Artificial Intelligence and Big Data for Supporting Road Safety Actions

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Road Safety and Big Data

- Road traffic injuries are a leading cause of death for people of all ages and the number of road fatalities in several countries remains unacceptable
- Innovative data-driven solutions could contribute to a proactive approach of addressing road safety problem, which is a core principle of the Safe System
- The rise of smartphones, sensors and connected objects offers more and more transport data
- The interpretation of these data can be made possible thanks to progress in computing power, data science and Artificial Intelligence

Need for New and Big Data

- Alternative data that could lead to new advanced road safety analyses in order to:
  - ✓ more efficiently identify key road risk factors
  - ✓ address road user behaviour and errors
  - ✓ address proactively critical traffic, infrastructure and vehicle risk factors
- Continuous driver support aiming to improve driver behaviour and develop better road safety culture for all road users
- Great new potential for evidence based public and private road safety decision making at all levels

Road Safety Data to Support Evidence-based Policies

- Fatalities and their evolution
- Exposure
- Safety Performance Indicators
- Causation (in-depth crash investigations)
- Health indicators
- Economic indicators
- Driver behaviour, attitudes etc.
- Road safety rules and regulations
- Road safety measures assessment

Do we have the data we need?

Do we need the data we have?

Road Safety Big Data Sources (1/2)

- A wealth of big data becomes available
- This enables differentiations per road user category and focus on niche analyses (e.g. vulnerable road users, professional drivers, freight vehicles etc.).

A multitude of data sources:

- Mobile Phone data
  - ✓ Sensor Based Data (e.g. Google Maps, Here, Waze)
  - ✓ Cellular Network Data (e.g. mobile phone operators, etc.)
- Vehicular On-Board Diagnostics data (e.g. OEM industry)
- Camera data:
  - ✓ On-vehicle (internal, dash-cam and peripheral)
  - ✓ On the road (cities, operators, police)
- Data from Car Sharing Services (e.g. Uber, Lyft, BlaBlaCar)
- Data from Bike Sharing Services (e.g. 8D Technologies, Mobike)
- Data from Micromobility Operators (e.g. Bolt, Lime)

Road Safety Big Data Sources (2/2)

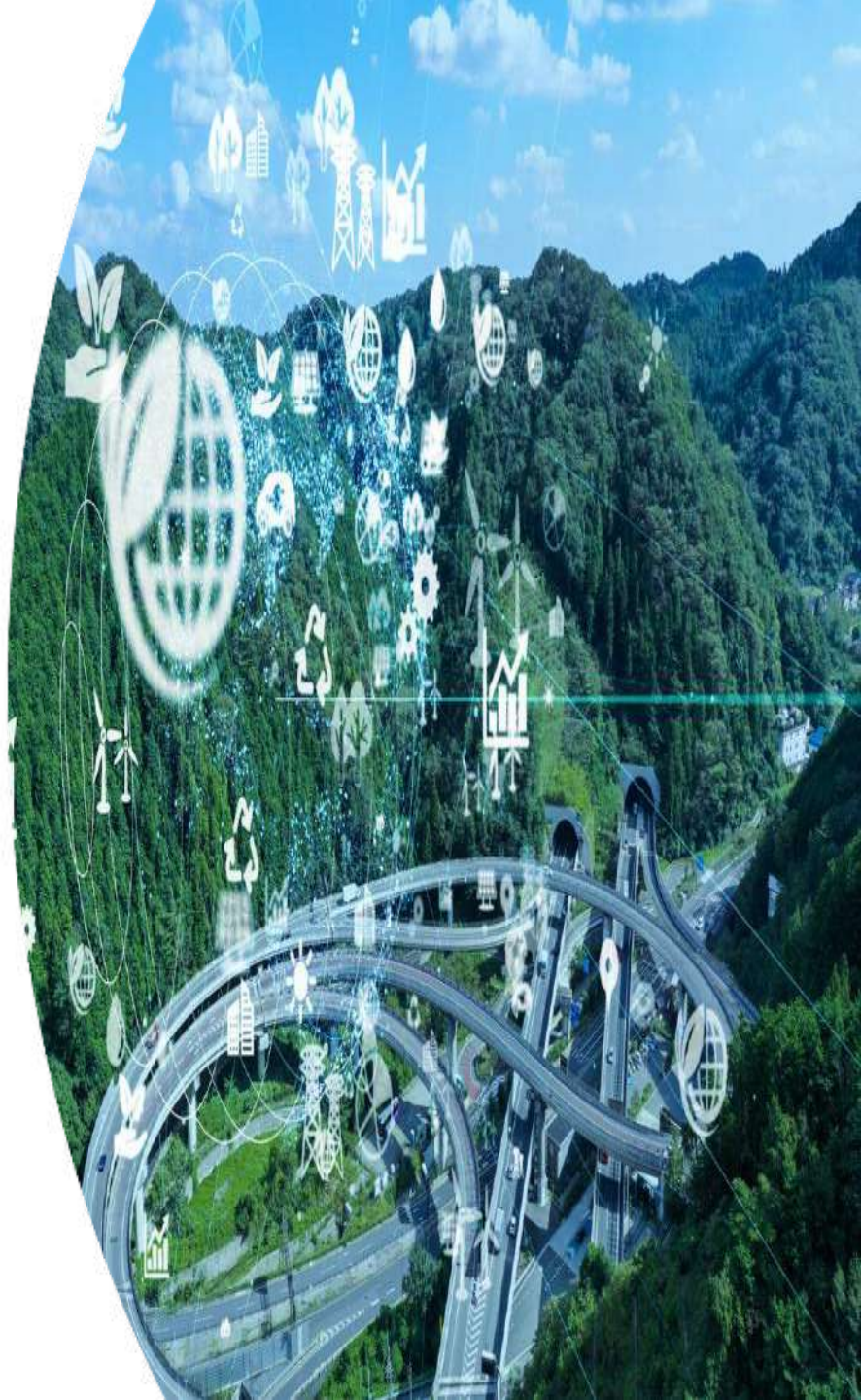
- Telematics companies (e.g. OSeven, ZenDrive, Octo)
- Private agency sensor data (e.g. INRIX, Waycare)
- Travel Card data (e.g. Oyster card, Opal card)
- Public authority sensor or traffic measurement data
  (e.g. Ministries, Public Transport Authorities, Cities, Regions)
- Weather data (e.g. OpenWeatherMap, AccuWeather, etc.)
- Census data (e.g. Eurostat, National Statistics)
- Digital map data (e.g. OpenStreetMap, Google Maps, etc.)
- Shared mobility data (e.g. GPS, routing, etc.)
- Social Media data (e.g. Facebook, Twitter)
- Research oriented data (e.g. floating car/instrumented vehicles)

Crash Data

- Automated data collection is possible through:
  - Instrumented/floating vehicles
  - Smartphone sensors (harsh braking, harsh accelerations, harsh cornering, driving distraction via cellphone use, speeding, poor road surfaces)
- Technologies like automatic crash notification (eCall) and event data recorders enable data-driven responses to post-crash problems
- Street imagery, also collected by floating vehicles, supports the assessment of road safety performance (star-rating for roads)
- Drones and satellites complement the range of data, capturing solutions with increased market penetration
- Active safety system activation can also be considered among surrogate safety metrics, for systems such as:
  - Anti-lock Braking System (ABS)
  - Electronic Stability Control/Program (ESC/ESP)
  - Autonomous Emergency braking (AEB)

Geometric Data

- The development and application of crash prediction models and road safety assessment techniques is closely related to the availability of geometric design data:
  - ✓ horizontal and vertical alignment
  - ✓ cross section elements
  - ✓ roadside conditions
  - ✓ other road features and equipment
- The correlation of geometric design data with crash data, while also considering exposure (i.e. traffic data) is a fundamental element of quantitative road safety analysis
- Potential road geometric design data sources commonly include:
  - ✓ national road authorities databases
  - ✓ data from vehicle mounted cameras and road survey vehicles
  - ✓ data from High Definition (HD) maps
  - ✓ Open GIS road geometry data, CAD, Google Earth



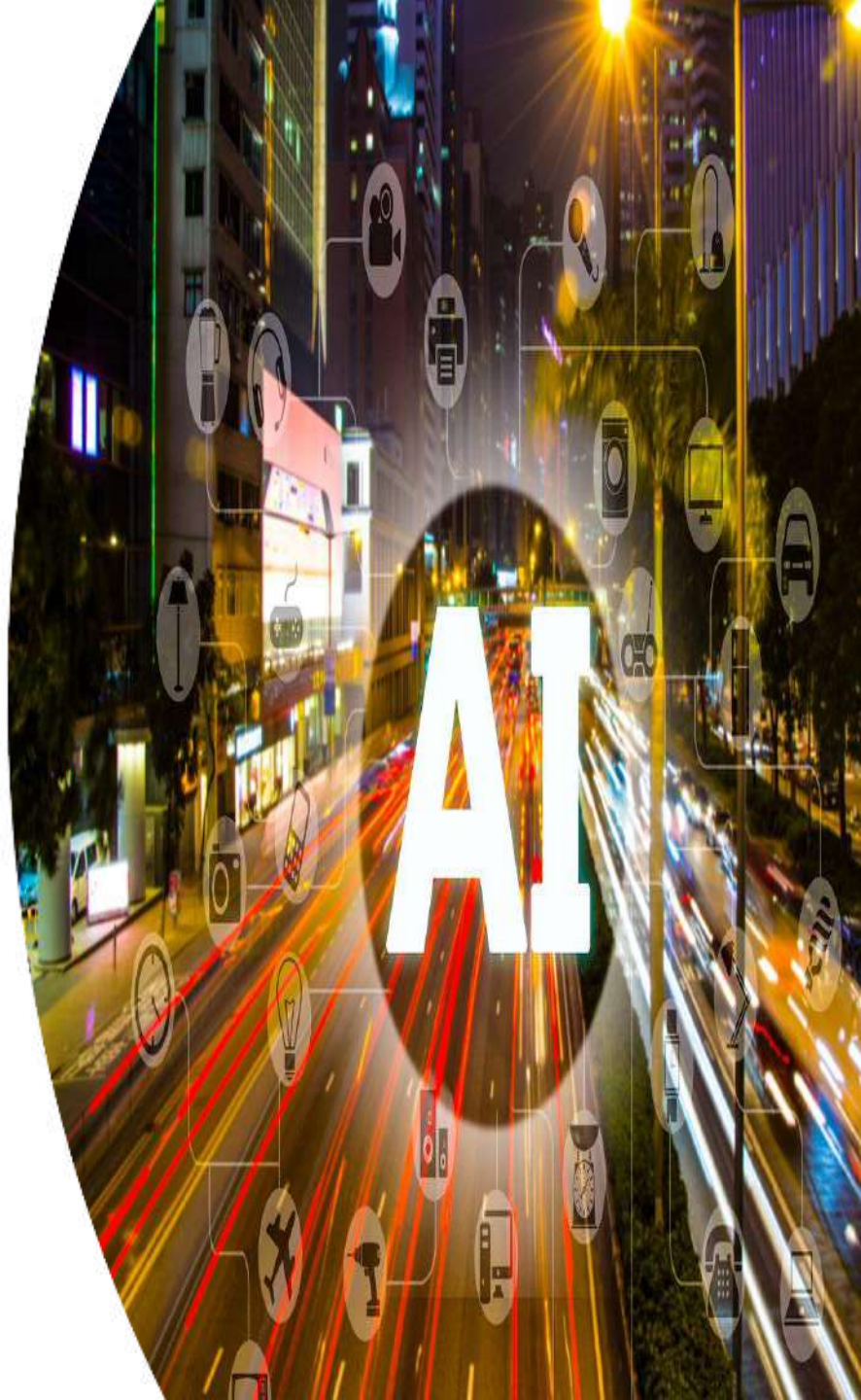
Telematics Data

- A range of telematics solutions already exist for:
  - ✓ fleet management
  - ✓ usage-based insurance
  - ✓ eco-driving
  - ✓ safe driving coaching
- Driver telematics were initially based on On-Board Diagnostics (OBD), having access to data from the engine control unit
- Current technological advances make data collection and exploitation substantially easier and more accurate through Smartphones
- Smartphone and OBD driver behaviour telematics metrics:
  - ✓ Mileage driven, duration and time of the day driving
  - ✓ Road network used (through GPS position)
  - ✓ Speed, harsh acceleration, braking and cornering, mobile phone use
  - ✓ Fuel consumption and seat belt wearing (OBDs only)
  - ✓ Drink and drive, fatigue and driver state (additional devices)

AI + Big Data = Road Safety

AI facilitates the proactive management of traffic safety in various ways:

- Collection of data on road infrastructure conditions and traffic events through wide and broad-scale sensors and systems such as real-time computer vision
- Identification of high risk locations proactively, through predictive multi-layer models
- Enabled by multiparametric big data, AI pushes the limits of pattern recognition and reaction times beyond human capabilities and may thus uncover new crash-prone road configurations
- Recent developments in the field of so-called "explainable AI (XAI)" begin to cope with the challenge of the "black box" phenomenon



Critical Issues

- Punishment Vs Positive Feedback (Incentives)
- Regulatory and Voluntary Data
- Secure anonymisation might increase penetration (e.g. blockchain)
- Ownership of data
- Exploitation of data (charging schemes)
- Sharing of safety data (EU legislation)

Conclusions

- Great potential for seamless big data driven procedures from safety problem identification to selection and implementation of optimal solutions
- Newfound net present value in road safety data, available for (real-time) early problem detection and prompt and customized decision support on each level
- Considerable ground remains to be covered for existing road safety AI applications (vehicle, telematics crash analysis)
- Completely unexplored directions remain in several road safety aspects (crowdsourcing options, measure effectiveness, data harmonization)
- Big Data and Artificial Intelligence can become efficient catalysts for achieving Vision Zero road fatalities by 2050

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