A WAY TO OPTIMIZE WINTER MAINTENANCE IN LATVIA

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ABSTRACT

Since 2009 the government of Latvia has been forced to reduce the financing to road maintenance and road management. However, the expenses for winter road maintenance remained significant. They reach ¼ - $^1/_3$ of the road budget. If we want to keep and improve a quality level of road winter maintenance without increase of expenses, we will have to make significant changes in management of road maintenance.

1. INTRODUCTION

Latvia is a small country, which is located in the Northern Europe. Latvia has approximately 500 km long maritime boundary with the Baltic Sea. About 60 % of the territory is lowlands and 40 % - uplands. The highest point is 312 meters above the sea level. The major part of the territory of Latvia is 100 meters above the sea level.

Latvia is located in the temperate climate zone. Average temperatures of January are 2°C below zero in the coastal area (the Western part) and 7°C below zero in the inland area (the Eastern part). Sometimes air temperatures drop below 30°C below zero in January and February. Permanent snow covers last 80 - 90 days in the coastal area and 100 - 120 days in the inland area. Because of frequent thaws, the snow cover is thin, about 15 – 20 cm thick in the coastal area and 30 – 50 cm thick in the inland area. In harsh winters snow thickness can reach 1 meter.

You can see some key information about Latvia in the table below:

Territory	64 589 km^2
Inhabitants	2.1 million
Total road length	69 688 km
Gross domestic product	22.2 billion EUR
Road length per one inhabitant	0.033 km
GPD per one inhabitant	0.0106 mill EUR
Road density	1.08 km/m^2

Table 1 - Key information about Latvia

The most important roads belong to the state. Total length of state roads is 20119 km. They are divided in three groups according to importance - main roads (1651 km), regional roads (5317 km) and local roads (13150 km).

Figure 1- Latvian state roads network

2. STANDARDS AND RULES

The Government has established winter maintenance standards. They define five road maintenance classes with different level of maintenance. The maintenance level corresponds with traffic intensity, as well as, road classification.

AADT (vehicles per day)	Main roads	Regional roads	Local roads
> 5000	A	A	-
1000 – 5000	A1	A1	A1
500 – 1000	A1	B	B
100 – 500	-	C	C
< 100	-	-	D

Table 2. Road maintenance classes and traffic intensity

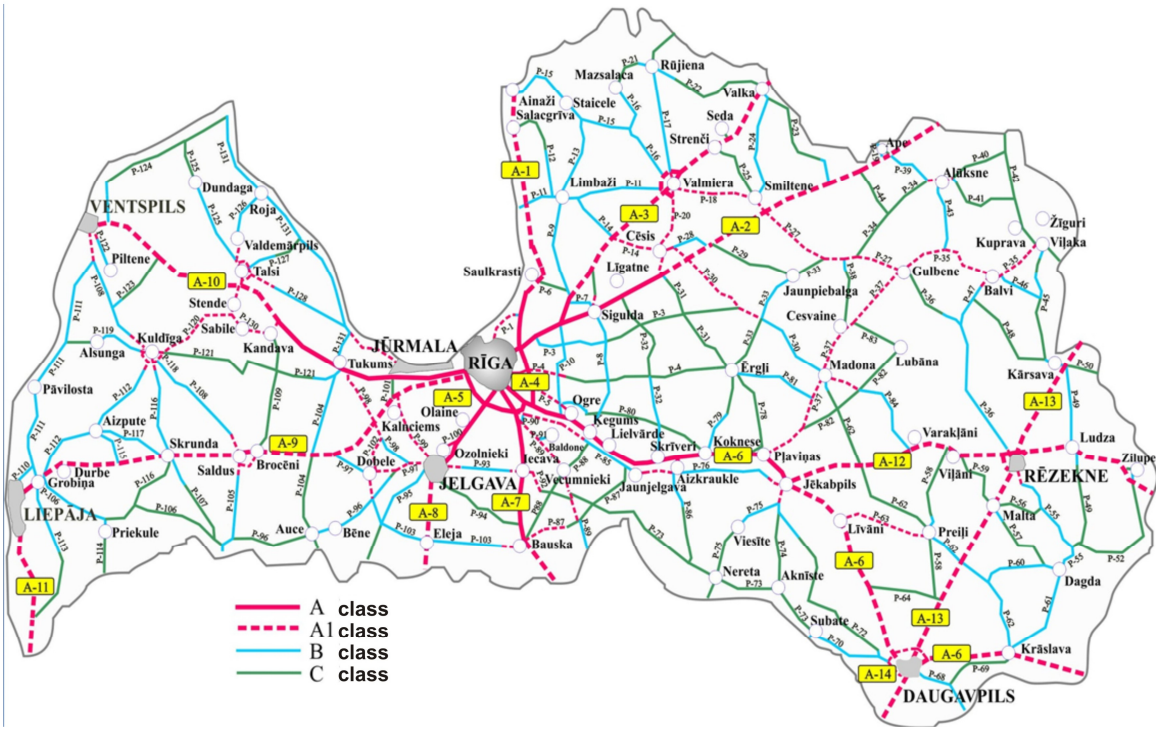

Figure 2 - Road maintenance classes in winter of 2012/2013

Maintenance quality standards for each class define quality indicators, for example, unevenness, snow thickness and performance time. Indicators change according to weather conditions and time of day. At night, maintenance levels are reduced by one class.

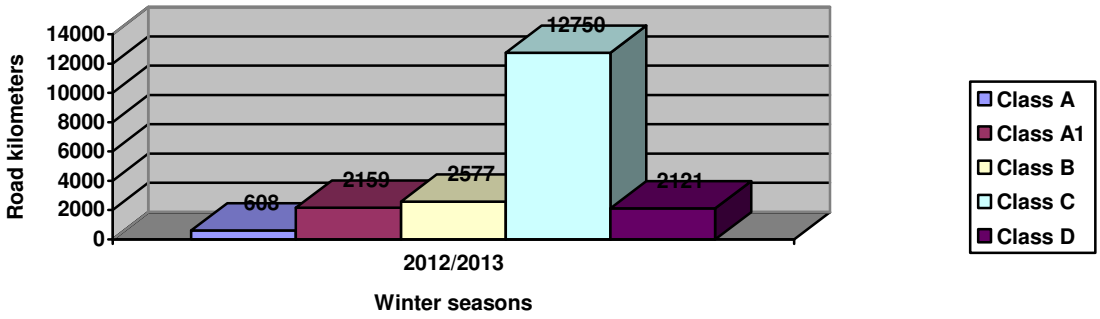

Chart 1- Length of road maintenance classes in the winter of 2012/2013.

Weather conditions are divided in three groups. There are stable weather conditions, changing weather conditions and extreme weather conditions. Quality of driving does not change in stable weather conditions. Therefore, there is no need to perform maintenance activities like snow ploughing, salt or sand spreading. Changing weather conditions mean there is a snowfall or a blizzard or ice is forming on the road surface. Current weather has impact on the road quality. Therefore, it is necessary to plow snow or spread salt or sand on the road. Extreme weather conditions arise due to extremely strong or very long snowfall, snow blizzard or freezing rain. During extreme weather conditions it is not possible to perform road maintenance according to standards. Time limits and qualitative indicators are not defined for extreme weather. In this case it is necessary to ensure the driveability on the most significant roads. Extreme weather conditions may affect roads all over the country or roads only in a local area, or roads only of a certain class. For

example, rain and thaws in winter have huge impact on driving quality on low maintenance roads, but negligible impact on high maintenance roads.

The maintenance classes A and A1 have the highest requirements for road quality. During stable weather conditions there may be 1 cm of snow on the road surface. It means that in stable weather conditions the road surface should be free of snow and ice. If air temperature is lower than -6℃, there can be snow and ice layer on road surface even in A and A1 maintenance classes.

Figure 3 - Maintenance classes A and A1 in stable weather conditions

During snowfall, snow up to 6 cm and snow mixed with salt or sand up to 3 cm on surface of A and A1 class roads is acceptable.

Figure 4 - Maintenance classes A and A1 in changing weather conditions

For B class roads, there is no request for road surface to be free of snow and ice.

Anti-skid activities have to be performed. In this class, snow up to 4 cm can cover the road surface in stable weather conditions and up to 8 cm of snow in changing weather conditions.

Figure 5 - Maintenance class B in stable weather conditions

In the maintenance class C, road surface can be covered with snow and ice. Anti-skid measures have to be performed only on separate sections – junctions, steep gradients and sharp turns – by spreading sand, a mixture of sand and salt or forming grooves in the snow layer. If C class roads have become too slippery (rain below 0°C and spring time thaw in the daytime and frost at night), the most significant roads of the C class are spread with the mixture of sand-salt or salt. D class roads have very low traffic volume. Therefore, they are rarely cleaned.

Figure 6 - Maintenance class C in stable weather conditions

Requirements for snow thickness on road shoulders are defined by the part of the shoulder that is located closest to the road. Depending on the maintenance class, admissible thickness of snow ranges from 5 cm (class A) to 20 cm (class C). An exception is a paved shoulder on 14 m wide roads. In this case, requirements for paved shoulders

are identical to the ones used for the carriageway. In practical terms, it is hard to keep these shoulder free of snow and ice, because they are used only by single vehicles driving at slow speeds.

Figure 7 - Road with paved shoulders.

Quality requirements for maintenance classes of state roads are summarized in the table below:

Requirements	Maintenance class				
	A	A1	B	C	D
	Admissible parameters				
Thickness of snow in stable weather conditions	Occasionally 1 cm	Occasionally 1 cm	4 cm	10 cm	Not defined
Thickness of snow in changing weather conditions	6 cm	6 cm	8 cm	10 cm	Not defined
Ruts	Up to 1 cm	Up to 2 cm	Up to 4 cm	Up to 5cm	Not defined
Time for clearing	3 hours	4 hours	6 hours	18 hours	Not defined
Time for prevention of slipperiness	3 hours	4 hours	6 hours	Not defined	Not defined
Thickness of snow on 2/3 of a shoulder	5 cm	10 cm	15 cm	20 cm	Not defined
Working hours	6-22	6-20	6-18	6-18	Not defined

Table 3 - List of requirements for winter maintenance classes.

Technical specifications for maintenance works on states roads have been prepared by SJSC “Latvian State Roads”. These specifications define requirements for equipment, materials, technologies and quality assessment.

3. ORGANIZATION OF ROAD MAINTENANCE

SJSC “Latvian State Roads” (hereinafter - LSR) is a state owned company under Ministry of Transport of the Republic of Latvia. LSR administrates roads in compliance with the contract with the Ministry of Transport and Road Law. LSR is responsible for development,

management and control of the road network, as well as, acts as a customer in tenders for roads works.

Winter maintenance works and routine maintenance works are executed by a state owned company “Latvijas autoceļu uzturētājs” (hereinafter - LAU). The owner of this company is the Ministry of Transport. LAU performs winter maintenance, routine maintenance and construction works not only on state roads, but for other different clients too - municipalities, state and private companies. More than ¾ of its works LAU gets from the LSR. Currently LAU has a contract for seven years with LSR.

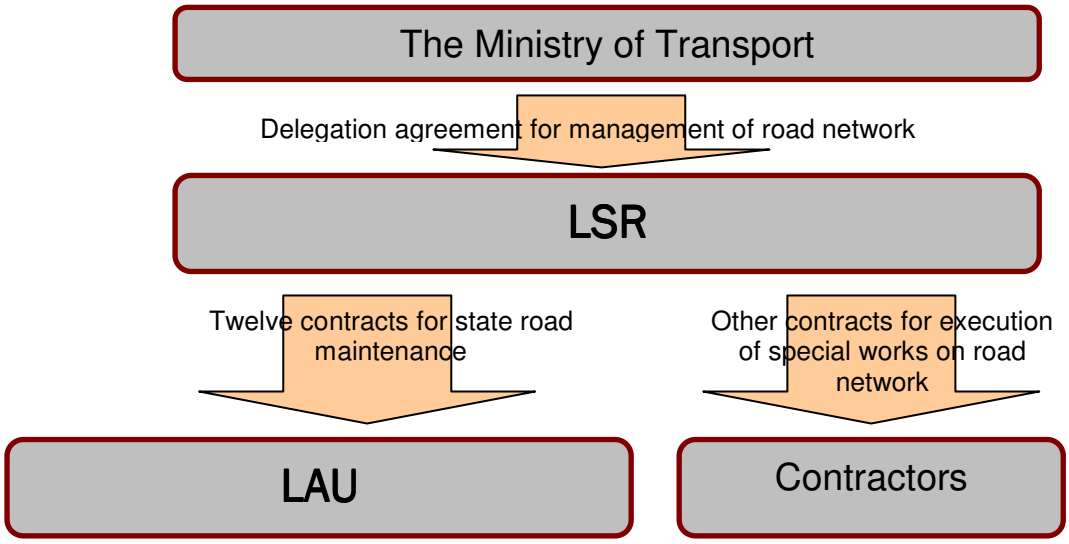

Figure 7 - Current situation in road maintenance organisation

In summer of 2007, LAU won the tender and gained rights to perform routine maintenance on state roads in the time period of 2007 – 2014. In this tender 20.1 thousand km of state roads were divided in 12 contracts. Length of roads in these sections varied from 1000 to 3000 km. Total cost of the twelve contracts was 470 million EUR, 45 % of which were planned for winter maintenance works.

According to provisions of the contract, every year before winter the list of maintenance classes is renewed and financing available for the respective winter is specified. Contract amendments are prepared for the implemented changes. According to the contract, LAU is responsible for providing winter service operations. In winter, staff of approximately thirty persons is on duty. They have to keep track of weather and road conditions and need to make decisions on necessary works. The contractor receives payment for every performed work, multiplying the defined unit price with the amount.

Situation is slightly different in three contracts with the highest traffic density. In this case, payments are made for ensuring compliance of roads to the respective maintenance class. Payments are made once a month. Amount of a payment is related to weather conditions in the respective month. It is estimated with the help of price variation factor:

Number of days with changing weather conditions	Price variation factor
Up to 3	0.5
4 – 8	0.8
9 – 18	1.0
19 – 21	1.1
More than 21	1.2

Table 4 - Values of price variation factor

LSR regional departments supervise the quality and amount of performed works. LSR engineers accept performed work for payment. Control is performed with regular road inspections. Evaluation of quality and amount is performed by processing information from automatic data registration system and data from road inspections. The main indicator of quality of maintenance works is execution at the right time. The right time means time interval that is defined in respective standards.

4. WINTER MAINTENANCE TECHNOLOGIES

The main equipment for winter road maintenance is high-power trucks with snow blade, side plough, bottom plough, and salt and sand spreader. Spreaders on A and A1 class roads have to be connected to an automatic data registration system that registers work and route by using GPS.

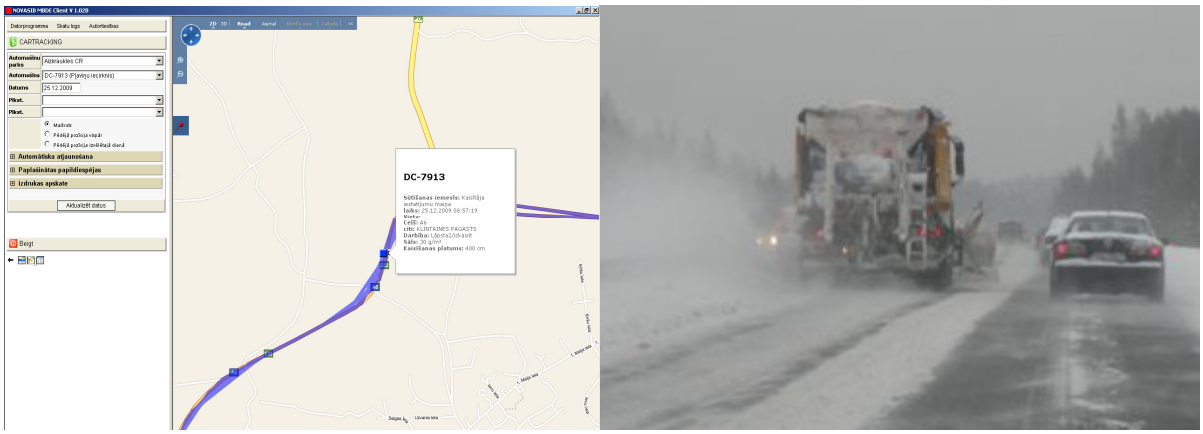

Figure 8 - Registration of a truck, equipped with GPS transmitter, in the database

LSR is satisfied with the registration of spreading works and credibility of route determination of machinery. Unfortunately, it cannot be said about the registration of the cleaning works. Sensors installed on ploughs are subjected to both mechanical and chemical influence. Therefore, they are getting damaged often and LSR is not satisfied with the credibility of data.

Graders and tractors equipped with snow ploughs are used for cleaning shoulders and local roads. Wet salt spreading is mostly used for slipperiness prevention on A, A1 and B class roads. Special sections on C class roads are spread with a sand-salt mixture. Usually one cubic metre of mixture contains 120-150 kg of salt. On these roads wet salt or sand is used less often.

The slipperiness prevention constitutes the biggest share of winter maintenance costs. Spreading of wet salt is a key technology, and its usage forms 84 % of the costs. Other technologies are used less – spreading of salt-sand mixture forms 11 %, sand spreading - 0.5 % and forming of grooves on compacted snow – 4.5 %.

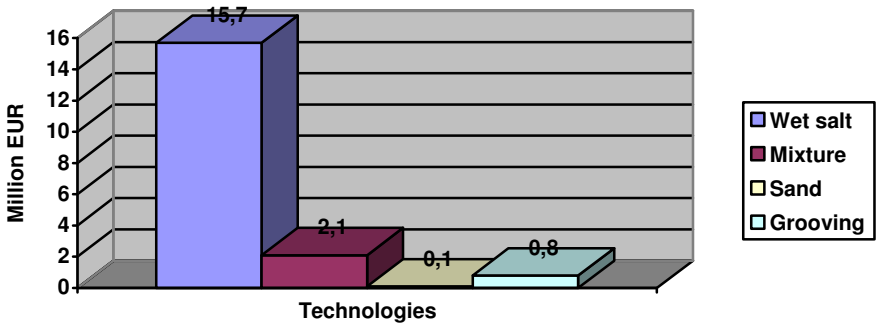

Chart 2 - Costs of technologies for preventing slipperiness in 2012

For winter maintenance needs, LSR has developed a road weather information system. It consists of 53 road weather stations and 51 video cameras. The cameras and stations are located together on state main roads. LAU and LSR employees have online access to this system and data from Meteorological Institute.

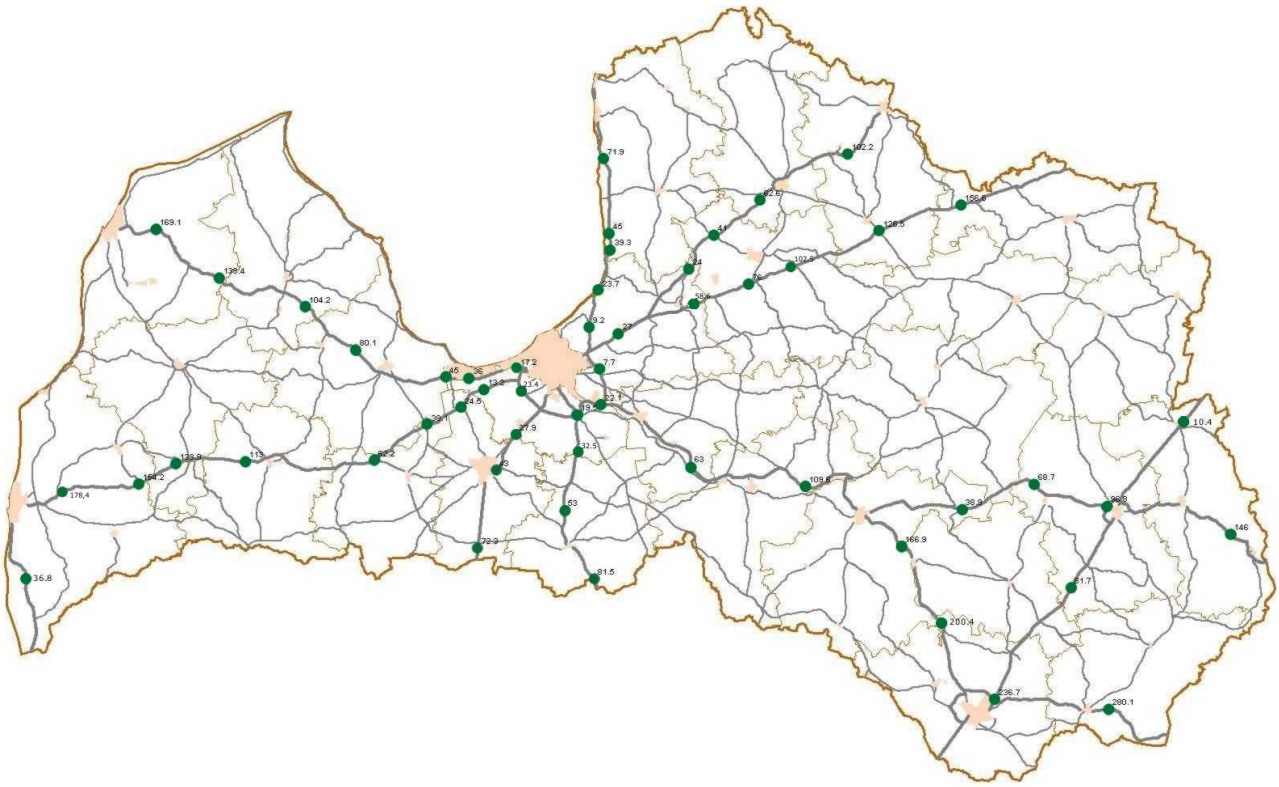

Figure 9 - Map of road weather stations and cameras

5. CONCLUSIONS

The most important factor, that describes transport situation in a country, is road safety. Number of traffic accidents on state roads was decreased from 3343 (in 2009) to 2596 (in 2012). Unfortunately, I do not have data on how many accidents happened in winter on state roads with poor maintenance. Total amount of accidents that happened on icy and snowy roads are in the table below:

Road conditions	2009	2010	2011	2012
Icy	116	228	178	175
Compacted snow	100	195	52	150
Wet snow	113	117	68	107
Total:	339	540	298	432

Table 5 - Number of traffic accidents on icy and snowy pavement

It is obvious that we need to improve performance of winter road maintenance works. We would be able to reduce the number of accidents due to poor maintenance, as well as, maintenance expenses.

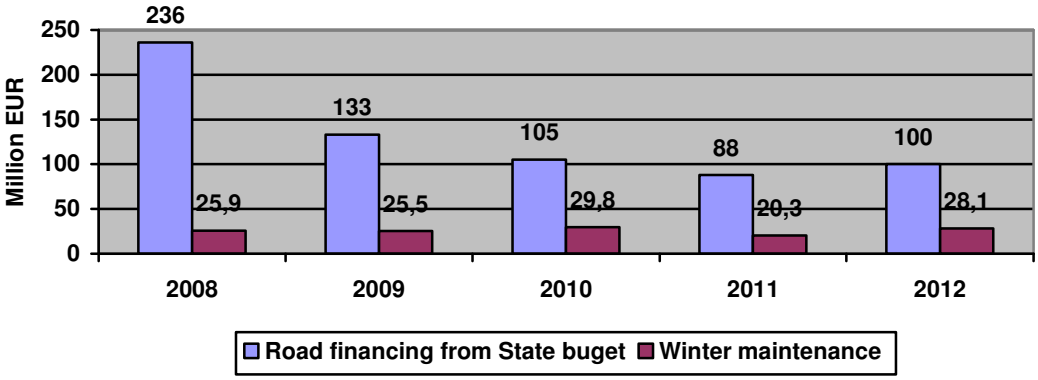

Chart 3 – Funds for the road maintenance and the road management

We can do it by improving a road surface ice prediction and by changing tactic from de-icing to anti-icing. It can be successful if we stop paying for performed maintenance works on A, A1 and B class roads and start executing payments for road compliance to maintenance class. Therefore, we must find a way to evaluate compliance with the class by measurements. These could be the snow cover thickness and friction ratio measurements.

In the case of roads with very low traffic (C and D class roads), it is better to pay for performed works. It is not possible to predict amount of works on those roads that is necessary for safe traffic. If payments are made for compliance to the class, the road quality could decrease.

References

1. www.lvceli.lv
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