Case Study
B-Italy
SS 114 Orientale Sicula (km 110+000, Sicily)

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 114 Orientale Sicula is a road in Sicily (South of Italy). It extends from the city of Messina (km 0+000) to the junction with A18 motorway (km 156+600) through the provinces of Messina, Catania and Syracuse.

The case study concerns an intervention carried out to signalise the intersection between the SS 194 and the SS 114 at the south suburbs of Catania (km 110+000).

Figure 1. Location of case study

Interventions

A large-diameter roundabout (100 m) with three legs, plus an “emergency” leg, was built, together with a free central area. The cross section of the approaching roads have wide lanes of 4.00 m width and paved shoulder of 1.50 m, while the roundabout has 2 lanes and paved shoulders. It replaces the 3-leg intersection shown in Figure 3.

The AADT was around 26,600 vehicles before the construction of the roundabout and around 13,500 vehicles after the operation. This decrease in traffic flows is due to the construction of the nearby Catania-Siracusa motorway.

The implementation was carried out between 2006 and 2007 for the total cost of € 1,832,561.
The iRAP Demonstrator has been used to illustrate what the effect of this measure has been on the Star Rating for this section of road. It is assumed in this rating that the roads are as described in the text, images and diagrams above and that the speed limit in the rural area is 90km/h and the operating speed is 100km/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 drops to 60km/h after installation of the roundabout due to the deflection in the design geometry.

Introduction of roundabouts provide an improvement in Star Ratings for vehicle occupants at the intersections (Table 1 and Figure 4) from 1- to 3-star. Motorcyclist safety is improved from 1-star to 2-star (the relatively smaller improvement due to the inherent vulnerability of motorcyclists and particularly at roundabouts). (Please note that in the “before” situation the vehicle occupant and motorcyclist Star Rating Scores are beyond the upper limit of the chart scale and so do not fully convey risk and potentially omit some of the elements of that risk.)
Crash Data

A “traditional” before and after study has been carried out using crash data, for the intersection proximity (i.e. from CH.110+000 to CH.111+000). Since the works were completed in the period 2006-2007, 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.

At the intersection (CH.110+000 – CH.111+000) 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 70% in the years following the construction works, going from about 2.6 crashes per year between 2001 and 2005 to about 0.8 crashes per year in the period 2008-2015. A 77% percentage reduction was observed for the average annual number of injuries, which decreased from 4.4 to 1 injured/year.

The following Charts present the road crashes and injuries recorded between 2001 and 2015, at the specific road section.

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

The data highlight that the measures had a significant effect on the number of events and a small reduction in severity.

<table>
<thead>
<tr>
<th></th>
<th>Crashes per kilometer</th>
<th>Mortality rate (n. of deaths every 100 crashes)</th>
<th>Casualty rate (n. of deaths + n. of injured)/n. of crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>2.60</td>
<td>0.00</td>
<td>1.69</td>
</tr>
<tr>
<td>After</td>
<td>1.00</td>
<td>0.00</td>
<td>1.20</td>
</tr>
</tbody>
</table>

Table 2. Road crash severity rates

<table>
<thead>
<tr>
<th></th>
<th>Head-on collision</th>
<th>Side impact collision</th>
<th>Sideswipe collision</th>
<th>Rear-end collision</th>
<th>Impact with vehicle at a temporary stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>7.7%</td>
<td>23.1%</td>
<td>7.7%</td>
<td>53.8%</td>
<td>7.7%</td>
</tr>
<tr>
<td>After</td>
<td>16.7%</td>
<td>33.3%</td>
<td>0.0%</td>
<td>50.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Table 3. Types of road crashes
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:

![Image: Chart 3. SS 114 – Type of crashes - Crashes percentage 'before' and 'after']

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.

In terms of average social cost there is a decrease of about 71% in the five years following the end of the construction works.

Based on this approach and using average daily traffic values (AADT) before: 26,661 veh/day and after: 13,561 veh/day. The effectiveness is approximately 24%.

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.

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

Moreover, the efficiency of the measures, considering for roundabouts a service life of 25 years and a total investment of € 1,832,561 is a BCR of 2.1.

<table>
<thead>
<tr>
<th>SS 114 Orientale Sicula</th>
<th>CH.110+000 – CH.111+000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average annual social costs</td>
<td></td>
</tr>
<tr>
<td>Before</td>
<td>€ 214,327.2</td>
</tr>
<tr>
<td>After</td>
<td>€ 61,648.8</td>
</tr>
<tr>
<td>% change</td>
<td>- 71%</td>
</tr>
</tbody>
</table>

Table 4. Average annual social costs
Conclusions

Crashes and the severity of crashes after the upgrade to this intersection have reduced. Further analysis to check how this site compares with untreated control sites would be useful. Modelling using the iRAP Star Rating also shows an increase in safety, vehicle occupant safety increasing by 2 stars and safety for motorcyclists by 1 star. 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.