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ROad safety in South East European regions

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An Application of a Road Network Safety Performance Indicator

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Safety Performance Indicators (SPIs) - Definition

Road Safety is a typical field with high risk of important investments not bringing results.
Systematic monitoring of:
-road safety actions/investments,
- road safety performance indicators
- road safety results
is the only way to optimise the investments' results.

SPIs are defined as the measures (indicators), reflecting those operational conditions of the road traffic system, which influence the system's safety performance (SafetyNet, 2005).

Safety Performance Indicators (SPIs) - Purpose

- To **reflect the current safety conditions** of a road traffic system;
- to **measure the influence of various safety interventions**, but not the stage or level of application of particular measures;
- to **compare different road traffic systems** (e.g. countries, regions, etc).

SPIs may concern particular groups of road users or compliance with important safety rules or cover specific areas such as the urban road network or the trans-European network.

Safety Performance Indicators (SPIs) – Conditions for success

- Be sensitive to significant changes in the system's conditions and over time.
- Be invariant and independent from changes of non-focused circumstances.
- Cover a meaningful range of changes in the systems' conditions.
- Be sensitive to the influence of external factors.
- Be estimated in a statistically reliable and valid manner and be of good and homogeneous quality.
- Be comprehensible, because visualization of results is important.

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Safety Performance Indicators (SPIs) – Limitations

- More general SPIs play mostly **descriptive and not explanatory roles** for "final outcomes" (accidents/ casualties).
- A comparison of SPI values is applicable **for similar conditions only**. Moreover, the conditions for which SPIs are estimated should be defined explicitly, where the remaining differences between the compared entities should be underlined.
- **Interrelations** among different SPIs are possible.

SPI examples

- **Road user behaviour related:**
  - speeding, comparison to mean speed, speed variance, speed limit violations;
  - percentage of seat belts', child restraints' and helmets' use;
  - incidence of drinking and driving;
  - failure to stop or yield at junctions or at pedestrian crossings;
  - inadequate headways – close following;
  - use of daytime running lights;
  - use of reflective devices for cyclists and pedestrians;
  - use of pedestrian crossing facilities by pedestrians.

SPI examples

- **Road and vehicle related**:
  - pavement friction mostly in winter and on wet road surfaces;
  - percentage of new cars with the top star rating according to EuroNCAP;
  - percentage of technically defective vehicles;
  - percentage of road network not satisfying safety design standards.
- **Quality of the post-crash care**.

Road Network SPI

- Safety performance of the road transport system is the result of **the right combination** of functionality, homogeneity, and predictability of the network, of the road environment, and of the traffic involved.

- **Assessment of the road network safety at:**
  - **The road design level:** individual roads should be designed in a safe way.
  - **The road network level:** the right road should be located at the right place from a functional point of view.

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Road Network SPI

At road design level, there are **no direct SPIs** in use at the moment.

Indirect SPIs could be formulated based on:

- the **Dutch Sustainably Safe Indicator** (SSI)
- the **Road Protection Score** (RPS) of EuroRAP

At road network level, an SPI was developed within the **SafetyNet project** based on:

- the German guidelines for road categories (FGSV, 1988)
- the method developed by Dijkstra (2003).

Development of a Road Network SPI

Functional road classification into six categories as proposed in SafetyNet

Rural areas (outside built-up areas)						
SafetyNet road classes	**AAA**	**AA**	**A**	**BB**	**B**	**C**
	Motorway	A-level road 1	A-level road 2	Rural distributor road 1	Rural distributor road 2	Rural access road
Functional road category	Through-road (road with a flow function)			Distributor road		Access road
Separation of opposing directions	Dual carriageway	Dual carriageway	Single carriageway, preferably with lane separation	Dual carriageway	Single carriageway, preferably with lane separation	Single carriageway
Lane configuration	2x2 or more	2x1, 2x2	1x2, 1x3, (1x4)	2x1, 2x2	1x2, 1x3, (1x4)	1x2, 1x1
Obstacle-free zone	Very wide or safety barrier	Wide or safety barrier	Wide or safety barrier	medium	medium	small
Intersections	Grade-separated	Preferably grade-separated	Preferably grade-separated	Preferably roundabout	Preferably roundabout	

Development of a Road Network SPI

Urban centres are grouped in five different categories based on their population.

Road categories that should be present between different types of urban areas are defined.

Centre types 1 and 4, 1 and 5 and 2 and 5 are connected only via other centre types (indirectly).

Road category A (single carriageway) is not considered for any connection because the AA road category is preferred for its dual carriageway.

Urban area (population)	Type 1	Type 2	Type 3	Type 4	Type 5
Type 1 (>200,000)	AAA	AAA	AA	Indirectly	indirectly
Type 2 (100,000-200,000)		AA	AA	BB	indirectly
Type 3 (30,000-100,000)			BB	BB	B
Type 4 (10,000-30,000)				B	B
Type 5 (<10,000)					C

Calculation of the Road Network SPI

1) **Definition of the study area**.
2) **List of all urban centres** in the study area and identification of their types based on population.
3) **Identification of needed connections** between centres using search circles

The city/town for which the circle is drawn is the centre of the circle and the radius of the circle is described by the shortest distance to the closest centre of the same type. The area within each circle is considered the area of influence of the specific city or town. Within this area, connections to other cities are assumed.

Start centre	Search for the centre of the same type	Centres in search areas	Assessment of the connections between
1	The nearest 1	2 and 3	1 and 1, 1 and 2, 1 and 3
2	The nearest 2	3 and 4	2 and 2, 2 and 3, 2 and 4
3	The nearest 3	4	3 and 3, 3 and 4
3	The nearest 4	5	3 and 5
4	The nearest 4	5	4 and 4, 4 and 5

Calculation of the Road Network SPI

4) **List of the connections** that need to be assessed.

5) **Evaluation of whether there is an actual connection**. Use of a detour factor (1.6) to investigate whether there is a connection of which the length is less than 1.6 times the direct distance between two cities.

6) In case there is an actual connection, **identification of the road categories** it is composed of.

7) **Comparison** of the current to the theoretically desired road category.

When the current is higher than or equal to the theoretically desired road category, the current road is considered to be appropriate from a safety point of view.

8) **Calculation of the proportion** of appropriate road category length for each road category.

9) **Calculation of the road network SPI** as the percentage of appropriate current road category length per road category.

Application of a Road Network SPI in Greece

Calculation of the road network SPI in the **Peloponnese** (Greece) in the framework of the ROSEE (ROad safety in South-East European regions) EU co-funded project .

Large geographical area which includes numerous cities and towns of various sizes and populations.

Relatively **"closed" road network** with a mountainous mainland.

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Application of a Road Network SPI in Greece

Definition and categorization of urban centres

- Decision to include only centres with a population higher than 2,000 inhabitants.
- Selection of 13 additional urban centres which attract a significant amount of interurban traffic due to their administrative or economic role.
- **70 urban centres** examined in total.
- No type 1 centre and only one type 2 centre.
- Consideration of some type 5 centres, as type 4 because the amount of traffic they attract cannot be reflected by their small population.

	Centre type				
	1	2	3	4	5
Urban areas	-	Patra	Korinthos Kalamata Tripoli	Loutrakion Nafplion Argos Sparti Pirgos Amaliadha Eghio Palea Epidavros Porto Heli Killini Kalavrita	Arhea Korinthos Eksamilia Agioi Theodoroi Assos-Leheon Velon Zevgolateion Vraxation Isthmia Nemea Xylokastron Athikia Kiato Ligourion Ermioni Kranidion Nea Kios Astros Leonidion Megalopoli Neapoli Voion Githeion Vlahiotis Molaoi Skala Gargalianoi Kiparissia Messini Hora Pilos Filiatra Andravida Vartholomio Varda Gastouni Zaharo Lehena Krestena Traganon Vrahneika Diakopton Kato Ahaia Ovria Demenika Paralia Rio - Agios Vasileios Rododafni Dherveni Tolo Monemvasia Koroni Methoni Meligalas Akrata Galatas Methana
					Type 5 centres of <2000 inhabitants but of special interest
					Centres upgraded from type 5 to type 4 due to high importance

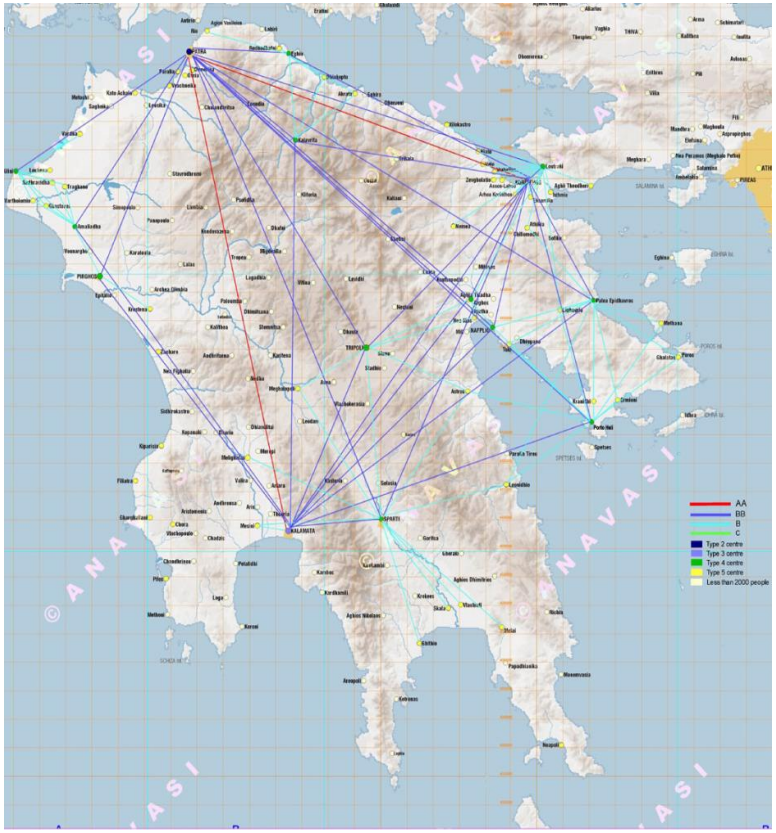
Application of a Road Network SPI in Greece

Theoretically desired connections

In total, 102 theoretical connections were identified.

Exceptionally, for connections between type 3 and type 5 centres , the radius is defined by the distance between the type 3 and the closest type 4 centre.

Theoretical connections between type 5 centres were not taken into account, as they were expected to have the minimum road category standards anyway.



Application of a Road Network SPI in Greece

Actual connections

Identification of actual connections using a free route planner available on the internet in combination with on-site observations.

The road classification of the route planner was transformed into the SafetyNet road classification.

SafetyNet category	Route planner category
AAA	Highway toll, Highway no toll
AA	National Road toll, National Road no toll (separation)
A	National Road toll, National Road no toll (no separation)
BB	Main paved road (separation)
B	Main paved road (no separation)
C	Paved road, road

Application of a Road Network SPI in Greece

Calculation of the SPI

In total, 6,020.3 kilometres of roads were examined, out of which 4,598.8 were of appropriate or higher actual road category than the theoretical one, resulting in a total road **SPI** equal to **76.4%** in this study area.

Theoretically desired road category	Current road category					
	AAA	AA	A	BB	B	C
AAA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AA	17.1%	6.1%	70.2%	0,0%	6.1%	0.6%
A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
BB	30.6%	2.9%	48.7%	0,0%	14.0%	3.9%
B	6.7%	0.0%	33.8%	0,0%	41.0%	18.5%
C	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

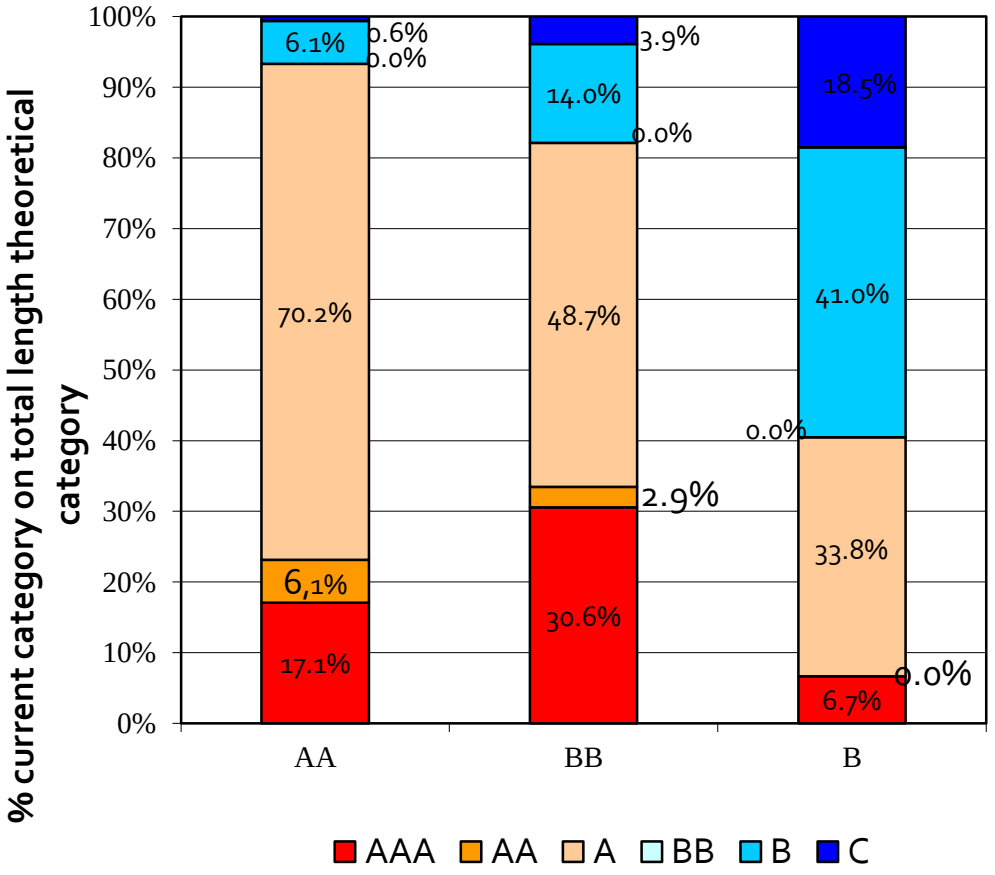
Application of a Road Network SPI in Greece

Calculation of the SPI

Theoretical connections of type **AA** are met only by **23%** of the total length of the actual connections.

Respectively, around **82%** of the total road length meets **BB** or higher standards.

For lower level connections, the SPI is equal to **81.5%** for type **B** connections.



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Discussion

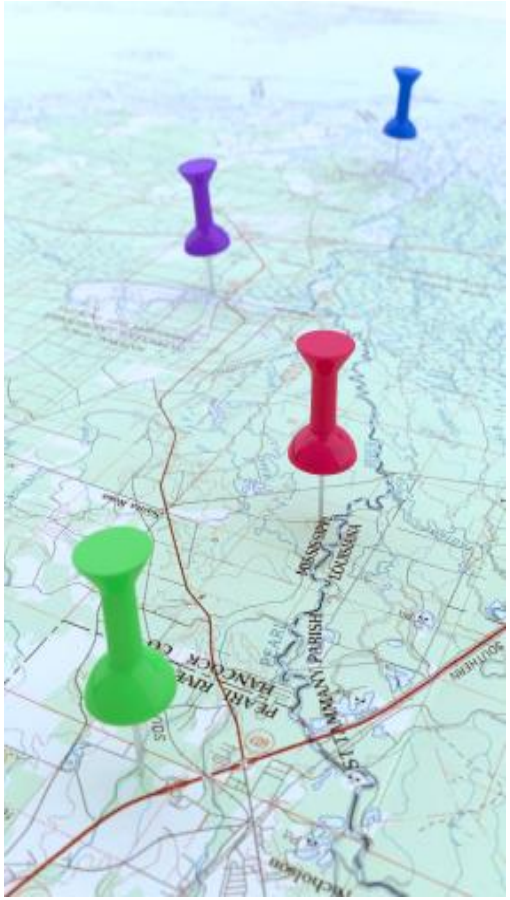
SPIs provide a better picture of the road safety level and **detect the emergence of problems** before they result in accidents.

The proposed methodology should be adapted to the real conditions and the particularities of each study area by implementing small changes about:

-**identification of circular areas** to avoid theoretical connections that normally should not be assessed

-**translation of route planner** road categories to SafetyNet road categories

-identification of the appropriate **detour factor** based on the landscape of the study area



Discussion

The methodology should be implemented by **engineers/planners familiar with the area** and the road network under examination in order to be able to make all reasonable assumptions and amendments.

Further steps for the improvement of the proposed methodology would include the use of **additional criteria** for the definition and classification of the centres, apart from the use of population as a unique measure.

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