

Road Safety Case Studies

iRAP road and design assessments and outcomes: A case study from Moldova

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Key Findings

- This is a before and after study of reconstruction of 93km of the M2-R7 in Moldova.
- It is estimated that around 300 fatal and serious injuries will be reduced over 20 years.
- Roadside protection, intersections and village quality have been improved.
- The percentage of relevant road sections rated 3-star or better has increased.
- An iRAP Safer Roads Investment Plan and safety audit show further savings possible.

Abstract

This work, supported by the Millennium Challenge Corporation, assessed the safety of the road infrastructure of a 93km section of the M2-R7 in Moldova in 2010 and 2015, before and after rehabilitation. The iRAP Star Rating with a Safer Roads Investment Plan guided provision of more than 22km of footway (sidewalk), a doubling in the number of pedestrian crossings to more than 50, installation of 12.3km of safety barrier, improvements in the quality of curves, the overall quality of the road surface, delineation and enhancement in the quality of intersections. Prior to upgrading, the safety rating of the road for pedestrians was poor (84% of the road rated only 1- and 2-star) and, for vehicle occupants, the road was predominantly 1- and 2-star (87%). Since reconstruction, the Star Ratings have improved. The percentage of the road rating 3-star and above has increased by around 30 percentage points for pedestrians, cyclists, motorcyclists and vehicle occupants. The post-construction Road Safety Audit by AECOM includes recommendations for improvements at intersections, in villages, on roadsides and for some measures related to the route. The pre-construction EuroRAP investment proposal showed that, for an overall package of safety countermeasures, there would be a reduction of around 300 killed or seriously injured casualties over 20 years, with a Benefit Cost Ratio approaching 4, a saving of almost a quarter of casualties on the road had there not been upgrading.

Keywords

infrastructure, star rating, investment, benefit-cost

Introduction

In 2010 EuroRAP was involved in the safety assessment of 93km of the M2-R7 in Moldova prior to the upgrading work funded by Millennium Challenge Corporation (MCC). The route runs centrally, north-south, from near Moldova's border with Ukraine, reaching halfway to the capital, Chisinau. The EuroRAP work provided a "Star Rating" for

the safety of this road for four road-user groups and showed that, for vehicle occupants, the road was predominantly 1- and 2-star (87%) and that, for pedestrians, 84% rated 1- and 2-star. A secondary part of the assessment was to provide a Star Rating from the design plans provided by URS Corporation (formerly United Research Services) and assess the likely character of the improved road. The M2-R7 upgrade and rehabilitation was designed to reduce

transportation costs and increase safety, commerce, access and opportunity through the rehabilitation of an existing 93km road segment. Savings would include vehicle operating costs and time for passengers and goods and reductions in road maintenance costs.

The aim of this paper is to compare the original Star Rating and Star Rating from Design road safety assessment results produced during 2010-11 with post-construction assessment results for the recently completed upgrades. It included a survey of speeds on the road and a Road Safety Audit of selected locations so as to maximise learning opportunities and provide opportunities to generalise to other projects.

Improvements made to the M2-R7 in Moldova

The pre-construction EuroRAP investment proposal showed that, for an overall package of safety countermeasures, there would be a reduction of around 300 killed or seriously injured casualties over 20 years, with a Benefit Cost Ratio approaching 4, a saving of almost a quarter of casualties on the road had there not been upgrading.

The quality of the M2-R7 was substantially improved with many enhanced features. This included widespread use of higher standards of roadside protection, the improvement of many intersection and improvements to the ambience and

visual quality of the villages and in provision for pedestrians. The following upgrades were made to the M2-R7:

- All existing roadside barrier was removed. This was previously of a very poor standard and quality. 12.3km of barrier was installed (Figure 1).
- More than 22km of sidewalk has been reconstructed or constructed.
- There has been a doubling in the number of village sections with pedestrian crossings to around 50.
- Improvements in the quality of curves, the overall quality of the road surface, delineation, enhancement in the quality of intersections (Figure 2) and greater consistency in the width of lanes, now almost exclusively recorded as “wide”.

The iRAP Star Ratings for the M2-R7 generally improved (Table 1). The percentage of the road with 3-star and above for vehicle occupants, motorcyclists and bicyclists all increased by around 30 percentage points. Due to the large distances between villages, there is very limited pedestrian activity on these road sections. Therefore, only the pedestrian activity in villages where 50km/h and 30km/h speed limit were present was rated. If any pedestrians are present on sections between villages, some will choose to walk on unpaved shoulders, on the carriageway, on parallel agricultural ways or on informal footpaths where they exist.



Figure 1. (a) Uncontrolled and unmarked 3-arm intersection “before”; (b) Well-designed and signed roundabout “after”.

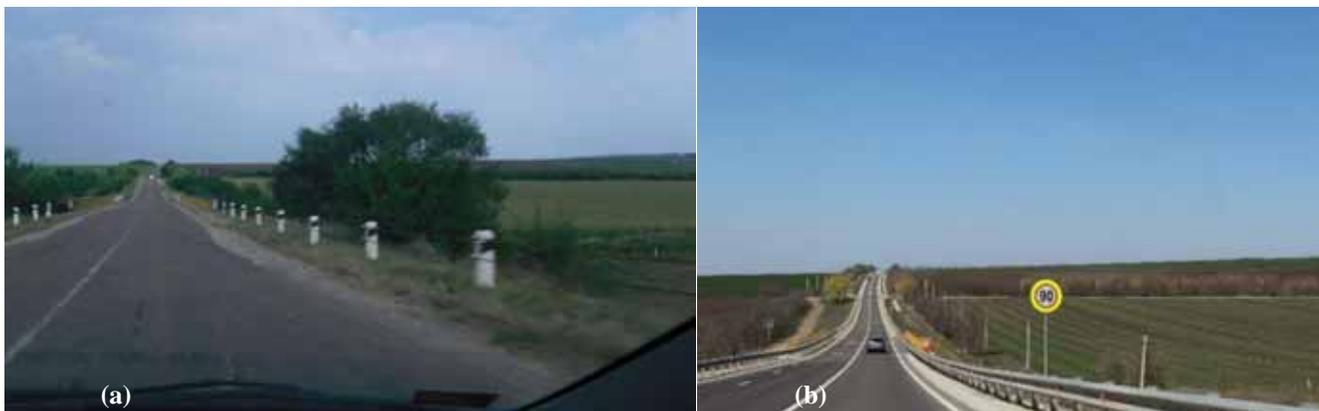


Figure 2. (a) Poor quality markings and barrier “before”; (b) Improved markings and protection “after”.

Table 1. Star Ratings of before upgrades (B) and after upgrades (A) and the difference (D)^a

Star Rating	Vehicle occupants			Motorcyclists			Pedestrians ^b			Bicyclists		
	B	A	D	B	A	D	B	A	D	B	A	D
5	0%	0%	0%	0%	0%	0%	0%	8%	8%	0%	0%	0%
4	0%	0%	0%	0%	0%	0%	0%	19%	19%	0%	1%	1%
3	13%	37%	24%	5%	33%	28%	67%	45%	22%	13%	45%	32%
2	17%	46%	29%	20%	28%	8%	24%	28%	4%	13%	50%	37%
1	70%	16%	54%	75%	29%	46%	8%	0%	8%	75%	3%	72%
Total	100%	100%	0%	100%	100%	0%	100%	100%	0%	100%	100%	0%

^a In addition to the M2-R7, three short sections of rehabilitated road were rated – the L110 at its intersection with the M2 (1.3km, – this scored 3-star for vehicle occupants and motorcyclists, 2-star for bicyclists and 1-star for pedestrians assuming a 50km/h speed limit), the R14 north from its intersection with the M2 (1.8km – scoring 3-star for all road-users other than pedestrians (1-star)) and the northern extension from the M2-R7 to the Soroca Fire and Rescue Station entrance (0.5km – scoring 3-star for all users).

^b Pedestrian activity is predominantly in the village areas (where 50km/h and 30km/h speed limit present) and only these areas are reported on here. Percentages may not sum to 100 because of rounding.

Results can be summarised as follows.

- The percentage of road rated 3-stars or better for vehicle occupants increased from 13% to 37%.
- The percentage of road rated 3-stars or better for motorcyclists increased from 5% to 33%.
- The percentage of road rated 3-stars or better for pedestrians in villages increased from 67% to 72% (with a notable increase in 4-star and 5-star provision (from none to 27% in total)).
- The percentage of road rated 3-stars or better for bicyclists increased from 13% to 46%.

The analysis shows that if speed compliance were improved, there would be a substantial improvement of the Star Ratings for pedestrians in urban areas and for vehicle occupants in rural areas.

Speed survey

The level of risk of death or serious injury on a road is highly dependent on the speed at which traffic travels. iRAP policy is that risk assessments are made using the “operating speed” on a road. Operating speed is defined as being the greater of the legislated speed limit or the measured 85th percentile speed. The posted speed limits for the M2-R7 were determined by the design teams in consultation with the traffic police and village mayors as part of the design process.

Rather than measure speeds at static sites along the M2 using a parked vehicle and traffic camera it was decided to

work with the Moldova traffic police in collecting data from a moving unmarked police car. Trials using a parked car at two static locations proved unsatisfactory – the presence of the vehicle adjacent to the carriageway alerted drivers to the presence of the speed survey and they in turn warned oncoming drivers to reduce their speed. The EuroRAP team therefore arranged with the Moldova police to use their equipment in an unmarked police car moving in the traffic stream to record the speeds of all oncoming vehicles in the journey described above, along the entire surveyed length of the route.

Photographs from this survey were then assessed and entered on a database noting the speed limit, vehicle type and the highest speed of any recorded for each vehicle photographed (where more than one image per vehicle was taken). If several images were taken of a single vehicle in a village location, then any available reading on a 30km/h section was used in preference to that on a 50km/h section. The speed of 21 vehicles in the sample (less than 5%) may have been limited to some extent by vehicles ahead of them, the overall result presented below therefore possibly understating the travelled speeds.

The speed survey data set included a sample of 466 (391 car/van/mini-bus, 75 truck) taken during a drive from Sarateni to Soroca (M2) and the R7 to Drochia junction. It included an additional double run (whilst driving in both direction within the village) in Prodenisti (57 observations). These results are presented in Table 2.

Mean speeds in the villages were typically lower than on the rural road sections for both categories of vehicle (cars/vans/minibuses versus trucks) although the mean speeds of (the small sample of) trucks in the 30 and 70km/h limits differed little. The 85thile speeds of the sample of truck speeds on the 30km/h section was higher than the sample of cars, vans and minibuses. For cars, vans and minibuses, 85thile speeds on the rural sections were more than 15km/h higher than the posted speed limit. In the villages, 85thile speeds for vehicles were more than 25km/h and 40 km/h respectively above the posted limits of 50km/h and 30km/h for cars etc.

At the 30km/h speed limit, all vehicles exceed the limit, at 50km/h the great minority exceed the limit, but at the 70km/h and 90km/h limit there is a more even split. It is estimated that speeds have increased on substantial part of the M2-R7 in both village and rural sections by around

Table 2. Mean speed and 85%ile speed by vehicle type at various posted speed limits on the M2-R7 (km/h)

	Rural				Villages			
	Speed observations outside villages on M2-R7, Sarateni-Drochia junction				Speed observations in villages on the M2-R7, Sarateni-Drochia junction			
	Car/van/ minibus	Truck	Car/van/ Minibus	Truck	Car/van/ minibus	Truck	Car/van/ minibus	Truck
Posted speed limit	90	90	70	70	50	50	30	30
Sample size	141	31	45	8	122	22	83	14
Mean speed	89	77	72	58	61	51	56	59
85%ile speed	107	97	88	70	77	60	72	81
Mean speed above speed limit	-1	-13	+2	-12	+11	+1	+26	+29
85%ile speed above speed limit	+17	+7	+18	0	+27	+10	+42	+51

10km/h. The 30km/h speed limit in place in villages, notably around pedestrian crossings, is ignored. More needs to be done to reduce speeds on entry to and when travelling through the villages.

Road Safety Audit

The Road Safety Audit of 9 sites on the M2-R7 identified items that require attention and remedial action. Many of the following recommendations and issues have been responded to by the Millennium Challenge Account Moldova.

At intersections – there were some inconsistencies of design layout and of signing, unsealed shoulders and debris on road, excessive vegetation around signing.

- In villages – location of some pedestrian crossings could be improved, give-way markings at some intersections were required, there was the potential for greater use of curbed refuge islands, there were occasional inappropriate positioning of objects on footways, uninterrupted sections with potential for high speeds, use of fishtail, unprotected or ramped barrier ends.



“Researched statistics suggest that as many as 40% of all fatal front and side vehicle impact crashes into safety barriers (guard-rail), occur at night and are into the ‘faces’ (as opposed to ‘ends’) of these barriers”.

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- On roadsides – as well as the deficiencies noted above, greater protection of a bridge structure was required.
- In some large areas where movement is controlled by road markings alone, there was insufficient deflection and advance warning was inadequate.
- Route issues – there were concerns about barriers, advance warning at intersections and of lane-loss (reduction from two lanes to one), and retention of the original signing causing information inconsistencies.

Safer Roads Investment Plan

The iRAP ViDA software provided a Safer Roads Investment Plan based on the data collected during the “after” survey. This proposes additional countermeasures and indicates that there are still opportunities to enhance safety on the road. An economic analysis of safety countermeasure options identified countermeasures in this enhanced safety package of almost 80m Moldovan Leu (about 4m USD) that could potentially save almost 300 fatal and serious injuries over 20 years, a reduction of more than a third (36%) of those likely to occur in that period. This would save approximately 180m Moldovan Leu (about 8.9m USD) in crash costs with a BCR of 2. Countermeasure costs are approximate and vary according to particular locations.

The improvements include: installing or improving roadside barriers, shoulder rumble strips, central hatching, clearing roadside hazards and shoulder sealing. Measures identified in other parts of the study involve reducing speeds, upgrading and extending safety barriers; and installing village “gateway” treatments.

Future recommended actions

Based on the assessment, the following recommendations are made:

- Enforce the speed limit at priority locations by means of average speed cameras, notably in the villages.
- Review the recommendations of the post-assessment Safer Roads Investment Plan and consider which investments may be a priority.
- Act on the recommendations of the Road Safety Audit at the specific locations recommended.
- Follow up those elements from the Road Safety Audit that are likely to be repeated at various points on the network. In particular, assess the location and design of barriers, notably those with ramped, unprotected or fishtail terminals.

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Perspective/Commentary on Road Safety

Tragic failure of a road system – an Australian example

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Key Findings

- Globally, road and traffic systems are providing the conditions to allow some 1.25 million people to die every year.
- The application of root cause analysis methods can identify systemic factors in road injury.
- Some road authorities are not embracing a safe system approach to road safety.
- People are generally complacent about the continuing road trauma crisis.
- A louder community voice is the key missing element in the struggle to eliminate road deaths and injuries.

Keywords

Safe system, systemic injury causation analysis, community demand