EFFECTS OF TECHNOLOGY IMPROVEMENTS ON WINTER MAINTENANCE OF ESTONIAN ROADS

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1.Abstract

In recent years several measures have been implemented to ensure safe and uniform road conditions for road users in Estonia in winter:

1. Since 1999 all national roads in Estonia are submitted to snow and ice control;
2. Advanced equipment for anti skid treatment and preventive winter maintenance technology have been taken into use;
3. Several legal acts related to winter maintenance have been adopted;
4. Pure salt and brine for ice control and efficient salt spreaders have been taken into use more widely;
5. Road Weather Information System has been developed;
6. management reform has been started.

The economic effect is considerable and a better level of service has been achieved which is very important when funding is limited. The environmental damage has also been reduced.

This paper contains a description of positive changes due to technology improvements regarding winter maintenance of Estonian roads.

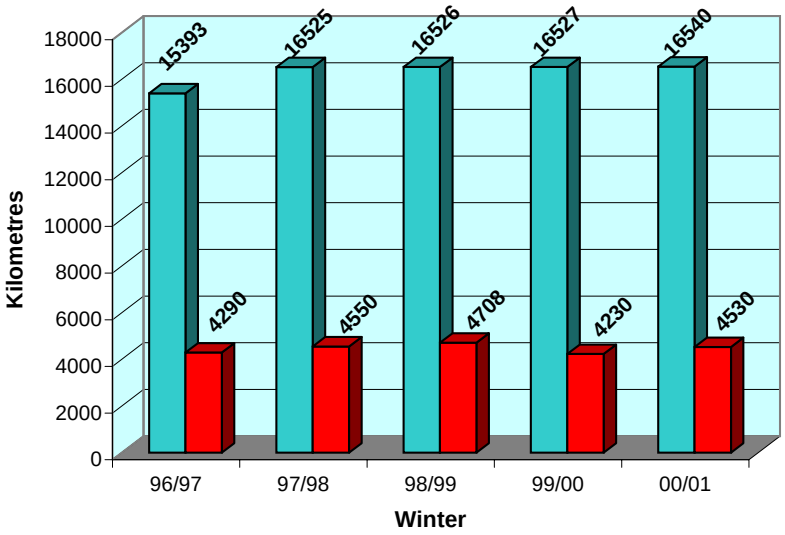
2.General Backround

The total length of Estonia's public road network is 50,500 km including 16,540 km of state roads. The management of the network is under the responsibility of the Estonian Road Administration. Winter maintenance is currently performed for all state roads whereas for other roads, it is done to the extent of 50%. Anti skid treatment is performed for state roads where traffic is over 500 AADT. New legal acts, enacted by the Minister of Transport and Communications, which regulate winter maintenance, are in force since autumn 1999. A private enterprise is performing all annual maintenance works in Põlva region for state roads (approximately 1,100 km) since April 1, 2000, including winter maintenance. This enterprise was selected at a state procurement tendering procedure. This year, road maintenance has also been transferred to private enterprises in two other regions (a total of approximately 2,100 km).

3. Road Network Submitted To Winter Maintenance And Related Costs

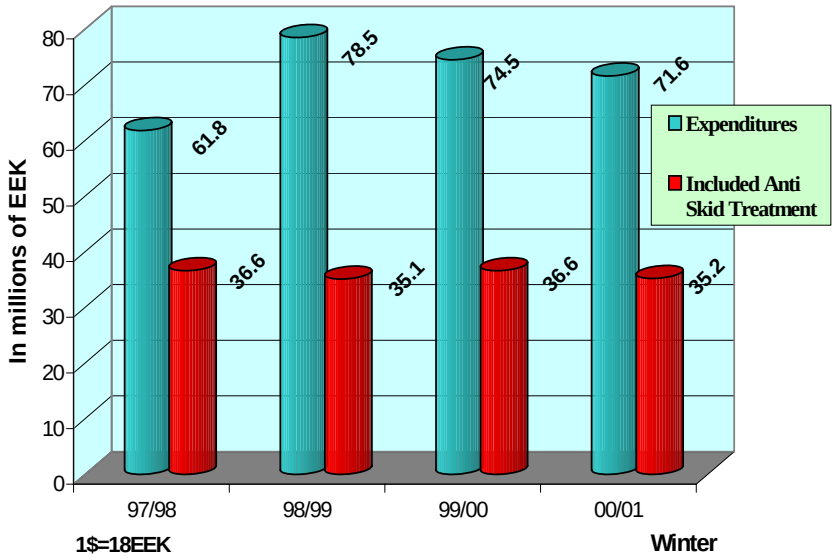
Currently the total length of state roads is 16,540 km, i.e. 1,150 km or 7.5% more than five years ago.15 road administration branches have performed winter maintenance of this network, each of them having a separate budget and a separate fleet of vehicles. Winter maintenance is performed for all this network, regular anti skid treatment for 4,530 km, while elsewhere, the snow is just removed and only at permanently hazardous places mineral anti skid treatment is applied (bridges, abrupt upward or downward slopes), as well as in extreme weather conditions (rain in winter, snow melting period, etc.). The following chart characterises winter maintenance of the relevant network:

Length of Road Network Submitted to Winter Maintenance



Approximately 50% of winter maintenance costs are due to anti skid treatment, 40% to snow management and 10% to patrol service, weather forecasts and supply of traffic information. During last four years, the share of expenditure to road weather stations and information systems has increased. Anti skid costs have remained almost the same, in spite of the increase of network submitted to anti skid treatment. Snow management costs have decreased to some extent. The following chart characterises the cost allocation of winter maintenance:
efficiency. Winter maintenance costs have decreased by 10% during last three years and in five years the share of winter maintenance within the overall maintenance budget has decreased from 39% to 29%. At the same time, the budget of maintenance has grown by 30% during last four years.

Expenditure structure of winter maintenance

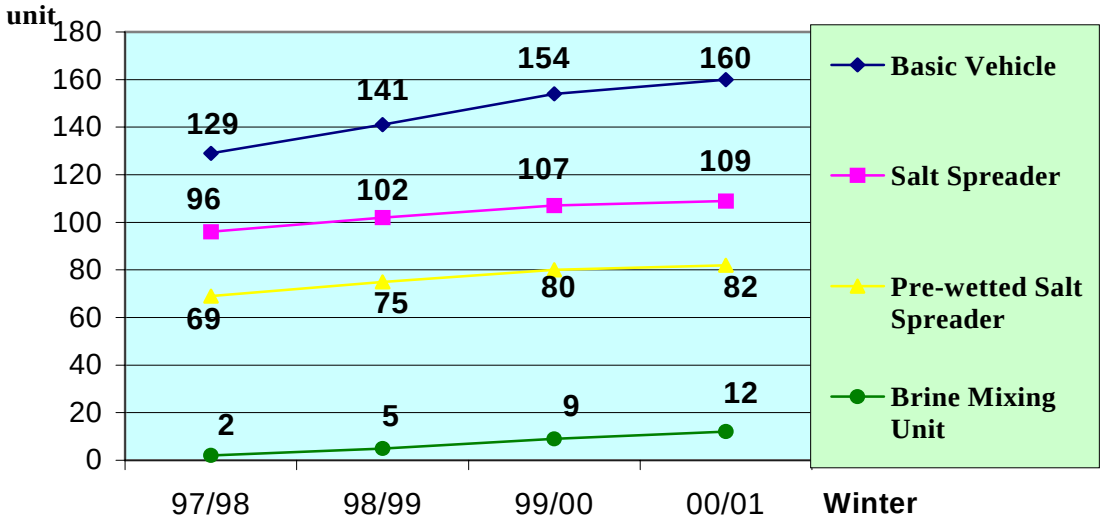


The significant increase in costs for winter 1998/99 was due to the increase of road network by 1,100 km. However, the following years, the summing up of costs regularly decreased and this was achieved by establishing a road weather station network and information systems, thus improving the general

4.Tehnological Changes In Winter Maintenance

Today, the process of technology renewal has reached a point where previous, Russian-origin technology has been replaced by new or second hand Western winter maintenance basic vehicles, most of which include two snowploughs and underbody plough. Moreover, the majority of vehicles have modern spreading devices which make possible to moisture the chlorides spreaded and also allow to work with minerals on secondary roads. Since last autumn, 12 devices for preparing brine were in operation, some of which preparing the brine for several road administration branches. The following chart gives a picture about winter maintenance technology changes:

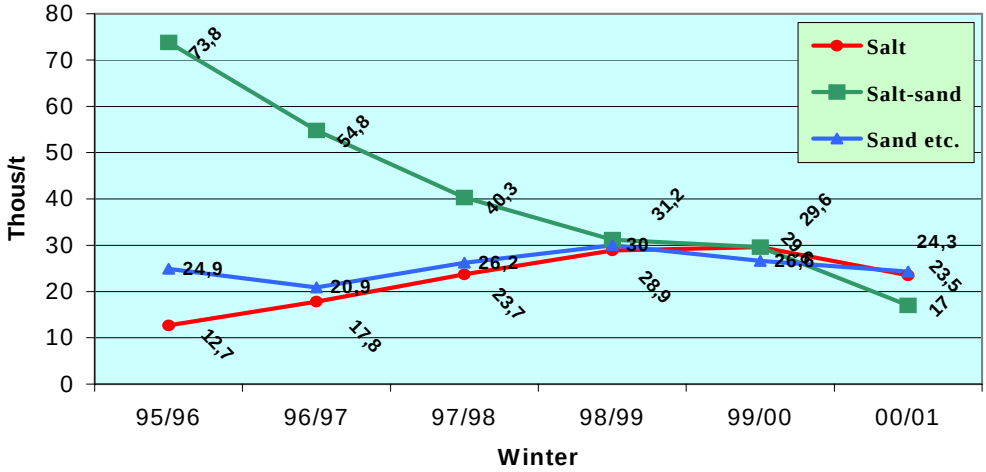
Changes In Anti Skid Tehnology



The following figure gives a picture about the costs of materials which have been used for anti skid works during last six winters:

The comparison of data clearly shows that the use of salt-sand has significantly been reduced to the benefit of modern spreading techniques, while the use of pure chlorides has been extended

Anti Skid Treatment

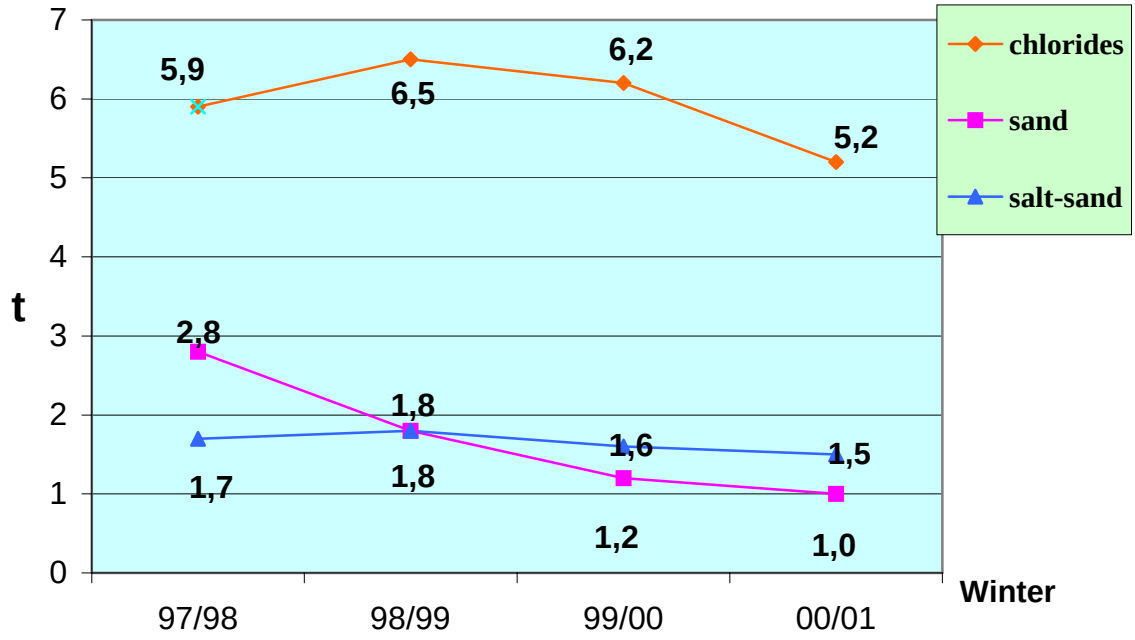


Apparently, the current use of salt-sand and sand (mineral materials) has reached an optimal point, taking into account the current winter maintenance road network and condition requirements, as for some roads, there is no requirement of keeping the pavement clean in winter and on gravel roads, pure chlorides cannot be used.

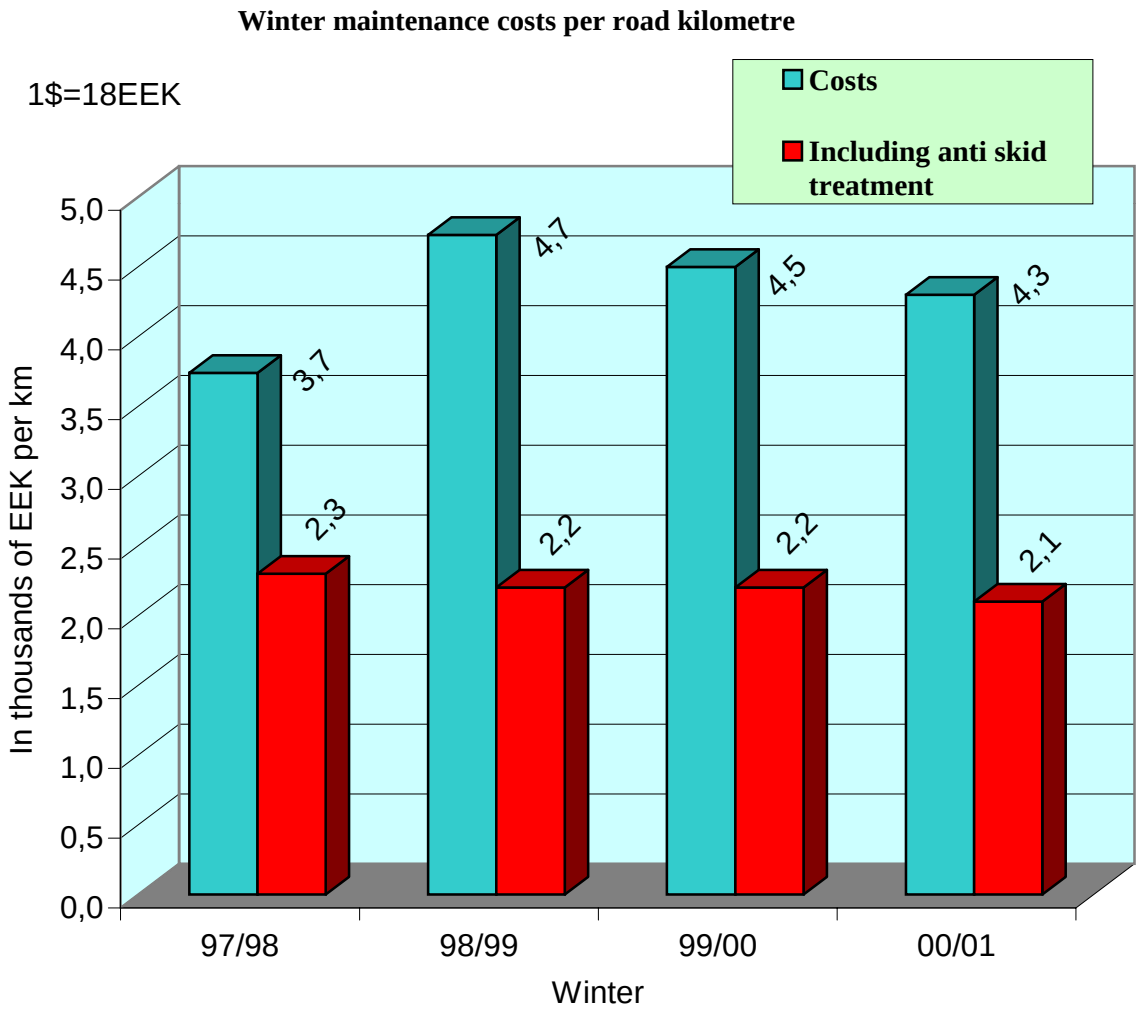
During recent years, the use of pure chlorides has been reduced as well, although the road network submitted to anti skid treatment has increased to some extent. This has been obtained first of all by enhanced experience of spreader operators regarding their work with pure chlorides. Secondly, different chlorides promoted by different suppliers have been tested as to the efficiency of their anti skid qualities. As a result, the best value for money has been identified and today mainly German-origin materials are used. Only in Southern Estonia region Byelorussian and Ukrainian salt is less expensive at this stage, due to high railway transport costs needed for delivering the salt from ports.

As a result of all above mentioned measures, the cost of spreading materials per 1 km of roads has decreased regularly and the chart referring to these data gives an idea of it.

Cost Of Materials Spreaded Per 1 Km Of Roads



The above mentioned reasons and the data within the last chart explain why during recent years the costs of winter maintenance, including anti skid treatment per 1 km of road have been reduced. The following chart characterises visually the corresponding changes:



5. Legislative Changes And New Legislation

On February 17, 1999, the Parliament of the Republic of Estonia adopted the Road Act. This Act provides for road-related requirements and responsibilities regarding infringements of traffic security requirements, regulating also road maintenance, road utilisation and road safety, together with protection of people and the environment against hazards which result from traffic. This Act also provides for the need to establish requirements regarding winter maintenance of roads and streets as well as the technology to be used to perform such works.

In this connection, according to the Road Act, the Minister of Transport and Communications signed a Regulation on November 1, 1999, which provides for requirements regarding the conditions of roads during winter period. Although there had been similar requirements in force in Estonia at an earlier stage already, these had no legal act status and were legally not binding. Another difference which was enacted by the legal act determining the state of roads, consisted in common minimal requirements for cities and other local governments. Earlier, the local governments had established such requirements without common basis and therefore there were substantial differences both in requirements and actual state of roads and streets. This is not to say that immediately after the regulation was issued, all requirements became coherent on all local government territories and that the winter state of streets is of the same level everywhere, however, this provided a basis in this direction and as time passes, the state of streets will certainly become more similar everywhere.

Renewed requirements of road conditions determine more precisely requirements foreseen for different road categories (altogether 4 different state levels). Main indicators which characterise roads

in winter and which set allowed limits, are the skid resistance, the thickness of snow and thickness of the salt-snow mix, the minimal width of the road between snow banks and the evenness of the road (table 3.1). For instance a 3rd state road (main roads with traffic frequency up to 8,000 AADT or other roads from 3,000 to 8,000 AADT) require anti-slippery treatment within 4 hours after the road has become slippery. In case of snowfall or sleeting, the traffic fluidity should be re-established within 5 hours after the end of the snowfall or sleeting and the salt-snow mix should be removed from the road within 8 hours. Similar requirements for 1st state roads (traffic up to 1,000 AADT) should be 24 hours for anti-slippery treatment and the snow and sleeting should be removed within 36 hours. The Minister's regulation also provides for requirements to clean roads from the left material of winter maintenance during the spring (by May 15 at the latest), the procedure for establishing an emergency situation and behaviour which should then be adopted, as well as other conditions which are relevant for road-users in winter conditions.

Table 3.1.

Indicators	Levels of road states and their characteristics			
	1	2	3	4
SLIPPERY ROADS Road surface condition	Snowcovered or icecovered pavement, anti-slippery treatment in dangereous places	Snowcovered or icecovered pavement, anti-slippery treatment of the entire road	Snowfree and icefree ruttings	Snofree and icefree pavement by lane breadths
<u>SNOWINESS/ CLEANING ROADS FROM SNOW</u>				
loose snow under	10 cm	5 cm	3 cm between ruttings	–
Wet snow or sleeting, salt and snow mix under	6 cm	3 cm	2 cm between ruttings	–
Distance between snow banks on a road, measured from the surface, more than	6 m or at least width of the road	8 m or at least width of the road	9 m	10 m
EVENNESS Ruttings or Unevennesses in packed snow under	4 cm	3 cm	There may be a layer of packed snow under 2 cm between ruttings	Clean pavement, air temperature below –12 °C authorised snowlayer between ruttings up to 1 cm

As a difference compared to previous legislation, the Road Act provides for the road owner's responsibility in case the state of the road is under the required level. This provision is somewhat unpleasant for road owners, but from the road users viewpoint, it is essential to be able to claim reimbursement of any damages which occured due to bad road condition.

The Estonian Road Administration has not only specified and supplemented road state requirements, but also performed a considerable task in informing road users about established

requirements and the requirement differences as to different road categories. Up to now, road users frequently lodged in protests about road state/condition, without realising that it is not reasonable, in the interests of best use of taxpayers' money, to require high level conditions of low traffic roads, similarly to main roads, and road works might take more time in smaller roads as well. In addition to informing road users about road state requirements by radio, TV and newspapers, the distribution of free flyers in gas stations has become a very efficient way of informing road users. In this way, useful information reaches the best target group in time. Moreover, the gas stations are places where people come in after emergency situations in winter or simply where drivers, who are tired of driving in winter conditions, drop in to get help or just rest. Becoming aware of the situation, thanks to the information flyers, helps them to understand the work of those who perform road maintenance. In this way, people learn time limits for pavement cleaning and this often reduces road users' eagerness to protest. Information flyers also provide a road map of Estonia, where different colours show different categories of road states, complete with photos how different roads should look like according to requirements. The flyers contain also, of course, useful phone numbers, websites and radio stations, from where more information may be obtained about road conditions.

Together with the establishment of state requirements for normal roads, there are rules of building an ice road, complete with requirements for such roads. When winters are cold enough, ice roads are in use in Estonia. These roads are built on sea ice or lake ice cover and help to improve the connection between the islands and the mainland. The state sees for the building – according to winter conditions – of 4 ice roads with a total length of approximately 56 kilometres. Local governments build other ice roads. The above mentioned regulation provides for necessary studies and weather conditions which are the prerequisites for ice road building. In function of the thickness of the ice, there are provisions regarding vehicle categories which might use such roads, as well as distances between vehicles and traffic rules. The regulation also provides for signs which mark an ice road, rules of surveillance and information provided to the public about the state of ice roads. Similarly to normal roads, there are state requirements for ice roads as well, determining the thickness of the snow cover, the evenness of the road and the width of the ice road.

Together with state requirements established for different categories of roads and streets, there are requirements for winter road maintenance technologies to be used. The categories of salts used for anti-slippery treatments are very precise, as well as their physical and chemical properties, complete with grain size requirements. Use of chlorides on sideways and pedestrian paths is banned. For driving roads there are recommended salt and brine dispersion quantities according to climate conditions, volume of precipitations and the location of the road. Under technology requirements, there is a list of additional equipment used for winter maintenance, however, there is no specification of basic vehicles to be used.

In conclusion, it might be said that during the last two years, the legislative environment providing for traffic in winter conditions, has significantly changed. To a certain extent, this has reduced the freedom of those who provide road maintenance and has increased their responsibility regarding road condition, but for road users, the established requirements have become more understandable, whereas it is easier to measure how the requirements are met and there is an enhanced feeling of safety as to road conditions laying ahead of road users in winter.

6.Changes In Winter Maintenance Management Structure

75% of planned network of road weather stations have been developed within last four years and as a result, it is possible to constantly provide updated information about road traffic conditions as well as enhance the efficiency of anti skid operations. Preliminary spreading enables us to save up spreading materials. Thanks to the network of road weather stations, the Road Information Centre is operating, communicating information both to road users and, when necessary, to winter maintenance managers. In cooperation with the Finnish Road Administration and Latvian and Lithuanian colleagues, we have set up a joint website on wintertime road conditions in the three countries.

At the moment, we have no precise feedback on the use of this website, but Estonian road users have become used to our Road Information Centre and ask a lot of information on wintertime road conditions.

Since April 2000 we have started outsourcing of winter maintenance by means of state procurement procedures and this will continue this year, the first stage should end by December 2002, when winter

maintenance will be performed by only 6 road administration branches instead of 12 today (in 3 regions, private enterprises are already involved at this moment). In other words, approximately 60% of public road network submitted to winter maintenance will be managed by the private sector. During upcoming years we have to carry out an economic analysis of these developments, however, the first year experiences in one region did not put forward any negative opinions – road users did not submit particular complaints during the whole winter.

7. In Conclusion

We may state that since the last Winter Congress until today, the techniques and technology of winter maintenance in Estonia have been further developed and during last year a shift occured towards the private sector to perform winter maintenance.

In spite of inflation and thanks to tehcnological advances as well as changes in management, we have achieved the following:

- to reduce financial means in general and per 1 km of road treated for the state road network submitted to winter maintenance;
- to increase the road network submitted to anti skid treatment; and
- reduce the general costs as well as costs of spreading per 1 km of anti skid materials.

However, we are facing substantial changes when maintenance will be transferred to the private sector. The economic soundness of this approach will be figured out within the three years to come. After that, we will be able to plan next steps when selecting winter maintenance offers. Anyway, the technological development should continue both on the level of state bodies as well as private enterprises.