



**ICTR** 2023

**11<sup>th</sup> INTERNATIONAL CONGRESS on TRANSPORTATION RESEARCH**

**Clean and Accessible to All Multimodal Transport**

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**HIT- HELLENIC  
INSTITUTE OF TRANSPORT**



**HELLENIC INSTITUTE OF  
TRANSPORTATION ENGINEERS**

# **Risk analysis of Western Greece road network using the Highway Safety Manual (HSM)**

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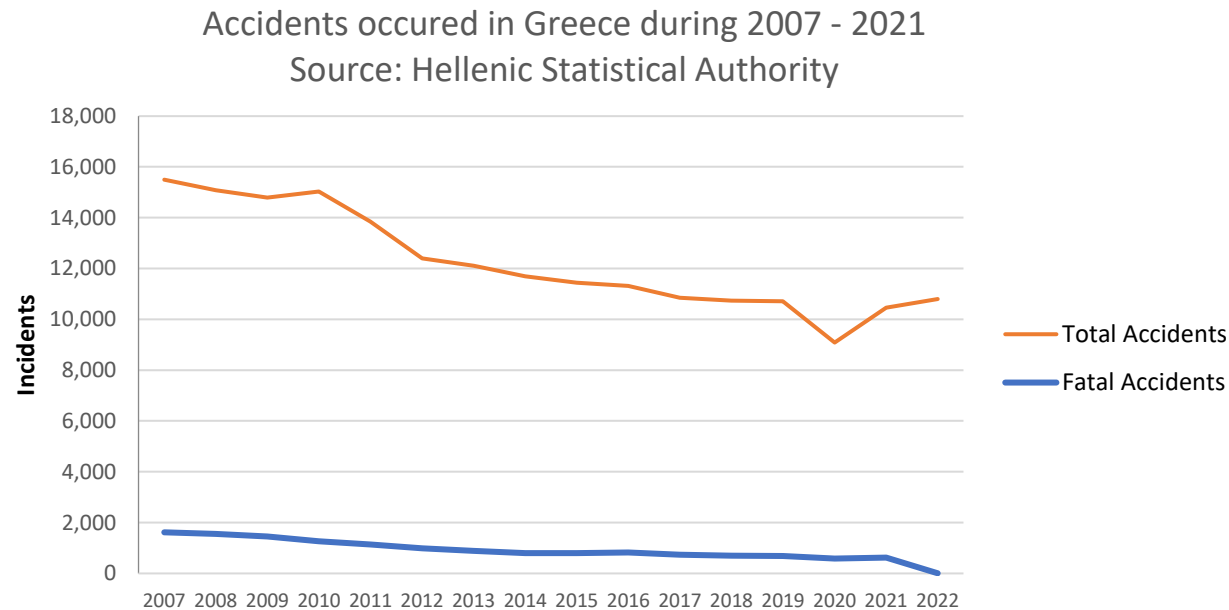
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Transport Safety II  
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# Introduction

- Road collisions and traffic injuries are global concerns → societal and economic implications,
- Road safety is influenced by geometric characteristics of the road,
- Challenges in Greek highways in the early 2000 → efforts in road infrastructure both quantity and quality,
- Downward trend in collisions, however, there has been an increase in the past few years



- Highway Safety Manual (HSM) proposes a predictive method for average crash frequency estimation under given time period, with constant:
  - a) Traffic volume (known or forecasted), and
  - b) Geometric design.
- HSM predictive method is a tool for:
  - a) Evaluation of any traffic flow changes, countermeasures implementation, or design features of an existing road network,
  - b) Evaluation and assessment of the design of a new proposed network (forecast traffic volumes).

Other guidelines have been proposed, however, there are restrictions and limitations in their applicability

# Objective

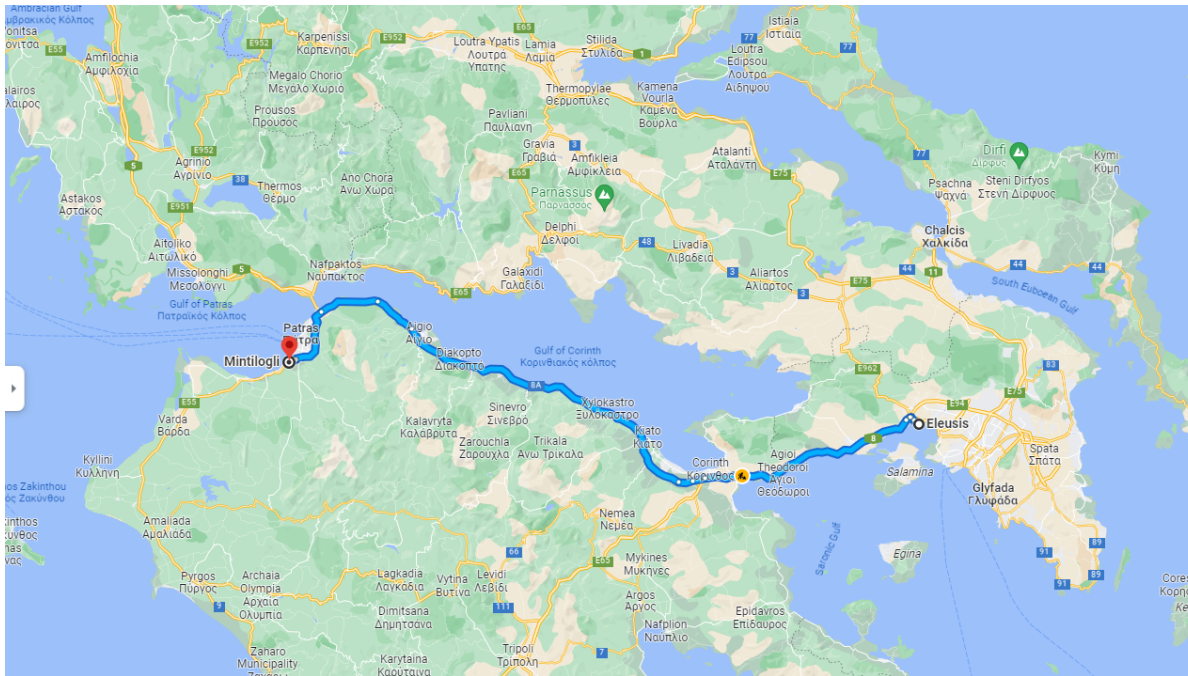
This study aims to assess the implementation of the proposed method in European context by evaluating its applicability to Greek highways Ionia and Olympia roadways.

- HSM methodology was applied for Ionia and Olympia Odos,
- Predicted average crashes were calculated for each roadway,
- Comparison of the observed and predicted values was conducted.

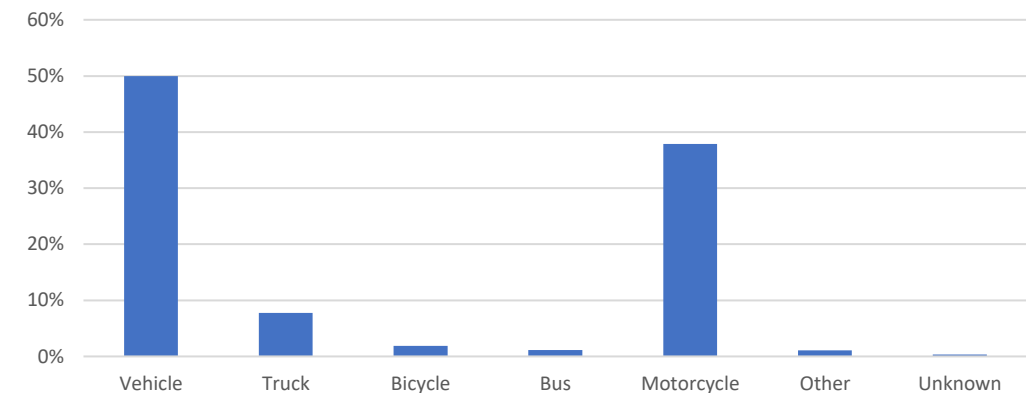
# Case Study I – Olympia Odos

- Major transportation artery that connects Central and Western Greece – 201.8km,
- Google maps for geometric design characteristics

- During 2009 – 2015: 5,954 collisions resulting in injuries or fatalities, 89% injuries (categorized as: 15% severe)
- Most collisions took place under ideal weather conditions (84%) and during daylight hours (63%),
- Korinthos – Patras under construction during time period → road characteristic data used pertains to the completed highway.

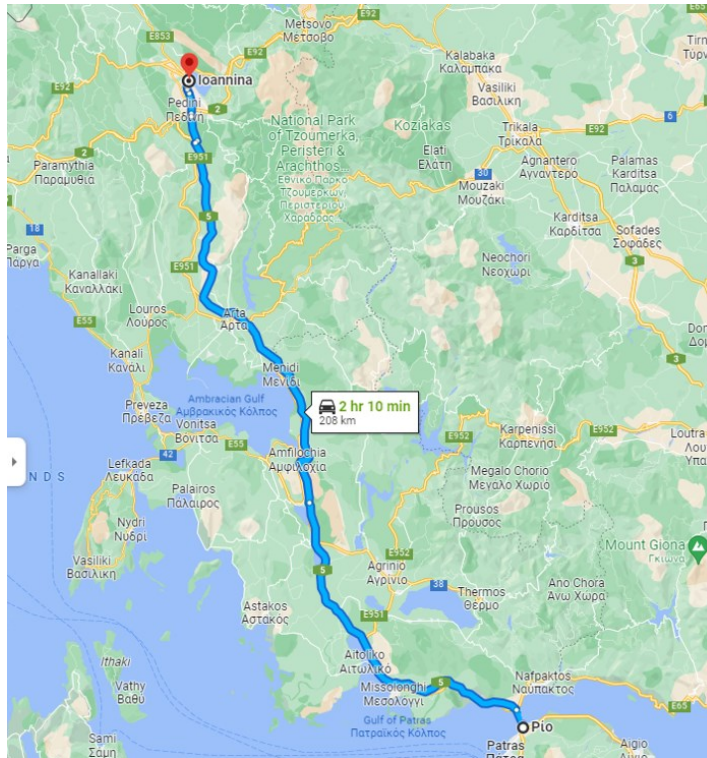


Accidents by involved vehicle type - Olympia Odos (2009-2015)  
Source: Hellenic Statistical Authority



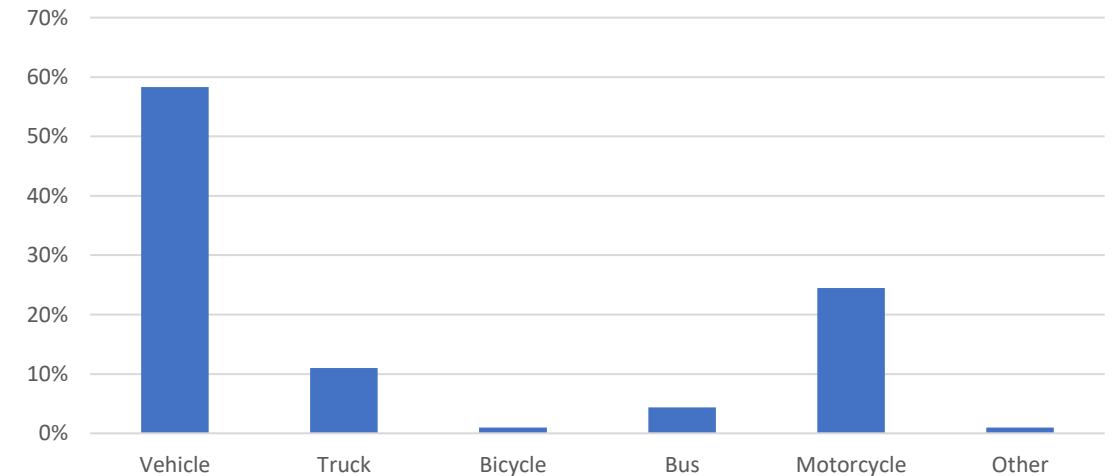
# Case Study II – Ionia Odos

- 196 kilometers motorway - links Epirus and West Greece, serving as a transportation route for Ioannina, Arta, Agrinio, and Patras,
- Google maps for geometric design characteristics



- During 2012 – 2019: 503 collisions, 86% of them leading to injury (categorized as: 10% severe injury),
- Most of collisions occurred under ideal weather conditions (85%) and during daylight hours (76%),
- Under construction during 2016-2017 → road characteristic data used pertains to the completed highway.

Accidents by involved vehicle type - Ionia Odos (2012-2019)  
Source: Hellenic Statistical Authority



- Predicted average crash frequency

$$N_{predicted} = N_{spf,x} \times (AMF_{1x} \times AMF_{2x} \times \dots \times AMF_{yx}) \times C_x$$

- Regression model for the prediction → Safety Performance Factor (SPF) for baseline conditions,
  - Different SPFs for different sites (divided or undivided highway, intersection etc.),
  - Baseline conditions concern: widths, lighting, traffic control feature, etc.
- Accident Modification Factors (AMFs) for adaptations regarding geometric design, traffic control features, lighting conditions, etc.
- Calibration factors ( $C_x$ ) to incorporate local conditions in the jurisdiction of the network

# Implementation of HSM methodology

- Data on:
  - Traffic flow: Hellenic Statistical Authority
  - Accident Data: Hellenic Statistical Authority
  - Geometric characteristics data: Google Maps
- Both networks separated into distinct roadway segments (sites) and HSM methodology was applied,
- Crash data were distributed to the sites based on vehicle-km.
- For Olympia Odos: 2009-2011 accident data → to estimate 2012  $C_x$   
Likewise for 2013-2015 (Moving Average)
- For Ionia Odos: 2013-2015 accident data → to estimate 2016  $C_x$   
Likewise for 2017-2019 (Moving Average)



# Results

The predictions presented in the table are derived from the analysis conducted on the distinct roadway segments

- Ionia Odos shows a significant underestimation of the predicted values,
- The highest variances are reported at the largest segments (-88.4%), and vice versa (-29.7%)
- Olympia Odos has better outcomes than Ionia Odos with highest value 50.1%,
- The highest variances are reported at the largest segments (50.1%), and vice versa (0.3%)

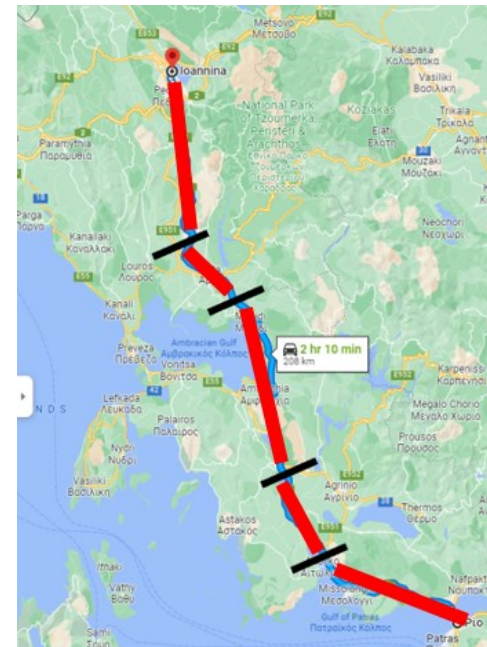
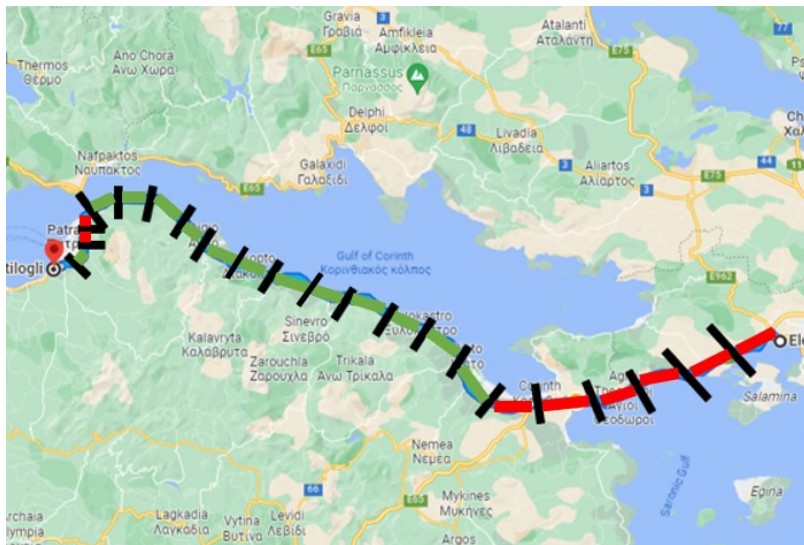
	2016			2017			2018			2019		
	Nobserved	Npredicted	%	Nobserved	Npredicted	%	Nobserved	Npredicted	%	Nobserved	Npredicted	%
Ionia Odos	18	13.08	<b>-37.6%</b>	19	15	-26.7%	18	16.1	-11.8%	17	13.65	-24.5%

	2012			2013			2014			2015		
	Nobserved	Npredicted	%	Nobserved	Npredicted	%	Nobserved	Npredicted	%	Nobserved	Npredicted	%
Olympia Odos	61.06	56	-9.0%	57.36	44	<b>-30.4%</b>	49.55	46	-7.7%	49.03	69.98	<b>29.9%</b>

# Conclusion and Recommendations

- Overall, the proposed prediction method showed mixed performance,
- Olympia Odos' better predictions due to the homogeneity of each roadway segment in contrast with Ionia Odos,
- Geometric factors and traffic volumes were identified as potential contributors to the prediction discrepancies.
- For better outcomes:
  - High quality data collection,
  - Optimal segment size, homogeneity, and well-distribution of accident data





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## Thank you for your attention!

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