Title: VINTERMAN

Introduction
In a typical winter in Denmark, there are about 100 call-outs for salting due to risk of icy conditions, on approximately 11,000 km of the national and county roads. Salting as a result of snowfall, on the other hand, occurs only 5-10 times a year. In Denmark, preventive actions are taken to salt the roads, before they get slippery. The decision on whether a call-out is needed is made at a winter operation central in each county, while the actual activity is carried out by a local contractor. Two computer systems have been developed to support these tasks at the winter central - the Road Weather Information System (RWIS) and VINTERMAN.

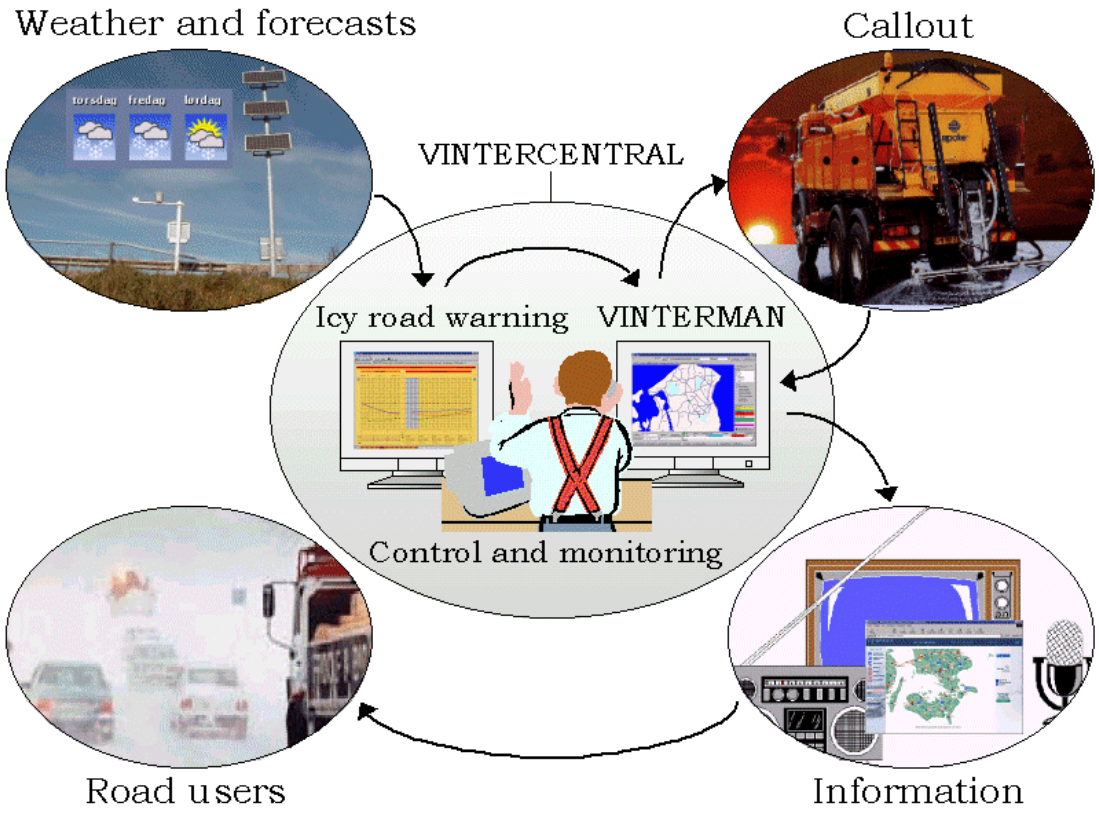


Figure 1: Information flow for the Road Weather Information System and VINTERMAN

The Road Weather Information System includes 300 weather stations that provide information on the weather and road conditions. This information, together with weather forecasts and radar images, is used to determine the right time for starting the salt spreading and snow clearing operation.

Once the decision is made, VINTERMAN is used as a Decision Support System to assist the operators in carrying out the activities. VINTERMAN controls the communication with the contractors and stores all appropriate information in a logbook. This provides the opportunity to monitor and control the work quality. VINTERMAN is also used to send out information to the road users about activities and road conditions.

The Road Weather Information System and VINTERMAN are developed in cooperation with the Danish Road Directorate and the Danish counties. The Road Weather Information System has been in operation since 1985, and VINTERMAN was implemented during the winter season of 97-98.

For more information on the Road Weather Information System, please refer to the separate brochure.

VINTERMAN is unique in the way that it efficiently combines all information and procedures needed by operators and decision makers in a single system.

VINTERMAN

VINTERMAN provides functionality within the following areas:

Administrative information, e.g. persons, addresses, telephone numbers, duty schedules, routes, price lists and action plans. This information must be stored in VINTERMAN to support the work of the on-duty personnel.

Call-out Situation, in which VINTERMAN assists with initiation, control and monitoring of activities during salting or snow clearing.

Documentation of all events and activities via a structured logbook and online data collection direct from spreaders, snow ploughs and patrol, and follow up on the price of all activities carried out.

Information on the status of the road network is automatically extracted from VINTERMAN. The information is sent by fax, e-mail and SMS to other authorities and is also displayed on the Internet together with temperature information from the Road Weather Information System. The most recent information can be seen at www.vintertrafik.dk during the winter season.

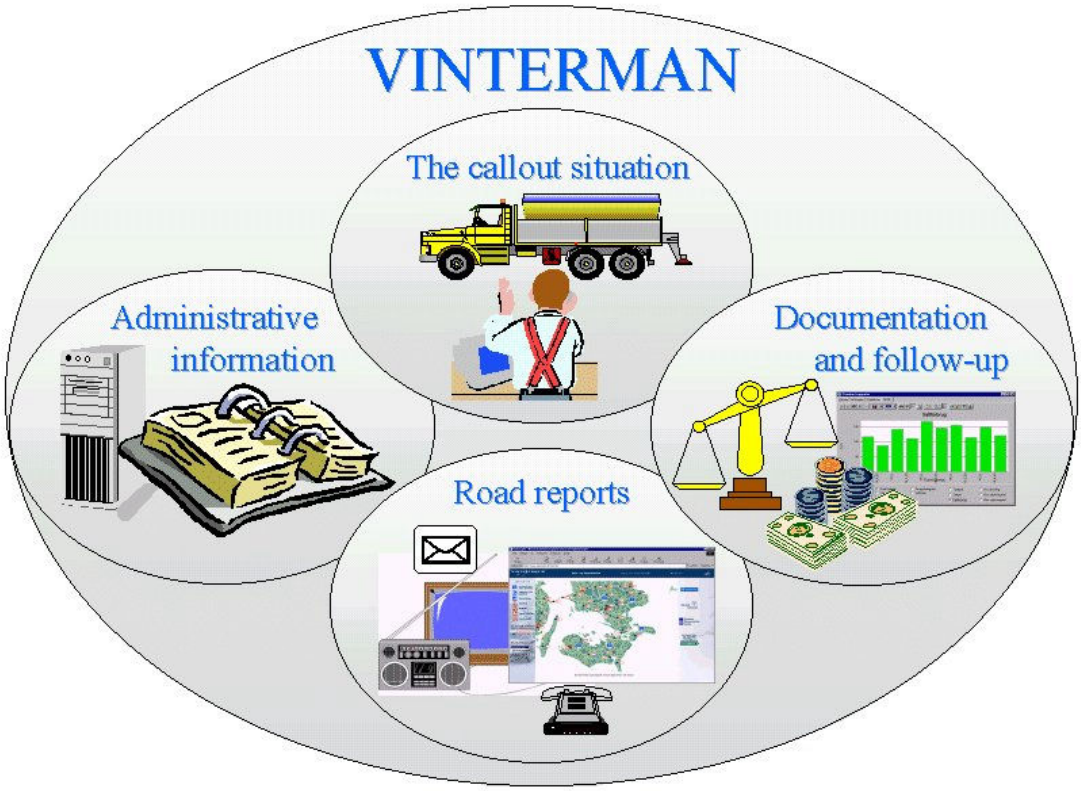


Figure 2: VINTERMAN´s tasks.

Administrative Data

VINTERMAN is structured around a comprehensive core of basic data, which is updated primarily before the start of the winter season. This basic data supports the collection of relevant information about the winter maintenance, so that the system can assist in the call-out situation in the best possible way. The basic data includes:

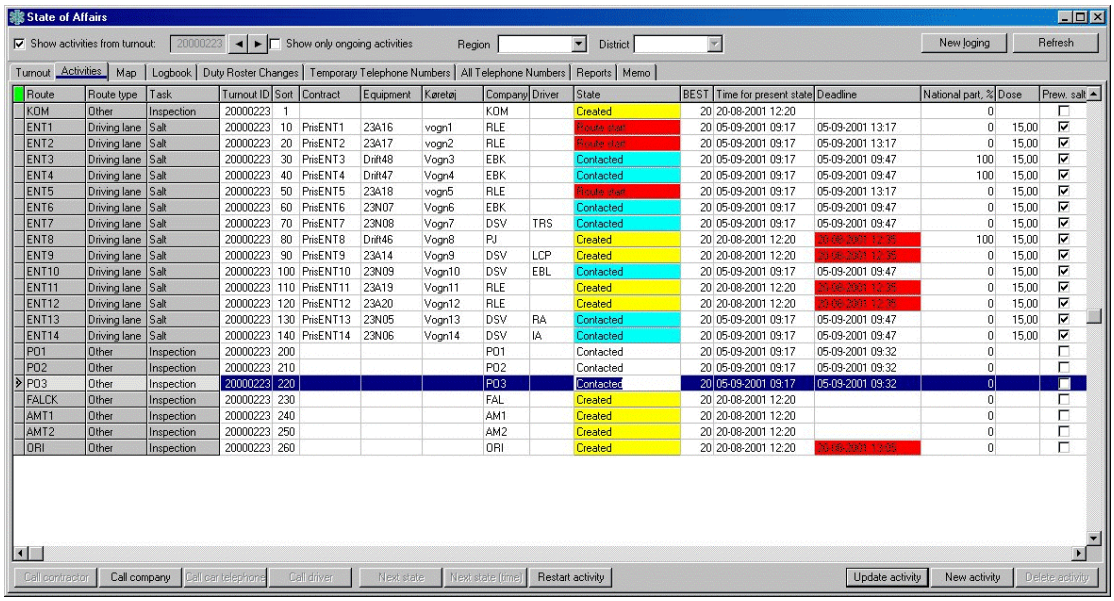
- Persons, contractors and contact possibilities (telephone, fax, e-mail, SMS, etc.)
- Salt depots with accounts for a number of materials
- Equipment, mainly spreaders and their capabilities
- Vehicles, i.e. trucks, tractors, patrols, bulldozers etc
- Contracts for settlement of accounts with contractors
- Duty schedule, where a person may be on duty on a route or a vehicle

This information is linked together in a reference plan. The plan describes how all things should work, e.g. which vehicle should be called out on a specific route. It is also possible to define a part of the reference plan as an action plan. An action plan describes the steps that should be taken in a given situation. An action plan for a salting can include activities such as salting 14 multilane routes, salting three tracks, contact with the loading officer on duty, and orientation to the nearest counties.

The Call-out Situation

VINTERMAN offers an advanced call-out system that the duty personnel at the winter centre can use to implement and follow up on a call-out for salting or snow clearing. As these duty personnel are usually not trained in computing, emphasis is

placed on ensuring that the call-out system is easy to operate. It is therefore important for as much basic data as possible to be stored in VINTERMAN, so that the duty personnel can concentrate on the call-out process.



Route	Route type	Task	Turnout ID	Sort	Contract	Equipment	Køretøj	Company	Driver	State	BEST	Time for present state	Deadline	National part, %	Dose	Prew. salt
KOM	Other	Inspection	20000223	1				KOM		Created	20	20-08-2001 12:20		0		☐
ENT1	Driving lane	Salt	20000223	10	PrisENT1	23A16	vogn1	RLE		Route start	20	05-09-2001 09:17	05-09-2001 13:17	0	15,00	☑
ENT2	Driving lane	Salt	20000223	20	PrisENT2	23A17	vogn2	RLE		Route start	20	05-09-2001 09:17	05-09-2001 13:17	0	15,00	☑
ENT3	Driving lane	Salt	20000223	30	PrisENT3	Drift48	Vogn3	EBK		Contacted	20	05-09-2001 09:17	05-09-2001 09:47	100	15,00	☑
ENT4	Driving lane	Salt	20000223	40	PrisENT4	Drift47	Vogn4	EBK		Contacted	20	05-09-2001 09:17	05-09-2001 09:47	100	15,00	☑
ENT5	Driving lane	Salt	20000223	50	PrisENT5	23A18	vogn5	RLE		Route start	20	05-09-2001 09:17	05-09-2001 13:17	0	15,00	☑
ENT6	Driving lane	Salt	20000223	60	PrisENT6	23N07	Vogn6	EBK		Contacted	20	05-09-2001 09:17	05-09-2001 09:47	0	15,00	☑
ENT7	Driving lane	Salt	20000223	70	PrisENT7	23N08	Vogn7	DSV	TRS	Contacted	20	05-09-2001 09:17	05-09-2001 09:47	0	15,00	☑
ENT8	Driving lane	Salt	20000223	80	PrisENT8	Drift46	Vogn8	PJ		Created	20	20-08-2001 12:20	[illegible]	100	15,00	☑
ENT9	Driving lane	Salt	20000223	90	PrisENT9	23A14	Vogn9	DSV	LCP	Created	20	20-08-2001 12:20	[illegible]	0	15,00	☑
ENT10	Driving lane	Salt	20000223	100	PrisENT10	23N09	Vogn10	DSV	EBL	Contacted	20	05-09-2001 09:17	05-09-2001 09:47	0	15,00	☑
ENT11	Driving lane	Salt	20000223	110	PrisENT11	23A19	Vogn11	RLE		Created	20	20-08-2001 12:20	[illegible]	0	15,00	☑
ENT12	Driving lane	Salt	20000223	120	PrisENT12	23A20	Vogn12	RLE		Created	20	20-08-2001 12:20	[illegible]	0	15,00	☑
ENT13	Driving lane	Salt	20000223	130	PrisENT13	23N05	Vogn13	DSV	RA	Contacted	20	05-09-2001 09:17	05-09-2001 09:47	0	15,00	☑
ENT14	Driving lane	Salt	20000223	140	PrisENT14	23N06	Vogn14	DSV	IA	Contacted	20	05-09-2001 09:17	05-09-2001 09:47	0	15,00	☑
PO1	Other	Inspection	20000223	200				PO1		Contacted	20	05-09-2001 09:17	05-09-2001 09:32	0		☐
PO2	Other	Inspection	20000223	210				PO2		Contacted	20	05-09-2001 09:17	05-09-2001 09:32	0		☐
PO3	Other	Inspection	20000223	220				PO3		Contacted	20	05-09-2001 09:17	05-09-2001 09:32	0		☐
FALCK	Other	Inspection	20000223	230				FAL		Created	20	20-08-2001 12:20		0		☐
AMT1	Other	Inspection	20000223	240				AM1		Created	20	20-08-2001 12:20		0		☐
AMT2	Other	Inspection	20000223	250				AM2		Created	20	20-08-2001 12:20		0		☐
ORI	Other	Inspection	20000223	260				ORI		Created	20	20-08-2001 12:20	[illegible]	0		☐

Figure 3. An activity list during a call-out

Figure 3 shows an activity list during a call-out where each line represents a single activity including various tasks to solve the problem. The on-duty personnel control all activities from the activity list, regardless of whether vehicles are equipped with data collection possibilities. In order to ease the registration work for the personnel and secure high quality in the call-out process, VINTERMAN has these support functions:

- VINTERMAN knows the registrations for each route in advance. Thus the on-duty personnel is able to register information such as the time for "Contractor contacted", "Activity started" and "Activity finished".

- VINTERMAN already knows the normal time frame for activities and is therefore able to warn if there are deviations on a route.

- VINTERMAN can control a telephone through a modem or a PC.-dialler. The duty officer is thus able to get a telephone connection through a headset to e.g. a chauffeur on a route.

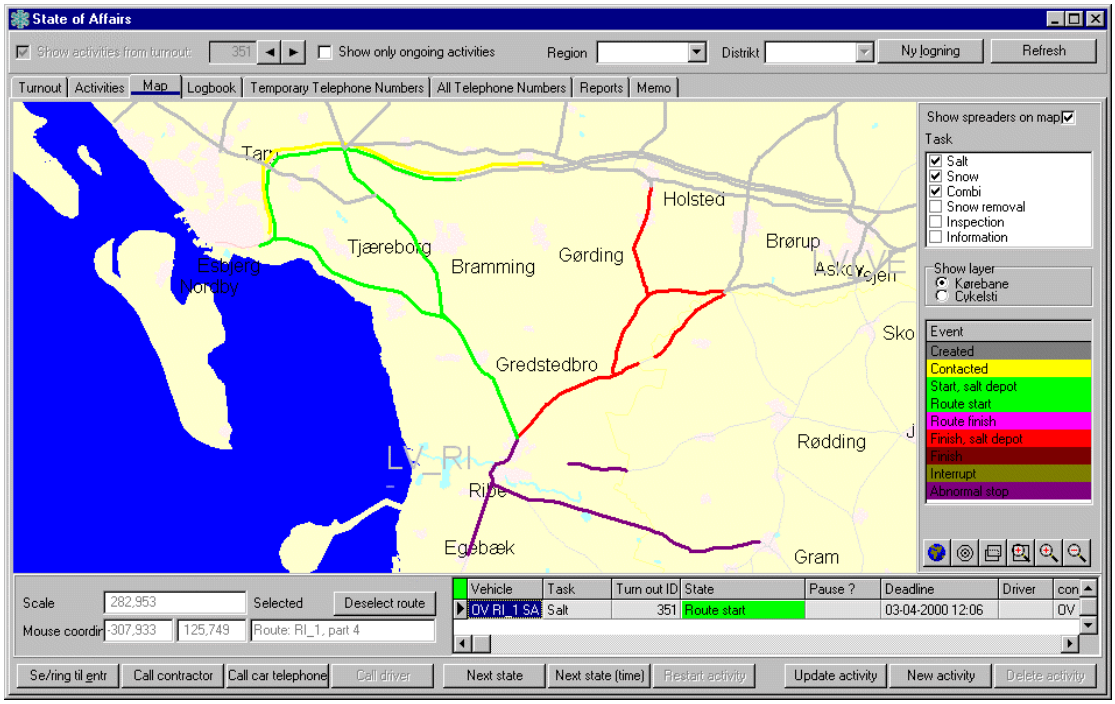


Figure 4. A map that shows status of salting on all routes.

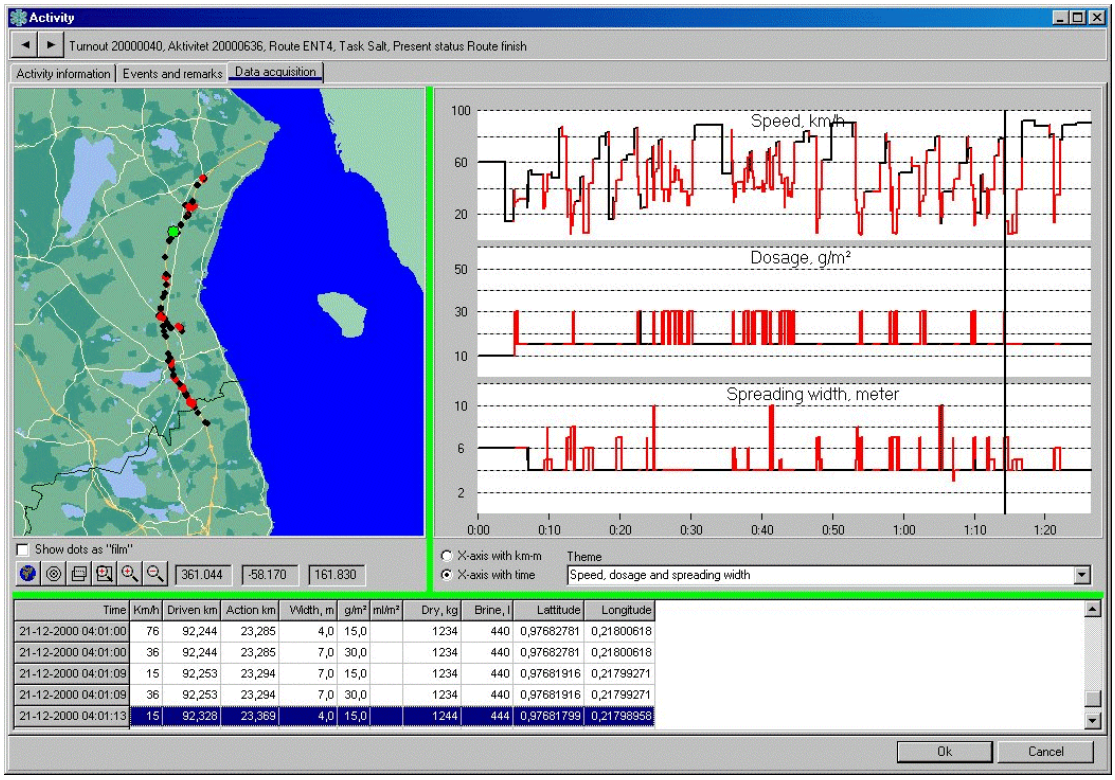
Based on the list of activities, VINTERMAN is also able to show all ongoing activities on a map (figure 4.) The activities are coloured distinctly to indicate their status on the routes. Equipment provided with on-line data collection (GPS) will be displayed on a map as a dot that indicates its position and direction. Information regarding the current position is typically used when transfer is needed and resources are moved from one route to another.

Together with the list of activities the map gives the on-duty officer a good view of the situation.

Data Collection

VINTERMAN contains special features for the presentation of data obtained from data-collecting equipment. During and after the activity (with use of on-line data collection), the function shown on figure 5 will be capable of displaying the received data from an equipment. The picture is divided into three presentation windows that are linked together. In this way, a click on either the map, graphics or list will automatically place focus correctly on the other two windows.

Data collection was initially only used on salt spreaders, but it is now available for trucks and tractors that are equipped with ploughs, and special patrol vehicles that are capable of measuring air and road surface temperature, air humidity, remaining salt etc. Data from these vehicles are also presented in VINTERMAN, where the graphic is corrected so the curves for items (e.g. road surface temperature) are replaced by data from a patrol vehicle.



Time	Km/h	Driven km	Action km	Width, m	g/m²	ml/m²	Dry, kg	Brine, l	Latitude	Longitude
21-12-2000 04:01:00	76	92,244	23,285	4,0	15,0		1234	440	0,97682781	0,21800618
21-12-2000 04:01:00	36	92,244	23,285	7,0	30,0		1234	440	0,97682781	0,21800618
21-12-2000 04:01:09	15	92,253	23,294	7,0	15,0		1234	440	0,97681916	0,21799271
21-12-2000 04:01:09	36	92,253	23,294	7,0	30,0		1234	440	0,97681916	0,21799271
21-12-2000 04:01:13	15	92,328	23,369	4,0	15,0		1244	444	0,97681799	0,21798958

Figure 5. Presentation of detailed data from equipment containing data collection.

The main purpose of developing the on-line data collection was to reduce dependence on vendors. Therefore the system is now able to receive data from various vendors in a general DAU compatible format. DAU is a German format, and today this format is supported by three vendors in Denmark for salt spreaders and patrol cars, while two others supply on-line equipment that collect positions e.g. from a plough.

In the season 2001/02 there are about 140 spreaders, 15 tractors/ploughs and 4 patrol cars equipped with data collection for VINTERMAN.

Logbook

VINTERMAN includes a structured logbook in which all relevant actions are recorded. The logbook keeps all data which are automatically registered during the use of the system. This includes activities on all routes, telephone calls and attempted calls, temporary telephone numbers, changes in duty personnel, reports sent etc. In addition to this, the duty officer can also manually enter information in the logbook as needed, e.g. when the police reports a problem. The logbook thus provides a complete documentation of all actions of the winter centre. Extracts of the logbook have successfully been used in insurance and legal disputes, where records 1-2 years old have been submitted as evidence.

Follow-up

Information regarding all call-outs can later be obtained along with comprehensive data. Many Danish counties are using these data in sending invoices to the contractors. Each month the contractors receive a report of all VINTERMAN-registered activities along with a checking suggestion. If the contractor approves the

invoicing information issued, he will simply forward an invoice of the amount. If there is any dispute regarding the amount, the registrations in VINTERMAN are used as a basis for discussion. This procedure drastically reduces the manpower required by the Danish Road Directorate to do manual checking and lightens the paperwork especially for the small contractors. From the many registrations VINTERMAN is also able to provide statistics on the number of activities, consumption of salt, duration and time of call-out along with the cost of salt and payments to contractors. The statistics can also be graphically displayed as in figure 6.

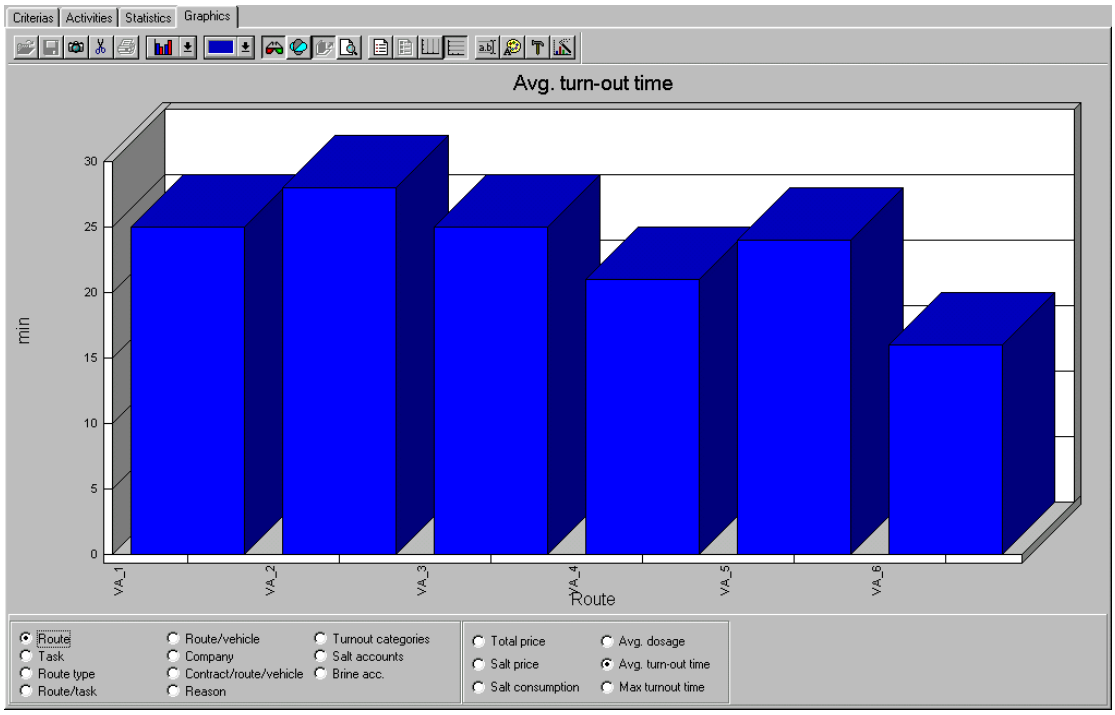


Figure 6. Statistics on the average time of call-out per route.

Road Reports

VINTERMAN includes a report module in which each road officer regularly reports on the road condition. The reports describe the officer's perception of the road condition based on the Road Weather Information System, his/ her knowledge of the distance to patrols, and ongoing activities. The reports can be sent by e-mail, SMS or fax to specified groups. All reports are also published on the internet site www.vintertrafik.dk (figure 7). Here, the reports are combined with observations and forecasts on air and road surface temperatures from all measuring stations in Denmark. If an observation or a forecast indicates a risk of icy roads there will be a special warning issued.

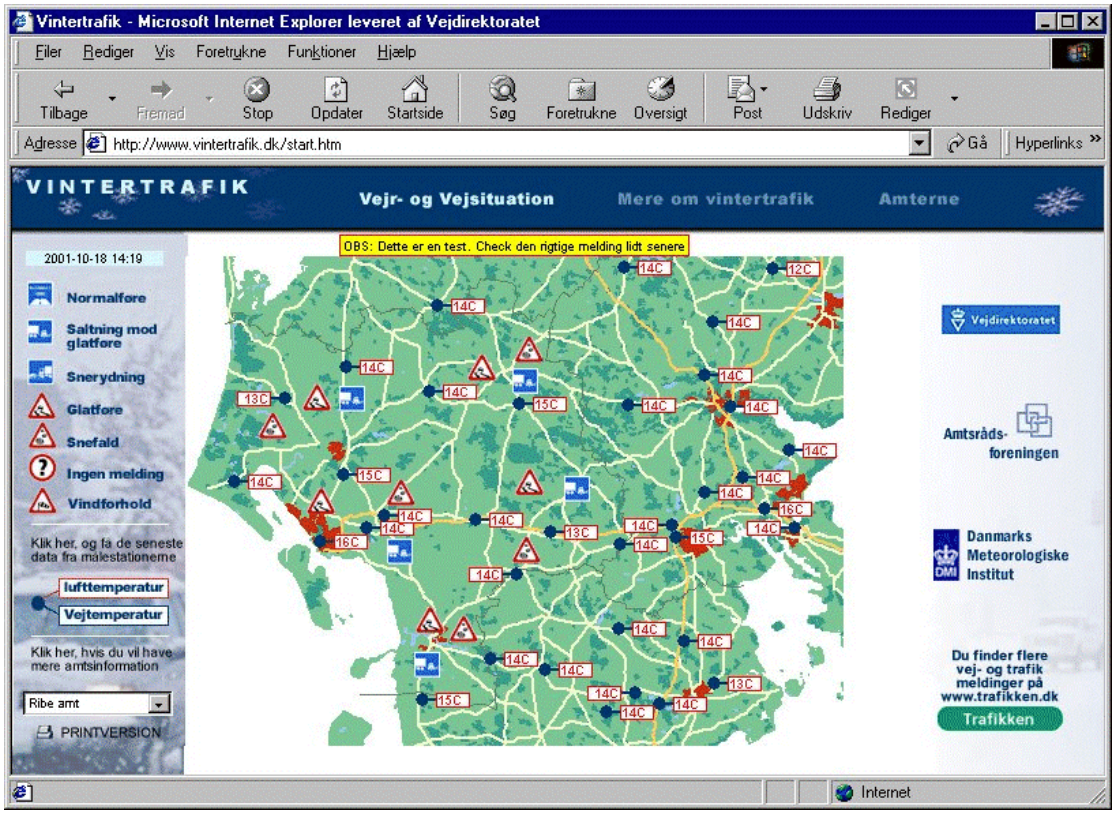


Figure 7. On www.vintertrafik.dk the road condition in the winter season is showed.

VINTERMAN Light

VINTERMAN Light, as the name suggests, is a limited edition of VINTERMAN. Compared to the full edition, most of the basic data, including the call-out system and report module, are removed. The aim is to create a system that does not need attention during the activities but can nevertheless present data from salt spreaders and others, both simultaneously and afterwards. The Light edition can also be used for manual registration of activities after a finished task.

The choice between VINTERMAN and its Light version will normally be made on the basis of availability of personnel to register, control and monitor salt spreading and snow ploughing. Large organisations usually have more manpower and hence the complete VINTERMAN will be a good tool. VINTERMAN Light will often be more suitable for smaller organisations or in situations where one wants a tool for documentation of activities to ease the settlements of accounts between Clients and Contractors.

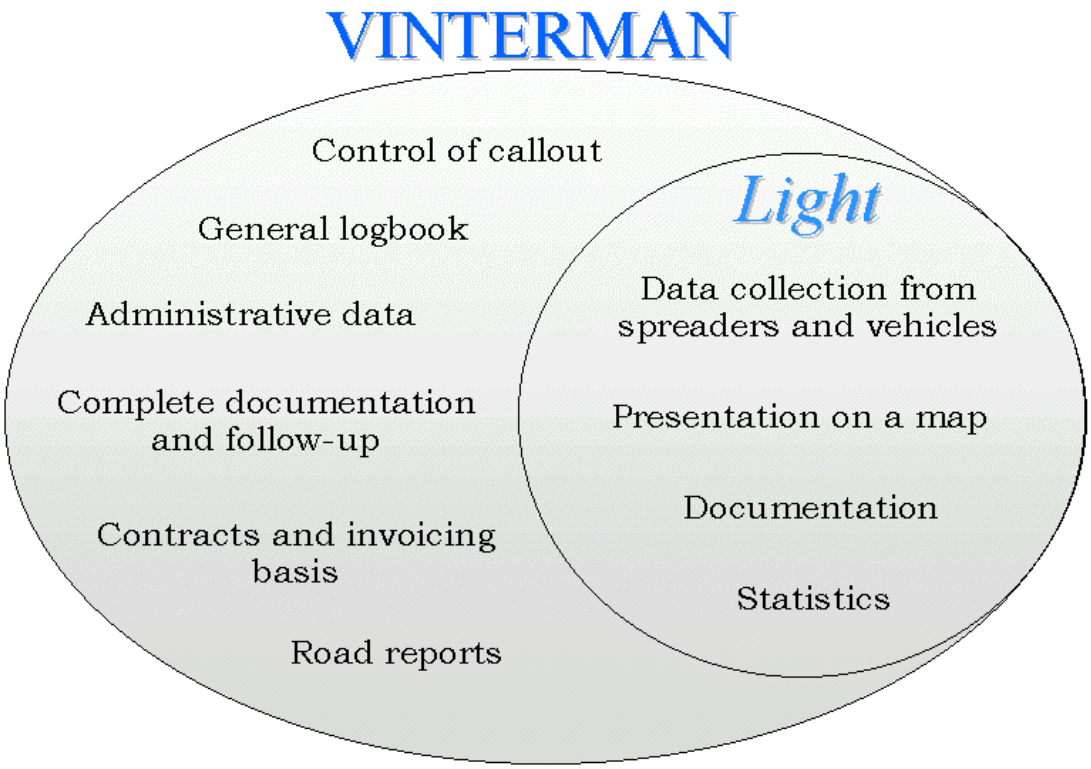


Figure 8. VINTERMAN vs. VINTERMAN Light.

VINTERMAN Light is to be seen as an alternative to the presentation programs that most salt spreading vendors can deliver. In addition to these programs, VINTERMAN Light can present data from various equipment vendors if they support the general DAU-based protocol for data transfer to VINTERMAN.

Suppliers of salt spreaders are welcome to join the "Light" group and be eligible to deliver VINTERMAN Light as a presentation program for data from their salt spreaders. The Danish supplier of winter equipment, Epoke, has joined the VINTERMAN Light project and can provide their clients with VINTERMAN Light.

Technology

VINTERMAN and VINTERMAN Light are both structured as client-server systems and can be run on a single PC.PC. or on a network connected to a database. A typical network VINTERMAN installation is shown in figure 9.

Normally Borland Interbase 6.0 is used as a database. In a network environment it should be placed on a NT- and Windows 2000 based server, while the VINTERMAN client program can be run on Windows 98, NT 4.0 or later versions. (Windows 95 can often be used as well). VINTERMAN's most fundamental requirement for the client p.c's is a resolution of 1024*768 with small fonts.

The maps in VINTERMAN and VINTERMAN Light are built with various layers, which are visible according to the scale of the screen. Thus it is possible to build a detailed map where only the details are visible while focusing on e.g. a specific route. Outside Denmark VINTERMAN is delivered without a map layer, because most road

authorities already have access to a map system. The map system in VINTERMAN is based on Graticule´s MapServer and is able to import a basic map in the SYSTEM-34 and WGS-84 coordinate system (longitude-lattitude in degrees or radians). It is possible to import maps from many of the most popular file formats, such as AutoCad (dxf), MapInfo (mif) and ArcInfo (shp).

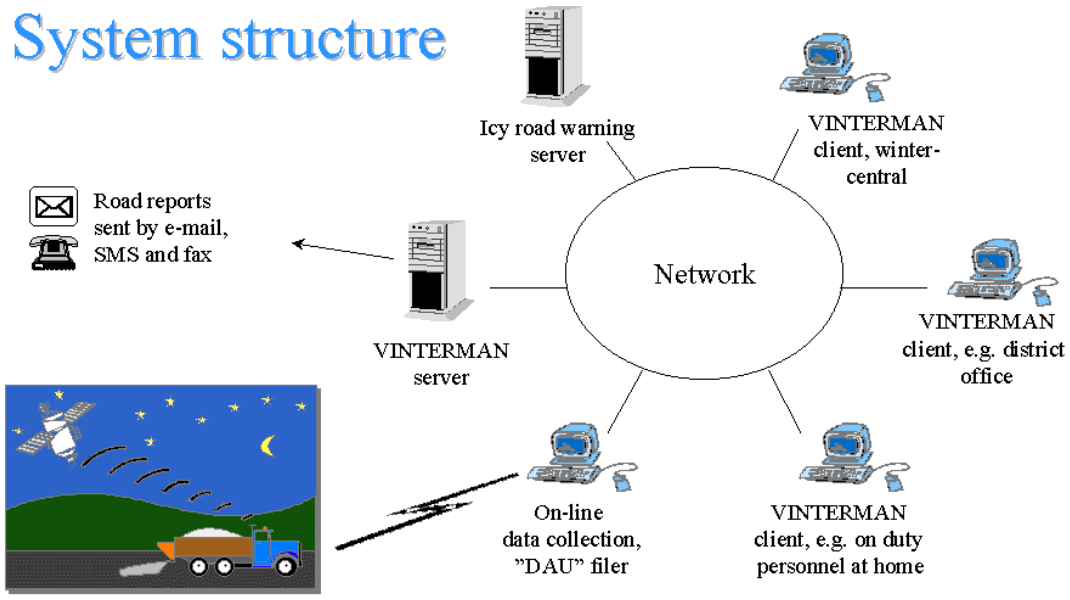


Figure 9. An example of the structure of a VINTERMAN installation

On-line data from salt spreaders is imported via text files in DAU-format. The vendor of the data collection system has a process running on a PC. that communicates with the equipment. This process delivers the files to the net, where a VINTERMAN-process reads the data and stores it in the database.

VINTERMAN and VINTERMAN Light are now available in Danish and English, and can be translated to most languages which are compatible with a normal Windows font system.