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Practice and deployment of variable message signs (VMS) in Viking countries – potential for harmonisation

VIKING

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TIIVISTELMÄ

Selvityksen tarkoituksena oli kerätä tietoa muuttuvien opasteiden käytöstä Viking-maissa (Norja, Ruotsi, Suomi, Tanska, Saksan viisi pohjoisinta osavaltiota) ja tämän perusteella edistää niiden yhtenäistä käyttöä alueella. Harmonisointitarpeet määriteltiin ja priorisoitiin. Lähtökohtana oli, miten kuljettajat havaitsevat ja ymmärtävät merkit. EU-maissa harmonisointia perustellaan turvallisuuden ja tehokkuuden paranemisella. Harmonisoinnin tulee perustua kansainvälisiin sopimuksiin, joista Wienin sopimus (1968) on merkittävin.

Työssä käsiteltiin varoitus-, kielto-, rajoitus-, opastus- ja ohjemerkkejä, sekä säännöksiä ja tiedottamista. Tiedot nykykäytännöistä sekä käytöstä perustuvat kyselyyn sekä sitä täydentäneeseen työpajaan. Lisäksi raportissa on esitetty harmonisointia tukevaa tutkimustietoa.

Harmonisointitarpeet aihepiireittäin on luokiteltu seuraavasti: ei tarvetta harmonisoida, harmonisoitu jo, voidaan harmonisoida nopeasti, voidaan harmonisoida pitkällä tähtäimellä.

Muuttuvien opasteiden käyttökohteet ja -tarpeet vaihtelevat maittain. Yhtenäisintä tällä hetkellä on varoitus-, kielto- ja rajoitusmerkkien väritys sekä niissä käytetyt symbolit ja piktogrammit. Opastusmerkkien käytössä on, mikä on luonnollista, enemmän vaihtelua. On kuitenkin tärkeää, että myös näissä merkeissä suosittaisiin piktogrammeja tekstien sijaan ja että tiedon määrä pidettäisiin riittävän pienenä.

Harmonisointia tarvitaan erityisesti kehitettäessä järjestelmien luotettavuutta, määritettäessä annettavan tiedon määrää, käytettäessä ja suunniteltaessa piktogrammeja ja päätettäessä vilkkuvien valojen käytöstä muuttuvissa opasteissa.

Seuraavia toimenpiteitä suositeltiin tehtävän pian harmonisoinnin edistämiseksi:

- Yhtenäistetään uusien merkkien ulkonäkö (suositaan LED-merkkejä tai vastaavan näköisiä).
- Määritellään ja perustellaan, missä tilanteissa vilkkuvia lamppuja voidaan käyttää.
- Yhtenäistetään muuttuvien nopeusrajoitusten ohjausperusteet. Jos sekä sää- että liikenneongelmia esiintyy, ohjauksen pitää perustua kumpaankin.
- Selvitetään mahdollisuudet ottaa käyttöön FIVE:n esittämä onnettomuudesta kertovan piktogrammi.
- Määritellään viestien enimmäispituus.

- Suositaan kansainvälisiä ilmauksia käyttöä kotimaisten sijasta. Luodaan sanasto Viking-maiden muuttuvissa merkeissä käytettävistä viesteistä.
- Annetaan lisätietoa tienkäyttäjille muuttuvia merkkejä käyttävistä järjestelmistä.

Pitkän ajan harmonisointitarpeita ovat esimerkiksi sääohjauksisten järjestelmien ohjauksen automatisointi, varoitusmerkkien käyttöperiaatteiden tarkentaminen, kiertotielle opastavan nuolen ulkonäkö, kaistakohtaisten ohjausmerkkien näyttämät ohjausta tarvitsemattomissa tilanteissa sekä varoitusvilkkujen käyttö kaistaopasteissa.

Tällä hetkellä useat kansainväliset ryhmät käsittelevät muuttuvia opasteita. Harmonisointia tulisi jatkaa Viking-maiden tieviranomaisten yhteistyönä. Koska muuttuvien opasteiden käyttö on todennäköisesti kasvussa, suositellaan tämän raportin tietojen päivittämistä muutaman vuoden kuluessa.

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SUMMARY

This study was designed to gain information about variable message signs and their appearance and use in the Viking countries (Denmark, Finland, Norway, Sweden and the five northernmost states in Germany), and to utilise this information to enhance the harmonised use of VMS in the Viking region. In the study, harmonisation needs were specified and prioritised. The focus was on harmonisation issues from the drivers' point of view, i.e. how the drivers perceive and comprehend VMSs. Harmonisation is motivated by the safety and efficiency demands in the EU countries. Efforts for the more harmonised use of traffic signs should be based on international commitments, the Vienna Convention (1968) being the most binding.

The three main sign categories - regulatory messages, danger warning signs and informative signs - are discussed. Several subissues are presented for each main topic. In addition, some general aspects of regulation and information are presented. The results of a survey and a workshop investigating the current practice and deployment of VMSs in the Viking countries are presented. The report summarises the relevant results of both research and more practical actions in the field of VMS harmonisation in Europe.

Conclusions summing up the harmonisation needs are presented for each subissue. The needs that should lead to harmonisation actions in the short or the long term are prioritised. In addition, the conclusions identify several VMS features and practices that have already been harmonised. Furthermore, the conclusions indicate differences, which initiate no harmonisation actions.

The usage areas and needs to use variable systems vary and may vary depending on the country. The most harmonised areas are the colours and the use of symbols and pictograms in regulatory and danger warning signs. More variation exists and is acceptable in informative messages. But also in this sign category, pictograms should be preferred to text messages, and information overflow should be avoided.

Common targets for both the short-term and long-term harmonisation actions are the development of the reliability of the systems, the amount of information presented, the use and development of pictograms and the use of flashers in VMSs.

Several more specific issues, which were regarded to be harmonised in the short term, were identified in the study. For example:

- Light-emitting signs with inverted colours should be preferred when planning new variable speed limit systems and developing old ones.

- The use of flashing lamps in speed limit signs has to be well-motivated and should be studied carefully, especially when developing new systems.
- Weather- and traffic-based control should be included in variable speed limits at sites, which experience both weather and traffic problems.
- The accident pictogram (suggested by FIVE) should be confirmed at the national level if an overall consensus can be reached (e.g. at the UNECE-level).
- The current definitions for the maximum length of text messages should be unified.
- International expressions should be preferred in text messages. It is suggested that a data bank of the messages used in the Viking language area should be created.
- More information on VMS qualities should be provided to the road users.

The long-term harmonisation needs identified in the study include: an increased level of automation in the weather-controlled systems, more uniform control principles for warning signs, a tested and commonly accepted re-routing arrow, and more harmonised message absence practices for lane signals and the more uniform use of amber lanterns in lane control.

Currently, the issues concerning variable signs are discussed in several international groups. The harmonisation process should be continued by the national road authorities of the Viking countries in co-operation with each other. Finally, as the use of VMS systems is probably increasing, it is recommended that this report should be updated in a couple of years' time.

The project has been granted European Community financial support in the field of Trans-European Networks - Transport.

FOREWORD

The study was designed to increase the harmonisation of the use of variable message signs in the Viking countries. The work was based on the earlier harmonisation activities in EU.

The study was made at VTT Building and Transport by research scientists Pirkko Rämä, Anna Schirokoff and Juha Luoma. The project was led by Finnish Road Administration (Finnra), Magnus Nygård being the chair in the project group. The other members in the project group were Mikko Karhunen (Finnra), Hans-Joachim Aumund (Transport & Mobility Consultants, DE), Charlotte Vithen (Road Directorate, DN) and Ingemar Wingård (Columna, SE) and Håkon Wold (Vegvesen, NO).

The data on the details of the practices in Viking countries was provided by

- Kenneth Kjemtrup (DN)
- Mikko Karhunen, Magnus Nygård (FIN)
- Matthias Richter and Frank Suesser (DE)
- Pål Hauge (NO)
- Bjarne Holmgren, Lars Ljungberg, Alf Peterson, Lars Sandberg and Jarl Wilfing (SE).

The results of the inquiry were discussed and completed in a workshop. The workshop was attended in addition to the project group by Esko Hyytiäinen (FI), Pauli Velhonoja (FI), Ania-Mee Bergh (SE), Lars Sandberg (SE), Jarl Wilfing (SE) and Pål Hauge (NO).

The study has been granted European Community financial aid in the field of Trans-European Networks-Transport.

Helsinki, November, 2004

Finnish Road Administration
Technical Services

CONTENT

1 INTRODUCTION

1.1 Background

The technologies used in advanced traffic systems are developing and therefore the use of variable message signs (VMS) is increasing. Hence the need for uniform systems is also increasing. There have been several efforts to improve the harmonised use of VMSs at the European level. The aims of the harmonisation are to increase the conformity and efficiency of the messages provided by VMSs, and to improve traffic safety and mobility. Harmonisation also serves manufacturers by providing common specifications to all actors.

Efforts for the more harmonised use of traffic signs should be based on international commitments, the Vienna Convention (1968) being the most binding. The UNECE (United Nations Economic Commission for Europe), with its annual meetings and working parties (especially WP 1), is the international body for the further development of international commitments in the area of sign harmonisation. In addition, there are international and European recommendations (previously made e.g. by CEMT) and standards. European road directors (WERD/DERD) have paid attention to the harmonised use of VMSs, and provided the paper 'action FIVE: Framework for harmonised implementation of VMS in Europe'. This work has been continued by the European VMS Platform. In addition, several research studies, both within EU R&D Framework Programmes and within national projects, have dealt with the harmonised use of VMSs.

1.2 The aim

This study was designed to gain information about variable message signs and their appearance and use in the Viking countries (Denmark, Finland, Norway, Sweden and the five northernmost states in Germany), and to utilise this information to enhance the harmonised use of VMS in the Viking region. Harmonisation needs are also specified and prioritised.

This Euro-regional Viking project focused on the Northern countries. It was assumed that focusing on regional circumstances and problems would promote both regional and Europe-wide harmonisation work. Furthermore, this progress could enable the creation of a specific programme for harmonisation work in the future. It is emphasised, however, that in this regional approach it is vital to be aware of European commitments and harmonisation work, and to make suggestions that are well-motivated and in harmony with other activities and knowledge at the European or international level.

It is acknowledged that even though the Viking countries have similarities, the area is not very homogenous. For example, in Germany VMSs are implemented mostly on multiple-lane motorways and are normally not used on two-lane roads, whereas in the Nordic countries VMSs are commonly implemented also on two-lane roads. There are also differences in the traffic systems, traffic volumes and regulation systems. On the other hand, these differences can also be seen as an advantage: the heterogeneity forces certain realism and brings up several Europe-wide questions or problems.

In this study the focus is on harmonisation issues from the drivers' point of view, i.e. how the drivers perceive and comprehend VMSs. The technical harmonisation (durability, luminance specifications etc.) is a separate and extensive field and is covered by the new standard prEN 129 66-1. It is expected that the technical specifications in the standard will unify the outlook of VMSs as well.

1.3 The approach

This document presents the results of several activities. First, the results of a survey investigating the current practice and deployment of VMSs in the Viking countries are presented. The questionnaire (reproduced in Appendix 1) was sent to traffic sign experts in each country in the autumn of 2003. The experts represented the following organisations: the Federal Ministry of Transport, Constructions and Housing in Germany, and the National Road Administrations in Denmark, Finland, Norway and Sweden. Second, in January 2004 a workshop was held in Helsinki during which the results of the survey were completed. The results of the workshop are included in the report. Third, the report summarises the relevant results of both research and more practical actions in the field of VMS harmonisation in Europe. These materials are presented to enhance the proper utilisation of the previous knowledge in combination with the knowledge in possession of the sign experts.

The three main sign categories - regulatory messages, danger warning signs and informative signs - are discussed in the following chapters. Several sub-issues are presented for each main topic. In addition, some general aspects of regulation and information are presented.

Conclusions summing up the harmonisation needs are presented for each subissue. It is acknowledged that harmonisation is not a value as such. User perspective and the safety and mobility of the transport system should motivate it. There always is and is allowed to be some variation in the practices based on cultural differences, in the existing differences in the fixed sign systems, in the solutions already made at the national level, and in the economic motivations.

The conclusions are based either both on the results of the survey and on the background – including the results of previous research – or, in some cases, just on the background information.

The conclusions are presented in boxes. The colour coding indicates the prioritisation of the harmonisation tasks (Fig. 1). There are also conclusions that initiate no harmonisation actions. In addition, some issues are already harmonised. The most important conclusions are the ones that lead to a harmonisation need in the short or the long term.

Figure 1. The colour coding used for conclusions in this report.

Harmonised already	**Can be harmonised in the short term**
No harmonisation needs	**Can be harmonised in the long term**

2 REGULATORY MESSAGES

The main purpose of regulatory messages is to signify a mandatory, prohibitive or restrictive rule to the road users. In this chapter, we discuss variable speed limits and lane control signals and signs.

The use and appearance of regulatory traffic signs are specified in the Vienna Convention. The amendments to the Vienna Convention described some specific (additional) rules for VMSs.

2.1 Speed limits

2.1.1 Colours

Variable speed limits generally use inverted colours, meaning that the background of the VMS is black and the characters (figures) are light. A red circle is commonly used to indicate a mandatory speed limit. This practice is in accordance with the Vienna Convention (1968) which allows dark-coloured signs with light symbols in variable signs but does not accept changing the red colour of the symbol of a sign or its border.

Survey results

All of the Viking countries preferred speed limit signs that use inverted colours (Fig. 2) and LED or fibre-optic technology (Table 1). In Denmark, only light-emitting LED and fibre-optic technologies are used, while the other Viking countries also use electromechanical signs. The colours of the background squares vary. The research results support the use of inverted colours by showing that these types of signs are currently more effective than signs that look more like fixed signs (see chapter Background, below).

Figure 2. Schematic representation of the LED or fibre-optic sign (left) and the electromechanical sign with black background square (right).

Table 1. Sign technologies used in variable speed limit signs (first priority solution indicated with bold letters).

Sign technology used	DEN	FIN	GER	NOR	SWE
LED	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Fibre-optic	Yes	Yes	Yes	Yes	Yes
Electromechanical	Yes*	Yes	Yes	Yes	Yes
Colour of the background square	Black	Black	Black or white	Grey	Black (LED) White or grey (el.mech.)
Use of fluorescent retroreflective sheeting	No	In some	No	No	In some

* Not included in the current policy.

Black/white inverting is authorised and used in all of the Viking countries (Table 2). There is no difference in the allowed colours.

Table 2. Authorisation of black/white inverting, use of the colours in variable speed limit signs, and drivers' knowledge of variability.

	DEN	FIN	GER	NOR	SWE
Authorised black/white inverting	Yes	Yes	Yes	Yes	Yes
Inverted colours (black/white) in LED/fibre-optic signs	Yes	Yes	Yes	Yes	Yes
Inverted colours (black/white) in electro-mechanical signs	No	No	No	No	No

In Finland, the appearance of all variable speed limit signs does not significantly differ from that of the fixed signs, but it is suggested that in the future it should. This is motivated by research results showing more pronounced effects and better traffic safety with exceptional-looking variable speed limit signs compared to the conventional-looking variable signs (see Background). In Sweden, except in Stockholm, the new experiments will use the same practice as in Finland. In Stockholm and in Norway the variability of the speed limit signs does not need to be shown. However, the noticeability of exceptional speed limits is aided using amber lanterns (see chapter 1.1.3).

CONCLUSIONS	
already	**Light-emitting (e. g. LED or fibre-optic) signs with inverted colours are recommended when implementing new speed limit systems, because they are better recalled and more effective than electromechanical signs.**
short term	**There are differences between countries about whether the appearance of the variable speed limit signs should differ from that of the fixed signs.**

Background

In practice, the appearance of a sign is connected with the sign technology. Signs with inverted colours are realised using LED or fibre-optic technology, and signs with traditional colours are usually electromechanical. Luoma and Rämä (1998) compared the effects of fibre-optic and electromechanical variable speed limit signs (Fig. 1). The results showed that the fibre-optic sign reduced the mean speed of vehicles travelling in free-flow traffic by 3-4 km/h more than the electromechanical sign. In addition, 91% of the interviewed drivers recalled the sign when the fibre-optic sign was used, compared with only 72% when the electromechanical sign was used. The effectiveness of the fibre-optic sign was confirmed a year later, although the magnitude of the speed effect was a bit smaller (Rämä, Luoma and Harjula 1999).

Electromechanical speed limit signs can be equipped with fluorescent retroreflective sheeting. The fluorescent retroreflective sheeting increases the luminance of the sign, the contrast between the legend and its background, the visibility distance, and the conspicuousness of the sign.

The effects of an electromechanical variable speed limit sign equipped with fluorescent retroreflective sheeting were compared with the effects of a fibre-optic variable speed limit sign (Penttinen, Anttila and Luoma 2000). In daylight, there was no statistically significant difference in speed between the two sign types, either before the speed limit sign or after it. In the dark, the fibre-optic sign cut the mean speed of cars and vans more (3.9 km/h) than the electromechanical sign. In the dark, the proportion of vehicles exceeding the posted speed limit by more than 5 km/h was also greater when the electromechanical sign was used. Consequently, the results showed that a fibre-optic variable speed limit sign is more effective than an electromechanical sign. In the dark, the more substantial effects of the fibre-optic sign were evident also in the higher recall rate of the speed limit and variability of the sign. The results were in accordance with earlier studies in which the positive effects of fluorescent retroreflective sheeting seem to be more evident in daylight than in night-time (e.g. Jenssen and Brekke, 1997; Jenssen, Brekke and Moen, 1998).

2.1.2 Symbols, pictograms

Survey results

In every Viking country a red circle indicates that the speed limit is mandatory (Table 3). Compulsory variable minimum speed limits are not used. The speed recommendations in Sweden are shown as directed by the Vienna Convention ('advisory speed' white figures on a black background with a white frame, even if presented here, are not included in the 'regulatory messages').

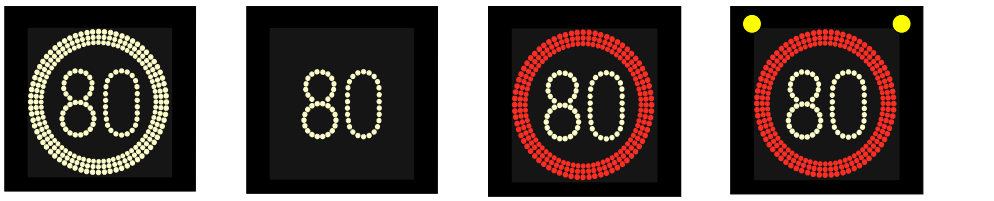
Table 3. Use of the red circle in variable speed limit signs and the use of different speed limit types.

	DEN	FIN	GER	NOR	SWE
Red circle indicating mandatory speed limit	Yes	Yes	Yes	Yes	Yes
Variable speed recommendations	No	No	No	No	Yes
Compulsory variable minimum speed limits	No	No	No	No	No

CONCLUSIONS	
already	**All countries agree that a red circle should be used to indicate a mandatory speed limit. The practice is in accordance with the Vienna Convention. The research results also support this practice.**

Background

The EU-funded TROPIC project investigated the comprehension of the control strategies and technical features of VMSs. In the study, drivers in three countries (England, Finland and Italy) were interviewed (Luoma, Rämä and MacLavery 2001). During the interview, different speed displays – both with and without a red circle - were shown to the drivers (Fig 3). The results in all countries showed that speed displays with a red circle were most frequently thought to be restriction signs. Consequently, the inclusion of a red circle in a speed limit sign is effective in rendering the sign mandatory. A white circle or a missing circle appeared confusing to some drivers and the message is most likely to be thought of as information only.



Speed display with a white circle | Speed display with no circle | Speed display with a red circle | Speed display with a red circle and flashing amber lanterns

Figure 3. Speed displays shown in the interview (Luoma, Rämä and MacLaverty 2001).

2.1.3 Amber lanterns and flashing signs

Amber lanterns are used in traffic signs to make them more conspicuous. For example, amber lanterns can be placed in the upper corners of a speed limit sign (see Fig. 3), in each corner of the sign or above the sign. It is also possible to make the sign itself blink or flash.

Table 4. Flashing amber lanterns and flashing variable speed limit signs.

	DEN	FIN	GER	NOR	SWE
Flashing amber lanterns	No	No	No	Sometimes, if needed	Sometimes, not with single LEDs
Flashing signs	No	No	No	No	No

Flashing speed limit signs are not used in any of the Viking countries. Denmark and Finland do not use flashing amber lanterns in variable speed limit signs either. In Sweden, speed limits (or recommendations) are included in the motorway control systems. In these motorway systems, flashing amber lanterns are used together with reduced speed limits. In Norway, flashing amber lanterns are sometimes used to improve the perception of the speed limit when an abnormal value is shown (Table 4).

CONCLUSIONS	
short term	**Flashing lamps are not commonly used in variable speed limit signs in the Viking countries. The use of flashing amber lanterns or flashing signs in variable light-emitting speed limit signs may confuse drivers, and therefore should be avoided. However, they are used in some tunnels with electromechanical speed limit signs in exceptional situations or as a substitute for dynamic re-routing.**

Background

The FIVE report (WERD/DERD 1998) recommends that flashing lamps around a VMS device should be used in a very limited way for regulatory messages; for instance, only for queue-tail protection.

Although there are differences in drivers' interpretation of any added technical features, the results of Luoma, Rämä and MacLaverty (2001) suggest that the addition of amber lanterns would convey a stronger message better than a flashing display. However, the road authority cannot be sure that drivers interpret the meaning of amber lanterns correctly, and there are many drivers who attribute no additional meaning to such lanterns.

2.1.4 Message absence situation

It is possible to have speed limit displays in 'no message' mode. In a message absence situation, it is common to show a black sign. In case of a failure in the control system, the figure is set manually. In some cases, the last message or the general speed limit for the road type (in Finland) is shown. Variable speed limits are used temporarily (on/off use) at special spots during road works in Finland, Germany and Norway (Table 5).

Table 5. Message absence in variable speed limit signs.

Variable speed limits	**DEN***	**FIN**	**GER**	**NOR**	**SWE**
'No message' mode		Yes, in special places	Yes, in special places	Yes, in special places	Yes
Sign is out of order		Either normal limit (usually 80) or black	Black or the last message	Black (LED) or the last message (electrom.)	Black (LED) or the last message (electrom.)
Background/ automatically controlled system fails		Manually set	Manually set	Manually set	Manually set
On/off use		Yes (road works)	Yes (road works)	Yes (road works)	No

* No quidelines yet

2.1.5 Usage area, motives for use, control principles and level of automation

Survey results

In all of the Viking countries there are road sections that utilise variable speed limit signs. In addition, in most countries – except in Germany – single

variable speed limit signs are also used. Controlling principles are most commonly based on congestion and weather (Table 6).

Table 6. Control of variable speed limits.

	The control of variable speed limits is based on
DEN	Traffic data from the section provided with VMSs Presence of children Road work
FIN	Weather and road condition data Traffic data from the section provided with VMSs Traffic data from the merging road School arrival/departure time Road work Road closure Combinations of the above-listed items
GER	Weather and road condition data Traffic data from of the section provided with VMSs
NOR	Weather and road condition data Traffic data from the section provided with VMSs Zone signing: tunnels School arrival/departure time
SWE	Weather and road condition data Traffic data from the section provided with VMSs Amount of vehicles on one line Traffic data from a side road Combinations of the above-listed items Presence of pedestrians

Not only the control principles but also the level of automation vary. Some control systems provide a continuous automatic categorisation of conditions corresponding to the alternative speed limits. This information either supports manual control or the speed limits are changed automatically on the basis of this classification. The possibility of manual traffic management is included in most systems.

The control principles and criteria vary both between and within the countries. Most countries do not have national guidelines (see 5.1), and common guidelines for the Viking or EU countries are not expected in the near future. However, the exchange of information should be enhanced e.g. concerning the main principles and criteria, the parallel use of several control principles etc.

In many countries, speed limits are quite commonly exceeded. From the road users' point of view it could be advantageous to be aware of the control

principles on a general level, for example whether the system is based on monitoring the weather, the traffic conditions, or both. That type of knowledge could motivate road users to better obey the speed limits shown. In the present situation, light-emitting speed limit signs have more substantial effects (both decreasing and increasing) on driver behaviour than fixed speed limit signs.

CONCLUSIONS	
no need	**In all countries control is based on traffic flow data in some deployments. In addition, in most countries many systems are based on weather and road condition data.**
short term	**It is recommended that systems should be controlled by both weather and traffic if both weather and traffic problems occur at the site. The documented principles should be collected for this purpose.**
short term	**The reliability of the systems is important for all deployments, and therefore should be developed.**
long term	**It seems that an automatic control system or a system that is based on the automatic classification of circumstances is needed for weather-controlled deployments.**

Background

The effects of weather-controlled variable speed limits on the injury accident risk were investigated in a recent study (Rämä, Schirokoff and Rajamäki 2003). Its results showed that high-quality systems which based control on the automatic classification of road conditions and used fibre-optic or LED signs decreased the injury accident risk by 13% in the winter and by 2% in the summer, on average. When using the other group of systems - with manual control and electromechanical signs - the safety was reduced. Although neither effect was statistically significant, it is assumed that a high level of automation is needed in weather-controlled systems to make it possible to react to suddenly changing circumstances and thereby to contribute to safer traffic.

2.2 Lane control

Lane control includes lane signals and VMSs for restricted lanes. However, the latter are not in use in the Viking countries.

2.2.1 Colours

Green and yellow arrows and red crosses are used in the lane signals.

CONCLUSIONS	
already	**There are no differences in the use of colours in lane control signals. Red crosses and yellow and green arrows are used.**

2.2.2 Symbols, pictograms and text messages

According to the Vienna Convention, the appearance of arrows may vary, as long as the drivers understand the message correctly. National laws regulate the size of the symbols.

CONCLUSIONS	
already	**Lane control signs should use pictograms and symbols, but generally not text messages.**

Background

The FIVE report suggests as a basic rule that 'symbols should be used as much as possible to avoid language problems and texts should therefore be minimised or short' (FIVE 1998). This is especially recommended for messages along the Trans-European Road Network (TERN). The majority of DERD representatives preferred symbols to texts in regulatory messages. The recommendation is motivated by quick perception and thus response, especially by international drivers (FIVE 1998).

The FIVE report (1998) recommends that in this sign category text messages should be used in the way described in the Vienna Convention (supplementary information under the sign). In some cases, additional text messages can be used to provide significant and meaningful information.

TROPIC studied pictograms for restricted lanes for buses, and restricted lanes for high-occupancy vehicles (HOV) (Luoma and Rämä 2001). None of the pictograms in their tested form were recommended for the restricted lane for buses pictogram. Nevertheless, the pictogram of the bus with arrows indicating the separate lanes might be acceptable, provided the depiction of the bus is improved (Fig. 4). None of the tested pictograms was recommended by Luoma and Rämä (2001) for HOV either.

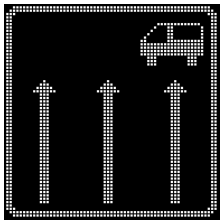


Figure 4. Pictogram suggested with modifications for the restricted lane for buses (Luoma and Rämä 2001).

2.2.3 Amber lanterns and flashing signs

Survey results

In Germany, flashing amber lanterns are used for re-routing and for special warnings in case of tunnel closure. In Sweden, they are used in lane control together with a yellow arrow when included in motorway control systems (Table 8).

Table 8. The use of amber lanterns in lane signals.

	Are flashing amber lanterns used in lane control
DEN	No
FIN	No
GER	No (only in special cases to support re-routing or danger warnings)
NOR	No
SWE	Yes, in the motorway control system

In lane control, a flashing yellow arrow is used to indicate lane change in most countries. Sweden does not have the flashing arrow but uses amber lanterns instead. (Table 9).

Table 9. Use of flashing lane signals.

	Are there any flashing signals
DEN	Yes, change lane - yellow arrow
FIN	Yes, change lane - yellow arrow
GER	Yes, change lane - yellow arrow
NOR	Yes, change lane - yellow arrow
SWE	No

CONCLUSIONS	
long term	**The Swedish practice with amber lanterns differs from the others, which use the flashing yellow arrow.**

Background

FIVE (1998) recommends that flashing lamps around a VMS should be used in a very limited way for regulatory messages; for instance only for queue-tail protection.

2.2.4 Message absence situation

In Finland, Sweden and Norway the lane control signal is shown only when needed and at all other times the signal is black. In some other European countries, the green arrows are on all the time (for example in tunnels).

In Sweden, if a signal is out of order, a signal identical to the one on the section before is shown. In Sweden and Norway, if the control system fails, the last message is sometimes shown. However, the systems are generally very safe.

CONCLUSIONS	
long term	**There are several different practices in lane signal message absence situations.**

2.2.5 Usage area, motives for use, control principles and level of automation

Lane control signals are most frequently used in tunnels. In Germany, lane signals are sometimes used for improving traffic flow at motorway intersections (Fig. 5). In addition, lane control can be used on bridges, in complex motorway systems, on reversible lanes (a rare deployment that exists in Sweden and Norway), and in ramp metering systems.

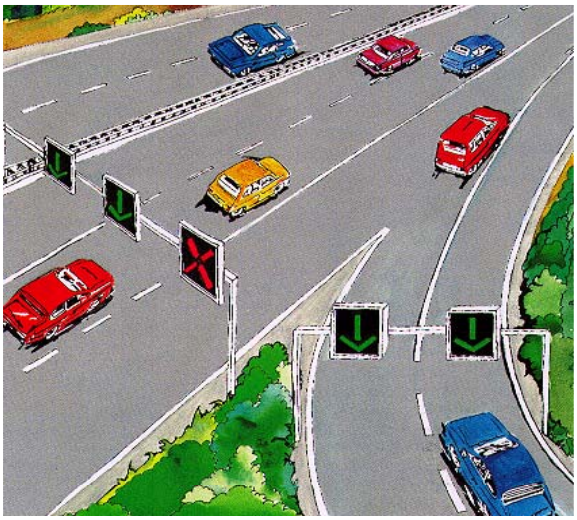


Figure 5. A schematic picture of lane control signals at a junction (Aumund 2004).

In Norway and Finland, the maximum speed limit for roads with lane control signals is 70 km/h. In Sweden and Denmark, no maximum speed limit has been defined.

The error-free control of a lane control system is vital.

3 DANGER WARNING SIGNS

Danger warning signs are intended to warn road users of a danger on the road and to inform them of its nature (Vienna Convention 1968). Messages on VMSs are intended to warn all road users about a specific immediate danger (close ahead) concerning weather conditions or the traffic status (FIVE 1998).

3.1 Colours

Survey results

LED or fibre-optic technologies are used in every country. In Norway and Sweden electromechanical signs are also used (Table 11).

Table 11. Sign technology used in warning signs.

Sign technology used	DEN	FIN	GER	NOR	SWE
LED	Yes	Yes	Yes	Yes	Yes*
Fibre-optic	No	Yes	Yes	Yes	No
Electromechanical	Yes	No	Yes	Yes	Yes

* The most commonly used

In the Viking countries, black/white inverting is authorised in the same way in warning signs as in speed limit signs (Table 2). There are no differences in the allowed colours. In Sweden, LED signs with normal colours are rarely used.

CONCLUSIONS	
already	**LED or fibre-optic signs with inverted colours are recommended to be used in warning signs at least on the main roads.**

3.2 Symbols, pictograms

Survey results

Combined messages are in use in all of the Viking countries (Table 12). The red triangle is always used in warning signs.

Table 12. The use of pictograms in warning VMSs.

		DEN	FIN	GER	NOR	SWE
Type of signs used	Pictograms	Yes	Yes	Yes	Yes	Yes
	Text messages	Yes	Yes	No	No	Yes
	Combined messages	Yes	Yes	Yes*	Yes	Yes
Use of the red triangle in danger warning signs		Always	Always	Always	Always	Always

* Only a short additional text (e.g.Unfall) if no pictogram exists

In all countries, queue, other danger and road works pictograms are used in VMSs (Table 13). Most of the pictograms that are used in the Viking countries have been recommended by FIVE (see Background, below).

Table 13. Messages conveyed by pictograms in 2003.

Messages conveyed by pictograms	**DEN**	**FIN**	**GER**	**NOR**	**SWE**
Congestion/queue	Yes	Yes	Yes	Yes	Yes
'Other danger'	Yes	Yes	Yes	Yes	Yes
Slippery road	Yes	Yes	Yes	Yes	Yes
Road works	Yes	Yes	Yes	Yes	Yes
Ice/snow	Yes (sub-panel)	No	Yes	No	No
Falling rocks	No	No	No	No	Yes (used for falling ice)
Two-way traffic	Yes	Yes	No	Yes	Yes
Pedestrians	No	No	No	Yes	Yes
Strong wind	Yes	Yes	No	Yes	Yes
Animals/moose		Yes	No	Yes	Yes
Re-routing	Info	Info	Arrow	Info + arrow	Info + arrow
Children	No	Yes	No	No	No
Open bridge	No	Yes	No	Yes	Yes
Accident	General warning + text	General warning + text	General warning + text	General warning + text	General warning + text

The Viking countries named some needs for new pictograms (Table 14). Among the suggestions were pictograms for accidents and low visibility, which were also discussed by FIVE.

Table 14. Needs for accepted pictograms in the EU (Vienna Convention area).

	Needs for accepted pictograms
DEN	Accident
FIN	Accident
GER	Accident, fog/bad visibility
NOR	Accident, pedestrians on the roadway, road closure, oncoming vehicle
SWE	Accident, fog/bad visibility

CONCLUSIONS	
already	**Combined messages are generally used in the Viking countries.**
already	**There are pictograms - for road works for example - which are used in all of the Viking countries. The use of the road works sign has been questioned by FIVE (2003, draft).**
short term	**The accident pictogram (suggested by FIVE, see Fig. 4.) is acceptable and should be confirmed at the national level if an overall consensus will be reached (e.g. at the UNECE-level).**
short term	**There are also differences in the use of pictograms (e.g. falling rocks + the text 'falling ice' and lorry ban).**

Background

The Vienna Convention suggests the use of a red triangle in warning messages ('the red border shall not be changed'). The TROPIC pictogram comprehension test conducted in six European countries (Luoma and Rämä 2001) showed that the red triangle indicates a warning for drivers. The finding suggested that all VMSs displaying warnings should include a red triangle.

According to the Vienna Convention, all warning signs can be shown in VMSs.

In the latest discussions by FIVE (2003 draft), the following pictograms are discussed and recommended for use on VMSs: lane control signal, maximum speed limit, prohibition of overtaking, other danger, accident, queue/congestion, slippery road and cross-wind.

The pictograms which FIVE (2003 draft) recommends not be used are: compulsory minimum speed limit, driving of vehicles less than … metres apart prohibited, and falling rocks. No conclusion was reached for the pictograms of ice, snow chains and road works (FIVE 2003 draft).

TROPIC studied pictograms for five warnings. Drivers were interviewed in six countries concerning the suggested alternatives (Luoma and Rämä 2001). Based on the results of comprehensibility and preference tests, TROPIC suggested pictograms for accident warnings, queue warnings and warnings about slippery road conditions (Fig. 6)

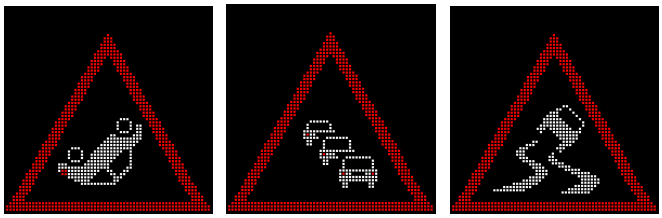


Figure 6. Pictograms recommended by TROPIC for accident, queue/congestion and slippery road warnings (Luoma and Rämä 2001).

None of the tested pictograms were recommended for fog warnings, because none of the alternative pictograms was comprehended well enough and clear misinterpretations were frequent. The pictogram with a car disappearing into fog might be used, however, in conjunction with a supplementary text, but only after information campaigns (Fig. 7).

The tested pictogram with a car and an arrow was not recommended as the oncoming vehicle sign because only 25% of the drivers comprehended the pictogram (Fig. 7).

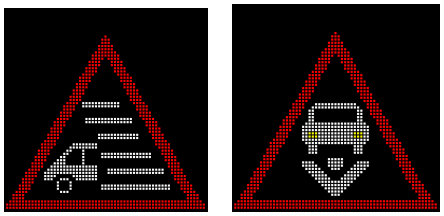


Figure 7. The fog pictogram that was tested but not recommended without support, e.g. information campaigns (left), and the pictogram for an oncoming vehicle that was not recommended (right) (Luoma and Rämä 2001).

3.3 Text messages

Survey results

General road safety messages are not in use in the Viking countries. Bilingual messages are used in Denmark, and in Finland's bilingual municipalities (Table 15).

Table 15. The use of bilingual messages in danger warning signs.

	DEN	FIN	GER	NOR	SWE
Use of bilingual messages	Yes (Danish and English)	Yes (Finnish and Swedish)	No	No	No

In Finland and Sweden, capital letters are used in VMSs, while other countries use mixed texts.

In the Viking language area, there are expressions or individual words, which are commonly understood or typical to one language only, or which have different meanings in different languages. International (or Scandinavian) expressions should be preferred when designing new text messages. In Norway, for example, 'via' is used instead of the Norwegian word 'om'.

CONCLUSIONS	
already	**The Viking countries prefer keeping the amount of information small by avoiding unnecessary information.**
no need	**Bilingual messages are shown in some deployments.**
short term	**Text messages are useful only in connection with a flexible signposting (dynamic re-routing), not for 'information reasons'. International expressions should be preferred in text messages. The creation of a data bank of the messages used in the Viking language area is suggested.**

Background

FIVE (1998) suggested that text messages should be used in variable warning signs in the same way as in fixed signs (to provide supplementary information) as defined in the Vienna Convention (1968).

The TROPIC comprehension test showed that drivers prefer pictograms to text messages when asked (Luoma and Rämä 2001).

Harjula, Luoma and Rämä (1998), and Anttila, Luoma and Rämä (2000) showed that it is possible to design a bilingual VMS displaying alternating text messages that is well-accepted and no more demanding than a VMS displaying the same messages simultaneously. However, the results further suggested that variable message signs are rather demanding in general.

3.4 Amount of information

Survey results

Denmark and Norway have rules for the length of text messages. On the basis of a study, Germany has developed new network control VMSs for dynamic signposting/re-routing on motorways that have a static frame with direction arrows and a freely-programmable content of 3 lines of text. Finland and Sweden do not yet have any rules.

The number of lines in a message is the same in the Viking countries. However, the number of characters per line varies (7-20), as does the number of items (4-8) (Table 16).

In Sweden, the operator can create the needed messages if there are no suitable messages in the database. In other countries, only fixed messages are used.

Table 16. Definitions for the maximum length of text messages, in parenthesis if only practices.

Text message definitions	**DEN**	**FIN**	**GER**	**NOR**	**SWE**
Rules/guidelines for the length of a text message	Yes	No, but there is limited space in the signs	Draft (to be introduced in 2004)	Yes, on hearing	Not yet, under consideration
Number of lines, max	3	(3)	(3)	3	3 (pref. 2)
Characters/line, max	7	(20)	Not defined yet	20	No more than 20 used
Number of words or items, max	4 words	Not defined	Not defined yet	8	Max 7 (pref. 4)

CONCLUSIONS	
already	**Pictograms are preferred to text messages.**
short term	**The definitions for the maximum length of text messages are not the same, except for the definition of the number of lines.**
short term	**If a text message is shown, it should be as short as possible and use as few words as possible.**

Background

Drivers' capacity to process all the necessary information is limited, and sometimes even items essential for decision-making are not perceived or processed. A revealing example comes from a recent study, in which a fixed warning sign, a general warning sign with a supplementary panel 'traffic investigation', was recalled on average by 6% of drivers randomly selected from the traffic flow (Rämä, Luoma and Harjula 1999). Consequently, increasing the information processing workload while driving is questionable.

When discussing the length of text messages, FIVE refers to the VAMOS 'White book', according to which the number of words (or information units) in one text message (accompanying pictograms or not) should be limited to 7.

3.5 Amber lanterns and flashing signs

Flashing VMS displays have been used, for example, to indicate extremely slippery road conditions (Rämä and Kulmala 2000). Flashing amber lanterns in VMS displays have been designed to alert drivers to dangerous traffic conditions down the road (Hogema and van der Horst 1997).

Survey results

Flashing signs are generally not used in variable warning signs, but amber lanterns may be used in Norway and Sweden (Tables 17 and 18).

Table 17. The use of flashing amber lanterns in warning VMSs.

	Are flashing amber lanterns used in VMSs
DEN	Yes
FIN	No
GER	No
NOR	Yes, optional, flashing yellow, two on the top
SWE	Yes, to emphasise a message (manual or automatic control)

Table 18. The use of flashing variable danger warning signs.

	Are there any flashing VMSs
DEN	No
FIN	No (has been, in an experiment)
GER	No
NOR	No
SWE	No

CONCLUSIONS	
already	**Flashing signs are not used in warning messages.**
long term	**Amber lanterns in warning messages are used in some countries. Flashing amber lanterns can be used in electromechanical warning signs depending on the site and the situation. LED or fibre-optic signs are conspicuous even without any flashers. Research results indicate that flashers may confuse drivers.**

Background

According to FIVE (1998), flashers might be utilised on VMSs to steer the attention of the drivers to a warning or changed situation.

The TROPIC results suggest that the addition of amber lanterns would convey a stronger message better than a flashing display (Luoma, Rämä and MacLaverty 2001). For example in queue warnings, the flashing sign was more often thought to have no added meaning while the sign with amber lanterns was more often thought to indicate a stronger warning. However, there were many drivers who attributed no additional meaning to such lanterns. An earlier field study had shown that many drivers may interpret the meaning of flashing displays incorrectly (Rämä and Kulmala 2000). Consequently, the road authority cannot be sure that drivers interpret the meaning of amber lanterns or flashing signs correctly.

3.6 Message absence situation for warning signs

Survey results

In all of the Viking countries, signs are dark when there is nothing important to tell. In many Finnish VMSs, there is an information panel below the warning sign that shows the weather and road temperature.

Table 19. Message absence situation for warning signs.

	How is a message absence situation indicated
DEN	No actual decision has been made
FIN	Dark sign /nothing (decided)
GER	Dark sign /nothing (decided)
NOR	Dark sign /nothing (decided)
SWE	Dark sign /nothing (decided)

CONCLUSIONS	
already	**Usually nothing is shown if there is no need to show a warning.**

3.7 Usage area, motives for use, control principles and level of automation

Variable warning signs can be part of the system, e.g. they can motivate reductions in speed limits. They can also be individual signs. The most important motivations for variable warning signs in the Viking countries are congestion, road works, weather and road conditions, and, in Sweden, accidents and traffic jams. In addition, general warning signs with additional panels are in general use.

The control principles are dependent on the type of deployment. In addition, there is variation in the details of the control systems. It would be useful to improve knowledge of and exchange information about the control systems.

If the situation to which the sign reacts changes rapidly and unexpectedly, there is substantial demand for automatic control. Congestion and road and weather conditions are examples of these deployments.

CONCLUSIONS	
short term	**The reliability of the system is important for all deployments.**
long term	**It is likely that there is substantial variation in the control principles both nationally and between countries. The more harmonised use of variable warning signs would be beneficial to the drivers. The use of warning signs and the principles will be monitored for this purpose.**

4 INFORMATIVE SIGNS

Informative signs should provide useful and meaningful information that does not distract the driver or cause information overload. In general, the very same issues concern the informative signs as the warning signs. For informative signs however, the rules or guidelines for placement for example are more free than for warning signs (FIVE 1998). The message could refer to traffic situations further down the road or somewhere else on the road network.

Informative VMSs include several deployments, such as link messages, network messages, re-routing messages (discussed in FIVE 1998), and dedicated journey time or traffic status panels containing link or network information (presented in the updated FIVE, draft 2003).

In general, traffic signs provide the driver with information to be used in tactical decision-making. During normal driving, the driver has to perceive and process large amounts of information. There is limited driver capacity to process all the necessary information, and sometimes even items essential for decision-making are not perceived or processed. At the tactical level, most of the information is obtained visually, and there is a danger of information overload. When information is provided while driving, it should be questioned how the information supports safe driving, and whether the information provided loads the driver too much or improperly.

The information should be such that it aids the performance of the task and does not make it more complicated and demanding. Furthermore, there are specific requirements set not only for the information content but also for the quality of the information and the human-machine interface (HMI) of each driver subtask. It is axiomatic that all of the information provided must meet some quality requirements, such as reliability and consistency.

Informative deployments are rare in most Viking countries. Hence, there was no specific survey for informative signs. Therefore, all issues are not discussed in detail.

4.1 Colours

Survey results

Most sign technologies are in use in informative signs in Viking countries (Table 20). The colours are usually inverted in LED signs.

Table 20. Sign technology used in informative signs.

Sign technology used	DEN	FIN	GER	NOR	SWE
LED	Yes	Yes	Yes	Yes	Yes
Fibre-optic	No	Yes	Yes	Yes	No
Electromechanical	Yes	Yes	Yes	Yes	Yes

All colours permitted in the national regulations are in use. The use of colours is more flexible in informative than in warning signs.

CONCLUSIONS	
short term	**All technologies are used in informative signs – the sign technology used depends on the situation and the requirements.**

Background

In the EU's TRAVEL-GUIDE project, one study concerned the development of optimal screen layout comprehensibility and the content of full colour information panels (FCIP, Fig. 8). For example, comparisons were made between coloured and black-and-white information elements (De Waard and Brookhuis 2002). The following recommendations (based on simulation studies) were made for the use of colour in informative FCIPs:

- Colour coding - if used at all - should be kept to a minimum, i.e. to standards such as red for 'danger' or 'avoid', and green for 'safe' or 'free'. Conventional VMSs generally lack colour coding. Therefore colour coding tends to create an unfamiliar appearance. The use of spatial colour coding, however, does have the potential to subdivide the total image into separate units (which one may call 'visual chunks').
- It remains unclear whether the use of a colour-coded map is recommendable. It may differ too greatly from conventional traffic signs. One should be cautious and not overuse colour.
- The use of tonal colour coding (highlighting) indicating relative travel time is generally poorly understood and therefore to be advised against.
- The red-coloured road alternative is sometimes misinterpreted as being obstructed, instead of congested.
- Colours can help increase recognition of a symbol (e.g., a white P on a blue background is more recognisable as a parking lot than a dot-matrix white P on a black background).

Figure 8. An example of a full colour information panel (De Waard and Brookhuis 2002).

4.2 Symbols, pictograms

Survey results

The same pictograms can be used in informative signs, as in warning signs (listed in Table 13). The sign types differ in appearance, for example in their colours. Combined text and pictogram messages are used in informative VMSs, but not in Finland. Re-routing arrows are in use in Germany (Fig. 9), Norway and Sweden.

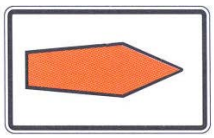


Figure 9. The re-routing symbol used in Germany (the symbol is not included in the Vienna Convention).

Centrico has proposed a common symbol for re-routing (2002). Norway is considering taking this arrow (Fig. 10) into use.

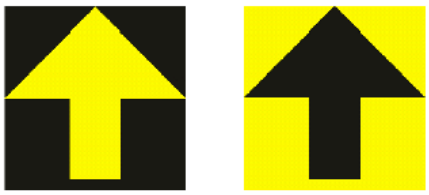


Figure 10. Centrico arrows.

CONCLUSIONS	
no need	**Combined messages are used in all of the Viking countries except in Finland.**
long term	**The re-routing arrow is in use in some countries (e.g. Germany). Its Europe-wide use is recommended, but an information campaign supporting the use should first be considered.**
long term	**In Norway, the Centrico arrow (see Fig. 10) may be used in re-routing in the future.**

Background

The TROPIC study included directional pictograms (Luoma and Rämä 2001). Based on the results of comprehensibility and preference tests, two diversion information alternatives were suggested (Fig. 11). The results were somewhat inconclusive, because each sign was rather poorly understood, several nearly correct interpretations were provided, and no alternative was available. Therefore, both of the tested pictograms were recommended with one reservation: the road authority using either of the pictograms cannot be sure that drivers will comprehend the exact meaning of the pictogram. Therefore, an information campaign would be necessary before these pictograms are adopted as policy.

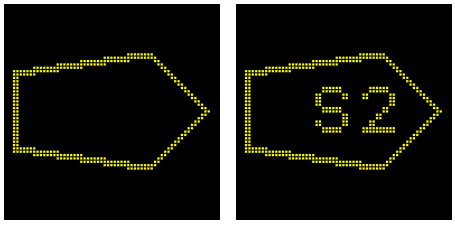


Figure 11. Two alternative directional pictograms recommended by TROPIC (Luoma and Rämä 2001).

The following recommendations were made during the TRAVEL-GUIDE project for the use of symbols in full colour information panels signs (FCIP, De Waard and Brookhuis 2002):

- In general, pictorial information is preferable to textual information. Pictorial information is inherently language-free and information-dense. It has the potential to enhance (the speed of) general interpretation, especially among non-native speaking drivers.
- Some of the specific findings of the experiment in relation to pictorial information include:
  - The red X-shaped symbol is associated with ‘road closed’ and should therefore only be used in this context.

- The smiley symbol (an unfamiliar or at least out-of-context symbol) might be distracting, and garners rather varying ratings (it is either liked or disliked, never in between).

- The meaning of the 'P&R (Park and Ride) symbol' is not known by many drivers. Moreover, it is not used in some European countries at all.

Based on the tests, the use of red and green was developed, and some textual information was replaced with the queue pictogram (tested in TROPIC).

4.3 Text messages

Informative signs and danger warning signs obey the same general principles.

CONCLUSIONS	
already	**The Viking countries prefer keeping the amount of information small by avoiding unnecessary information also in informative signs.**
long term	**Norway, Sweden and Germany follow the text message principles set by FIVE. Denmark recommends the use of FIVE (1998) principles. Finland has its own practises.**

Background

FIVE (1998) suggested that text messages should be used in variable warning signs in the same way as in fixed signs (to provide supplementary information), as defined in the Vienna Convention (1968).

The TROPIC comprehension test showed that drivers prefer pictograms to text messages when asked (Luoma and Rämä 2001).

Harjula, Luoma and Rämä (1998) and Anttila, Luoma and Rämä (2000) showed that in some environments it is possible to design a bilingual VMS displaying alternating text messages that is well-accepted and no more demanding than a VMS displaying the same messages simultaneously. However, the results further suggested that variable message signs are rather demanding in general.

The following recommendation was made during the EU's TRAVEL-GUIDE project for the use of textual information in full colour information panels (De Waard and Brookhuis 2002):

- In principle, text is the language-dependent counterpart of symbol use. Apart from near-pictogram-like statements such as 'OK', language use should be kept to a minimum. This is especially true if it leads to

interpretation problems for non-native speaking drivers. Provided that pictograms are well-designed, the efficiency of information transfer is potentially greater with pictograms than with text.

4.4 Amount of information

Information signs and danger warning signs (3.4) obey the same general principles concerning the amount of information.

Background

In the TRAVEL-GUIDE project, the following recommendations were made concerning the information density in full colour information panels (De Waard and Brookhuis 2002):

- Even with the best layout, pictograms, and other screen content, there is a real risk of overloading drivers with information. The [Reading Time = $N_{items}/3$ + 2s] formula should be used as a rough guideline. However, the problem with this formula is that an 'item' is a rather ill-defined concept. The interrelationship between the number of information elements on the one hand and the information content on the other should be stressed.
- In addition, traffic information systems should only contain information that is of interest to every driver.

4.5 Amber lanterns and flashing signs

Survey results

Flashing amber lanterns may be used in re-routing in Norway, Sweden and Germany (Table 21). The use of flashers can help steer the drivers' attention to an exceptional situation. However, the too-frequent use of the flashers may distract drivers.

Table 21. The use of flashing amber lanterns in informative VMSs.

	Are flashing amber lanterns used in VMSs
DEN	No
FIN	No
GER	Yes, re-routing changes , tunnel closure
NOR	Yes, optional, flashing yellow, re-routing
SWE	Yes, to emphasise a message (manual or automatic control), re-routing

CONCLUSIONS	
long term	**Amber lanterns are in use in some countries. The use of flashers in informative signs should be considered carefully.**

Background

According to FIVE (1998), flashers should not be used with informative messages.

The TROPIC results suggest that the addition of amber lanterns would convey a stronger message better than a flashing display (Luoma, Rämä and MacLaverty 2001). For example in queue warnings, the flashing sign was more often thought to have no added meaning, while the sign with amber lanterns was more often thought to indicate a stronger warning. However, many drivers did not attribute any additional meaning to such lanterns. Earlier research had shown that many drivers may interpret the meanings of both steady displays and flashing displays incorrectly (Rämä and Kulmala 2000). Consequently, road authorities cannot be sure that drivers interpret the meaning of amber lanterns or flashing signs correctly.

4.6 Message absence situation for informative signs

Survey results

In most of the Viking countries, signs are dark when there is nothing important to tell. In Finland, road and weather temperatures are shown to indicate that the sign is not out of order (Table 22).

Table 22. Message absence situation – informative signs.

	How is a message absence situation indicated
DEN	No actual decision has been made
FIN	Road and weather temperatures
GER	Dark sign /nothing (decided), electromechanical white
NOR	Dark sign /nothing (decided)
SWE	Dark sign /nothing (decided), electromechanical grey, travel time in the future

CONCLUSIONS	
no need	**Most frequently nothing is shown if there is no need to show an informative message.**

4.7 Usage area, motives for use, control principles and level of automation

Park-and-ride systems and re-routing during congestion are the most common deployments of informative signs in the Viking countries. The aim of these systems is to improve mobility and safety. Advice provision and driver comfort are also motives for their use. New informative sign deployments are emerging. Information provided by the new systems has to be based on high quality monitoring systems. In many cases automatic control systems are needed to guarantee the high quality of the information provided for the drivers. All information shown in the signs must be reliable already when implementing new systems.

CONCLUSIONS	
short term	**All information must be reliable. However, the reliability criteria may be somewhat lower for informative signs than for regulatory signs.**

5 REGULATION

The regulation of VMSs is based on international commitments and national traffic laws. Among the international commitments, the most important document is the Vienna Convention (1968). The Conference of European Directors of Roads (CEDR, previously WERD/DERD) has outlined suggestions and guidelines for the further development of VMSs. The European VMS Platform has been the forum for these discussions.

5.1 Needs to complete regulations from the VMSs' point of view

In the Viking countries, the national traffic laws are in harmony with the Vienna Convention. Specifically, all respondents replied 'Yes' to the question: 'Do you respect the Vienna Convention word for word?' (TROPIC 1997). In addition, there may be national supplementary rules or guidelines for the use of VMSs. In some cases, there may be a need for supplementary regulation.

The new sign regulations that are under work in Sweden will include VMSs. Norway has already drawn up new regulations for VMSs.

The following are some of the national supplementary regulative documents for VMSs:

Denmark:

- The FIVE Report is the basic document in use in Denmark. New Danish guidelines are to be drafted by the end of 2005.
- Danish guidelines for the geometry, photometric properties and physical performance of VMSs, September 1999
- PrEN 12966-1 'Vertical Road Signs – Part 1: Variable message signs'.

Finland:

- Preparation of the national guidelines will start in 2005.

Germany:

- Straßenverkehrsordnung (StVO) und Allgemeine Verwaltungsvorschrift zur Straßenverkehrsordnung (VwV-StVO), BMVBW
- Richtlinien für Wechselverkehrszeichen (RWVZ), Ausgabe 1997, BMVBW
- Richtlinien für Wechselverkehrszeichenanlagen (RWVA), Ausgabe 1997, BMVBW

- Richtlinien für die Ausstattung und den Betrieb von Straßentunneln (RABT), Ausgabe 2003, Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln, 2003
- Richtlinien für passive Schutzeinrichtungen an Straßen (RPS), Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln, 1989/1996
- Richtlinien für die Sicherung von Arbeitsstellen an Straßen (RSA-95), Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln, 1995, 4. überarbeitete Auflage 2001
- Richtlinien für Lichtsignalanlagen (RiLSA) – Lichtzeichenanlagen für den Straßenverkehr, Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln, 1998
- Technische Lieferbedingungen für Streckenstationen, Ausgabe 2002 (TLS 2002), BMVBW/BASt
- Zusätzliche Technische Vorschriften für Verkehrszeichenbrücken (ZTV-VZB), BMVBW
- Umnutzung des Seitenstreifens(Standstreifens) für den fließenden Verkehr, Allgemeines Rundschreiben Straßenbau Nr.20/2002, August 2002, BMVBW
- (Vorläufige) Hinweise für die Erstellung von Zuflussregelungsanlagen, April 2000, BMVBW
- Dynamische Wegweiser mit integrierten Stauinformationen (dWiSta), Entwurf bundeseinheitlicher Regelungen, Februar 2004, BMVBW/BASt
- Merkblatt zur Ausstattung von Verkehrsrechnerzentralen und Unterzentralen (MARZ), 1999, BASt
- Merkblatt „Nässeerfassung in Streckenbeeinflussungsanlagen', Entwurf 2002, Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln, 2002
- Hinweis für umsetzbare Stauwarnanlagen (HUS), Ausgabe 1999
- Hinweise für Verkehrsflussanalyse, Störfallentdeckung und Verkehrsflussprognose für die Verkehrsbeeinflussung in Außerortsbereichen, Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln, 1992
- Hinweise für Steuerungsmodelle von Wechselverkehrszeichenanlagen in Außerortsbereichen,
  Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln, 1992
- Hinweise für neue Verfahren zur Verkehrsbeeinflussung auf Außerortsstraßen, Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln, 2000

- Hinweise für Planung und Einsatz von Geschwindigkeitswarnanlagen, Forschungsgesellschaft für Straßen- und Verkehrswesen, Köln, 2001.

Norway:

- Bruk av variable trafikkskilt. Statens vegvesen. Høringsutgave november 2003.

Sweden:

- Technical specifications for VMSs (publ 2003:113) and a guideline for VMSs (publ 2004:122) have been approved for national use. A guideline for message wording - a draft for now - will also be included in the national guidelines.

5.2 Acceptance procedure for VMSs

Survey results

All of the countries have an approval procedure for new pictograms (Table 23).

Table 23. Approval procedure for new pictograms.

	Is there any governmental approval procedure for new pictograms?
DEN	Yes
FIN	Yes, the Ministry of Transport and Communications
GER	Yes, the Federal Ministry (BMVBW) and the competent supreme Länder authorities
NOR	Yes, the directorate of public roads for trial purposes, the ministry of transport for permanent use
SWE	Yes, the government

There is an approval procedure for text messages, in Denmark, Germany and Norway (Table 24).

Table 24. Approval procedure for new text messages.

	DEN	**FIN**	**GER**	**NOR**	**SWE**
Texts must be predefined	Yes	No	Yes	Yes	No

CONCLUSIONS	
already	**There are approval procedures for pictograms.**
long term	**Approval procedures will be developed for text messages.**

5.3 Siting criteria

In general, the same regulations are applied to VMSs as to fixed signs. VMSs can be located either above a carriageway on a portal or, according to FIVE (1998), on roadsides (both sides). This concerns speed limit signs and their general location. More specifically, variable speed limit signs may be located on a gantry (currently in Germany, see Figure 12, and in Sweden) or on the roadside. On gantries, the speed limits can be either lane- or direction-specific (Table 25).

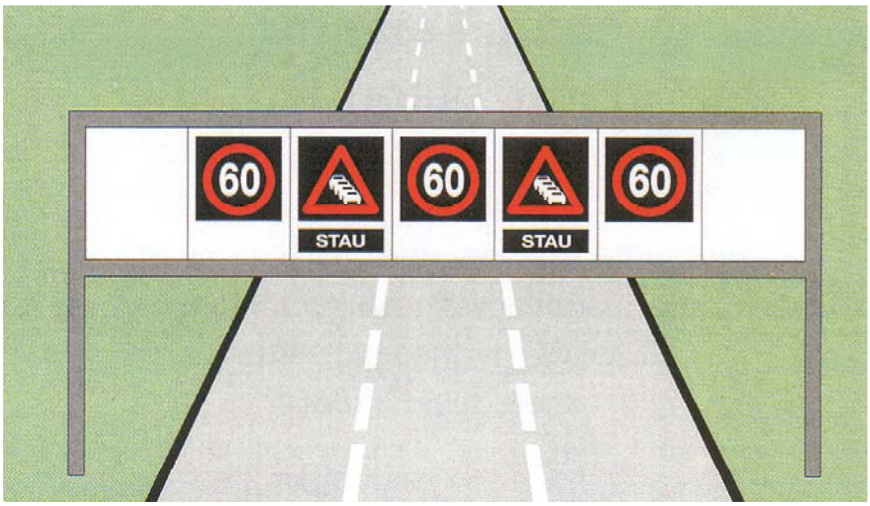


Figure 12.VMSs located on a gantry, a German practice (Aumund 2004).

Variable speed limits should follow the traffic sign regulations. For example, if there are two lanes running in one direction, the speed limit sign is to be shown on both sides of the road.

Table 25. Location of the speed limit signs.

	DEN	FIN	GER	NOR	SWE
Speed limit signs on gantries	Yes	No	Yes	No	Yes
Lane-specific speed limits	Possible by law, not in use	No	No	Possible by law, not in use	Possible by law, not yet in use

According to FIVE (1998), regulatory lane control signals shall be mounted above the lanes concerned. Informative signs can be located further away from the object either on the same road or on the road network (FIVE 2003).

In Germany and Sweden, lane signals can be located on gantries, and combined lane control and speed limit signs exist (altering messages). For

traffic safety reasons, German motorway stretches with a high accident risk are equipped with variable speed limit signs above each lane. However, lane specific speed limits are not used. Norway and Finland have no combinations.

According to FIVE (1998), warning signs should be placed according to the instructions given in the Vienna Convention.

On four-lane roads, except in Finland, it is common to erect warning VMSs on both sides of the road. In Germany, VMSs are shown only on gantries, and the messages can be repeated. On two-lane roads in Finland, Norway and Sweden, the signs are typically erected 150 to 500 metres ahead of the incident, but not on both sides of the road. Norway has new guidelines (Statens vegvesen 2003), which include several criteria.

CONCLUSIONS	
short term	**The siting criteria will be specified in the national guidelines. Viking co-operation is recommended when defining the guidelines.**

5.4 Prioritisation of messages

Message prioritisation is an issue discussed at the European VMS Platform. In Germany and Sweden, lane control signals have priority over speed limits (Platform 2002, Viking survey).

Denmark prioritises danger warnings over re-routing and close events over distant ones. In Germany, warnings about the least discernible danger that requires the imposition of the lowest speed limit have priority. However, lane control signals have priority over speed limits. In Finland, the slippery road warning has the highest priority of the common warnings; however, the warnings about serious incidents have higher priority. In Norway, according to the common practice, the incident closest to the VMS has the highest priority. Sweden has no special guidelines for message prioritisation (Table 26).

Survey results

Table 26. Message prioritisation.

	Message prioritisation
DEN	1. Danger warning 2. Re-routing 3. Close events before distant events
FIN	1. Serious incident 2. Slippery road 3. Road works Mandatory speed limits: no priorities are needed, only speed limits are shown
GER	Priorities in line control systems (not valid for network control): - Lane control signals have priority over speed limits - A warning about the least discernible danger that requires the imposition of the lowest speed limit has priority. If no danger warning is required, a temporary prohibition such as 'no overtaking' can be displayed - Reasons for the incident have priority over distance information / location of danger - A manually requested message takes priority over an automatic one
NOR	1. Dangerous situations directly downstream 2. Closed or blocked links in the network 3. Messages concerning the actual traffic status 4. Messages concerning planned events
SWE	No national guideline yet. However, lane control signals have priority over speed limits in motorway control systems. For freely-programmable VMSs, there are separate guidelines for each region, operated by regional Traffic Information Centres. Prioritisation is normally based on the location of the sign and of the disturbance and on how strongly the disturbance affects traffic.

CONCLUSIONS	
long term	**The available message prioritisation practices should be discussed and evaluated.**

6 INFORMATION

The effects of VMS systems are partly dependent on the quality of and the high technology implemented in the systems. To ensure maximum effect, drivers should be aware, for example, of the real-time control and should know something about the control principles of an advanced sign system.

Survey results

In many of the Viking countries, there is no systematic way to inform the road users of VMS systems (Table 27).

Table 27. Information about VMSs on road sections provided by the road authorities.

Information to drivers about VMS road sections	**DEN**	**FIN**	**GER**	**NOR**	**SWE**
Roadside information on all sections	No	No	No	No	No
Roadside information on some deployments	No	Yes	No	No	No
Systematically in the public media (radio, TV, newspapers)	No	Yes	No	No	No
Occasional information	Yes	No	Yes	Yes	Yes

According to the road authorities, drivers in Finland, Norway and Sweden do not always know about the variability of the signs. In Germany, all variable signs are alike and are located on gantries. Therefore it is assumed that drivers know about the variability.

Information on the controlling policies of the systems is provided in Finland and in Sweden concerning some deployments (Table 28). In Germany, information is provided when a new system is introduced.

Table 28. Information on the controlling policy of variable speed limits.

		DEN	FIN	GER	NOR	SWE
Information on the controlling policy of variable speed limits	For each deployment	No	No	No	No	No
	On some deployments	No	Yes	Yes	No	Yes
Drivers are informed about the message absence practise		No	No	No	No	Yes, through the public media

CONCLUSIONS	
short term	**Information on the qualities of VMSs is occasional or does not exist.**

Background

In Finland, several roadside interviews showed that drivers accept the weather-controlled variable speed limits and warnings, and that they are aware of the controlling variables. However, a closer study showed that only 56% of drivers were aware of the real-time nature of the systems (Rämä, Luoma and Harjula 1999). It was assumed that the effects of the VMSs would be more substantial if the drivers knew more about the controlling principles and the real-time nature of the VMS systems.

7 DISCUSSION AND CONCLUSIONS

Table 29 follows the structure of this report and sums up the conclusions reached concerning the harmonisation needs using colours (Fig. 13). The table shows that all four levels of harmonisation issues exist. It is acknowledged that harmonisation is not a goal as such, but has to be motivated. Therefore, the category 'no harmonisation needs' is needed. In addition to the identification of already harmonised features and practices, it was important to define the future harmonisation needs and targets. These were classified into two groups: those that were thought to be harmonised in the short term and those to be harmonised in the long term. The need for harmonisation is argued by the existing or anticipated differences in the variable sign systems, which may cause safety or efficiency problems for road users.

Harmonised already	**Can be harmonised in the short term**
No harmonisation needs	**Can be harmonised in the long term**

Figure 13. The colour coding used to describe the harmonisation needs.

Table 29. The structure of the document and a summary of the conclusions. The numbers in the cells refer to the chapter numbers in the document. The colours indicate the degree of harmonisation in the Viking countries.

	Regulatory messages		Danger warning signs	Inform-ative signs
	Speed limits	Lane control		
Colours	**2.1.1**	**2.2.1**	**3.1**	4.1
Symbols and pictograms	**2.1.2**	**2.2.2**	**3.2**	**4.2**
Text messages			**3.3**	**4.3**
Amount of information			**3.4**	**4.4**
Amber lanterns and flashing signs	**2.1.3**	**2.2.3**	**3.5**	**4.5**
Message absence situation	2.1.4	**2.2.4**	**3.6**	4.6
Usage area, motives for use, controlling principles, automation	2.1.5	2.2.5	**3.7**	**4.7**
Needs to complete regulations from the VMSs' point of view	**5.1**			
Acceptance procedure for VMSs	**5.2**		**5.2**	
Siting criteria	**5.3**			
Prioritisation of messages	**5.4**			

Information	6

No harmonisation needs

Table 29 shows that more variation is allowed in the practices and rules for informative signs than for regulatory messages or danger warning signs. The use of combined messages and different sign technologies could be mentioned as examples.

The usage areas and needs to use variable systems vary and may vary depending on country. Message absence situations are rare in variable speed limit systems and it is acceptable to have variation in practices, also with informative signs. Bilingual messages are necessary in some countries but not regarded necessary in all countries.

Harmonised already

The study showed that many features are already harmonised on the basis of the Vienna Convention or common practices. The most harmonised areas are the colours and the use of symbols and pictograms in regulatory and danger warning signs. In some cases the harmonisation is based on practices. The already harmonised objects include:

- Light-emitting (e.g. LED or fibre-optic) signs with inverted colours in speed limit systems and as danger warning signs on the main roads.
- A red circle indicating a mandatory speed limit.
- The avoidance of text messages in lane control.
- A small amount of information, and no unnecessary information.
- Pictograms instead of text messages, and combined messages.
- No flashing warning signs.
- The approval procedures for new pictograms.

Can be harmonised in the short term

The short-term harmonisation targets are considered to be solved in the near future. It is assumed that there are no considerable barriers for the harmonisation of these practices.

There were three suggestions concerning speed limits. First, it was noticed that there are differences between countries on whether the appearance of the variable speed limit signs differs from the fixed signs. It was concluded that light-emitting signs with inverted colours should be preferred when planning new deployments and developing old ones. Second, flashing lamps are used in some variable speed limit signs in the Viking countries. The use of flashing lamps or signs has to be well-motivated and should be studied carefully, especially when developing new systems. Third, it may be difficult for a road user to know the control principles of a variable speed limit system. It is recommended that systems should be controlled by both

weather and traffic if both weather and traffic problems occur at the site. Therefore, any documented principles should be collected and information should be provided to the road users.

The Viking countries prefer keeping the amount of information in warning and informative signs small. Therefore, the development of pictograms is important. First, the accident pictogram (suggested by FIVE) should be confirmed at the national level if an overall consensus can be reached (e.g. at the UNECE-level). The current definitions for the maximum length of text messages are not uniform - except for the definition of the number of lines - and they should be made more uniform. If a text message is shown, it should be as short as possible and use as few words as possible. International expressions should be preferred. It is suggested that a data bank of all messages used in the Viking language area should be created.

The reliability of the systems is important for all deployments. Information on the qualities of VMSs is occasional or does not even exist. However, it should be provided. The siting criteria should be specified in the national guidelines. Viking co-operation is recommended when defining new guidelines.

Can be harmonised in the long term

The long-term harmonisation targets are targets that are not considered to be high-priority needs or problems that seem to be difficult to solve in the current situation.

Two items concerned the use of flashers in traffic signs. The use of flashers should be considered carefully to keep the traffic environment and signs easily perceivable and to avoid information overload. Research results concerning the use of the flashers indicate that flashers may confuse drivers. Flashing amber lanterns in electromechanical warning signs can be used depending on the site and the situation. LED or fibre-optic signs are conspicuous even without any flashers. The Swedish practice of using amber lanterns in lane control differs from that of the other countries, which use the flashing yellow arrow.

An automatic control system or a system that is based on the automatic classification of circumstances is needed in weather-controlled deployments. This research and development would also improve the reliability of the systems, which is essential for their acceptability and effectiveness. All information presented using VMSs must be reliable. However, the reliability criteria may be somewhat lower for informative signs than for regulatory signs.

It is likely that there is substantial variation in the control principles both nationally and between countries. The more harmonised use of variable

warning signs would be beneficial to drivers. Therefore, all documented principles should be collected for common use.

There will be a need for a common re-routing arrow. A common symbol for this should be discussed, tested and chosen, and introduced along with some supporting information.

There are several different practices for lane signal message absence situations. An agreement should be reached on a common practice.

In the long term, differences in the use of pictograms should be minimised. Currently, there are differences in the use of pictograms (for example falling rocks + the text ‘falling ice’ and lorry ban). The approval procedures for text messages should be developed.

The available message prioritisation practices should be discussed and evaluated.

Future

The issues concerning variable signs are currently discussed in several international groups. The harmonisation process should be continued as a co-operative effort between the national road authorities of the Viking countries. Finally, as the use of VMS systems is probably increasing, it is recommended that this report should be updated in a couple of years' time.

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APPENDICES

VMS VIKING QUESTIONNAIRE

All questions and answers concern the use of Variable Message Signs (VMS) in your country. As a starting point we have used the data collected during the EU's TROPIC project (Traffic Optimisation by the Integration of Information and Control) completed in 1997 and in the European VMS Platform 2002 (reported in 2003). The data for the Viking countries are given if available.
Please check the given entries: If the information shown is correct, circle it, but if the information is incorrect, update the information.

Please tick off the alternative corresponding to the situation in your country and write the information requested.

Name of the contact person: _____

Address: _____

_____

E-mail: _____

Phone: _____

Name of the person interviewed: _____

Position: _____

Address: _____

_____

E-mail: _____

Phone: _____

1. Are VMSs used for the following purposes in your country?

VMS type	No	Yes	Number of deployments *)	(km, if available)
Regulatory messages				
- speed limit, road section (>1 km)				
- speed limit, single				
- speed recommendation, section				
- speed recommendation, single				
- open/closed lane				
- restricted lane				
- closed exit				
- others:				
Danger warning signs				
- slippery road				
- road works				
- general warning				
- elks				
- wind				
- congestion				
- accident				
- others:				
Informative signs				
- distance between vehicles				
- travel time				
- alternative route, re-routing				
- time to bus/train				
- availability of parking space				
- travel speed				
- weather				
- others:				

*) Number of deployments is the number of VMS systems or locations where VMSs have been installed. If you do not know the exact number, please give the approximate number or verbal estimate.

FOR SPEED LIMITS:

2. What are the sign technologies used in VMSs? (Please tick off if yes)

- ☐ 1. LED
- ☐ 2. Fibre-optic
- ☐ 3. electromechanical with black square
  - ☐ fluorescent sheeting
- ☐ 4. electromechanical without black square
  - ☐ fluorescent sheeting
- ☐ 5. flashing amber lanterns
- ☐ 6. other,
  describe: _____

_____

3. What is the current first priority solution, please specify? _____

_____

TROPIC 1997	**Den**	**Fin**	**Ger**	**Nor**	**Swe**
4. Is black/white inverting authorised? (Please circle the information if correct (specify); update if incorrect)	no	yes	yes	yes	no

Ger: Mandatory as outlined in the Vienna Convention
Nor: In the Traffic Signs Regulations
Swe: Not yet

5. Do you use inverted colours?

- ☐ yes
- ☐ no
- ☐ both signs with inverted colours and signs with no inverted colours are in use

6. How do the road users know the speed limit is variable?

☐ the outlook of the sign, please specify:

_____

Do all variable speed limit signs look alike?

☐ yes
☐ no

☐ information provided by the road authorities, please specify: _____

_____

_____

☐ both outlook and information
☐ they generally do not know

7. Do you use the red circle indicating a mandatory speed limit?

☐ yes, always

☐ sometimes, please specify when not _____

_____

☐ no

8. How do the road authorities inform drivers about a road section (not individual signs) equipped with variable speed limits?

☐ on the roadside

☐ yes, on all sections
☐ partly, in some deployments

☐ systematically in the public media (radio, TV, newspapers)
☐ no/occasionally

9. The control of variable speed limits is based on (you may select several items)

☐ 1) weather and road surface condition data
☐ 2) weather data
☐ 3) traffic data from the section provided with VMSs
☐ 4) traffic data from a side road
☐ 5) the time of day
☐ 6) the presence of children
☐ 7) the presence of animals

☐ 8) other, please specify _____

☐ 9) combinations, specify each of them (1+3, for example)

_____

10. Do you inform road users about the controlling policy of the variable speed limits?

☐ yes, for each deployment

☐ yes, occasionally when _____

☐ no

11. Do you use speed recommendations?

☐ yes

☐ How do they look compared to the mandatory speed limits?

_____

☐ no

FOR DANGER WARNING AND SPECIAL REGULATION VMSs:

12. What is the sign technology used in these signs? _____

_____

_____

13. The type of signs used (you may select several items)

- ☐ pictograms
- ☐ text messages
- ☐ combined (pictogram + text) messages

TROPIC 1997	**Den**	**Fin**	**Ger**	**Nor**	**Swe**
14. Is there a governmental approval procedure for new pictograms? (Please circle the information if correct, update if incorrect)	yes	yes	yes	yes	yes

Fin: The Ministry of Transport and Communications
Ger: The competent supreme Länder authorities and the BMW
Nor: The Directorate of Public Roads for trial purposes, the Ministry of Transport for permanent use
Swe: The government

15. Do danger warning signs include a red triangle?

- ☐ always
- ☐ sometimes, please specify _____

_____

- ☐ no

TROPIC 1997

16. Which colours are

(Please circle the information if correct (specify); update if incorrect)

	authorised	**forbidden**
Den	VMSs should look like other approved signs	red is not used for text
Fin	all, except red in text	red text (in official signs)
Ger	red ring or triangle, white figures or text or symbols	for pictograms and lane control any except red, green and yellow; for variable direction signs blue, orange, black and white are also allowed
Nor	those of ordinary traffic signs, white and yellow lettering on a black background	in text signs red is only allowed for single words signifying ‘stop’ or ‘closed’
Swe	the same as in the highway code	–

17. Which messages are conveyed by pictograms in your country? (European VMS Platform 2002)

(Please circle the information if correct (specify); update if incorrect)

	Den	Fin	Ger	Nor	Swe
Congestion/queue		X		X	X
Queue	X				
'Other danger'	X	X	X	X	X
Slippery road	X	X	X	X	X
Road works	X	X	X	X	X
Ice/snow	sub-panel		X		
Falling rocks					
Loose chippings					
Soft verges					
Two-way traffic	X	X		X	
Pedestrians					X
Strong wind	X				X
Hill up/down					
Animals/elks		elks			elks
Try your brakes					
Lorry ban			X		
No overtaking/cars			X		
No overtaking/lorries			X		
End of overtaking/cars			X		
End of overtaking/lorries			X		
Re-routing	info	info	arrow	info and arrow	info

18. Is there any need for new pictograms to be used in VMSs?

☐ yes, for what purposes _____

_____

_____

☐ no

TROPIC 1997	**Den**	**Fin**	**Ger**	**Nor**	**Swe**
19. Is there a governmental approval procedure for text messages? (Please circle the information if correct (specify); update if incorrect)	yes	no	no	yes	no

Den: Special approval for VMSs
Ger: Approval of text messages lies with the competent supreme Land authority; text messages in special cases only; a guideline for variable direction signs.
Nor: The Directorate of Public Roads comments

_____

_____

TROPIC 1997	**Den**	**Fin**	**Ger**	**Nor**	**Swe**
20. Are there any rules, guidelines or practices limiting the length of text messages? (Please circle the information if correct (specify); update if incorrect)	no	yes	no	yes	no

Fin: The width of the additional text panel cannot be substantially greater than the width of the sign itself. Max 3 rows, 20 characters each
Nor: The rules for ordinary signs are applied (the guidelines for LED signs in Oslo)

_____

_____

21. In text messages the maximum number of lines is

___items

☐ not defined

22. In text messages the maximum number of characters per line is

___items

☐ not defined

23. In VMSs the maximum number of information/ items is defined as

___ words, _____ letters or _____ _____

☐ not defined

FOR INFORMATIVE MESSAGES:

24. The type of signs used

☐ pictograms
☐ text messages
☐ combined (pictogram + text) messages

25. Languages used in text messages: _____

_____

GENERAL ASPECTS:

26. Are there any flashing VMSs?

☐ yes, please specify _____

☐ no

27. Are flashing amber lanterns used in VMSs?

☐ yes, please specify _____

☐ no

28. How is a message absence situation indicated?

☐ dark sign/nothing
  ☐ decided
  ☐ no actual decision has been made

☐ lamp/signal light

☐ neutral message, which _____

_____

☐ general safety message, which _____

_____

29. Drivers are informed about the message absence practice

☐ yes
☐ no

TROPIC 1997 (Please circle the information if correct (specify); update if incorrect)	**Den**	**Fin**	**Ger**	**Nor**	**Swe**
30. VMS location: Does it entirely and solely follow the general rules of road signing?	no	yes	yes	yes	no
31. Can VMSs transmit road safety messages which have nothing to do with traffic conditions at the time (e.g. fasten seat belts)?	no	yes	no	no	no
32. Can VMSs transmit general messages (e.g. don't abandon animals)?	no	no	no	no	no
33. Are bilingual messages used?	no	yes	no	yes	no

34. Message prioritisation (European VMS Platform 2002):

(Please circle the information if correct (specify); update if incorrect)

Den: 1. Danger warning
2. Re-routing
3. Close events before distant events

Fin: The danger warning: 'slippery road' has the highest priority
Mandatory speed limits: no priorities are needed, only speed limits are shown

Ger: Lane control signals have priority over speed limits
A warning about the least discernible danger that requires the imposition of the lowest speed limit has priority. If no danger warning is required, a temporary prohibition, such as 'no overtaking', can be displayed
Reasons for the incident have priority over distance information / location of danger
A manually requested message takes priority over an automatic one

Nor: The incident closest to the VMS has the highest priority, messages about the traffic situation on other parts of the network the lowest

Swe: No common guidelines. Separate guidelines for each region operated by individual Traffic Information Centres

35. Siting criteria (European VMS Platform 2002):

(Please circle the information if correct (specify); update if incorrect)

Den: According to the guidelines for permanent signs and the legibility guidelines for different VMS technologies

Fin: 150 m to 500 m ahead of the incident

Ger: Route control systems: every 1000 m to 1500 m
Junction control systems: every 300 m
Temporary use of the hard shoulder: every 1000 m

Nor: 150 m to 200 m before the incident, distance increased on motorways

Swe: 150 m to 500 m before the incident

36. Please, give information on ongoing national activities and priorities in the field of VMS harmonisation:

(Please circle the information if correct (specify); update if incorrect)

Swe: Improvements to the national guidelines and the VMS specifications.
Focus on the maximum permissible speedand the harmonisation of messages on different channels (VMS, radio, Internet);
new guidelines for activating/deactivating messages.

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