Case Study
A-Hungary
Road 4, Nyíregyháza – Ukraine border

It is well known that different road features contribute to the likelihood and severity of crashes. Changing or upgrading these road features may reduce risk. This case study is one of a series carried out on roads in south-east Europe to demonstrate a process of road assessment and crash reduction where Crash Risk Mapping can guide a selective Star Rating process.

Network-Wide Road Assessment

The SENSoR project was funded by the South East Europe Transnational Cooperation Programme, co-funded by the European Union and used iRAP protocols. The project was launched in September 2012 and completed in November 2014. The 2-year project brought together data from 14 countries – Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the then Former Yugoslav Republic of Macedonia, Greece, Hungary, Montenegro, Romania, Republic of Moldova, Serbia, Slovakia, Slovenia, and Ukraine. It included more than 27,000km of Crash Risk Mapping using fatal and serious crash data and Star Rating of about 19,000km. KTI (Institute for Transport Sciences Non-Profit Ltd and AF-CityPlan) were involved in the part of the project in Hungary. The report of the study was prepared by AF-CityPlan with support from the Road Safety Foundation.
The Crash Risk Maps identified the risk of being involved in a fatal or serious crash per billion vehicle-kilometres travelled. Figure 1 shows the national Crash Risk Map for Hungary. This case study shows how these maps may be used to guide crash countermeasures for different road users. The majority of the text and all images in this case study are used with permission from reports in the SENSOr study and as part of capitalisation of that project\(^1\) foreseen in the SLAIN proposal (section 2.2).

**Detailed Road Assessment**

Road 4 (circled in Figure 1) was identified from the Crash Risk Mapping as one of those worthy of further study. Road 4 starts in Budapest, and continues westward to Debrecen and from there northward to Nyíregyháza, where the case study section starts, ending at the Ukraine border (Figure 2). The section is 55km long. It is one of two major connections to Ukraine. The recorded traffic flow in 2013 was between 4400 and 6500 vehicles per 24 hours. It is a single-carriageway road through undeveloped or agricultural areas.

The Star Rating results for this particular section are very poor (Figure 3). After smoothing, almost entire length of the road for all of the four user groups was awarded only one star, rarely with two stars, which means very high-risk road.

To illustrate the risk distribution along the road, a specific VIDA tool can be used – the Risk Worm. The Risk Worm helps to quickly identify problematic locations when it displays the distribution of relative risk along the selected section in a graph. The “spikes” in the graph are usually connected to intersections, sharp curves or similar single factors which increase the risk significantly. The Risk Worm for the road 4 is depicted in Figure 4. The graph shows the risk distribution before smoothing, and this is why some short sections of the road fall in the 4-stars or even 3-stars category.

The statistics of coded attributes along the Road 4 give clue on the reason behind the poor rating. The entire section is undivided; the road condition was mostly coded as “medium quality”. The attribute that often lowers the overall road safety is the roadside objects. Along the road 4, frequent trees, signs, poles or posts with a diameter of >10cm are present, together with a deep drainage ditch along a significant road section. All these parameters together with high operating speed of 90km/h and frequent poor quality intersections resulted in the poor vehicle occupant Star Rating. Facilities for vulnerable road users are present along a very small part of the section which resulted in poor rating for pedestrians and bicyclists. Examples of the above stated safety deficits are shown in the following pictures (Figures 5-10).

\(^{1}\) [http://sensorproject.militos.org/](http://sensorproject.militos.org/) Lead partner Make Roads Safe Hellas
Figure 5. Aggressive non-frangible structure on the right side is very common in this section.

Figure 6. Poles, solid signs and trees in proximity of the road represent dangerous objects.

Figure 7. Deep drainage ditch with steep slopes on the right side.

Figure 8. Intersection without proper marking, signing and with bad alignment of its legs.

Figure 9. Trees on the road embankment represent dangerous objects.

Figure 10. Poles on the soft shoulder are very dangerous objects.
Proposed Countermeasures to be Implemented

The Safer Roads Investment Plan (SRIP) presents all the countermeasures proved able to provide the greater safety capacity and maximize the benefit over spent cost of the planned investments. The cost of each countermeasure is compared to the value of life and serious injuries that could be saved and Benefit to Cost Ratio (BCR) is calculated for each countermeasure proposed. The minimum threshold BCR for each 100m section was set to 1 and subsequently 3. Examples on parts of the network in subsequent report sections consider all economically justifiable measures and therefore a threshold BCR of 1.

Figure 11 presents the top 10 countermeasures. A threshold BCR=1 is used here and some costings varied to ensure fuller consideration of potential candidate sites.

<table>
<thead>
<tr>
<th>Countermeasure</th>
<th>Length / Sites</th>
<th>FSIs / FSI saved</th>
<th>PV of safety benefit</th>
<th>Estimated Cost</th>
<th>Cost per FSI saved</th>
<th>Program BCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional lane (2+1 road with barrier)</td>
<td>46.1 km</td>
<td>150</td>
<td>4,068,097,337</td>
<td>1,515,355,380</td>
<td>9,370,511</td>
<td>3</td>
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<tr>
<td>Skid Resistance (paved road)</td>
<td>27.9 km</td>
<td>81</td>
<td>2,051,907,154</td>
<td>1,353,305,010</td>
<td>18,822,490</td>
<td>1</td>
</tr>
<tr>
<td>Shoulder rumble strips</td>
<td>48.8 km</td>
<td>66</td>
<td>1,677,259,431</td>
<td>357,971,300</td>
<td>5,368,934</td>
<td>5</td>
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<tr>
<td>Footpath provision driver side (adjacent to road)</td>
<td>46.1 km</td>
<td>54</td>
<td>1,380,093,053</td>
<td>966,438,390</td>
<td>17,615,943</td>
<td>1</td>
</tr>
<tr>
<td>Footpath provision passenger side (adjacent to road)</td>
<td>42.5 km</td>
<td>48</td>
<td>1,224,871,478</td>
<td>885,094,050</td>
<td>18,177,703</td>
<td>1</td>
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<tr>
<td>Roadside barriers - driver side</td>
<td>36.6 km</td>
<td>45</td>
<td>1,142,871,593</td>
<td>783,112,170</td>
<td>17,237,197</td>
<td>1</td>
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<tr>
<td>Roadside barriers - passenger side</td>
<td>34.8 km</td>
<td>43</td>
<td>1,089,409,797</td>
<td>744,104,590</td>
<td>17,182,360</td>
<td>1</td>
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<td>Shoulder sealing driver side (&gt;1m)</td>
<td>53.8 km</td>
<td>31</td>
<td>789,896,763</td>
<td>179,766,970</td>
<td>5,725,055</td>
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<td>Bicycle Lane (on-road)</td>
<td>37.9 km</td>
<td>29</td>
<td>747,952,327</td>
<td>430,502,680</td>
<td>14,479,116</td>
<td>2</td>
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<tr>
<td>Street lighting (mid-block)</td>
<td>10.3 km</td>
<td>20</td>
<td>517,234,369</td>
<td>692,190,570</td>
<td>33,664,984</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Figure 11. SRIP for the Nyíregyháza – Ukraine border section
Assessment of Star Rating after Proposed Improvements

The Star Rating for vehicle occupants would be significantly improved after implementing this plan. The motorcyclists’ safety would also be noticeably better. As stated in the previous chapter, the effect on vulnerable road users is not as tremendous as in case of vehicle occupants but still significant. The Star Rating results of this section after implementing the SRIP are shown in Figures 12 and 13.

Conclusions

Safety deficits were identified in terms of frequent hazardous objects along the roads (trees, poles, ditches, barrier ends), missing safety barriers, inadequate quality of intersections and or lacking facilities for pedestrians and bicyclists.

The likely most common reasons of deaths or serious injuries on the inspected network were:

- Hazardous objects close to the road
- Lack of run-off protection
- Poor-quality junctions where brutal right-angled side-impacts may occur
- Lack of head-on protection

If all the proposed measures were applied in the Safer Roads Investment Plan for Road 4 the proposed countermeasures would save approx. 610 fatalities and serious injuries over the analysis period of 20 years. The estimated cost is about 26.3 million EUR and this investment should bring almost two times more benefits in saved lives and injuries.