The economic assessment of road safety projects is a valuable tool that allows decision makers to increase the efficiency of their policies, maximize the contribution of transport to the economy in general and achieve a safer and more balanced relationship between transport stakeholders, road users, society and the environment. Taking into account that funds for road safety are limited, decision makers and road safety stakeholders need to prioritize activities and base their decisions on evidence and data, using appropriate criteria. Especially for road safety, the economic efficiency of measures is a widely used criterion to identify good policies.

Objectives

The aim of this study is to present a methodology for the economic assessment of road infrastructure safety projects using international crash prediction models, adjusted for local conditions and accounts for limited data availability. The development and implementation of the methodology was commissioned and funded by the European Investment Bank (EIB) and carried out in order to assist Egnatia Odos SA (a state-owned company) in the assessment of the economic viability of the Greek Road Rehabilitation and Safety Project, focusing on the treatment of hazardous locations on the Egnatia Odos road network of Greece.

The examined project

The project was designed during 2012-2015 and was based on an extensive technical and visual review of the national and regional road network to identify sections with increased crash risk. A total length of 15,000km of roads was examined, including 4,200km of national roads and 10,800km of regional roads, spanning over 13 regions of Greece. The roads examined were mostly rural two-lanes two-way roads and did not include motorways and roads inside urban areas. The project resulted in the identification of approximately 7,000 hazardous locations (HL), spread over 2,500 km of the aforementioned road network, on 60 different roads.

For each identified hazardous location, low cost road safety interventions, capable of being implemented quickly without the need for further designs, were proposed, selected from a pre-developed list of countermeasures.

Methodology

The economic assessment methodology approach comprises two pillars: Pillar 1 - Technical Assessment focuses on the analysis of the proposed road safety schemes and the estimation of the resulting reduction in terms of accident numbers, fatalities and injuries, while Pillar 2 - Economic Appraisal focuses on the estimation of costs and benefits in monetary terms, leading to the calculation of the project’s Economic Rate of Return (ERR). The technical assessment pillar combines two engineering approaches in road safety, namely reactive and proactive engineering in a holistic method to reliably estimate the benefits of road safety schemes.

Pillar 1: Technical Assessment

Step 1: Data Collection and Review

Step 2: Accident Analysis

Step 3: Road Safety Inspections

Step 4: Accident Prediction Modelling

Step 5: Estimation of expected benefits (in monetary terms)

Step 6: Estimation of Road Safety Benefits (non-mandatory)

Step 7: Estimation of ERR for selected schemes

Step 8: Estimation of ERR for the whole Project

Pillar 2: Economic Appraisal

Step 1: Definition of Economic Appraisal Parameters

Step 2: Definition of Economic Appraisal

Step 3: Estimation of schemes (costs only)

Step 4: Estimation of Road Safety Benefits (non-mandatory)

Step 5: Estimation of ERR for the whole Project

Results of Economic Appraisal

Key parameters for the economic appraisal were assumed as follows:

- analysis timeframe: 15 years
- reference interest rate: 5%
- average service life of countermeasures: 25 years
- construction costs
- construction cost adjustment factor: 1.15
- Value of a life: 1,774,750€
- Value of a hospital stay: 61,461€
- Value of a non-hospital stay: 27,899€
- Value of a slight injury: 2,206€
- Value of a serious injury: 17,654€
- Value of a fatal injury: 2,345,158€
- Hospital stay: 15 days
- Non-hospital stay: 15 days
- Slight injury: 21 days
- Serious injury: 100 days
- Fatal injury: 1,500 days

The economic rate of return for the project is defined as “the interest rate at which the project’s discounted benefits equal discounted costs”, a project is considered economically viable if the ERR exceeds a minimum threshold. Values of the ERR for each examined sub-region, along with a preliminary estimate for the whole project in Greece (based on the weighted average reduction of fatalities and casualties in Viotia and Imathia and the actual number of fatalities and casualties in each sub-region) are presented in Table 2.

Case Study

The developed methodology was implemented for the economic assessment of the project in the sub-regions of Viotia, in northern Greece, and Imathia, in central Greece. A total of 116 hazardous locations covering 38.9km of road network were proposed for improvement in Viotia (Figure 2) and 111 hazardous locations covering 42.9km of road network in Viotia (Figure 3). Three countermeasures, as proposed by the designs, included the installation of 20 km of safety barriers, construction of 560,000m² of anti-skid asphalt wearing course and 1,570m² of road markings in these two sub-regions.

Conclusions

On the basis of the above analysis and the experience from the case study in Viotia and Imathia sub-regions, the following aspects are worth noting:

- A considerable difference between the ERRs in Viotia and Imathia is evident in Table 2, both in sub-regions. The estimated reduction of accidents in the examined locations attributed to the road safety schemes was similar: 38.5% in Imathia and 41.5% in Viotia. However, in Viotia approximately 7.3% are to be spent for the treatment of 30.9km of hazardous locations, resulting in 0.189% per km, whereas in Imathia 11.9% are to be spent for 27.9km (for locations outside built-up areas), resulting in 0.333% per km. Also, the examined road network of Viotia has higher traffic volumes and a higher estimated annual increase of AADT according to the data from the National Traffic Model and therefore more road users are expected to benefit from the road safety interventions. All these factors contribute to the increased ERR of Viotia road safety scheme.

- The results of the economic analysis are not particularly sensitive to changes in the input data and assumptions. This is evident in Table 2 where the sensitivity of Scenario 1 to erosion and 2 (w/out underreporting) and particularly Scenario 1 (w/out underreporting) constitutes extreme variations from the suggested scenario, yet the project in all cases is considered economically viable.

- In accordance with relevant international experience, road infrastructure safety investments and especially low cost measures suitable for rapid implementation are characterized by a very high economic rate of return, i.e. are very cost-effective.

This can be attributed to the combination of the low implementation and maintenance costs with the high value of their benefit (e.g. 2,151,595€ for every fatality saved). An additional factor is that measures are targeted specifically to locations that exhibit serious safety deficiencies and therefore have a significant impact on crash numbers.