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International comparisons of road maintenance and management

Chaired by Milko Tietäväinen and Harri Vitikka

Mr. Milko Tietäväinen, M.Sc., Construction Director

Milko Tietäväinen is a construction director in the City of Tampere. He has over 20 years of experience in road and transportation infrastructure sector. He is especially interested in development of city Infrastructure and has previously worked as a managing director in Tampere City Infrastructure Enterprise. He has been active in several challenging infrastructure projects in Tampere.



Mr. Harri Vitikka, M.Sc., Head of Traffic systems Unit

Harri Vitikka is working at Pirkanmaa Centre for Economic Development, Transport and the Environment (ELY-centre) as Head of Transport Systems Unit. The main objectives of the Unit are: Pre-planning, Transport service level, Traffic safety, Transport system management and Bus transport outside of Tampere City Region.



New guidelines for winter maintenance in Finland, Otto Kärki, Finnish Transport Infrastructure Agency

Guidelines and quality requirements for winter maintenance were renewed in Finland in 2018. The main triggers of the work were climate change, customer feedback and the needs of heavy vehicles, commerce and industry. The main objectives of the guidelines are to provide as constant level of service in winter as possible. However, road users have also be prepared to adapt their traffic behaviour according to weather conditions. The guidelines are usually renewed at least ones in a decade.

The service level for winter traffic is traditionally planned mostly according to traffic volume and road classes. Volumes of heavy vehicles and trailers are new factors affecting winter maintenance classification since 1st January 2019. Strong evidence was found that taking account of heavy vehicle volumes both benefits traffic safety and enhance the needs trade, industry and other businesses. Especially risk for serious head-on accidents in winter is higher on roads with high heavy vehicle volumes. The aim was achieved that winter maintenance class does not change as often on main roads as before 2019.

The new guidelines are implemented in two stages: approximately 11 000 km winter maintenance class was raised on main roads on 1st January 2019. On regional and connecting roads changes of winter maintenance classification, shorter circle times and other quality requirements are implemented according to tendering of the contracts during the years 2019–2023. Costs of the first stage were approximately 10 million euros per year meaning winter maintenance costs were raised by 10%. The total costs of the winter maintenance is awaited to raise approximately 20 million euros per year by 2023. The implementation of winter maintenance guidelines is supported by implementing the new daily maintenance contract model based on target price at the same time. The emphasis is also put on ensuring quality by using digital tools and information systems.

Otto Kärki, M.Sc., Expert of Maintenance Finnish Transport Infrastructure Agency



Otto Kärki started working as an Expert of Maintenance and Digitalization at Finnish Transport Agency 1st March 2016. Previously he worked for seven years as a Head of Maintenance Unit and Planning Unit at a Centre for Economic Development, Transport and the Environment. <http://www.ely-keskus.fi/>Kärki has over 20 years' experience of state organisations. Kärki has previously worked as a Research Scientist at Technical Research Centre of Finland (VTT) and University of Technology (TUT) and in his home town Vaasa.

Comparison of winter maintenance requirements in Estonia, Latvia, Lithuania, Jānis Kastanovskis, Latvian State Roads

Three Baltic states are located next to each other on the coast of the Baltic Sea. Similarly to Finland, density of population in these countries is low. All three countries have large amount of state roads with low traffic density.

Climatic differences are minimal. Milder climate is in coastal area but inland the weather conditions are more severe. The average air temperature in January in Estonia is from -2 to -7 degrees Celsius but in Lithuania from -1 to -5 degrees Celsius. The number of snowy days fluctuates from 50 to 120.

All three countries have common contracts for summer and winter maintenance where the responsibility for maintenance activities lays on the contractors. Despite common history the methods of the assignment of road maintenance contracts are different in every country.

Estonia awards contracts in open tenders and has performance-based contracts. Latvia has the contract awarded to the State Joint Stock Company «Latvijas autoceļu uzturētājs» (“Latvian Road Maintainer”) by law and the contract is unit price based. Lithuania has the contract awarded to the state-owned company « AB Kelių priežiūra» and the contract is unit price based.

The requirements for road conditions are quite similar in all three countries. They have three levels of maintenance.

High service level means snow and ice-free surface of the road pavement during winter in constant weather conditions and quick response in case of worsening road conditions.

Medium service level means that snow and ice is allowed on the surface, but activities have to be undertaken to improve skid resistance.

The lowest service level means that snow and ice is allowed on the surface and activities to improve skid resistance (mostly only snow cleaning) may be undertaken in some spots only.

In Estonia the expenses for winter maintenance are lower than in the neighbouring countries but it does not have impact on traffic safety during winter.

The main goal is to gather reported information from all contractors and supervisors in Finland in HARJA in order to ensure high quality in winter maintenance measures. As a result, the Finnish Transport Agency as a purchaser and all the road users get the service exactly as described in the maintenance contracts.

HARJA interface descriptions, source code as well as updated information on the development are available on: <http://finnishtransportagency.github.io/harja/>.

Jānis Kastanovskis, *Head of Maintenance Supervision Department, State Joint Stock Company “Latvian State Roads*



From 1976 till 1982 Jānis Kastanovskis has studied in Riga Technical University, and has obtained qualification of Engineer in Road Building specialty. From 1982 till 1986 he worked in various construction companies as a workman. From 1986 till 1993 he worked in Road Administration as an engineer for introduction of new technologies. From 1993 till 1997 he worked in Road Administration as an engineer for asphalt surfacing. Since 1997 is working in Road Administration (State Joint Stock Company Latvian State Roads) as head of Road Maintenance Supervision Department.

Technology of winter road maintenance in Russia, Anna Klimentova, Association of Winter Road Maintenance

Winter Road Maintenance in Russia: Safety, Efficiency and Budgeting

Synopsis: There are almost 1.5 million km of roads in Russian Federation. Over a half of that makes urban roadway networks and is under municipal management, regulated by the federal law. In accordance with that standard, urban roadways must be maintained in clear surface condition, cleared of snow and ice within 3 hours after precipitation. This is a tough challenge to meet, especially in cities with high traffic volumes, and winters with down to -30C temperatures.

Considering many climate zones in Russia, there is no universal “cookie cutter” approach or single solution to winter road maintenance valid for every locale.

With this at hand, we developed a scientific methodology to create efficient individualized solutions for any city.

We analyze weather patterns and climate data, existing infrastructure and equipment available for snow and ice removal, we consider soil condition and environmental circumstances, then we build a mathematical and financial model. Our model, developed jointly with the Financial University under the Government of the Russian Federation, takes into account a wide set of variables, including direct costs, such as ice-melts, snow removal, melting/storing, and indirect costs, such as costs of medical coverage and insurance payouts as a result of injuries and accidents on roads with slippery conditions, costs for soil re-cultivation, and repairs of the infrastructure damaged by ice-melts. Aside from a detailed economic model, and taking climate and environmental analysis into our calculations, we create “prescriptions” for specific ice-melts, formulated to be most efficient for that exact location. We call these multi-component ice-melts because they contain a mixture of various types of salts.

When implemented, this approach results in decreased rates of injuries and traffics accidents due to winter slippery conditions, and soil overselling to the past reliance solely on sodium chloride.

Anna Klimentova, Chief of Operations, National Association of Winter Roads Maintenance, Russian Federation - Russian NGO



Anna is the leading expert on winter roads and sidewalks maintenance in Russia. The country spans 11 time zones and in some regions winters last over 5 months while summer temperatures are near or below zero Celsius.

Anna entered the field as a marketing and communications professional about 10 years ago, and since then focused on the scientific and applied studies in the field. She has numerous

articles published and is listed as one of the leading experts on the subject in the national database of industry experts. Anna can be reached at: expert@roszimdor.ru

Setting Credible Speed Limits: Case Studies From Finland and World, Jaakko Klang, Centre for Economic Development, Transport and the Environment

This presentation is based on the work of the World Road Organization's PIARC Road Safety Committee Working Group 2016-2019 and a published report. This presentation does not reproduce all the work group's entries and suggestions in detail, as the report is published and available on the organization's website. This presentation deals with the findings, discussions, ideas and thoughts that emerged from the working group.

The report of case studies on the topic of speed limits includes a series of implemented countermeasures or experimental proofs of concept to help improve the road safety in a specific location or area.

Credible is in general an individual task and influenced by drivers' culture and acceptance. Within the Road System and Administration, the task of 'setting credible speed limits' remains therefore to be a highly sophisticated and multi-responsible procedure. The focus for Road Operators and Administrations is to provide safe speeds by design of the road system that reduce crash risks and/or severity.

Roles and responsibilities in setting speed limits are different in countries and areas. There are different approaches for road design and roads in operation. Therefore, no general suitable rule and procedure can be offered, but a look at examples from best performing road administrations might help.

The case studies received are from all over the world. The collection of case studies represents an important step toward the construction of knowledge and should help Road Authorities and engineers to find helping solutions in their work to set credible speed limits.

The analysis of the case studies puts in evidence that the effectiveness of a specific case study will vary according to the local conditions, driving habits, traffic rules, regulations and signing and marking standards. A countermeasure that seems to poorly impact road safety in a specific region, may demonstrate a better impact in other regions with different conditions.

The studies indicate that certain specific road and environment features influence the credibility of the speed limit. It is not possible to determine a limit that is equally credible for all drivers. But it is possible to determine a limit that is more credible for all. After all, the studies show that drivers are to a large extent influenced by the same road and environment features.

There are still quite a few problems in the practical application of credible speed limits. For example, we must realize that we cannot simply increase a speed limit because it would be more credible. A safe limit always remains a primary prerequisite. The alternative – to alter the road image – can sometimes be achieved with relatively simple means, but in other cases it will be more difficult. Furthermore, there are still many research questions to be answered.

Jaakko Klang, Traffic safety engineer, Center for Economic development, transport and the Environment in South West Finland



Jaakko Klang has worked as a traffic safety engineer at the Center for Economic development, transport and the environment in Southwest Finland (ELY-centre). His main task is to improve the transport system so that nobody needs to be killed or seriously injured in road traffic. In addition, his job is to coordinate, consult, coach and support municipal road safety work. He is a representative of the ELY-Center in the Regional Game Council of Southwest of Finland.

He is a technical member of traffic accident investigation board in Southwest of Finland and he has studied over 189 fatal road traffic accidents.

He has been active for 7 years as a member of the Nordic Transport Forum and 12 years as a member of the World Road Association, where he participates at the moment in the Technical Committee C 2.2. Design and implementation of Safer Road Infrastructure.

He has written several articles to an important Finnish road transport industry magazines from following themes: the maintenance of transport infrastructure, transport system and the promotion of cycling and walking in road safety point of view.

In 2015, he was awarded the Road Safety Merit Medal and in 2016, he received the Police Traffic Safety Award for his work in the field of road safety. In February 2018, his presentation on the road safety impact of the Finnish winter speed limit system was awarded the Best Paper Award at the World Winter Road Congress in Gdansk.

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Steps of Automation & Utilization of information

Chaired by Katja Skille and Harri Orko

Mr. Harri Orko, Senior Vice President, Road maintenance



Harri Orko leads the road maintenance business division at YIT. He has extensive experience in road maintenance, business development, contracting and project business. He spends his free time with his family and triathlon. Harri's motto is "Trust needs to be earned every day."

Ms. Katja Skille, M.Sc., Principal Engineer



Katja Skille is a Principal Engineer at the Norwegian Public Roads administration for division Operations and Maintenance. She has a Master of Science

in Transportation and Environmental Engineering from Aalto University. She has been working with R&D of winter maintenance with focus on winter operations on bike and pedestrian paths since 2015. In addition she is working with winter operations on strategic level, with special focus on R&D and innovation and climate and environment in winter operations.

Automation of road traffic in snowy and icy conditions, Ilkka Kotilainen, Traficom

Automated driving expected benefits, such as enhanced traffic safety, are only fully realized in the future when the vehicles are able to manoeuvre in all weather conditions. Finnish transport agencies and EU CEF funded projects aim was to study automated driving in icy and snowy conditions. The four studies of digital and physical infrastructure to support automated driving included post and poles, Cooperative Intelligent Transport Systems (C-ITS) hybrid communication, accurate positioning of vehicles and vehicle remote control using cellular communication. The results presents a prototype of passive radar reflectors, better C-ITS hybrid communication ETSI G5 stability but lower coverage than commercial cellular LTE and reliable positioning system for automated vehicle in arctic north extreme weather conditions.

Ilkka Kotilainen, M.Sc. Ec., Project manager, Traficom

Mr. Ilkka Kotilainen (M.Sc. Ec.) works as a project manager in the Trials and Automation



unit at the Finnish Transport and Communications Agency Traficom. He holds a Master of Science degree in Information Systems Science. His duties include road automation, vehicle-to-vehicle communication and mobility services, and related experiments and projects, legislation and international cooperation. Previous work experience is knowledge management and analytics, and human-technology interaction research in driver behavior.

The development of autonomous road maintenance, Petteri Tervamäki, Arctic Machine Ltd

Vehicles and equipment intended for road services are being digitalised, and the number of autonomic functions they contain and the amount of distributed information are growing fast. This generates new services for road users and operators maintaining the roads.

Real-time digital information and the integration of data from various sources enable better cost-efficiency and road maintenance quality control with cloud service tools. Measurable parameters, such as weather conditions, forecasting models, friction values, traffic volumes and various other input data are read in real-time in a preliminary system where data analysis plays a key role in the development of autonomous services. Industry-specific expertise and experience are needed to process the data in order to achieve the best and most functional automatic decision-making model. It should, for example, be able to indicate when to start clearing ice and snow from the roads and how to dispense the correct amount of salt automatically in different circumstances and locations.

Will we see self-driving road maintenance vehicles in the 2020s? As we have seen in different kinds of pilot trials, there will be more of such advanced applications that utilise autonomous driving and working device control technologies. Arctic Machine has taken steps towards fully autonomous road maintenance vehicles in, for example, projects coordinated by Väylä, where the working devices are controlled automatically without the involvement of a driver. We have taken decisive steps on this path of development, from data collection to an autonomous road maintenance unit. As a goal, this is not a distant vision of the future. Since the necessary technology is already available, the question remains as to when the legislation and general mindset will be ready for the change. It should also be noted that fully autonomous working devices are already used in many fields – so why not in road maintenance as well?

From a contractor's point of view, road maintenance is evolving continuously. Working devices are evolving, and new features are added to them. However, there have been developments, that may be the least visible to the outside world, in control systems and the number of services provided using data acquired from these systems and other external sources. Ignorance is bliss, they say. While true to some extent, what about the other side of the coin? You need data to make decisions in contracting. Is the available data current? Can you make decisions, and so on, based on it? Still, you have to make decisions at every step of a contract, regardless of how the information was collected or how correct it was. Real-time data about road maintenance vehicles, together with several parameters obtained from cloud services, enable the use of a new generation of contracting tools.

The significance of and opportunities provided by real-time data have been understood in road maintenance contracting, and they have already been put into use. Contractors will need a knowledgeable partner to develop new real-time tools for various road maintenance solutions and stay on top of their game. It is only through joint development that we can ensure a top competitive position in an industry where equipment manufacturers, service providers and contractors are subject to cost pressures.

Petteri Tervamäki, Product Development Manager, Arctic Machine Ltd.



Petteri Tervamäki, a Bachelor of Engineering Degree Program in Mechanical and Production Engineering, has over 20 years of experience in product development leadership, both in road maintenance processes and the development of road maintenance equipment in numerous projects. He is responsible for developing Arctic Machines products and design processes with modern CAD / FEM / PDM / ERP methods. Recent years product development projects has been at the forefront of the development of intelligent machines and control systems. Machinery is moving into the network with the rapidly growing digitalisation.

Street cleaning 4.0 - towards co2 neutral and energy-efficient sweeping, Antti Nikkanen, MBA, CEO at Snowek Oy

Major cities and industrial sites are setting plans to cut CO₂ emissions of their maintenance fleets. These initiatives are an integral part of the cities' and governments' climate plans. For instance, a range of Nordic cities, including City of Copenhagen, has set their carbon-neutral plan's target year to 2025. Also, in Finland the City of Helsinki has a well-known 'carbon-neutral by 2035' plan. In these initiatives mitigating the co₂ emissions of the heavy-duty vehicles is going to be a major burden for both the industries and the municipality officials and city planners.

At the same time during the past decade Nordic cities carried out a significant amount of research on air quality impacts of street dust cleaning, and the awareness of the harmful PM_{2,5} and PM₁₀ street and silica dust emissions increased rapidly across the globe. In the beginning of the last decade the REDUST research project in capital region of Finland studied also the impacts of different methods of street cleaning and their ability to mitigate PM levels in the surrounding air. Similar research has been carried out elsewhere in Nordics and in the world for instance by the City of Toronto in Canada. In North America another stream of the research has focused on the removal of dust off the street surfaces due to harms the chemicals and dust ingredients cause for drain water and cities water systems. Both of these study streams conclude similarly, street sweeping must be done, but the efficiency needs to be significantly improved.

The conclusions from the street dust research have suggested that to truly impact the surrounding air quality, the cities need to operate street cleaning either with high power vacuum systems combined with high pressure water flushing, or alternatively these vehicle operations separately. The impact of only using generic suction sweepers in street cleaning has been suggested to have little to no impact for air quality. The Nordic cities additionally face the need of heavy dirt and sand removal after winter gritting of the street surfaces. This means utilizing equipment that are capable of mechanically and efficiently remove the heavy coarse materials off the ground in order to avoid these materials to end in suction systems of the high-end street dust removal equipment.

After reviewing the cities green energy plans for their vehicle fleets, and the existing research on the actual efficiency of street cleaning and dust removal, it becomes evident that street cleaning fleets currently need to use an excessive number of diesel-powered engines to solve the complex weekly street cleaning operations. Switching the power input for these operations zero carbon free, will need radical changes of thought from the city maintenance planning as well as radical innovations from the sweeping industry, in order to make such solutions affordable and feasible. The Winter Road Congress 2020 Seminar presentation "Street Cleaning 4.0 – Towards CO₂ Neutral and Energy Efficient Sweeping" will discuss the steps required for greening the air-quality improving and practical street sweeping operations of cities and industrial sites.

Antti Nikkanen, MBA, CEO at Snowek Oy.



Major cities and industrial sites are setting plans to cut CO2 emissions from their maintenance fleets. At the same time street sweeping and street dust removal remains a massive challenge ahead. Sweeping fleets consist of a range of heavy duty vehicles with heavy duty power requirements. Antti Nikkanen is the CEO of a Finnish road maintenance innovator Snowek Oy and will focus in his keynote to illustrate and discuss the challenges and solutions in transferring the current street cleaning thought and

processes into the new carbon neutral future.

Automated data production test: mobile laser scanning of road network, quality control and accurate road geometry Nina Heiska

Co-writers Tauno Suominen and Veli-Pekka Puheloinen, Nordic Geo Center Ltd

Accurate and precise mobile laser scanning (MLS) was tested in the project of the Finnish Transport Infrastructure Agency. The aim of the test was to find out how accurate MLS can be used for planning of the maintenance and management of transport infrastructure. It was also investigated if the current road condition measurements (e.g. PTM in Finland) can be replaced with MLS and what kind of additional value is achieved compared with current methods. In addition, the feasibility to use MLS in quality control of new road surfaces and the measurement of ground frost on roads and was studied.

A high accuracy of the measurements was achieved on all test roads and the absolute positional accuracy was less than 10 cm. The precision of the measurements is within millimetres.

A filtered 3D surface model of the road surface and the center line can be obtained fully automatically. The calculated transverse profiles can be analysed both for road geometry and drainage. The horizontal and vertical geometries are automatically fitted to the center line, which permits the calculation of the radius of the curvature and line parameters as well as comparison to road design. The accuracy of the surface model allows also to detect longitudinal long waves in the road.

Ruts, IRI and other road condition parameters were calculated automatically using the filtered road surface model and center line. These values were studied separately in another test (Liikenneviraston tutkimuksia ja selvityksiä 17/2018) which concluded that the rut values are not fully comparable with the values measured with a traditional 19 laser point method. On the other hand, the repeatability of these values was clearly better using MLS.

The advantage of Mobile Laser Scanning compared to traditional methods is the possibility to use the one time data acquisition to create multiple analyses and products step-by-step. First the traditional road condition parameters can be calculated, and the necessary maintenance actions can be decided. If repairs are needed, the same data can be used for the repair design. When resurfacing the road, small geometry improvements can also be planned. After resurfacing, the quality of the surface and new road geometry can be controlled with a new measurement.

It should be understood that these results can be achieved only with the most accurate commercial MLS systems, sound data acquisition methods and proven calculation algorithms. Most MLS systems in the market do not even theoretically enable the necessary high accuracy and precision. In addition, network level road inspections are not financially feasible if the system requires additional signalling of the roads.

Accurate and precise mobile laser scanning is possibly a somewhat more expensive method compared to the traditional road condition measurements (PTM). However, the amount of information is far superior and would require several data acquisition campaigns

using several instruments. The data provides also more accurate positional accuracy for road sections which can be laser used as a base for less accurate road inspections.

Nina Heiska, Product manager in Laser Scanning, Nordic Geo Center Oy

Nina Heiska has worked with mobile laser scanning and digitization of roads since 2014.



She has been since involved in several road digitization projects for road and rail construction including test projects for the Finnish Transport Infrastructure Agency. Nina Heiska started working with surveying and remote sensing in 1998 as a university researcher and has specialized in laser scanning since 2005.

Enhanced mobile friction measurement on highway 4, Mikko Malmivuo, Innomikko Ltd

The highway 4 is the longest main road in Finland. When situating in north-south axis, the weather conditions especially in winter time varies strongly. In recent years, the wintertime road conditions on highway 4 have been criticized. On the other hand, the new law for highways recommend authorities to utilize new digital services to develop the highway service level.

In this project, eight optical road weather sensors RCM411 were installed on heavy vehicles (4 buses and 4 lorries) operating actively on highway 4 between Helsinki and Oulu. Project started in the autumn 2018 and will last 2-3 winter seasons. There are two main objects in the project: to assess the benefits and technical performance of enhanced mobile friction measurement. The accuracy of the system has already been evaluated in earlier studies.

The used RCM411 system consisted of three elements: the road weather sensor, the bluetooth unit and mobile phone. The bluetooth unit transferred the data wirelessly from the sensor to the in-cabin phone. The phone took pictures from the road and transferred the sensor data and pictures to the service provider's (Teconer Ltd) server. The road authorities and winter maintenance operators were able to monitor the real time data from the service provider's web-based user interface. The user interface presented the results (mainly friction and road condition) on the map.

The technical performance has been reasonable. The benefits of the phone component is the ability to take pictures, but the disability is, that it's not designed to work autonomously for long periods. The phone needs driver's activation about 1-4 times per month. If the driver didn't know how to activate the phone, it has been the project personnel task. Also the bluetooth unit has caused some problems during the first season, but these problems seem to have been solved on the second season. However, the service provider (Teconer Ltd) has given good technical support. The preliminary object was to pay little extra for drivers as they look after the system. However, the big number of drivers in a single vehicle (especially in buses) made this object impossible.

The benefits of this kind enhanced mobile friction system seems to be even better than expected. The system has clearly pointed the road sections with most slippery conditions. The slipperiness in cold weathers, especially below -6°C, when the salt is inefficient, seem to be a remarkable problem. The effect of traffic volumes seems also be clear: the slipperiness happens most often in low traffic road sections, even when compared to high traffic road sections with the same road maintenance class.

During the first winter season (from 1st October to 30th April) the total data from highway 4 consisted almost 500 000 kilometres. The project of making further analysis of this massive data is to be started.

The benefits of enhanced mobile friction measurement seem to be undisputable. The tested system were not 100 % autonomous year around and therefore needs better driver accountability to be expanded to larger road network. This project was financed by Uusimaa, Central Finland and North Ostrobothnia Centres for Economic Development, Transport and

The Environment. The Finnish Transport Infrastructure Agency will finance further analysis with project data. The writer is grateful for their precious support.

The public report will be published in The Finnish Transport Infrastructure Agency internet pages at summer 2020.

Mikko Malmivuo, M.Sc., Innomikko LTD



Mikko Malmivuo is a consultant (M.Sc.) specializing in winter transport. Malmivuo worked as a traffic safety researcher at VTT between 1996 and 2008 and since 2008 he has been an independent consultant with Innomikko Ltd. Malmivuo has been responsible for nearly 50 winter transport studies.

How does road weather information support decision making in Estonia, Märt Puust, Teede Tehnokeskus AS

Despite the road weather information gathering with road weather stations started a quarter of a century ago, in last five years there has been a systematic approach to develop the local capability to provide road maintenance operators with best road weather and information services. By starting with two years research and development project together with Finnish Meteorological Institute, which was followed by a one year service contract with Foreca, Estonian Road Administration (ERA) finally signed a five year development contract with the Estonian Environment Agency (EEA). There is a clear understanding that even Estonia is almost eight times smaller by the area than Finland the weather can be quite different due to surrounded by water on three sides and the best knowledge of local circumstances is a prerequisite for providing reliable and high-quality services.

Great cooperation between motivated partners led to the birth of comprehensive road weather information and forecast service tik.teeilm.ee which is since Autumn 2016 actively in use among all highway maintenance companies in Estonia, EEA and ERA. This tool connects road weather stations of neighbouring countries and Estonia, including Vaisala, Saab and Lufft stations and also EEA automated stations. There are together several observation services including camera pictures, radars and satellites and also forecast services like text forecasts, map layers with different parameters and also point forecasts for each road weather station up to next 48 hours. Four general road models are running to predict road temperature and road status for each of 70 road weather stations. Special tool for verification of different forecasts was developed and is in use for generating quarterly reports of the progress of road model development. For winter maintenance quality control and assistance different integrations to the service have been made, including map layers of real-time maintenance operations, friction measurements (Eltrip and mobile sensors), road users and rescue service warnings.

Because of the complexity of the system, there is a belief that in the near future there is no need for the human to follow the changes behind the monitors but instead of that system itself is monitoring and if needed gives notifications and alerts to the responsible teams. During the winter 2018/2019 extensive pilots were carried out and next winter the service



should already cover the whole road network. This presentation gives an overview of how the step by step development have been carried out and what lessons have been learnt.

Märt Puust, Project manager, Teede Tehnokeskus AS

Nationwide road state service from vehicle cameras and mobile sensors, Markus Melander, Vaisala Ltd

Road transportation is facing in Finland two kind of megatrends, which both do have a significant influence to maintaining roads. First is climate change, winters in Scandinavia are changing and there will be less ground frost and real winter conditions protecting roads during harsh winter. Wet pavements and close to zero temperatures with stunned tires are consuming pavement more than before. Second significant megatrend is urbanization. In Finland we are going to face roads where there is not enough traffic to justify it's rehabilitation and most likely our traffic is centralizing to main network in crowing numbers.

For mentioned challenges new mobile sensing technology and computer vision are interesting solution to help road operator to get better data and manage roads in more detailed manner. We have always heard claims that with detail information there is change for early intervention and preventive, more cost efficient, maintenance operations. Road data have been costly but now in era of artificial intelligence this can be changed. Today we can practically change every vehicle a road scout if needed.

Idea about nationwide fleet based road surface data is based on continuous mobile video recording and in vehicle mobile sensors providing information for road operator and maintenance contractors. Road state in detail and pavement condition mapping with computer vision twice a year from every road is promising opportunity to take steps toward efficiency leap in road maintenance. In operational pilots there have been used post cars, trucks and road inspectors vehicles. New technology is ready to use and Finland have a good change to take a leading role in using it.

Markus Melander, M.Sc. Head of Business Development, Computer Vision R&D, Vaisala

Markus Melander has previously worked as a Director of the Digitalisation Project at the Transportation Infrastructure Agency and has been responsible for the Digiroad system reform project. Today, he leads Vaisala's business on machine vision technology. (RoadAI, artificial intelligence for road management processes)



Reputation, Road Users & Contracts

Chaired by Anne Kasari, Tampere University & Magnus Nygård

Ms. Anne Kasari, Senior lecturer, TAMK University of Applied Sciences in Tampere



Mr. Magnus Nygård, Director of Maintenance department, Finnish Transport
Infrastructure Agency



On cooperation of the Road Administration with the media in order to give winter road maintenance positive reputation, Diana Lorents, Estonian Road Administration

Our problem: In 2014, after the media blamed all the accidents that occur on slippery roads on the road maintainers after a tragic traffic accident, we felt that something was wrong in the Road Administration's communication about road maintenance in winter. This situation had occurred largely due to our own inadequacies, particularly because of the general attitude of the Road Administration that there was no point in explaining our activities in the media. We had hidden ourselves in a trench, never going on the offensive ourselves. Road maintainers didn't want to speak in the media, as they believed that the press was negative about them anyway and didn't understand the nature of their work.

Our solutions: We admitted honestly that we had a problem. We carried out an analysis proceeding from the golden rule of communication: target group-message-time-channel. In the specific action plan created on the basis of this, we approached the following:

a. The people working in the area of maintenance

Our hard-working people were clearly frustrated with the constant media beating. Even if the news were neutral, the comments added by people were mean and hostile, which really hurt them. The first thing was to improve their self-awareness.

The *TeeLeht* magazine – we reviewed the objective and target group of the magazine. Instead of being of making it too technical or entertaining, we started talking about the people working in our field. Road workers were not interested in speaking in the media and even getting comments for press releases from them was difficult. They didn't trust reporters or the employees of the Public Relations Department. A requirement was added to all maintenance contract: appoint a specific person for media communication. We taught the people in the technical field how to speak to the general public understandably in various media channels.

We recreated the tradition of professional competitions. We continued the tradition of professional competition that had been discontinued 15 years ago and also made a media event.

b. Relationships with reporters

We organised safe driving training for reporters. We paid reporters for articles, which motivated them to really get to know our field and they have later been able to use this knowledge in their independent articles. Very good investment. We cooperate with the Institute of Communications of the University of Tartu, where we teach future reporters in lectures by "visiting practitioners".

Traffic messages from the traffic management centre – we made the text friendlier and simpler. For example, we stopped using the expression "disturbing road works". We added simple and laconic weather-based traffic safety recommendations to messages about road conditions.

c. Cooperation with the general public

We understood that the time of handing out leaflets is over. You have to speak to people in a manner that attracts their attention and is witty. The only way you can reach your target group in today's media space is in a manner that is witty and attracts attention. We monitor the reach and impact of our messages.

Summary: The media is our partner and we must know the working principles of our partner. We must create our own story and work for our reputation all the time.

Diana Lorents, Director of the Public Relations Estonian Road Administration

Diana Lorents has been working in communications since 1992. She graduated from the Tallinn Pedagogical Institute in 1994 and the University of Tartu in 2012. She worked as an editor and a presenter on Estonian Television for ca 20 years and later as the communications manager in West-Tallinn Central Hospital and the Ministry of Social Affairs. She has worked as the head of the Public Relations Department of the Road Administration since 2014.



In her presentation, she will share experience of media communication to improve the reputation of road maintenance in winter in Estonia and invite everyone to think along how to better use media for the popularisation of this area.

Utilizing customer feedback to maintain and develop the road network – case winter road maintenance, Katariina Korteoja, The Centre for Traffic Customer Service at ELY-Centre

In the digitalization project, in 2017-2018 Finnish Transport Agency (Liikennevirasto, currently Väylä) the Palauteväylä.fi -service was introduced. The service interacts between the customer and the Road Administration Agency, as well as the road contractor. Through the service, the customer learns whether his or her issue is been heard or shall it be responded.

The purpose of the service's further development is to provide a development path for the sharing of customer-generated data between experts and the Agency. This is the theme of today.

This study focuses on the elements of utilizing customer feedback in the agency. Other forms of collected data are not addressed since several forms of information is collected from various locations and is stored in different systems. The purpose is to get the information collected through feedback systems out of their own silos and to improve operations and their development in the agency. The key is to get the feedback processed so that it becomes visible and part of customer relations management. Feedback management should be a transparent process. By the new service, Palauteväylä.fi, the customer feedback is published on the map, and the actions taken are visible.

The aim of this work is to describe the process of processing feedback, making it responsible within the organization, and utilizing the information in the future actions. As part of the feedback process, Traffic Customer Service will provide a service/ product called "Feedback Information".

Handling and utilizing feedback information is been recognized as a challenge in organization for many years. Experts and executives have experienced that feedback information is left untapped, and organizations lose valuable sources of information. However, experts consider feedback providers, ie. road users, to be an important "monitoring organization". For the ecosystem to function effectively, according strategy, the ecosystem of knowledge utilization has be modeled.

Katariina Korteoja, Customer Service Manager, The Centre for Traffic Customer Service, ELY-Centre



Katariina Korteoja is the Customer Service Manager for the Traffic Customer Service. The Centre for Traffic Customer Service is a nationwide unit providing advice in transport matters and serving as a feedback contact point. Traffic Customer Service is a contact service for road, railway and waterway issues belonging to the Finnish Transport Infrastructure Agency, the ELY-Centres' area of responsibility Transport and Infrastructure and Traffic Management Finland Group.

The importance and development of cooperation in the new road maintenance contract model, Joonas Peltoniemi, ELY Centre for Lapland & Ilkka Nissilä, YIT Finland Ltd

Joonas Peltoniemi acts as the buyer and the supervisor in the Kuusamo road maintenance contract launched in autumn 2019 for 2019-2024. YIT Finland Ltd was selected as the contractor for the five-year contract, with Ilkka Nissilä acting as the contract and procurement manager on their side.

The new road maintenance contract model was introduced in Finland for public road maintenance on a large scale, in contracts that began during autumn 2019. The tender comparison price consisted of contract procurements, management and administration fees, management fees and quality promises. At the core of the new road maintenance contract model, is the road user, and the provision of a flexible service for them. The starting point is to develop the interaction between the contractor and the buyer, as well as, to increase cooperation. The openness of the contract model is reflected in an open book procedure, in which the buyer also participates in the tendering process for procurements, and is aware of the costs of the procurements, as well as the contents of the contracts.

At best, a successful cooperation can lead to achieving a permanent state of trust for the other party. This state can be maintained by following jointly agreed rules and operating models. Both the challenges and the successes are visible to everyone at the same time. In this contract, quality management and procurement can be considered as the key areas of cooperation.

It was important to start the open approach and dialogue, immediately after the procurement decision. A kick-off meeting was held at the beginning of the project, with a larger group attending from both organisations. The development of cooperation began with regular meetings on how to act in competitive tendering for subcontractors, how to manage quality and, above all, how to initiate cooperation.

As the contract launched on 1 October 2019, communication has been a daily discussion on customer feedback, quality issues and contract development. At least once a week, the buyer has come to the contractor's office to discuss topical matters and future procurement tenders. The implementation of the contractor's management plan, quality and quality promises have been recorded in monthly site meetings.

This operating model requires more time from the buyer, but awareness of the status of the contract, and the background factors affecting it, is increasing. The open dialogue between the buyer and the contractor also provides a better platform for the development of the entire sector. Continuous dialogue and its preservation require daily efforts. This ensures an uninterrupted information flow. The change in the contract model has been significant. The elements of the new model will certainly be slightly refined over the years. At this stage, it is still too early to draw further conclusions from the new contract model, but it can be stated, that the emphasis on cooperation and transparency has somewhat reduced the pressure on both sides. In addition, regular dialogue between the parties enhances the planning of the work. After all, the aim is a satisfied end user, the road user.



Joona Peltoniemi, Regional Manager, ELY Centre for Lapland

Joona Peltoniemi works as regional manager of road maintenance contracts at the ELY Center in Lapland. He is a procurer and supervisor for two road maintenance contracts. Kuusamo contract, has started on October 1, 2019 with a new contract model. The maintenance contracts cover a total of about 2000 km of public roads. Peltoniemi has been working with maintenance contracts for four year and he is based in Kuusamo. Previously, he has worked in the public sector on road

construction and engineering projects.

Ilkka Nissilä, Job Manager YIT Finland Ltd



Ilkka Nissilä is an civil engineer and he has road maintenance experience from 10-year period, almost the whole of his professional career. In 2009, I started as a supervisor and currently I work as site manager. He have worked throughout my career in YIT. He has gained his previous experience in North Ostrobothnia and Oulu district projects. Now he is based in Oulu.

Alliance contract model in routine maintenance in the city of Turku, Mari Helin, City of Turku, Mikko Kuusisto & Rauno Kuusela, Destia Ltd

The City of Turku implements Alliance contracting model in routine maintenance of streets, parks, market squares, greenspaces, playgrounds. Works include activities like cutting grass, tree care, maintaining cleanliness, litter collection, snow and ice removal, asphalt repair and other small repairment works.

The development phase started 1.3.2019 and service phase 1.10.2019. Alliance group “Desentti” is responsible for activities during the next 8 years.

Target cost is app. 30 Milj. € for 8 years. It is one of the largest Alliancing city maintenance contracts in Europe.

Traditional contracting forms do not facilitate (nearly any) change. Such contracts are overwhelmed with legal and financial consequences and penalties statements. Alliancing requires all project participants to work as one integrated team and it covers the whole process of the project starting from design stage until completion. Every change for better service is possible.

Working as team (City and the Contractor) means need for more cooperative methods. Some solutions will be shown in the presentation.

Turku has practical goals for high quality city area, equal accessibility, health- and safety-issues and for overall comfort of city residents and high satisfaction level for tourist customers and for the local business. All this will be done under tight target cost, for ex. normal cost level rising must be compensated by better productivity and / or by new service concepts

Saved money is divided into parts for the City-customer and contractor, same with realized risks that mean extra costs. Both participants benefit for the better effectivity and part of the saving will be used for repairments or for otherwise developing service.

In the presentation is show methods for end-customer idea development like meetings for different customer groups or web-based idea board for collecting and testing new possibilities by Customer Journey-method and Service Design. Also, traditional surveys like usergroup-gallup surveys will be done.

Mari Helin, Maintenance manager at the City of Turku. Mari Helin Works in the Urban Environment Division. Division manages and maintains city streets, market squares, parks, bridges, recreation islands, and other public areas.



Mikko Kuusisto, Destia



Rauno Kuusela, Research and Development, Destia Ltd



Role and Responsibility of a subcontractor Jani Sihvonen, Puuppolan Konepalvelu Oy

Road maintenance today from contractor's viewpoint

Jani has vast experience of different road care operations from both client's and contractor's side. His presentation addresses selected topics in the area of safety of operations, client-contractor collaboration and impact of digitalization.

In regard to types of contracts presentation brings up positive developments towards stronger collaboration between client and contractor as well as contractor and sub-contractors. However need for further clarification can be seen especially in definition of responsibilities and material supplies used for execution of a contract.

Digitalization is rapidly changing landscape of road maintenance operations. Puuppolan Konepalvelu Oy is one of forerunners in this area having real time connectivity from machine to back office for monitoring but also for other purposes. It speeds up operational processes and significantly reduces need for printed material. Reliable and robust data accumulates day to day and could be broadly utilized for other cross functional needs. But aligned systems and data formats is key need in order to avoid negative impact from need for overlapping systems.

Employee safety first is clear to everyone. However it is often diluted due to mixed out of sync requirements. For instance use of TMA is true leap towards safer operation but suffers from confusing instructions regarding demand of use. Sweden leads the way in terms of safety requirements and many best practices should be applied in Finland too. This would lead to more safe operation and traffic. Jani's recommendation is that safety elements would be ranked and used as decision making criteria in a selection of contractor.

Jani Sihvonen, CEO, Puuppolan Konepalvelu

He has 30 years of experience in road and street maintenance. He has worked as a hands-on practitioner, entrepreneur and contractor in a regional contract. He has worked for YIT for about 12 years as a fleet manager and leader/manager in Kotka and Jyväskylä regional contracts. Developing equipment and working methods have been part of his job description, as well as training on the topics. Currently he is the Managing Director of Puuppolan Konepalvelu Oy, a company that provides maintenance services on a large scale, mainly in Central Finland.



KEYNOTE: The Potential of digital Twins in Road Maintenance

Mr. Mats Bayard, CEO, Triona Sweden



Mats Bayard is working as CEO in Triona since 2001. He is also a board member (Vice Chairman) at the University Governing Board at University of Dalarna since 2010. He has Twenty-eight years of experience within software engineering and telecom. He has mainly been working in roles connected to leadership and management of knowledge/service based organizations with its focus on business development.

Mr. Idar Kirkhorn



Idar Kirkhorn is a civil engineer with 27 years in the industry, working as road designer first and then he has been involved in the digitalization of civil engineering through the development of Novapoint and Quadri. Idar now manages Trimble's CEC offices in the Nordics.

Mr. Jo Forren



Jo Forren started his career in a power company 1997 (worked with low and high voltage). He has been working in Norwegian road administration from 2011 until 2018 as a construction/project manager mainly in electro and automation field. Now he is working as a discipline leader electro for Nye Veier.

Winter Cycling & Maintenance

Chaired by Nina Raitanen & Jyri Mustonen

Ms. Nina Raitanen, D.Sc., Managing Director, Finnish Road Association

Ms. Raitanen has made her career in the field of infrastructure. Before joining Finnish Road Association she worked for Aalto University, Destia Ltd. and Ministry on Transport and Communications.



Mr. Jari Mustonen, Lecturer in Infrastructure Construction, Häme University of Applied Sciences



The Year-Round Potential of Bike-Sharing – a Comparison of 50 Station-Based Systems Worldwide Martti Tulenheimo

Co-authors: Mikko Raninen & Niklas Aalto-Setälä, Martti Tulenheimo, Mikko Raninen & Niklas Aalto-Setälä

In Spring 2019 Helsinki City Transport, the City-owned public transport company of Helsinki, commissioned a study to find out how the bike-sharing system of Helsinki compares to other station-based bike-sharing systems in Europe and in North America.

A commonly used metric to weigh the rates of usage among the various bike-sharing systems and to compare the daily number of rides made with each bike within a specific system is *"Rides per Bike per Day"*. This metric was used in the study commissioned by Helsinki City Transport to compare 50 station-based bike-sharing systems to each other.

This presentation will shed light on the one hand on the results of the study, and on the other hand on the question of how commonplace is the year-round use of bike-sharing systems generally.

The study was carried out between January and March of 2019. The data was gathered from the operators using a questionnaire and by using open-source data available. 89 systems and their operators were approached and data was received for 50 systems.

Of the 50 systems compared in the study, 31 systems operated 365 days a year. The rest, 19 systems, were either started during the year 2018 or did not operate 365 days a year.

The results of the study were that outside of Asia, the leading station-based bike-sharing systems worldwide are in the cities of Helsinki, Dublin, Valencia, Barcelona, Lyon and Paris when compared to each other with the *"Rides per Bike per Day"* metric.

Some of the main characteristics consistent among the leading bike-sharing systems that stood out in the study were e.g. the size of the system, pricing, and the quality of the planning and implementation of the systems. A key observation in the study was that 2 out of 3 bike-sharing systems are operated 365 days a year.

A remarkable feature that was found in the study to explain the vast popularity of the system in Helsinki was the possibility to return the bikes to stations even when the stations were full.

Martti Tulenheimo, Specialist, Finnish Cyclists' Federation



Martti Tulenheimo is a specialist at the Finnish Cyclists' Federation. He is interested especially in designing a built environment for cycling. For the years 2015-2019, he has led the Cyclist Federation's Winter Cycling campaign. Previously, he has been a program director in Brussels for the European Cyclists' Federation (ECF), working internationally with top experts in the European cycling industry. He has e.g. promoted ECF's Cities for Cyclists network, which brings together experts from leading European cycling cities and advised ECF on designing a bicycle-friendly built environment for cities. Through his own company Tulenheimo Urban Solutions, he has been involved in a number of city bike, bike and mobility services projects, including: planning city bike procurement for Oulu, Jyväskylä and Tampere. In 2019,

Tulenheimo, in cooperation with Sweco Oy, carried out a study for the City of Helsinki (Transport Department), comparing 50 city bike systems with each other and evaluating the effects of city bikes, sustainable and active mobility.

Ground frost on salted bike- and pedestrian paths in Norway, Katja Skille, Norwegian Public Roads Administration

Co-authors: Bård Nonstad, Norwegian Public Roads Administration, Hampus Karlsson, SINTEF Community

In Norway, a bare road standard on bike- and pedestrian paths was introduced in 2013. The road surface should hold bare the whole winter season with help of sweeping and salting. Even though the level of service of the bike- and pedestrian paths was clearly increased after introducing this new method, the effects were not only beneficial. Only after a short time, the pavement started cracking and some local frost heaving was observed which lead to unevenness and later to rapid degradation of some of the bike paths. A literature survey and an interview of maintenance engineers was carried out in 2019 to find out what could cause this problem and how spread the problem is in Norway.

Literature survey brings out knowledge about ground frost, frost heave and what role salt plays in these processes. The results show that it is difficult to give a clear conclusion on the effect of salt on ground frost. The reason for this is a combination of the fact that there are several different theories related to how ground frost and frost heave occurs and how the presence of salt can change the basic principles that help form ice lenses in the various theories as well as little research has been found which highlights this specific issue. The phenomenon is complex and together with increased traffic with heavy maintenance vehicles on the bike and pedestrian paths it is likely that the salt is not the only cause of the degradation of the bike paths.

The interview of the maintenance engineers in Norway shows that the maintenance vehicles that are in use are quite heavy. It has been observed several places in Norway that after the bare road strategy has been taken in use, the bike paths have started to degrade. However, after setting maximum weight limit for the maintenance vehicles and repaving the bike paths, the problems have disappeared. It seems that cracks on pavement lead to more water and salt brine down into the road construction which further causes ground frost and frost heave and further decreased bearing capacity. Heavy traffic by maintenance vehicles on this type of bike path accelerates the degradation. A proper road construction together with pavement without cracks and lighter maintenance vehicles seems to be the key factors for longer duration of bike paths that are being salted.

Katja Skille, Head Engineer, Norwegian Public Roads Administration

Co-authors: Bård Nonstad, Senior Principal Engineer, Norwegian Public Roads Administration, bard.nonstad@vegvesen.no,

Hampus Karlsson, Master of Science, SINTEF Community, hampus.karlsson@sintef.no

Katja Skille, Head Engineer, Norwegian Public Roads Administration

Katja Skille is a Head Engineer at the Norwegian Public Roads administration for division Operations and Maintenance. She has been working with R&D of winter maintenance with focus on winter operations on bike and pedestrian paths since 2015. In addition she is working strategically with winter operations, with special focus on R&D and innovation and climate and environment., katja.skille@vegvesen.no



Operating guidelines and salt instructions for sweep-salting of cycleways, Anna Niska, Swedish National Road and Transport Research Institute (VTI)

A high winter maintenance service level is a precondition for cycling in the wintertime and is also important for the safety of cyclists. About every sixth cyclist severely injured in traffic has been involved in a single-bicycle crash because of slipping due to ice and snow (Niska & Eriksson, 2013). "Sweep-salting" is a winter maintenance method with the potential to increase winter cycling. The method involves a front-mounted power broom for snow clearance and salt for de-icing. Although several evaluations have been carried out in recent years (eg. Niska, Blomqvist & Järtskog, 2017) and municipalities and entrepreneurs have gathered experience regarding the application of the method, this knowledge has not been fully implemented in practice.

At present, there are about 30 Swedish municipalities that apply sweep-salting, to a varying extent, from Umeå in the north to Malmö in the south. For a municipality that is initiating an application of the method, there are several practical issues to consider. For example, what type of equipment is best suited for the municipality's conditions and needs, what kind of salt should be used in what amount under different weather conditions.

A lot of strategic decisions also need to be taken, such as the amount of snow that requires constant brushing until the action can be finalized with salting, how measures can be adjusted with regard to dew point temperatures in relation to road temperature, etc. By combining the theoretical knowledge gathered in research studies with the practical experience gained by operators and maintenance managers, the Swedish National Road and Transport Research Institute (VTI) and the Municipality of Karlstad have developed new operating guidelines and salt instructions for sweep-salting of cycleways, which will be described and made publicly available in this presentation.

Anna Niska and Göran Blomqvist (VTI), Tomas Stomberg and David Nordström (Karlstad municipality)

Anna Niska, Research Leader, Swedish National Road and Transport Research Institute (VTI)



Anna Niska (maiden name Bergström) is a research leader at the Swedish National Road and Transport Research Institute (VTI). She is also the coordinator of the Swedish Cycling Research Centre at VTI established by the Swedish government in January (2018). Anna has a Master of Science in Environmental Engineering and a PhD in Highway Engineering, with the title "Winter maintenance and cycleways" of her doctoral thesis. Her main field of research is within effects on cycling of road maintenance and operation including accident analysis, effects on cycle flows, mode choice, riding comfort, and evaluations of winter maintenance methods and equipment. Anna has more than 20 years of experience in the field and has been the project leader of several cycling research projects over the years. Her research has

gained considerable dissemination and attention, especially regarding the development and evaluation of the “sweep-salting” method.

Use of warm-wetted sanding on walkways and Cyclepaths, Bård Nonstad Norwegian Public Roads Administration

Co-Authors Katja Skille, Norwegian Public Roads Administration, Hampus Karlsson, Sintef

Warm-wetted sanding is a gritting method which have been used in Norway for 20 years on roads intended for vehicles. The advantage of warm-wetted sanding on roads intended for vehicles is that acceptable levels of friction are maintained over longer periods of time and that it can reduce the amount of sand.

Reduced use of sand and number of measures will contribute to lower costs connected to winter maintenance as well as it will reduce the amount of sand that have to be swept away in the spring. Increased durability of the measures will also reduce motorized transport on sidewalks which is positive both for traffic safety and damages caused by heavy vehicles.

Warm-wetted sand consist of a mix of hot water and sand. The amount of water in the mixture is approximately 30-weight percentage, and the normal dosage of sand used is equivalent to 150- 200 grams/m² as an average. Scientific studies have revealed that measures carried out with this method last longer than traditional sanding methods. While the effect of using cold and dry sand can disappear after the passage of 100 vehicles, warm-wetted sand can maintain acceptable friction values even after the passage of 2000 vehicles. Under favourable road and weather conditions, satisfactory friction values have been maintained for up to 3 to 7 days on roads with AADT of 1,500. During the last years there has been an increase in use of this method. Last winter season 20 % of the amount of sand was spread with this method, but not on walkways and cycle paths.

In the research and development program “Bevegelse” we are looking at the possibility to use warm-wetted sand also on the areas for pedestrian and cyclists. We have a collaboration with the spreader supplier Falköping and the contractor Veidekke in the Kongsvinger area where the testing will take place this winter. The spreader that will be used in this test are a prototype and the first of its kind. It is fitted to be used on the back of a tractor.

The tests will assess how the friction values develop over time and if the users recognize any differences from normal winter maintenance. The testing activity will also contribute with important information about spreading pattern, driving speed, spreading dosage and required water temperatures in order to obtain desired results on walkways and cycle paths.

The spreader is put into ordinary activities for the contract and the method should be used when the air temperature is below -1 celcius degrees and the friction level is below the requirements in the contract.

Unfortunately for the project there has been a very mild winter in the inland of Norway so far, and we have had a kind of weather that is not suited for this method. Despite that some testing have been done. One thing we have seen is that the spreader pattern is depending on the spreading speed. Velocities under 10 km/h is preferable if we want a pattern that is suited especially for pedestrians.

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Bård Nonstad, Chief Engineer, Norwegian Public Roads Administration

Bård Nonstad is a chief engineer at the Norwegian Public Roads Administration in Trondheim.



He is working with different research projects in maintenance, particularly with winter maintenance and friction measurements.

Road Maintenance & Management

Chaired by Toni Korjus & Juha Jääskelä

Mr. Toni Korjus, Head of Infrastructural Services, M.Sc (eng.), City of Espoo, Public Works Department

Toni Korjus is working as a Head of Infrastructural Services in city of Espoo. Infrastructural Services consists of four units; Street Maintenance, Green Area Maintenance, Traffic Control and Administration of Land Use.



Mr. Juha Jääskelä, M.Sc (econ.) CEO of Arctic Machine Ltd, NVF

Juha Jääskelä is the CEO of Arctic Machine Oy, a company that is the leading road maintenance solution provider in Northern Europe. He is also a member of the board of The Nordic Road Association (NVF) national association in Finland.



New Contract model for Road Maintenance in Finland, Magnus Nygård, Transport Infrastructure Agency

The active development work to create improvement on the existing road daily maintenance contracts started around year 2012. The overall objectives of this development work was to increase productivity and quality to further improvement the service for road users. Other objectives were to increase co-operation, improve ability to react on evolving needs and to use target price.

The road daily maintenance contracting areas and model were developed around year 2000 when the daily maintenance work was gradually outsourced from the Finnish National Road Administration. This contracting model has been used thorough Finland for more than two decades. During the years there has been several adjustments made in technical requirements and contracts. Finnish Transport Infrastructure Agency is responsible for maintaining the state-owned road network. The practical procurement process is conducted by the regional Centres for Economic Development, Transport and the Environment.

The variation between different winters seems to be greater than some decades ago. During some winters, there has been for example a significant increase in weather conditions around 0 °C thus creating more demand for winter maintenance actions, especially de-icing. The demands for improved quality of road maintenance has been obvious from industry and other road users.

The first pilot-projects in developing of the new road maintenance contract model were implemented 2014. The results on these new pilot contracts were followed. The formal decision to implement this new method starting year 2019 on the national roads was made 5th February 2018 when the minister of Transport and Communications made a decision for a develop programme of winter maintenance. The programme also included updated guidelines for winter maintenance, continuous development of digitalization and more information that is effective.

Finnish Transport Infrastructure Agency together with Centres for Economic Development, Transport and the Environment area procuring the daily road maintenance divided in 79 area contracts. The new road maintenance contract model has been in use in 17 area contracts in Finland during the winter 2019-2020. Furthermore, the next 13 area contracts are under bidding process in the beginning of February 2020 and the new contracting method will be in use in these 13 areas starting 1st October 2020.

The results of the develop programme of winter maintenance has been successful leading to road users' satisfaction. In addition, the new contracting method has been able to show very promising results in the first years.



Magnus Nygård, Director of Maintenance department, Finnish Transport Infrastructure Agency

Utilization of new digital data sources in winter road maintenance management, Janne Miettinen, Finnish Meteorological Institute and Seppo Kaarto, Destia Ltd

Destia and Finnish Meteorological Institute (FMI) have together developed in the 5G-SAFE R&D project snow plough scheduling application and forecast for hard packed snow. The Snow plough scheduling application has been working for several years but has been lacking the information from the latest maintenance operations.

Nowadays this information is available through a machine readable interphase. When enriching the weather data and weather forecast with the latest snow plough information we can have better situation awareness about the snow amounts on the road. This will help the road weather center operators when planning the upcoming snow plough events.

The other application developed in the project was the hard packed snow forecast which used observations from Jalonne RoadData to analyze where hard packed snow was present and FMI road weather model was harnessed to forecast these circumstances.

Janne Miettinen, Account Manager, Finnish Meteorological Institute



+15 years experience at FMI.
Formerly worked as an on duty aviation meteorologist.
7 years of experience of road weather services.
Working also in R&D projects developing new services for road maintenance and road users.
Account Manager
Customer Services
Finnish Meteorological Institute



Seppo Kaarto, Head of Road Weather Center, Destia
Head of Road Weather Center at Destia.
Seppo has extensive experience with winter maintenance management, acquired over 36 challenging winter seasons
Seppo has been strongly involved in developing ICT systems to support maintenance.

Real time road weather data in winter maintenance of cycling routes, Antti Hirvonen, Suomen Kuntotekniikka Ltd

Co-writer Heidi Jokinen, City of Turku

CYCLING AND THE PROBLEM OF WINTER

Current developments in our urban, everyday mobility include a demand for more possibilities in winter cycling. So far winter cycling has been a habit of a relatively few. Municipalities have either been unwilling to promote winter cycling or their efforts have been burdened with perceived ambiguity of cycling route conditions. In order to make winter cycling more mainstream, decisive measures are mandatory.

TURKU OPENS A TEST ROUTE FOR WINTER CYCLING

City of Turku is known for its many cyclists. According to a research conducted by the city, 63 % percent of the citizens choose cycling at least once a week during summer months. This figure drops to 23 % during winter. In 2017 Turku improved possibilities for cyclists even further by introducing city bikes (Föli bikes) as a public service.

Around the same time, they also sat around a drawing table and planned a 12-kilometer route which they committed to keep free from snow and ice during the usually challenging winter months. The usual maintenance method, gritting was replaced by brushing in combination of de-icing salt. This as well was a favor to cyclists as gritting tends to wear out tires. A contract with a contractor was tied until winter 2020-2021 so the effort for winter cycling will go on at least for two more winters. The goal is that by then a ten percent increase in the number winter cyclists is made.

MONITORING ROAD WEATHER CONDITIONS AND COST-EFFICIENCY ALONG THE ROUTE

Furthermore, City of Turku took action in order to oversee road conditions along the cycling route, activities of the contractor and cost-effectiveness of the chosen method. This was achieved by installing two road weather sensors (IRS sensors from Lufft) and acquiring a software (INFRAWEB) with which to monitor their values and assign automatized alarms whenever critical criteria would be met. City officials have been able to monitor effects of maintenance in real time.

WHAT COULD BE DONE MORE?

So far only city officials have had access to road weather data for cycling roads, but in order to tackle the unwillingness to cycle during winter, cyclists need an access to the information as well. Taking a look at a weather forecast constitutes a part of the morning ritual for many, but the weather forecast doesn't always translate well to tell about road conditions as they don't take maintenance processes into account. Thus, city administration's responsibility is to find ways to gather meaningful road weather information, make it understandable and to distribute it to citizens in an easy-to-use way so that they can be informed before hopping on a bike.

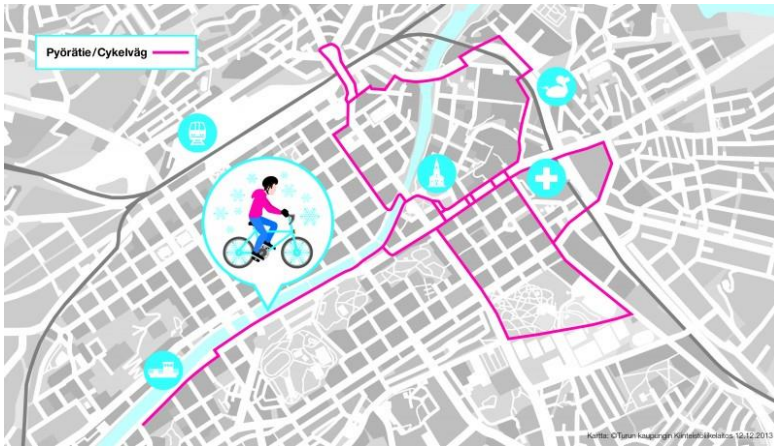


Figure 1: The winter cycling test route in the city of Turku, https://www.turku.fi/uutinen/2017-10-26_talviyorailyn-testireitti-keskustan-alueelle

Background text: <https://www.turku.fi/civitas-eccentric>, several projects

Antti Hirvonen, Project Manager, Suomen Kuntotekniikka Oy, Co author Heidi Jokinen, Street Engineer, city of Turku



Antti Hirvonen has experience in street network maintenance and in life cycle management for infrastructure assets in Finland. With his expertise in municipal decision-making processes, he is the person to listen to if you're eager to learn more about current well-being of our public street network and what could be done in order to turn the course. His current emphasis as a project manager is on weather information services.

Matching the needs for cycling infrastructure and winter maintenance, Oskari Kaupinmäki, Antti Takkunen & Marek Salermo, the City of Helsinki

The City of Helsinki has been developing a comprehensive cycling network since the introduction of Helsinki's Cycling Strategy in 2014. It involves a comprehensive set of world-class best practices, which have created a need to implement more functional solutions. This sets new requirements for winter maintenance as well. The development has been slow, and therefore a project to match the needs for cycling infrastructure and winter maintenance has initiated.

The goal of the project is to increase the popularity of year-round cycling. The aim is to develop a roadmap for traffic planning and maintenance departments, and thus achieve a shared vision and aims for future cooperation. The key viewpoints are to make year-round cycling user friendly by prioritizing maintenance so that cyclists can use the same familiar routes year-round. Additionally, ensuring appropriate solutions for maintenance at network level and ensuring adequate space for maintenance operations are key.

Oskari Kaupinmäki: Project Manager, The City of Helsinki

Antti Takkunen: Walking and cycling coordinator, Maintenance of public areas, The City of Helsinki

Marek Salermo: Traffic Engineer, The City of Helsinki

Tuomas Lautaniemi: Maintenance Engineer, The City of Helsinki

From Data to need of Actions, and to Work tasks, Lauri Kettunen, Jalonne Ltd

(Jalonne Oy in co-operation with Destia) Modern information technology enables new possibilities to monitor and to follow the road and street infrastructure in real time with crowd-sourced phones. Collecting data from phones attached to the windscreen is straightforward, but the challenge is in transforming data into useful and valuable information.

The need of road care and maintenance is reliable information of road and street conditions in order to make decisions on maintenance operations. Some operations, such as road salting may create significant costs, and hence, reliability of the information is a key issue. The basic approach to increase reliability is statistics and increased sampling. Sometimes this is, however, not possible. For, there are cases that require immediate maintenance actions leaving little time for collecting statistical data.

Modern mobile phones are advanced measuring devices. For the needs of road care and maintenance, the image, location, and inertial data is especially useful. While machine vision enables to detect targets and conditions from the image data with a rather good accuracy, it is also worthwhile to recognize object recognition will, by construction, never match flawlessly with the human needs. The inertial data makes it possible to compute the roughness of roads and streets. Complementing the image data with inertial data results in reliable information on the conditions of the road surface.

In the presentation we illustrate with examples several approaches to transform crowd-sourced data to useful information for the needs of road care and maintenance.

Data collection and creation of real-time information is the first need of road care and maintenance. The second goal is to employ this information to allocate and schedule work tasks. For this, an interface from the data collection and analysis system to work control systems is needed. This is demonstrated with a video produced in co-operation between Jalonne, Destia, and Fluent Progress RT.

Lauri Kettunen, Jalonne Ltd