



WINTERMAN

The Danish Winter Maintenance Management System

Bo Sommer



Road Directorate
Ministry of Transport - Denmark



The Sky Mountain

Highest point in Denmark: 173 meter above sea level



Winter in Denmark...

- Approx. 5-10 days with snowfall, 30-50 cm a year
- Main problems:
Hoar frost and wet freezing roads





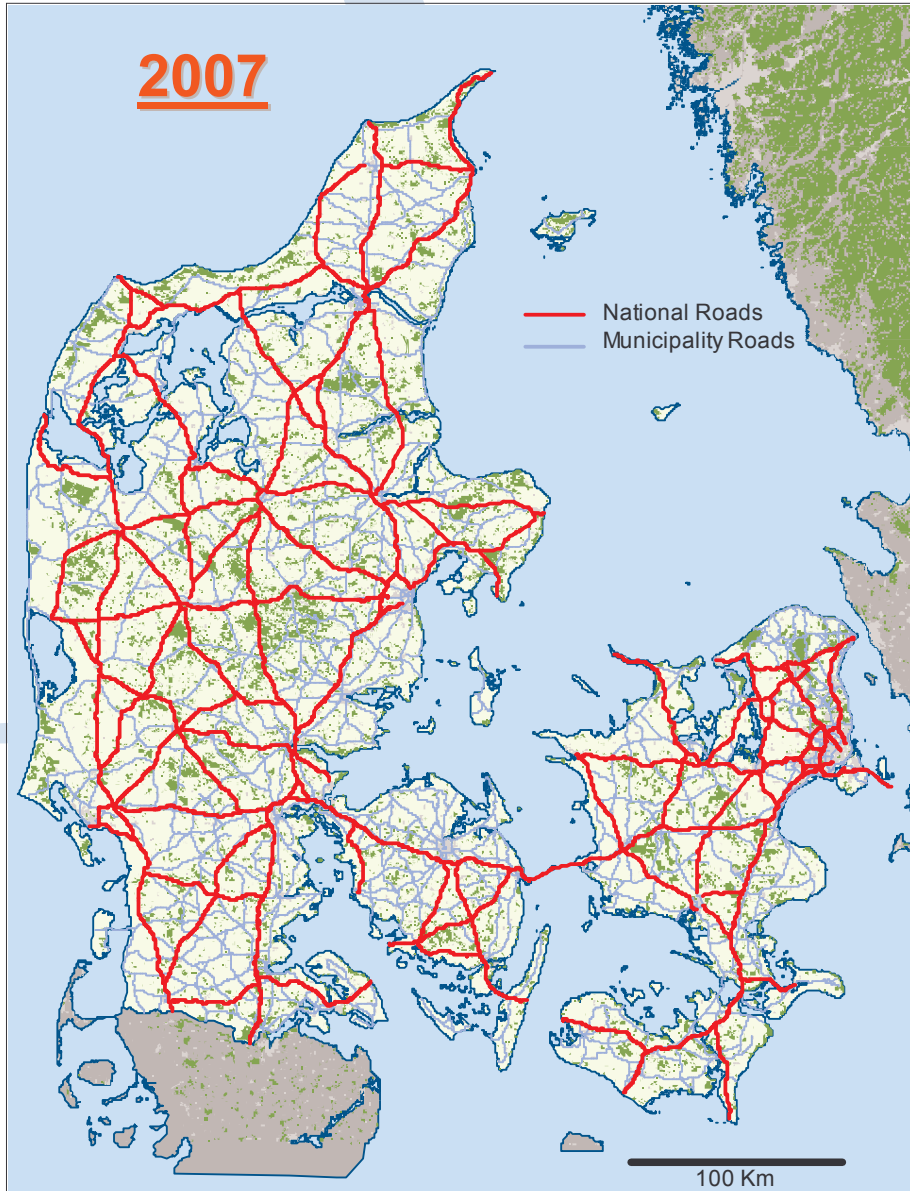
We do also have snow...



February 2007



The Danish Road Network



Road authorities in Denmark

2006

- Road Directorate: 1,600 km.
- 13 Counties: 10,000 km.
- 271 Municipalities: 60,000 km.

2007

- Road Directorate: 3,800 km.
- 98 Municipalities: 68,000 km.



Salt Consumption on Main Roads ~ 12.000 km

🔑 Actions per year: Approx. 100

🔑 Dosage: • Hoar frost 5-10 g/m² (20-40 kg/lane-km)

Snow 15-20 g/m² (60-80 kg/lane-km)

🔑 Consumption: 150,000 tons annually

🔑 1.25 kg/m² (5.0 tons/lane-km)

🔑 All roads: 300,000 tons annually

≈ 200 kg/vehicle





Guidelines - Organisation

- ✓ The service objective is always to have black road surface
- ✓ Decision is taken by 6 winter centrals
- ✓ Private contractors carry out salting and snow ploughing
- ✓ Dosage is based on a guideline

Roads			
Class	Type of road	Service objectives	Desired duration of Road Conditions below the Service Objectives
State roads Priority county roads	<ul style="list-style-type: none"> •Freeways •Regional Roads •European Freeways •Other priority roads 	Should be passable without major inconveniences 24 hrs. a day Desired road conditions: <ul style="list-style-type: none"> •Dry •Wet 	Slippery roads without snow: <ul style="list-style-type: none"> •Rime frost 0 hours •Ice 0 hours After snowfall: <ul style="list-style-type: none"> •Slush 2 hours •Light snow 2 hours •Compacted snow 0 hours After blown snow: <ul style="list-style-type: none"> •Driven snow 2 hours •Blocked 0 hours
			Other county roads Other regional roads Should be passable without major inconveniences 24 hrs. a day Desired road conditions: <ul style="list-style-type: none"> •Dry •Wet

Situation	Pre-wetted salt		"Combi" spreader ⁽¹⁰⁾		Salt Brine ⁽¹⁰⁾		Remarks
	Programmed [g/m ²] brine + dry salt [ml/m ² + g/m ²]	Total salt dosage [g/m ²]	Programmed brine + dry salt [ml/m ² + g/m ²]	Total salt dosage [g/m ²]	Pro-grammed [ml/m ²]	Total salt dosage [g/m ²]	
Roads							
Preventive salting against expected rime ice on a DRY/MOISTY road: Expected road temperature ca. 0°C Expected road temperature over -3°C Expected road temperature under -3°C	6 = 1,8 + 4,2 8 = 2,4 + 5,6 12 = 3,6 + 8,4	4,7 6,2 9,3	10 + 0 20 + 0 20 + 4	2,6 5,2 9,2	10 20 30	2,6 5,2 7,7	
Preventive salting against expected ice on a wet road (freezing wet roads): Expected road temperature over -3°C Expected road temperature under -3°C	12 = 3,6 + 8,4 18 = 5,4 + 12,6	9,3 14,0	20 + 4 20 + 8	9,2 13,2	30 40	7,7 10,3	In case of very wet roads the dosage should be increased.
Preventive salting against expected snowfall: Under 3 cm of snow More than 3 cm of snow	15 = 4,5 + 10,5 20 = 6,0 + 14,0	11,7 15,5	20 + 6 20 + 10	11,2 15,2	40 60	10,3 15,5	When salting against snowfall, dry salt can be used.
Preventive salting against expected freezing rain (super cooled rain):	20 = 6,0 + 14,0	15,5	20 + 10	15,2	60	15,5	
Other types of salting when a slippery road accident already has occurred:	15 = 4,5 + 10,5	11,7	20 + 6	11,2	40	10,3	Dosage varies in relation to the road temperature and the ice layer thickness.

The brine solution contains 22% of salt (by weight).



Tasks and Tools

Weather & forecasts



Call-out



Winter Central

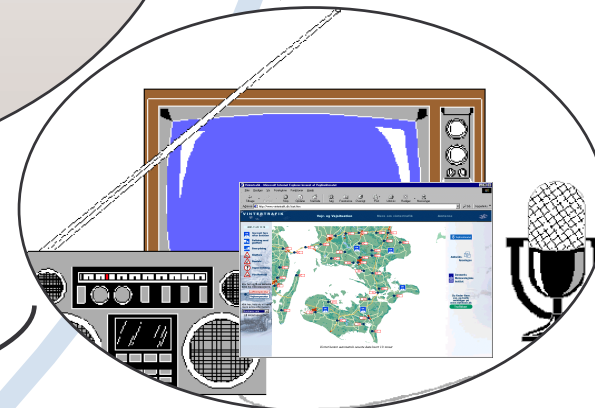
RWIS

VINTERMAN

Control and Monitoring



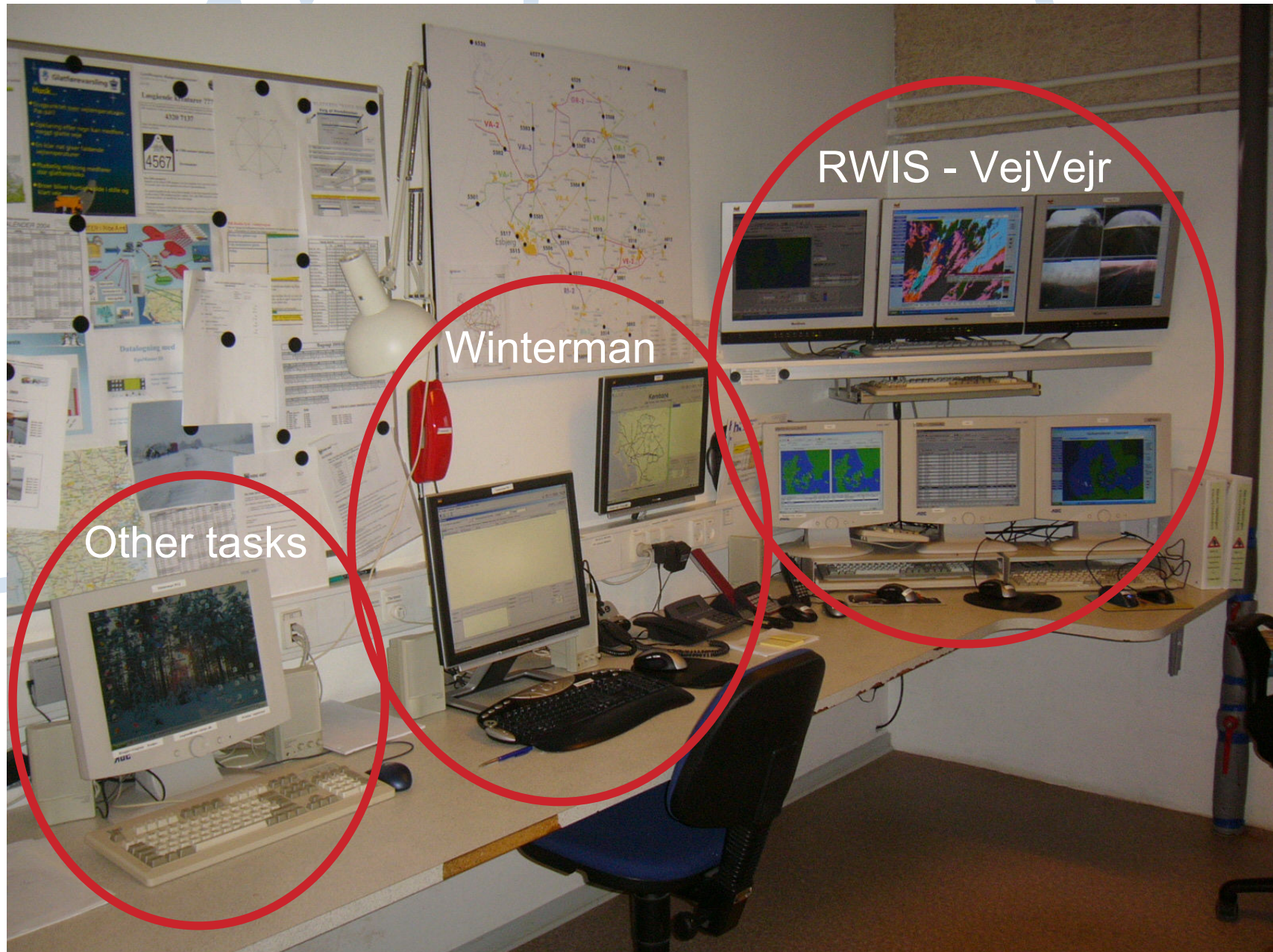
Road Users



Information



The Winter Central in Ribe



Other tasks

Winterman

RWIS - VejVejr



RWIS Structure

~320 Stations



Measurements
Every 5-10. minute

Prognoses for each station
Regional 5 hour prognoses
Radar images
Satellite images

