SPEED BEHAVIOUR MONITORING IN ESTONIA

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INTRODUCTION

After re-establishing its independence in 1991 Estonian motorization development has been one of the most rapid in the world. During last ten years the car fleet has been almost doubled and car ownership level has grown from 137 in 1988 up to 297 in 2001 (table 1).

<table>
<thead>
<tr>
<th>Table 1. The main data of Estonian traffic</th>
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<tbody>
<tr>
<td>Indicator</td>
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<tr>
<td></td>
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<tr>
<td>Motor vehicles registered, 1000</td>
</tr>
<tr>
<td>Car ownership, cars per 1000 inh</td>
</tr>
<tr>
<td>Motor vehicle performance, mill.km</td>
</tr>
<tr>
<td>Fatalities</td>
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</tbody>
</table>

Remark *- Motor vehicle registration principles changed in 2001.

Today only 28 per cent of car fleet in Estonia is consisting of old Soviet made cars, even if 71 per cent of the fleet is elder than 10 years.

Estonian road safety remains one of the worst in Europe. The fatality risk in Estonia is 5-6 annual fatalities per 10,000 motor vehicles, which is 2-3 times worse than in western European countries, especially big is the difference with neighbouring Scandinavian countries (figure 1).

Estonian Road Administration (ERA) has set up targets for improvement of safety on roads.

Estonian National Road Safety Programme declares that the number of fatalities should be decreased by half in next ten-fifteen years (figure 2). Thus the number of fatalities should not exceed the number of 100 in 2014/2015. The National Road Safety Programme has been worked out and modified during last three-four years, but still now the document has not been approved by the Parliament, when the Government has once approved the main content and goals. But after the collapse of the former coalition the new Government has been postponed the Programme, mainly because of some political reasons.

Even without the formal acceptance the Estonian Road Administration takes the programme as the basis of safety development and plans its activities in accordance with the Programme. Thus the National Road Safety Programme has an unofficial status in Estonia.
Figure 1. Traffic safety comparison in Baltic and Nordic countries.

Figure 2. Safety targets of the National Traffic Safety Programme.
The main measures for safety development according to the National Road Safety programme are:

- Pedestrian and bicyclist safety;
- Road safety of national road network;
- Children and elderly road users safety;
- Drinking and driving;
- Driving education and enforcement;
- Road safety at poor driving conditions (night time, winter, etc.).

In spite of this, there has been large pressure to increase speed limits on Estonian rural roads.

**HISTORY OF SPEED EXPERIMENTS**

In Estonia, the general speed limit on rural roads is 90 kph and 50 kph on urban streets. This has given raise the question: is it possible to raise the speed limit without compromising safety?

In May 1997 without any preparation and with a surprise for traffic supervisors and experts, the Road Traffic Commission at the Ministry of Roads and Communications of Estonia decided to increase the general speed limit for summer period on all Estonian roads from 90 to 100 kph, except road sections with decreased speed limit. As this decision was made without any public discussion and expertise, it was nearly impossible to prepare the study of this decision's impact on road safety, road user opinion, or speed behaviour. A special speed commission was urgently set up by ERA, with an aim of analysing the road safety situation development in result of this "experiment".

The opinions of the speed committee about the general speed limit increase for summer period in Estonia were generally negative, but it was recommended by the committee to prepare the special study about the speed limits in Estonia for the summer of 1998.

The Road Traffic Commission of the Government of Estonia decided in early 1998 about an experiment where speed limits only on certain sections of Estonian main roads were increased from the regular 90 kph to 100, 110 or 120 kph for the period from May 1 to September 30, 1998. Estonian Road Administration organised the experiment and called for a study of the effects on safety. The study that was partly funded by the Finnish Ministry of Transport and Communications was conducted by Stratum, the local consultancy of Estonia. Mr. Veli-Pekka Kallberg from VTT Communities & Infrastructure from Finland served as consultant to Stratum.

Results of the study were generally as follows:

- Increased speed limits at summer period on road sections of technically sustainable level were not resulted by increase of road accidents but increase of accident severity;
- Speed study allowed to determine these demands, which road sections should pass for increased speed limits;
- It is important, that only road sections which pass technical demands could be used for increased speed limits;
• The technical demands (what road sections should pass for the use of raised speed limits) should be worked out and legalised by the Ministry of Roads and Communication.

Since 1999 the speed monitoring system has been started to develop in Estonia. The aims of the system are:

• Get regular, relevant and comparable data of speeding behaviour on Estonian roads;
• Monitoring the effects of seasonal speed limits on speeding and safety;
• Analyse the results of higher speed limits on road sections where the road conditions are following the technical demands;
• Give recommendations for the ongoing or next season on the basis of speed behaviour and safety development, if necessary;
• Developing the technical equipment and data processing opportunities.

The speed monitoring system has been developed in cooperation of Estonian Road Administration, Stratum and Technical Research Centre.

INTERNATIONAL RESEARCH ON SPEED AND SAFETY

The effect of speed on safety has been the subject of dozens of studies. An overwhelming majority of methodically sound studies have confirmed that accidents increase with increasing speed. These studies have resulted in a rule of thumb that a 1kph increase in the mean speed causes a 2 to 3 per cent increase in the number of injury accidents. Several studies have presented summaries of individual statistical studies, and all are in line with this rule (Andersson & Nilsson 1997, Ranta & Kallberg 1996).

Speed affects both the frequency and the severity of accidents. As speed increases the frequency of fatal accidents increases approximately twice as much as the frequency of all injury accidents (Andersson & Nilsson 1997, Ranta & Kallberg 1996). This finding is compatible with the Swedish model according to which all injury accidents increase as the 2nd power of the mean speed and fatal accidents as the 4th power of the mean speed (Andersson & Nilsson 1997). This relationship is illustrated in Figure 1 for the initial speed of 80 kph.
Figure 3. The effect of the change in the mean speed on the number of all injury accidents and fatal accidents according to the Swedish model for the initial speed of 80 kph.

Based the national distribution of accidents into severity categories and national unit values of accidents in different severity categories, it can be calculated that fatal and serious injury accidents, that are most affected by speed, comprise major part of national costs of road accidents in Europe (ETSC 1997). According to Finnish studies, raising of the speed limit by 10 kph increases the mean speed of traffic by 2 to 4 kph (Ranta & Kallberg 1996).

SCOPE OF SPEED MONITORING

There are approximately 1,200 kilometres of main roads, 2,700 kilometres of basic roads and 11,500 kilometres of local roads in Estonia.

During last three years the proposals of road sections for raised speed limit, proposed by local road authorities has become less. In result of this, also the kilometrage of road sections, which is allowed for the introduction of raised speed limit by the Road Administration, has also decreased. There are mainly three main reasons of this phenomenon:

(i)- Estonian Road Administration has less encouraged the local road authorities for proposals for raising the speed limits, also because of the less pressure from politicians;

(ii)- Road Administration’s speed commission has taken strict position towards the technical demands of road sections for raised speed limit;

(iii)- Analysis of previous experiences on certain sections has shown rather negative influence of raised speed limits on safety. Thus these sections have been eliminated from proposals until it’s technical condition remains unchanged.
To qualify for raising of the speed limit the road section has to pass the following criteria:

- Smaller than road’s average accident risk;
- Minimum roadway width between 7.5 m (for AADT1 less than 2,500 vehicles) and 10.5 m (for AADT less than 12,000 vehicles);
- Good pavement quality, maximum roughness less than 0.42 (IRI), minimum friction 0.4 (at 60 kph);
- Longitudinal visibility at least 400 m (or overtaking forbidden);
- Adequate intersection layout;
- Good condition of centre and edge line markings, good condition of traffic signs;
- Minimum length 3 kilometres for speed limit 100 kph and 5 kilometres for speed limit 110 or 120 kph.

Altogether about four hundred kilometres of proposed roads have passed these criteria. The amount of road kilometres, where the speed limit is been raised has generally remained unchanged during last years.

Table 2. Raised speed limits on Estonian roads, 1999-2002.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total km with raised speed limit</th>
<th>Of which 110 kph</th>
<th>Of which 100 kph</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>402</td>
<td>118</td>
<td>284</td>
</tr>
<tr>
<td>2001</td>
<td>480</td>
<td>68</td>
<td>412</td>
</tr>
<tr>
<td>2000</td>
<td>383</td>
<td>66</td>
<td>317</td>
</tr>
<tr>
<td>1999</td>
<td>386</td>
<td>68</td>
<td>318</td>
</tr>
</tbody>
</table>

The first speed limits were raised on May 1st and the last of these raised limits was changed back to 90 kph on October 8th.

**STUDY DESIGN AND DATA COLLECTION**

In the present the speed monitoring system has been used both on road sections with raised speed limit as well on road sections which did not pass the criteria or which were not proposed for speed raising by the local road authorities.

Thus these roads can give us a picture of what happens to speeds on sections where the speed limit remains unchanged. Comparison data on driving speeds was largely collected from all kind of road sections.

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1 Average Annual Daily Traffic
Speed measurements were made at automatic speed and volume measurement sites. They were made using automatic speed measurements devices that automatically record the speeds of vehicles driving over the induction loop embedded in or on the road surface.

Speed measurements take place on roads during periods of the year, but especially two periods are always chosen:

- Summer period with raised speed limits (normally between May and October);
- Winter period with dominating bad driving conditions (long darkness period of the day and poor visibility often, because of rain or snow).

**IMPACTS ON SPEED**

According to the measurements at the measuring sites the average speed during the period of increased speed limits has been nearly 96 kph (speed limit 110) and 93 kph (speed limit 100).

It is worth noting that the mean speed in the before period was approximately the same as the speed limit of the road, meaning that about fifty per cent of the drivers exceeded the speed limit. The mean speed on the 90-kph roads was as high as 89.7 kph.

<table>
<thead>
<tr>
<th>Speed limit</th>
<th>Observation period</th>
<th>Mean speed (kph)</th>
<th>85 th percentile speed (kph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>110 kph road (Road No 2)</td>
<td>Before (90 kph)</td>
<td>90.2</td>
<td>98.9</td>
</tr>
<tr>
<td></td>
<td>During (110 kph)</td>
<td>95.9</td>
<td>108.4</td>
</tr>
<tr>
<td></td>
<td>After (90 kph)</td>
<td>94.7</td>
<td>105.1</td>
</tr>
<tr>
<td>100 kph road (Road No 5)</td>
<td>Before (90 kph)</td>
<td>91.2</td>
<td>100.7</td>
</tr>
<tr>
<td></td>
<td>During (100 kph)</td>
<td>91.5</td>
<td>104.3</td>
</tr>
<tr>
<td></td>
<td>After (90 kph)</td>
<td>91.3</td>
<td>103.1</td>
</tr>
</tbody>
</table>

In general the impact of increased speed limits were generally in line with the finding of international studies that raising speed limit by 10 kph increases mean speed by 2 to 4 kph. But especially characteristic to Estonian situation is extremely high level of mean speeds in spite of speed limit. Thus the mean speed is often close to the speed limit level or even higher than an actual speed limit. This fact could be explained by poor enforcement and wrong attitudes of road users towards the knowledge of road safety.
Figure 4. Results of the speed measurements on Estonian main roads after introducing increased speed limits.

Figure 5. Speed characteristics development, 1995-2001.
IMPACTS ON ACCIDENTS

Generally the road safety level in Estonia has increased when comparing with previous periods since 1998.

When comparing road accidents on sections with increased speed limit with sections where the speed limit remains unchanged it could be stated that the number of accidents and casualties has not increased due to raised speed limits in general. On 57 road sections where speed was raised last year, accidents happened on 19, and 38 sections remained without any serious accidents. On 19 sectors mentioned, 26 accidents occurred, and there was only one road section where the number of accidents was more than 2. This section on road No2 (speed limit 110 kph) was considered as dangerous and is now recommended for the introduction of additional safety measures. But some sectors, passing the criteria, have still resulted with a number of accidents.

Thus we can state that road section evaluation criteria for speed limit increasing is right in general. Same time, higher speeds were resulted with more serious results of the road accidents.

ROAD USERS' OPINIONS

One of the most popular statements, especially among the people who are fighting for the higher speed limits is that the majority of road users are against speed limits as they are today, and it is the reason why such a big percentage of road users are not following the existing speed limit system.

Right after the first experiments with raised speed limits as well as during last two years we have made a large scale road users opinion study. This study is consisting of questionnaire study of road users about safety measures introduced in Estonia as well as road users behavioural processing information collection on roads and streets (field study).

The first study, right after the first experiments with increased speed limits included also a survey where 1,676 drivers were interviewed at the roadside about the speed limit experiment and speed limits in general.

Generally the drivers support the speed limits used on Estonian roads. Majority of road users will accept higher speed limits for summer period and decreased limits for winter period, when local roads' limits on winter could be even decreased up to 80 kph instead of existing 90).

Table 4. Road users’ proposed and existing speed limits

<table>
<thead>
<tr>
<th>Road type</th>
<th>Winter period, kph</th>
<th>Existing speed limit, kph</th>
<th>Summer period, kph</th>
<th>Existing speed limit, kph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual carriageway</td>
<td>100</td>
<td>90</td>
<td>120</td>
<td>110/90</td>
</tr>
<tr>
<td>Single carriageway</td>
<td>90</td>
<td>90</td>
<td>100</td>
<td>100/90</td>
</tr>
<tr>
<td>Local roads</td>
<td>80</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Urban roads</td>
<td>50</td>
<td>50</td>
<td>60</td>
<td>50</td>
</tr>
</tbody>
</table>
When asking the road users—does higher speed limits will affect negatively to road safety situation, we got answers as follows:

Speed limit increase will have:

- big negative effect on road safety: 434 answers (26% of total)
- small negative effect: 501 answers (30%)
- no effect at all, neither negative or positive: 285 answers (17%)
- a little positive effect: 376 answers (22%)
- big positive effect: 79 answers (5%)

Thus—generally the road users support the speed limits used on Estonian roads. Majority of road users will accept higher speed limits for summer period and decreased limits for winter period, when local roads’ limits on winter could be even decreased up to 80 kph instead of existing 90).

During last two years we have conducted a large-scale road users’ behaviour study. This study includes both the questionnaire and field studies. A normal sample, consisting of 1,000 road user’ opinion was questioned about their attitudes towards the traffic safety measures introduced, including speed limits and speed behaviour.

Due to the study the speeding has been considered to be one of the most dangerous behavioural aspects (together with drinking and driving) among the 13 chosen.

<table>
<thead>
<tr>
<th>Table 5. Road users’ ratings of road safety measures usage.</th>
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<tbody>
<tr>
<td><strong>Average Rating</strong></td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>1 Drinking and driving</td>
</tr>
<tr>
<td>2 Speeding on rural roads</td>
</tr>
<tr>
<td>3 Usage of seat belts, back seat</td>
</tr>
<tr>
<td>4 Speeding, urban areas</td>
</tr>
<tr>
<td>5 Usage of pedestrian reflectors by adults</td>
</tr>
</tbody>
</table>

**Overall road user safety behaviour**: 3.02 +0.05

*Subjects were asked to rate the adherence to the listed items and their responses were assigned the following point values: 1. poor, 2. unsatisfactory, 3. satisfactory, 4. good and 5. very good.**

**The changes in the adherence over the last year to these listed items were asked and their responses scaled as follows: -2 substantial deterioration; -1 moderate deterioration; 0 no change; +1 moderate improvement; and +2 substantial improvement.**
CONCLUSIONS

Speed monitoring reports can make general conclusions as follows:

- Increased speed limits at summer period on road sections of technically sustainable level were not resulted by increase of road accidents but increase of accident severity;
- Increase of mean speeds was in average 3…6 kph per 10 kph of increased speed limit. Mean speed increased by 1 kph also on road sections were speed limit remained unchanged;
- Road users' opinion is supporting the seasonal speed limits use;
- Speeding is considered as one of the most important reasons for existing poor safety situation is Estonia;
- Speed study allowed to determine these demands, which road sections should pass for increased speed limits;
- It is not recommended not to encourage the speed limit raise if the local road authority looks it unnecessary;
- It is important:
  - that only road sections which pass technical demands could be used for increased speed limits;
  - that the technical demands (that road sections should pass for the use of raised speed limits) have been legalised now by the Ministry of Roads and Communication;
  - to develop further the speed enforcement system in Estonia;
  - that the speed monitoring system in Estonia has been established now, but it needs some further development;
  - to prepare the use of automatic speed measurement system in Estonia, first on three on main roads;
  - to keep similar studies in urban areas of Estonia.
REFERENCES


