Traffic safety effects of variable speed limit in Finland

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Presentation outline

- Background: VMS Guidelines in Finland, history

- Results of Study of effects on Highway 1 (1+1 road)
  - Effects on driving behaviour
  - Attitudes of car drivers

- Traffic safety of variable speed limits in Finland

- Conclusions

- Discussion
Guidelines for VMS?

- Even though the history with Variable Message Signs (VMS) in Finland is relatively long, there’s not yet any detailed guidelines on the use of VMS.

- Implementation of VMS systems has been guided with
  - 1996 Finnra’s policy for experiments and use of VMS
  - 1997, 2000: Finnra’s traffic management strategy
  - 1999: Finnra’s policy for variable speed limits
  - 1999: Guidelines for evaluation of variable speed limits
Guidelines for VMS, main principles

- Systems should work automatically.
- Traffic centres should monitor the system. Manual control is possible.
- Systems use information on weather and road condition, traffic situation and even incidents (esp. in tunnels).
Safety of variable speed limits in Finland
Effects of weather-controlled variable message signing in Finland
- case highway 1 (E18)
Type of VMS on Highway 1 (fiber optical)
Road weather monitoring system

- Data is collected with road weather stations and analysed, and further calculated into speed limits/recommendations for speed limits.

- Road weather cameras are used to optically check the conditions on the road.
## EFFECTS ON SPEEDS IN WINTER (Highway 1)

("free cars", time to car in front > 5 s)

<table>
<thead>
<tr>
<th>Road condition</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>- 2,5 km/h</td>
</tr>
<tr>
<td>Normal</td>
<td>(2,8…4,2) km/h</td>
</tr>
<tr>
<td>Poor</td>
<td>(1,5…1,8) km/h</td>
</tr>
<tr>
<td>Normal</td>
<td>(0,2…0,5) km/h</td>
</tr>
<tr>
<td>Poor</td>
<td>(2,3…2,6) km/h</td>
</tr>
<tr>
<td>Normal</td>
<td>(1,5…1,8) km/h</td>
</tr>
<tr>
<td>Good</td>
<td>(0,0…0,6) km/h</td>
</tr>
<tr>
<td>Normal</td>
<td>(6,6…6,9) km/h</td>
</tr>
<tr>
<td>Good</td>
<td>(5,9…6,1) km/h</td>
</tr>
</tbody>
</table>
### EFFECTS ON SHORT FOLLOWING DISTANCE (Highway 1) (change on close-following < 1 s)

<table>
<thead>
<tr>
<th>Road condition</th>
<th>Effect towards Helsinki</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>- 18 %</td>
</tr>
<tr>
<td>Normal</td>
<td>- 6 %</td>
</tr>
<tr>
<td>Poor</td>
<td>- 20 %</td>
</tr>
<tr>
<td>Normal</td>
<td>- 14 %</td>
</tr>
<tr>
<td>Poor</td>
<td>+ 8 %</td>
</tr>
<tr>
<td>Normal</td>
<td>+ 6 %</td>
</tr>
<tr>
<td>Good</td>
<td>- 6 %</td>
</tr>
<tr>
<td>Normal</td>
<td>+ 60 %</td>
</tr>
<tr>
<td>Good</td>
<td>+ 31 %</td>
</tr>
</tbody>
</table>
ATTITUDES - INTERVIEWS OF CAR DRIVERS

• 96 % of drivers think that variable speed limits are useful
• 92 % think that speed limit was correctly set
• 86 % knew that the speed limits are controlled according to weather and road condition
• 86 % recalled the right speed limit (distance 3 km)
• 41% recalled the combination “slippery road” -warning sign and text message “aqua planning” (distance 10 km)
Conclusions

- the control system affected the speeds significantly more than road conditions did
- drivers accept the speed limits and trust the system to function correctly - this puts great demands on reliability
- 60 and 80 km/h -speed limits together with “slippery road” -warning sign had positive effect on safety by lowering speeds
- the use of 100 km/h to increase fluency should only be used in good conditions
- the effects of the system controlled by traffic centre operator (“semiautomatic”) were similar to the effects of automatic system
Traffic safety of variable speed limits in Finland
Study of traffic safety effects of Variable Speed Limits

- Variable Speed Limits covered 230 km on 2003
- Several years of experience of the use of systems
- Roads with single carriageway (1+1 lanes)
- Direct effects on safety have not been studied earlier due to relatively small extents of systems
  - (and small amount of accidents - statistical significance)
- Two technologies:
  - 1. Fiber optical / LED,
  - 2. Electro mechanical
Safety of variable speed limits in Finland
Aim of the study

- The traffic safety effects of variable speed limits controlled by information on weather and road surface condition
Variable speed limits on public roads year 2003

- 15 road stretches
- Control based on weather and road condition - 8 roads
  - 4 close to coastal areas
  - 4 in mainland
- Control based on weather and road condition and also traffic situation - 4 roads
- Others (not included in study):
  - Raippaluoto bridge (specially wind),
  - Ruissalo - ground water protection
Earlier studies

- Effects on
  - speeds and
  - (time) distance between cars
  - Attitudes

- Promising results:
  - 86-95% of car drivers recall correctly the posted speed limit
  - 95% of car drivers think that the systems are useful
  - The systems with speed limits combined with warnings have most positive effects in difficult road conditions
  - The average speed increases when a higher speed limit is posted
Method

- Before - after study
- Comparison with general traffic safety development

- Studied in two groups
  - **Group 1**: fiber optical/LED signs, speed limits are calculated automatically, warning sign, 100 km/h ca 10 % of time
  - **Group 2**: electro mechanical signs, no automatic calculation of speed limits, 100 km/h over 50 % of time
Highway 1 Lohja - Sammatti, before winter-80

Vt 1 Lohja - Sammatti
vertailutiet
+27,3 %

-18,1 %

Hvjo-riski [omm./100 milj. autokm]
Safety of variable speed limits in Finland

Highway 7 Pyhtää - Kotka, before winter-80 and -100

Hvjo-riski [onn./100 milj. autokm] -9,1 %
-20,1 %

Vertailutiet

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Safety of variable speed limits in Finland
Highway 4 Jyväskylä - Äänekoski, before winter-80

Vt 4 Jyväskylä - Äänekoski
vertailutiet

Hvjo-riski [onn./100 milj. autokm]

kesät
talvet

-3,1 %
+19,0 %

Safety of variable speed limits in Finland
Summary of results

Results are not statistically significant (due to small amount of accidents)

Group 1
- Injury accidents in winter -13 % and summer -2 %

Group 2
- Injury accidents in winter +8 % and summer +21 %
Summary

- "High class systems" (group 1) increase traffic safety even if speed limit 100 km/h is used in winter-time.

- "Lighter systems" (group 2) decrease traffic safety. The control policy of these systems should be evaluated and changed if necessary.

- There are at least four different factors between groups 1 and 2: type of sign, automatic calculation of speed limits, warning signs and the share of 100 km/h used in winter.

- More statistics are needed to check the results.
Discussion

- Car drivers are very positive towards variable speed limits
  - reliable systems are crucial

- Results indicate that the inverse coloured signs are understood better and have more effect on drivers

- More information is needed to
  - check the results (statistically significance)
  - evaluate the effects of "more complicated systems" such as speed limits on:
    - motorway sections (2+2),
    - queue warning and lane control in tunnel sections
Thank you for Your attention!

Finnish studies in English:

- Nygård, M., Hautala, R., Effects of weather-controlled variable message signing in Finland - case highway 1 (E18), ITS Madrid 2003