Case Study
B-Italy
SS 13 Pontebbana

The information detailed in this case study has been provided by ANAS. The case study shows how a traditional crash “before and after” study on part of a network may be informed and enriched by the use of complementary iRAP data.

The SS 13 Pontebbana extends from the city of Venice (CH.7+252) to the state border with Austria near Coccau di Sopra (Udine) (CH.228+811) and crosses the regions of Veneto and Friuli Venezia Giulia in northern Italy. The case study is located between CH.40+00 and CH.44+00 at the municipality of Susegana. On this stretch the SS 13 has a single carriageway with one lane for each direction and the Average Annual Daily Traffic flow (AADT) is about 15,000 vehicles per day.

This section of the SS 13 has a history of being a high-risk road according to the Crash Risk Mapping protocol devised by iRAP and EuroRAP. See for example Figure 3 which is the European map published by EuroRAP as far back as 2007 using data from 2004-2006.

Construction was carried out during 2006-2007.

Interventions

Three intersection interventions were implemented between 2006 and 2007 at a total investment of €1,773,915. These are shown in Figure 4.

The following construction works have been carried out on this section:

1. The intersection with the SP 34 in Priula di Susegana (pk 40+200) was transformed to a roundabout with 4 legs (external diameter of 51 m.).

2. Upgrading of the “T” intersection channelised between the SP 34 and the SS 13 “Pontebbana” at CH.41+950. The project also provided for the construction of a lighting system at the intersection.

3. Construction of a roundabout with 5 legs with an internal diameter of 50 metres to replace the intersection at grade between the SP 138 and SS 13 (CH.43+000).
Case Study

Results

*iRAP Risk Assessment*

The iRAP Demonstrator has been used to illustrate what the effect of these measures has been on the Star Rating for two of these three sections of road. The complex intersection of the SP 34 and the SS 13 at “Pontebbana” has not been modelled because this intersection has effectively been converted from one intersection to three separate and simpler ones and in this particular situation the iRAP model may not be sufficiently sensitive to assess the change. It is assumed in this rating that the roads are as described in the images and diagrams above and that the speed limit in the urban area is 50km/h and in the rural area 90km/h. In-flow from the side arms is assumed to be 100-1000 AADT. It is assumed that the operating speed (and de facto speed limit) at the intersection of SP 13 and SP 34 drops to 60km/h after installation of the roundabout.

Introduction of roundabouts provide an improvement in Star Ratings for vehicle occupants at the two intersections where they have been installed (Table 1, Figures 8 and 9). Motorcyclist safety is improved very marginally in the urban setting (Figure 8) and more in the rural, from 1-star to 2-star. (Figure 9).

<table>
<thead>
<tr>
<th>Section including:</th>
<th>Vehicle occupant Star Rating Before</th>
<th>Vehicle occupant Star Rating After</th>
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<tbody>
<tr>
<td>Intersection with the SP 34 in Priula di Suseggana</td>
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<td>✭✭✭✭</td>
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A “traditional” before and after study has been carried out using crash data. Since the works were completed between December 2006 and July 2007, the analysis of road crash data was carried out considering the years 2001-2005 as the before period and the years 2008-2015 as the after period.

The trend of road crashes shows a decrease in the number of crashes with a reduction in the average annual number of road crashes of 38% in the years following the construction of roundabouts, going from about 9.4 crashes per year between 2001 and 2005 to about 6 crashes per year in the period 2008-2015. The same percentage reduction was observed for the average annual number of deaths and injuries, which decreased from 0.4 to 0.3 and from 14.6 to 9 respectively. The following Charts present the road crashes and injuries recorded between 2001 and 2015, at the specific road section.

If only the first five years after the end of the construction works are taken into account, the reduction in the average annual number of crashes and the average number of injured would be 32%. With the annual number of crashes reducing from 9.4 to 6.4 and the average number of injured from 14.6 to 10. While the number of fatalities remain the same.

The crash data indicators calculated for periods before and after the road section under assessment are:

<table>
<thead>
<tr>
<th>Crashes per kilometer</th>
<th>Mortality rate (n. of deaths every 100 accidents)</th>
<th>Casualty rate (n. of deaths + n. of injured)/n. of accidents</th>
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</thead>
<tbody>
<tr>
<td>Before</td>
<td>2.35</td>
<td>4.26</td>
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<tr>
<td>After</td>
<td>1.60</td>
<td>6.25</td>
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</table>

The data in charts 1-3 show year-to-year variation in crashes. Table 2 shows a reduction in crashes but not in their severity.

In terms of type of the crashes, a reduction in head-on and side collisions and run-off road crashes was recorded in the period following the improvement of the intersections, while there was an increase in rear-end collisions and crashes involving pedestrians.
Assessment of Crash Data

The analyses were conducted by analysing road crash data before and after the implementation of the measures and comparing the costs of the investment with the economic benefits in terms of reduction in social cost.

For each measure, therefore, the following have been evaluated associated with before and after infrastructure upgrade:

1. changes in the average annual number of crashes and deaths
2. changes in the crash indicators:
   a) frequency of crashes
   b) mortality rate
   c) casualty rate;
3. changes in the types of crashes
4. effectiveness and efficiency of the measures

Where the effectiveness is calculated based on the observed before crashes (scaled up for any variation in the flow) in comparison with the observed crashes after:

\[
\text{Effectiveness \%} = \left( \frac{\text{FA}_{\text{after}} - \text{FA}_{\text{before}}}{\text{FA}_{\text{before}}} \right) \times 100
\]

For the service life the indications of the “Handbook of Road Safety Measures” have been taken as a reference.

For the calculation of the social cost, reference was made to the study conducted in 2010 by the General Directorate for Road Safety of the Ministry of Infrastructure and Transport, whose approach is based on Human Capital, i.e. the economic consequences of road accidents.

For the calculation of the social cost, the formula used is:

\[
\text{Social Cost} = (\text{CMF} \times \text{NF}) + (\text{CMm} \times \text{NM}) + (\text{CG} \times \text{NI})
\]

where:
- CMF is the average cost for an injured person, of €42,219.00
- NF number of injured
- CMm is the average cost per death, of €1,503,990.00
- NM number of deaths
- CG are the average operating costs per accident, of €10,986
- NI number of accidents

Based on this approach and using average daily traffic values (AADT) before: 12,593 veh/day and after: 15,879 veh/day. The effectiveness is approximately 46%.

Finally, in order to calculate the efficiency of the intervention, the benefit cost ratio (BCR) has been considered. The benefits have been evaluated as proposed in the Ministry of Infrastructure and Transport guidelines through the product between the average annual reduction of social costs and the service life for the road safety measures. The costs are those related to the implementation of the measures.

In terms of average social cost there is a decrease of about 17% in the five years following the end of the construction works.

<table>
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<th>SS 13 Pontebbana</th>
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<tr>
<td>CH.40,000 – ch.44,000</td>
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<td><strong>Average annual social costs</strong></td>
</tr>
<tr>
<td>Before</td>
</tr>
<tr>
<td>After</td>
</tr>
<tr>
<td>% change</td>
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Therefore, the efficiency of the measures, considering for roundabouts a service life of 25 years and a total investment of €1,773,915 is a BCR of 1.27.
Conclusions

Crashes after the upgrade to these intersections have reduced. Further analysis to check how this site compares with untreated control sites would be useful. Modelling using the iRAP Star Rating shows a potential increase in safety at the two sites assessed (for both vehicle occupants and motorcyclists). The Star Rating and crash analysis are useful tools as supporting evidence of the benefits of scheme changes.

The Star Rating assessment is of course available without having to wait for the assessment of the after period (commonly 3-5 years) and can also be used to assess the safety of designs at the planning stage.