## Katalog wymagań w zakresie bezpieczeństwa tuneli w ruchu drogowy Metoda oceny wpływu zastosowanych środków technicznych i organizacyjnych na bezpieczeństwo w tunelach drogowych

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- Tunnel safety documentation includes:
  - hazard assessment including a road traffic forecast along with an accident risk analysis,
  - risk analysis (dangerous goods, derogations)
- The opinion covers the transport of dangerous goods
  - assessment of the hazards for tunnel users and the environment, resulting from the carriage of dangerous goods through the tunnel, possible accidents and incidents involving them, and assessment of the nature and size of possible consequences of these events





#### European **Road Safety** Charter Definitions How we can define?

• Hazard

• Risk





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## European **Road Safety** Charter SAFETY **ISO 31000**

- Safety a state of freedom from unacceptable risk
- Risk the impact of uncertainty on goals

#### APPLICATION

 Risk management is possible provided that the objectives to be implemented are defined







### European Road Safety Charter **Tunnel targets** The most obvious ...

- Number of events at a certain level, with traffic
- Number of victims at a certain level, in the presence of traffic
- The frequency of accidents to collisions at a certain level
- Number of events lower in the tunnel than on the alternate route

There are risk assessment methods based on the Austrian, German, French, Dutch, American, Japanese and Canadian realities, and each of them reflects the expectations in a given country.





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# European Road Safety Charter Polish problem











### European **Road Safety** Charter Austrian model Input

- Tunnel events 2,372 events / 1 million vehicles / 1 km (2,372.00-10-3)
- Collision in the tunnel:
  - Local road 0.082 events / 1 million vehicles / 1 km (82.00-10-3)
  - Highway 0.077 events / 1 million vehicles / 1 km (77.00-10-3)
  - Unseparated traffic 0.112 events / 1 million vehicles / 1 km (112.00-10-3)









•	Data for WHOLE traffic		1.E-01
•	Data for 1 km		1.E-02
			1.E-03
•	One fatalities events annual frequency 1 • 10-4 (0.0001	czna)	1.E-04
	events per year, 1 event every 10,000 years) to 1 •	stotliwość (ro	1.E-05
	10-1 (0.1 events per year, 1	Czę	1.E-06
	event every 10 years).		1 E 0
			1.E-0

1.E-08





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- Żołnierzy Wyklętych
- Statistics:
  - 2018 accidents 22, collisions 503 (1 killed, 23 injured)
  - 2019 accidents 32, collisions 574 (2 killed, 33 injured)
  - 2020 accidents 35, collisions 479 (1 killed, 40 injured)
  - 2021 accidents 22, collisions 507 (1 killed, 25 injured)



#### The route - the streets of Płażyńskiego, Sucharskiego, Słowackiego, and





- Route: Płażyńskiego, Sucharskiego, Słowackiego streets, and Zołnierzy Wyklętych
- Length of the route is about 15 km
- Average traffic volume is about 5,000,000 / year in each direction
- Accidents (average / year) 27, Collisions (average / year) 515
- Accidentality
  - 0.018 accidents per 1 km / 1 million vehicles (18.00-10-3)
  - 3,433 collisions per 1 km / 1 million vehicles (3,433-10-3)







- Events for the tunnel Gdańsk
- Traffic volume 2020 9 667 637, 2021 9 669 590 average 9.7 million vehicles
- Length of the tunnel is 1377 m
- Accident rate:



# Collisions 2018 - 8, 2019-15, 2020 -9, 2021 -6 - average 9.5 events per year

#### 0.715 collisions per 1 km / 1 million vehicles (715.00 $\cdot$ 10 $^{-3}$ )





- **Road** events (collisions) 3,433 per 1 km / 1 million vehicles (3,433-10-3)
- Tunnel events (collisions) 0.715 per 1 km / 1 million vehicles (715.00-10-3)
- Collision frequency in the tunnel is lower than for the road (715: 3,433)
- Austrian requirement Local road 0.082 events / 1 million vehicles / 1 km  $(82.00 \cdot 10^{-3})$
- The actual collision frequency in the tunnel (715.00 10-3) is approx. 9 times higher than in the Austrian model (82.00-10-3)







### Award-winning solution

- Study presenting a list of possible measures to change the number of accidents and to minimize the consequences of such accidents in road tunnels
- The recommended agents have been divided into groups related to their characteristics and the possibilities of their application
- As part of the measures, technical and organizational solutions that may lead to the reduction of accidents are presented

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### Award-winning solution

- Analytical methods used in the European Union for tunnel analysis in Poland
- It became necessary to develop a method that allows to assess the risk to transport through the tunnel while taking into account qualitative values
- An inventory of relevant activities was made and then were divided into:
  - B (Basic) Basic measures,
  - P (Prevention) Prevention,
  - M (Mitigation) Mitigation of effects- reaction to an event.

#### Our commitment saves ves

#### Wykaz środków stosowanych w tunelach

Środki (aktywności i rozwiązania), które są związane z budową i eksploatacją tunelu mające na celu ograniczenie ilości zdarzeń lub ich skutków w tunelu podzielono na podane poniżej

#### grupy:

<u>B (Basic) Środki podstawowe:</u> B1 środki związane z przepustowością (nawy, pasy),

- B2 środki związane z pochyleniem,
- B3 środki związane z przygotowaniem ewakuacji i działań B4 środki związane z dostępem dla służb ratowniczych,
- B5 środki związane z organizacją ruchu,
- B6 środki związane z instalacjami,
- B7 środki związane z konstrukcją, B8 środki związane z monitorowaniem.

P(Prevention) Zapobieganie: P1 środki służące utrzymaniu stanu technicznego (pojazdów

- P2 środki mające na celu edukację, szkolenie lub wsparcie
- P3 środki zapewniające identyfikację, kierowcy,
- P4 środki mające na celu unikanie sprzecznych kierunków P5 środki mające na celu uniknięcie różnic prędkości,
- P6 środki mające na celu uniknięcie zmiany pasa
- (w nieodpowiednich miejscach),



European Commission





### Award-winning solution

- The material was created, among others, on the basis of the concept presented in the study "Prevention and mitigation of tunnel – related collisions" (PIARC Document 2019R03EN).
- It assumes the possibility of influencing the safety of traffic in the tunnel through the use of preventive measures.
- This study does not constitute a translation of the work, but on its basis a coherent system of preventive measures affecting safety has been proposed.



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## Award-winning solution



- The presented catalogue includes technical solutions, the latest ideas and solutions as well as alternative solutions • One such solution is to model driver behavior by rewards
- them.
- The summary of the study is a summary of the estimated amounts of impact of individual measures on the frequency of events or their effects.

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#### Next works

- We are currently working on determining the "discomfort index" for individual infrastructure components.
- It reflects the change in speed (m /s) and the position of the vehicle relative to the center of the road (m) over time (s).
- The indicator is measurable and determines the magnitude of the reaction to the obstacles or the road in the environment

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## Thank you for your attention!



