PIETARI PELTONEN

THE IMPACT OF WEATHER, ROAD CONDITIONS, TREATMENT AND MAINTENANCE ON WALKING AND CYCLING CONDITIONS

RAMBØLL

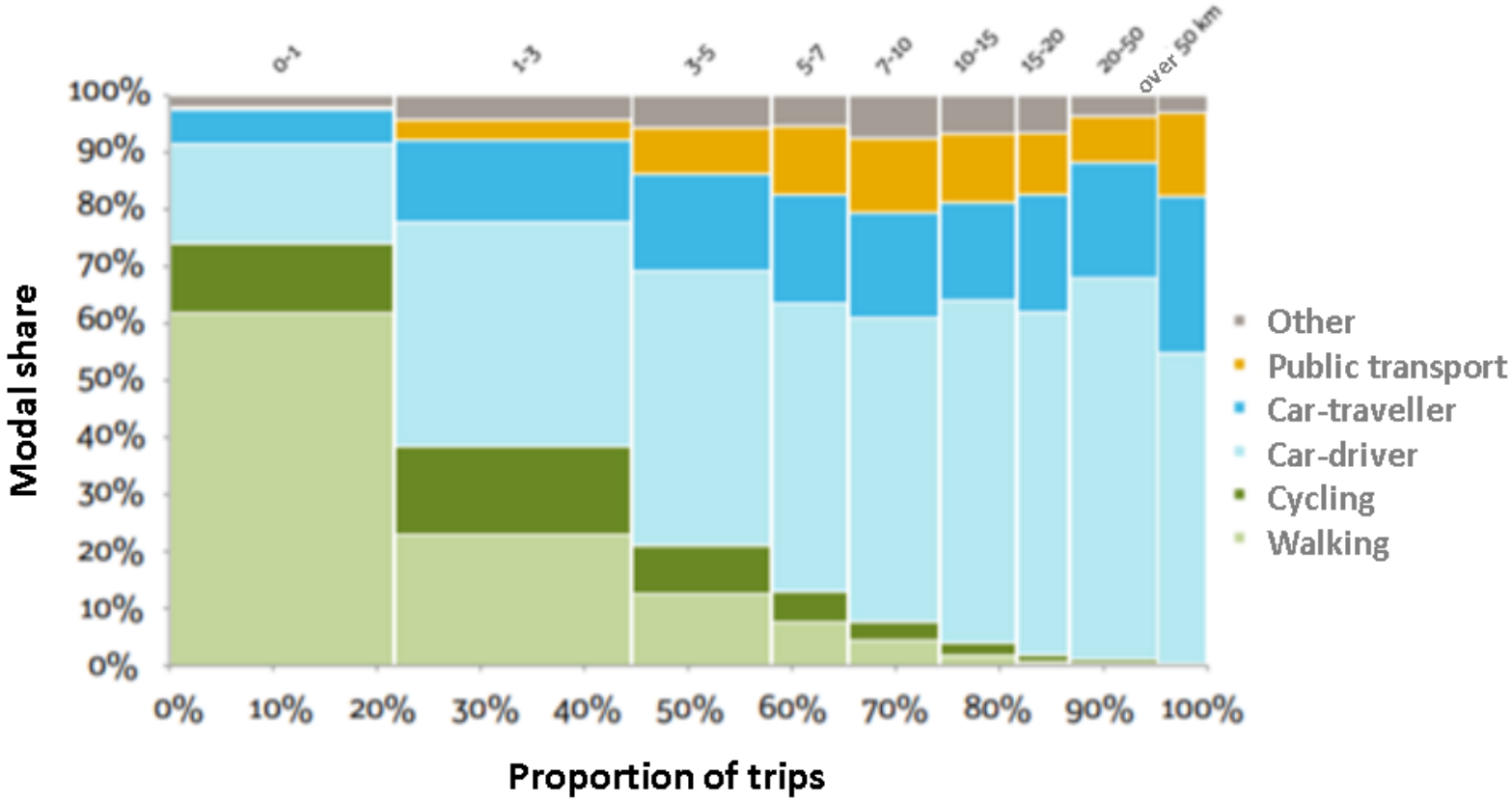
BACKGROUND

- Project initiator is Jaakko Klang from Centre for Economic Development, Transport and the Environment of Southwestern Finland (later ELY Centre)
- Consists of smaller parts
  - Master's thesis: literature review about walking and cycling conditions and "before-study". Results are used to form recommendations and suggestions. Winter 2017-2018.
    - Final title: The impacts of traffic environment, weather, road conditions and maintenance on walking and cycling travel
  - Follow-up study next winter
  - Test site in Turku region, but the goal is for the methods to be used elsewhere as well
  - Thesis supervisor: Milos Mladenovic, Aalto University School of Engineering
  - Thesis advisor: Erica Roselius, Ramboll Finland Oy
- Funding by ELY-Centre and Finnish Transport Agency

RAMBOLL

THE STUDY

BACKGROUND



(Somerpalo et al. 2015)

BARRIERS

- Too dangerous
- Too much traffic
- Bad weather
- Personal factors
- Too busy
- Lack of daylight
- Inconvenience
- Lacking sufficient fitness
- Uncomfortable
- Lack of time
- Being tired
- Too much effort
- Difficulties with trip chaining

RAMBØLL

WALKING AND CYCLING IN WINTER

- Cycling is clearly more common in summer than in winter
- Common reasons for not cycling in winter include darkness, cold temperatures, slipperiness, snow, wetness, precipitation and strong winds
- Winter cycling can be even safer due to cyclists being cautious and riding on lower speeds

RAMBØLL

WALKING AND CYCLING IN WINTER– SEASONAL BARRIERS

- Temperature
  - Temperature decreases, cycling levels decrease and walking levels increase
  - However, temperature often not the main reason

- Rainfall
  - Rain increases, cycling and walking levels decrease
  - Time of day: if in morning, drop is higher

- Snow and/or ice on the road
  - As the amount of snow and/or ice on road increases, the modal share of cycling decreases, and walking increases
  - Cycling+walking relatively constant

- Accident risk is 5 to 10 times higher on snowy and/or icy road conditions
  - Slippery road conditions caused 60% of all bicycle accidents (hospital data from Östergötland)
  - In Umeå, the number is 40% (also 4 out of 10 accidents occur during winter)
  - 84% of accidents was at least partly caused by ice or snow

RAMBØLL

FACILITATORS FOR CYCLING

- Infrastructure and facilities
  - Bike lanes
  - Cycle tracks
  - Bike paths
  - Bicycle boulevards / neighbourhood greenways / living streets
  - Shared bus and bike lanes
  - Contraflow
  - Bicycle parking
- Networks
  - Coverage and continuity
  - Nodes: intersections, junctions, crossings
  - Bike boxes/advanced stop lines
  - Combined bike lane / turn lane
  - Intersection crossing marking

RAMBØLL

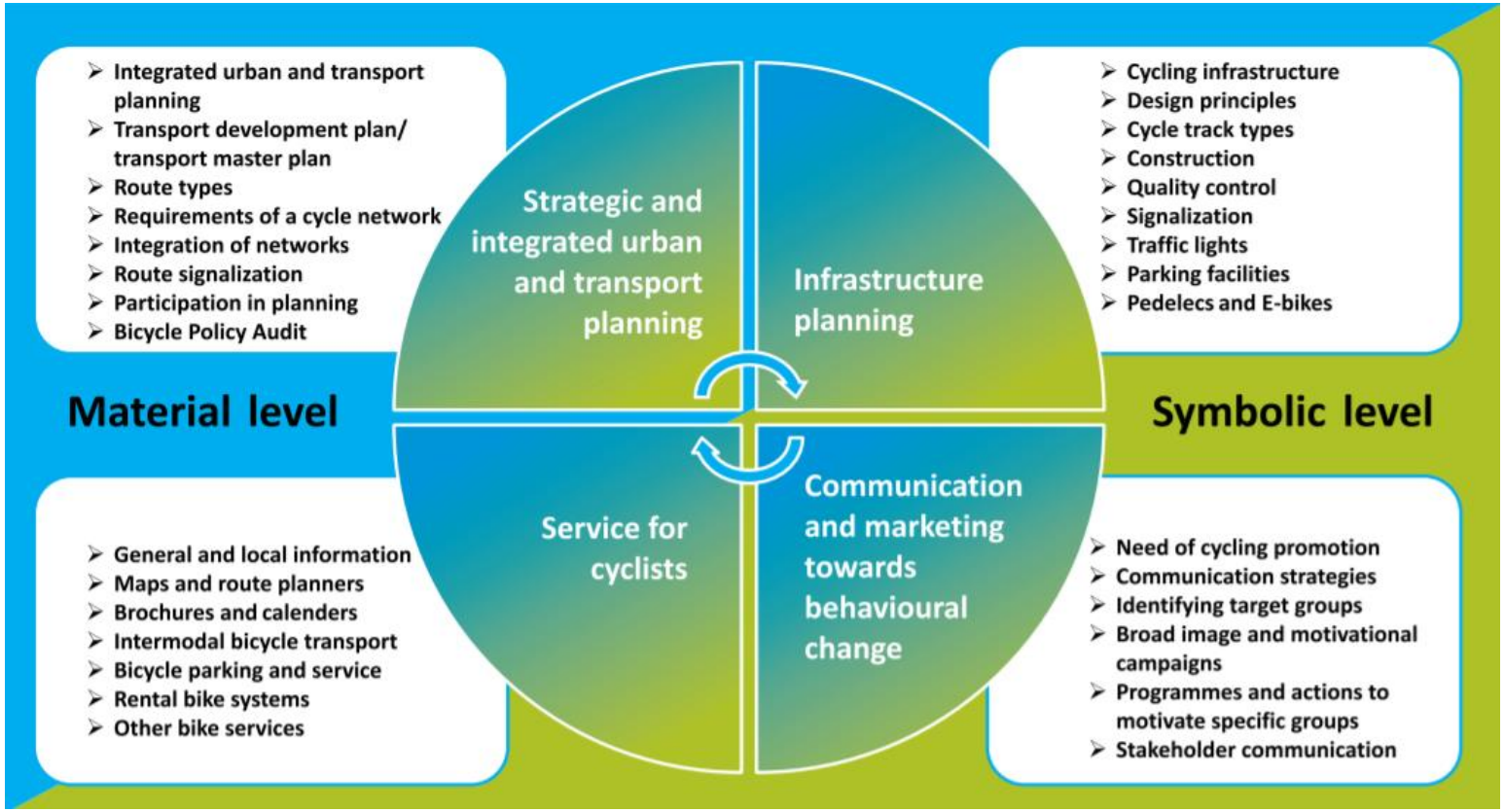
WALKING FACILITIES

- Sidewalk
- Multi-use paths
- Walking trails
- Broadwalks
- Pedestrian zones, malls, promenades
- Bollards, railings, gates, fences
- Street furniture
- Bridges, overran underpasses
- Crosswalks, signals
- Stairs

RAMBOLL

CYCLING PROMOTION AND PROGRAMS

- Programmatic interventions to increase cycling
  - Attitudes
- Promotional activities, media campaigns, educational events and other means
  - Cycling schools
  - Handouts
  - Breakfast for winter cyclists
  - Kilometre competitions



(Deffner et al. 2012)

RAMBØLL

WINTER MAINTENANCE – PHYSICAL/MATERIAL ASPECTS

- Clearing the path
  - Different equipment
    - Plows, brushes, blowers
- Storage of snow
  - Snow accommodation areas along roads
    - Design!
  - Haulage of snow

- Different chemical ice melters
  - Rock-salt the cheapest, and thereby most common
  - Different environmental impacts
  - Corrosion
  - Application form
- Gritting
  - Different materials
- Additives help limiting negative impacts
  - (Sugar) beet juice
  - Brines
  - Molasses

RAMBØLL

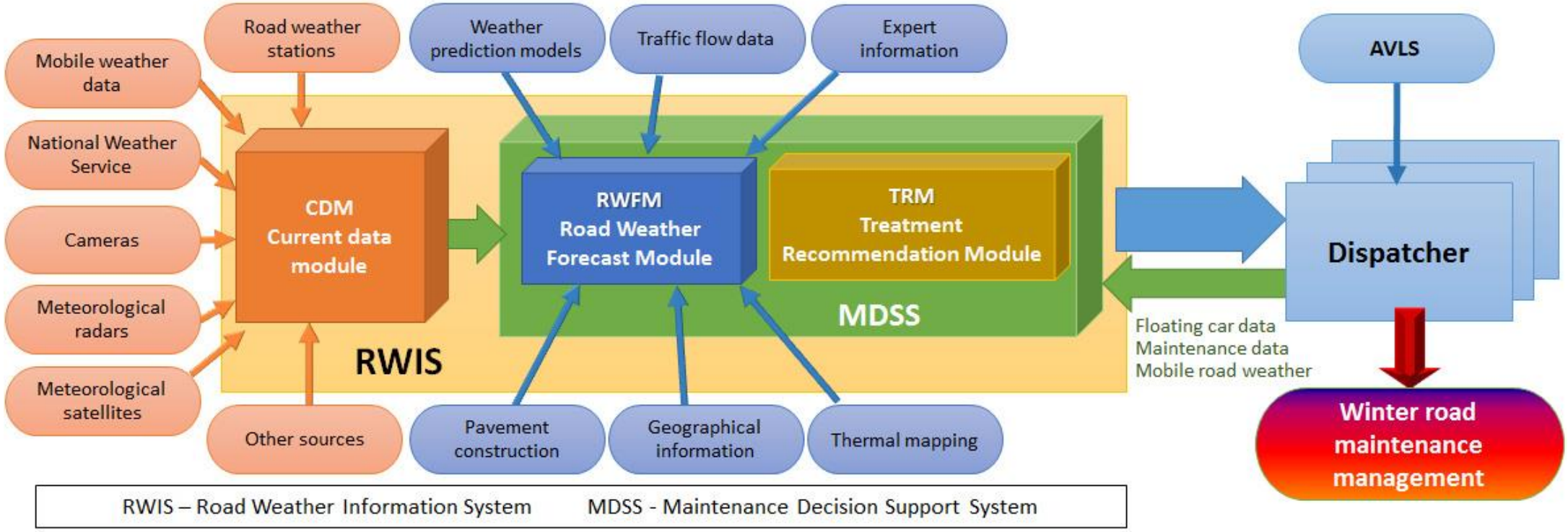
WINTER MAINTENANCE – PRIORITIZATION AND CONTRACT MODELS

- Routes are maintained in specific order according to their importance to traffic
- Contract models around the world
  - Snow limits
  - Action times
  - Procedure times
  - Maintenance methods
  - Equipment control

(Finnish Transport Agency, 2018)

RAMBØLL

WINTER MAINTENANCE – INTELLIGENT MAINTENANCE MANAGEMENT



- RSI
- ROSTMOS

(Kociánová, 2015)

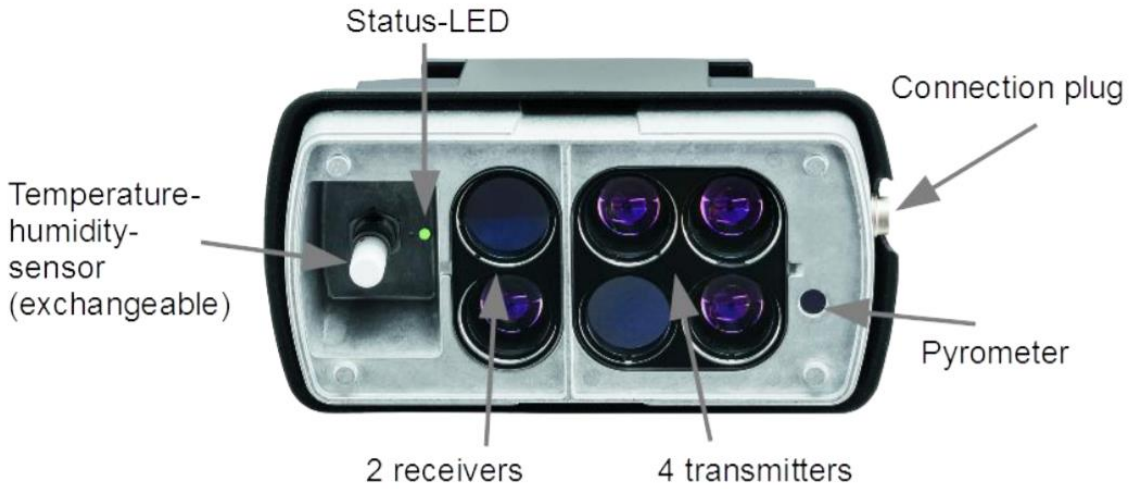
CASE STUDY

- Walking and cycling paths of Regional road 110 between Turku and Kaarina
- Current winter maintenance methods according to "Quality requirements on highways" by Finnish Transport Agency
- January 22nd to March 4th

(Modified from OpenStreetMap, 2018)

CASE STUDY – WEATHER SENSOR

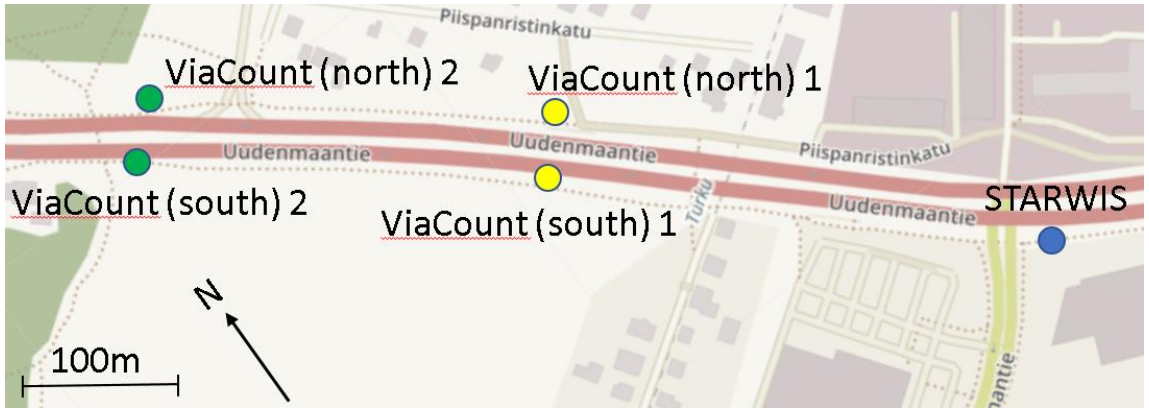
- STARWIS weather sensor
  - Surface temperature
  - Relative humidity
  - Dew point
  - Friction
  - Ice percentage
  - Road status
- MARWIS
  - +Ambient temperature



(Lufft, 2017)

CASE STUDY – TRAFFIC COUNTING

- ViaCount
  - Doppler radar
  - Two-directional detection
  - Counting bicycles and pedestrians
- Manual counting once a week



(Modified from OpenStreetMap, 2018)

RAMBØLL

CASE STUDY – SURVEY

- Questions about moving habits, evaluations of weather, maintenance etc. factors
- Answering
  - Webropol
  - Form on site
- Advertising
  - ELY-centre web page
  - Local newspapers
  - Social media

7. How strongly do you experience following winter characteristics?
1 = no effect, 5 = prevents me from cycling/walking.

- Temperature
- Wind
- Precipitation
- Darkness
- Slipperiness
- Snow on cycling/walking path
- Snow blocking visibility
- Rutted cycling path (only for cyclists)
- Other, please specify

8. How do you evaluate following characteristics of the cycling/walking path between Turku and Kaarina?
1=very poor, 5 very good

- The condition of the pavement
- Lighting
- Cycling facilities / taking pedestrians into account
- Safety
- Overall review of the cycling path (only for cyclists)

9. How do you evaluate following parts of winter maintenance on the cycling/walking paths between Turku and Kaarina?
1=very poor, 5= very good

- Result of snow removal
- Timing of snow removal
- Accommodation of snow
- Skid control methods
- Skid control results
- Skid control timing

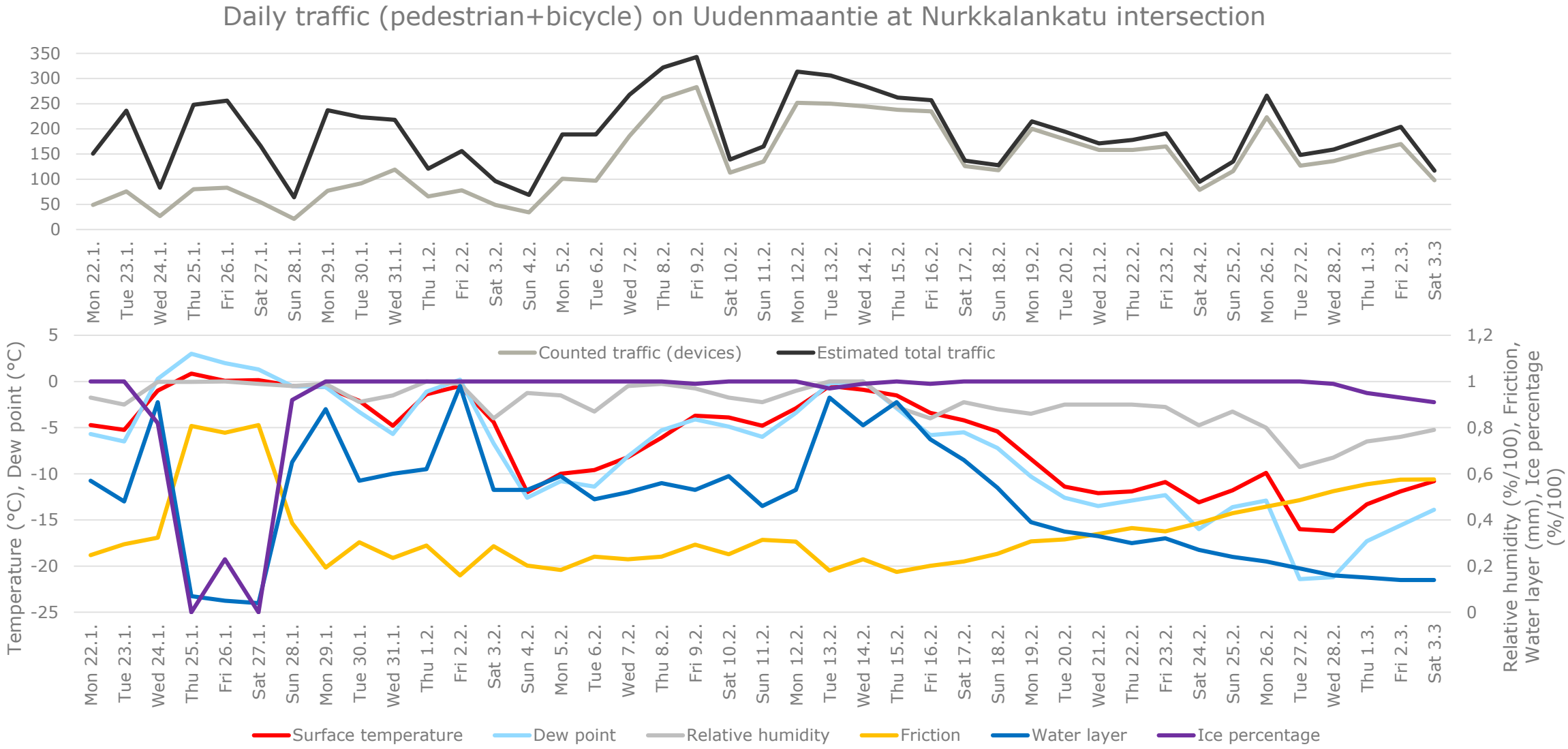
10. How would you develop winter cycling/walking conditions?
Checkbox answers:

- Different snow removal methods (for example snow blower, brush)
- Use of salt and/or other skid control methods
- Other, please specify

11. If the things you mentioned earlier were fixed, how often do you believe you would cycle / how often would you make walking trips during the winter season?

- Five days a week or more often
- On 2-4 days a week
- One day a week
- Several times in a month
- Several times in the season
- Less

CASE STUDY – RESULTS



CASE STUDY –SURVEY RESULTS

- Total of 353 answers, of which 57 as a pedestrian, 296 as cyclists.
- Winter reduced the number of trips more among cyclists than pedestrians
- Pedestrians evaluated wintery factors to be more considerable barriers on mode choice than cyclists (exception: snow)
- Cyclists evaluated the case study location and its winter maintenance more positively than pedestrians
- Majority of pedestrians and cyclists would develop winter maintenance with various methods
  - Roughly half of pedestrians would use different friction enhancing methods. 43% of cyclists would also.
  - More efficient snow and slush removal was mentioned frequently.
  - Cyclists' attitudes towards salt were surprisingly positive. Also ending the use of grit was often suggested. Pedestrians also mentioned decreasing the amount of salt used.
- Around 50% would consider information about road condition useful, about performed maintenance as much as 80%
  - More than half believe that such information providing service would increase the number of walking or cycling trips made

RAMBØLL

DISCUSSION - RESULTS

Phenomenon	Case study	Survey result (opinion)	Previous studies
Seasonal volumes	Significant reduction among cyclists (based on traffic volume counting of 2015).	Pedestrians: minor reduction in winter Cyclists: Considerable reduction in winter	Pedestrians: noticeable increase in winter Cyclists: Considerable decrease in winter
Temperature	Cold temperatures reduce the number of pedestrians and cyclists	Pedestrians: low impact Cyclists: low impact	Pedestrians: increase in T decreases activity Cyclists: increase in T increases activity However not the only factor in winter
Precipitation	Strong, reducing impact	Pedestrians: moderate barrier Cyclists: moderate barrier	Reduces the number of pedestrians and cyclists moderately. Depends also on study period.
Snow on road	Considerable barrier together with precipitation	Major barrier for both travel modes	Major barrier
Slipperiness	Strong, reducing impact, significant correlation only during change in friction.	Pedestrians: major barrier Cyclists: considerable barrier	Considerable barrier
Traffic environment		Safety of traffic environment and fluency of network are important facilitators. Separation of modes is desired.	Safety of traffic environment and fluency of network are important facilitators.

RAMBØLL

DISCUSSION – RECOMMENDATIONS, TRAFFIC ENVIRONMENT

- Repairing the pavement where required
- Changing and/or complementing certain segments on the route, improving the continuity of the route
- Separation of traffic modes
- Walking and cycling specific facilities increasing safety and comfort
- Planning of underpasses and intersections with maintenance in consideration
- Accommodation of snow

RAMBØLL

DISCUSSION – RECOMMENDATIONS, WINTER MAINTENANCE

- Ensuring the fulfillment of contracts, improved communication between different organizations and stricter enforcement
- Changeable snow removal tools for different road surface conditions
- Coordinated friction and pollution control of road surface
- Proactive maintenance before snowfall for salt use minimization
- Alternative deicer materials
- Storage and depot locations, and utilization and updating of stock
- Utilization of existing, and development of maintenance management support systems

RAMBØLL

DISCUSSION – RECOMMENDATIONS FOR LONGER TIME PERIOD

- Increasing the priority of maintenance on pedestrian and cycling paths
- Adaptivity for the quality requirements
- Increasing winter maintenance budget
- Simplifying administrative procedures
- Development of contract models
- Implementation of road weather data collection systems

DISCUSSION – RECOMMENDATIONS, INFORMATION SYSTEMS

- Information about winter maintenance for road users
- Information systems to improve the efficiency of winter maintenance
- Road weather data

- Campaigns

CONLCLUSIONS

- Keep the infrastructure in good condition
- Follow the contracts and agreements
- Adapt to local conditions
- Provide safe and attractive facilities for cyclists and pedestrians
- Separate modes

REFERENCES

- Deffner, J., Hefter, T., Rudolph, C., & Ziel, T. 2012. Handbook on cycling inclusive plan-ning and promotion. Frankfurt/Hamburg, Germany. [Cited 13 May 2018] Available at: http://www.mobile2020.eu/fileadmin/Handbook/M2020_Handbook_EN.pdf
- *Finnish Transport Agency. Winter maintenance classes of highways. [Internet-page]. [Cited 12 Sep 2018]. Available at: https://www.liikennevirasto.fi/tieverkko/kunnossapito/talvihoito*
- Kociánová, A. 2015. The intelligent winter road maintenance management in Slovak con-ditions. Procedia Engineering. [Electronic journal]. Vol. 111. P. 410-419. [Cited 6 Feb 2018]. ISSN 1877-7058. Available at: http://www.sciencedirect.com/science/arti-cle/pii/S1877705815013582
- Lufft. 2017. User Manual MARWIS / StaRWIS. [User manual]. Fellbach, Germany. 56 p. [Cited 7 Mar 2018]. Available at: https://www.lufft.com/download/manual-lufft-marwis-starwis-en/
- OpenStreetMap Foundation. (2018). [Map service]. [Cited Mar 2018]. Available at: https://www.openstreetmap.org
- Peltonen, P. The impacts of traffic environment, weather, road conditions and maintenance on walking and cycling travel. [Master's thesis]. Available at https://aaltodoc.aalto.fi/handle/123456789/32417
- Somerpalo, S., Kallio, R., Lehto, H., & Krankka, A. 2015. Pyöräilyanalyysi henkilöliiken-netutkimuksen aineistosta. [Study]. Liikenneviraston tutkimuksia ja selvityksiä 32/2015. Helsinki: Liikennevirasto. 70 p. [Cited 1 Feb 2018]. ISSN 1798-6664. Available at: https://julkaisut.liikennevirasto.fi/pdf8/lts_2015-32_pyorailyanalyysi_henkiloliikennetutki-muksen_web.pdf

RAMBOLL

THANK YOU!

THE STUDY REPORT AVAILABLE AT HTTPS://WWW.DORIA.FI/HANDLE/10024/159471 (IN FINNISH)

QUESTIONS?

PIETARI.PELTONEN@RAMBOLL.FI

RAMBOLL