water height.

Road weather stations are important part of decision making process because they provide **remote overview in real time**. Even if there are safety measures to protect stations against vandalism, still there are people who cannot understand their importance (see Figure 1).



Figure 1. Fallen road weather station at Cotkytle. (Image courtesy: SÚS Pk)

3.2 Road weather information system

Currently there are two separate web-based road weather information systems in operation for the Czech Republic – METIS and JSMIS. Both systems have its users.

METIS is a nationwide road weather information system since 2003. In 2013 the 4th version has been put into operation complying contemporary standards for web-based applications. METIS provides the dispatchers with the real time data from weather stations as well as with the road weather forecast (using SSWM model) and other weather information sources. METIS 4 brings several new features which partly react to users' demands. In short future it will feature also a **treatment recommendation** module to fully support the decision making.



METIS is **technology independent** solution for sharing and presenting the road weather data. It integrates all relevant weather information sources – road weather stations (from different producers), remote sensing products, traffic cameras, weather forecasts etc., and presents the information using maps, (animated) images, graphs, tables and text with emphasis on present and future weather situation on the roads.

METIS is based on a **modular structure** and its main components include the following items. In the Czech Republic all items are used, but for example in Sweden the users use only Status map, Stations and MDSS.

- Status Map
- Road weather stations (Stations)
- Cameras
- Remote sensing products
- Forecasts and MDSS
- SMS / E-mail warning system

Status map is interactive so that the user can zoom, pan, search, switch displayed values and get to the detail of selected weather station. In the detail there is an interactive 24-hour graph of measured values, table of values, camera images, some stations feature also a forecast graph. METIS integrates remote sensing products provided by Czech Hydrometeorological Institute as well as specialized textual regional weather forecasts.

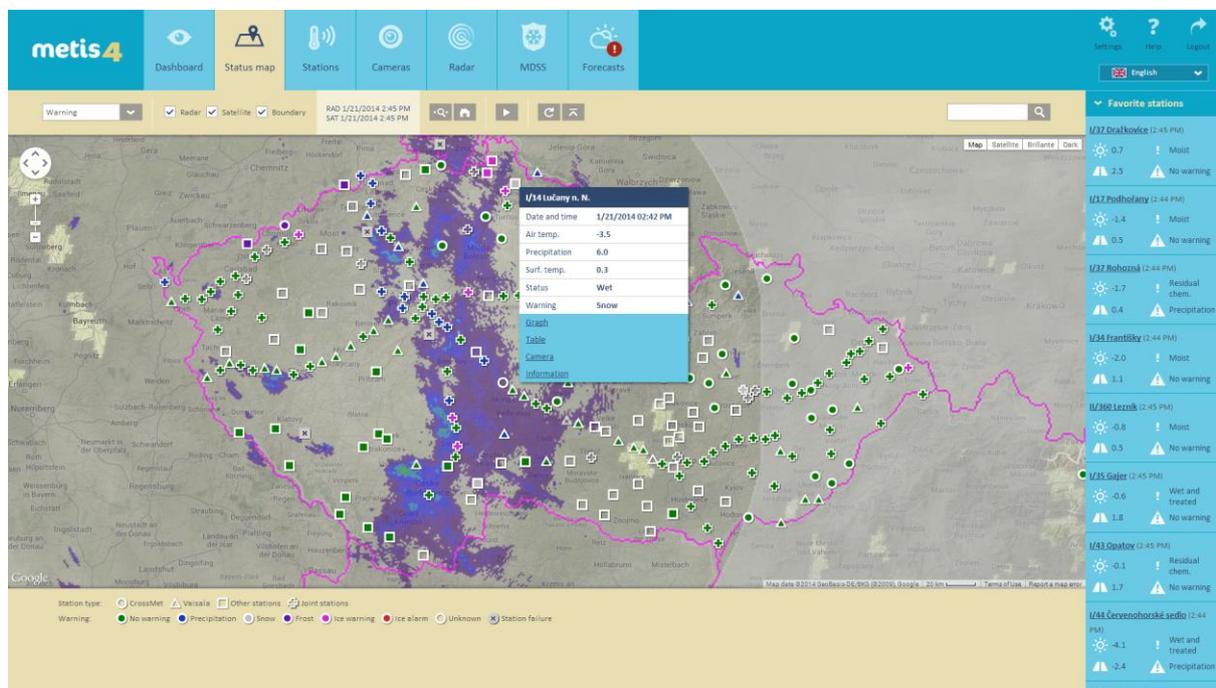


Figure 2. METIS interactive status map with road weather stations.

The main part which provides an outlook into the future is the **maintenance decision support system**. Currently the system provides road surface forecast based on **SSWM model** which calculates the forecasts by downscaling the grid based NWP model to road level. In the Czech Republic ALADIN NWP model (provided by CHMI) is used with cell size of 4.7 km. The forecasts of SSWM model are focused on road stretches of 1 km length and the forecast is produced for next 12 hours with one hour steps and one hour interval of forecast renewal.

More information on Czech MDSS system and SSWM model is presented in the paper 0124 “Can MDSS systems really work? Km by km forecasting improving winter maintenance efficiency in the Czech Republic” on PIARC, 14th International Winter Road Congress in Andorra during February 4th and 7th 2014.

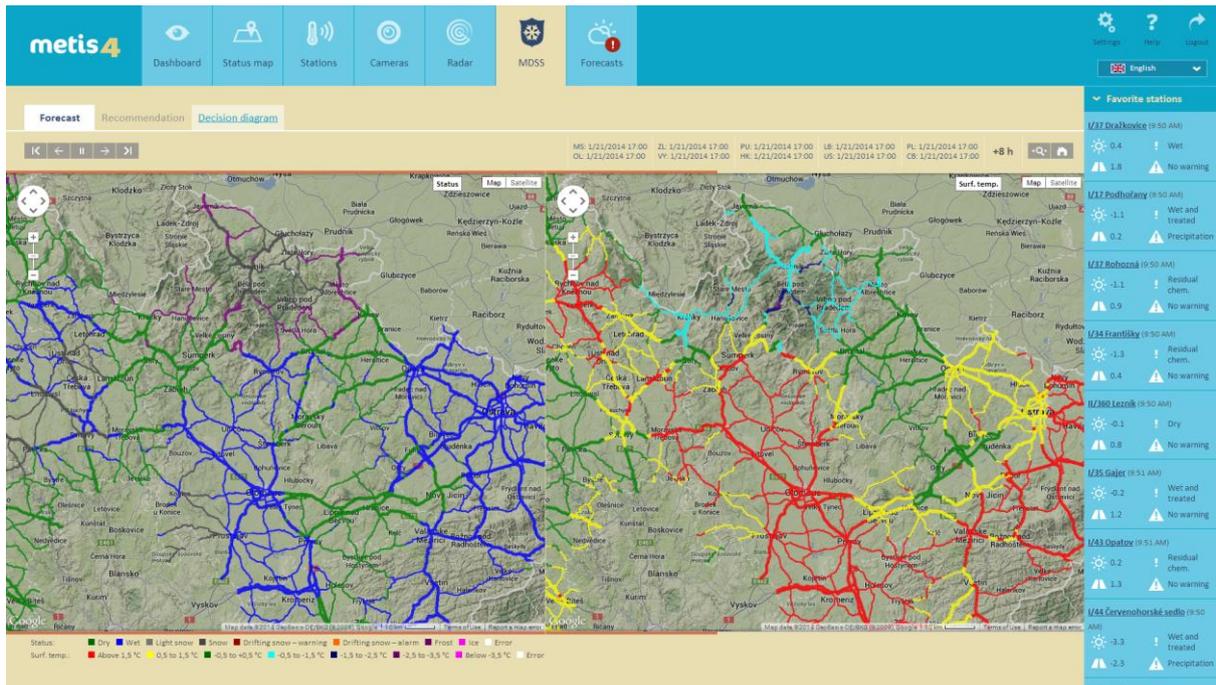


Figure 3. METIS integration of SSWM road surface forecast.

3.3 Winter maintenance operators training

Another feature, which was identified as key for optimal performance of winter road maintenance, is thorough and regular training of winter maintenance operators / dispatchers. Local inspections performed in last few years showed that the dispatcher is really a key person in the management of maintenance operations.

Dispatchers are fully responsible for decisions in winter maintenance. They have to decide (often under pressure) whether to send the maintenance vehicles, when and where to send them and what type of maintenance should be performed (scattering, ploughing). Usually there are several support systems that can be exploited by dispatchers in their practice (weather stations, RWIS, MDSS etc.). However, the most important part of the winter maintenance management is **experience and skills** of the individual maintenance operators.

In this scope the working group started to enforce **annual training** with final exams and certification. This way we can support the initial **qualification** of dispatchers which is needed to optimally exploit the means of winter maintenance. The annual training contains mainly these features:

- Basics of road meteorology
- Hazardous weather phenomena for winter road maintenance
- Road weather stations and data interpretation
- Interpretation of other weather information sources
- Winter maintenance manual
- Best available technologies
- Dispatcher's decision diagram

4 CONCLUSIONS

We are sure that the standardization is the way we have to promote and control so that we achieve the target which is the optimization of winter road maintenance, both in the safety and efficiency of maintenance point of view and in the limited budget point of view.

We also believe that through the assessment of the adequacy and usage of RWIS and MDSS systems it is possible to optimize the winter maintenance and reduce its overall costs while maintaining quality.



Winter road maintenance in the Czech Republic is not bad. On the other hand we cannot say it is perfect. We have only limited comparison with neighbouring countries. We know there is still something to improve and we should constantly try to find a better way.

We would welcome views from other countries from all over the world and we thank SIRWEC organizers for creating the space for knowledge and experience sharing.

5 REFERENCES

- [1] Prehledy z informacniho systemu o silnicni a dalnicni siti CR, stav k 1. 1. 2013. Road and Motorway Directorate of the Czech Republic, 2013. Available at <<http://www.rsd.cz/doc/Silnicni-a-dalnicni-sit/Delky-a-dalsi-data-komunikaci/prehledy-z-informacniho-systemu-o-silnicni-a-dalnicni-siti-cr>>.