Telematics, Big Data and Road Safety

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Department of Transportation Planning & Engineering

- The mission of the NTUA DTPE is to educate scientists engineers and promote science in the field of transportation planning and engineering.

- The NTUA DTPE is a Research and Innovation Center of Excellence with global recognition [Ranked 9th in Europe, 39th worldwide (Shanghai Ranking’s 2017), Scientific citations: 3rd in Europe, 19th worldwide (Pulse 2017), Road Safety: 2nd in Europe, 6th worldwide (AAP, 2018)].

- A Team of 60+ Scientists: 7 Internationally recognized Professors, 15 Senior Transportation Engineers and PostDoc, 25 PhD Candidates, 15 Transportation Engineers and other scientists.

- NTUA DTPE Activities in figures (since mid 80s):
  - More than 1.100 Diploma and 30 PhD Theses,
  - More than 330 road safety research projects, mostly through highly competitive procedures,
  - More than 1.100 scientific publications (> 400 in Journals), widely cited worldwide,
  - More than 150 scientific committees,
NTUA Road Safety Observatory

- An international reference road safety information system since 2004, with the most updated data and knowledge, with:
  - more than 3,000 visits per month,
  - tens of items and social media posts/tweets annually
Background
Background

- Road transport is responsible for the majority of transport fatalities, with an annual **1,35 million road traffic deaths** worldwide.

- **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 with aim to improve driver behavior and develop better road safety culture at all road users.

- Great new potential for evidence based public and private road safety decision making at all levels.
Road Safety Big Data Sources

- **Mobile Phone Data**
  - Sensor Based Data (e.g. Google Maps, Waze)
  - Cellular Network Data (e.g. Cosmote, Vodafone, Wind)

- **Vehicle On-Board Diagnostics Data**
  (e.g. OEM industry)

- **Data from Cameras**
  - On-vehicle (inside and outside)
  - On the road (cities, operators)

- **Data from Car Sharing Services**
  (e.g. Uber, Lyft, Bla bla car)

- **Data from Bike Sharing Services**
  (e.g. 8D Technologies, Mobike)

- **Social Media Data**
  (e.g. Facebook, Twitter)
Road Safety Big Data Sources

- Telematics companies
  (e.g. OSeven, ZenDrive, Octo, )
- Private Agencies’ Sensor Data
  (e.g. INRIX, Waycare)
- Travel Cards Data
  (e.g. Oyster card, Opal card)
- Public Authorities Sensor Data
  (e.g. Ministries, Public Transport Authorities, Cities, Regions)
- Weather Data
  (e.g. AccuWeather, ClimaCell)
- Census Data
  (e.g. Eurostat, National Statistics)
Road Safety Big Data

- **GPS traces** of the app users are the main core data elements.
- Data coming from **connected navigation devices** (embedded in cars, applications in smartphones etc.)
- **Various sources may be combined** by some companies: vehicle sensors, smartphones, PNDs, road sensors, connected cars, fleet management companies etc.
- Data related to **road network**, **traffic parameters** and **speed** are the most available.
- **Traffic accidents** may be recorded as a subgroup of recorded incidents mainly through:
  - Crowdsourcing,
  - Partnerships,
  - Algorithmically generated flow-based incidents
Accident Data Collection (1/2)

- Automatic data collection is possible through
  - instrumented floating vehicles and/or
  - smartphones (hard braking, poor road surfaces, speed).

- Active safety systems can also be considered among surrogate safety metrics, such as:
  - ABS for anti-lock braking,
  - ESP for electronic stability control and
  - AEB for autonomous emergency braking
Accident Data Collection (2/2)

- Technologies like automatic crash notification and event data recorders propose 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 started complement the range of data, capturing solutions and play an increasing role.
Telematics for Driver Performance Feedback
Telematics solutions

- A range of **telematics solutions** already exist for:
  - fleet management,
  - usage-based insurance,
  - eco-driving and
  - 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**.
Telematics metrics

Smartphone and OBD driver behaviour telematics metrics:

- **Mileage** driven
- Road **network** used (through GPS position)
- **Duration** and time of the day driving

- **Speed**
  - Harsh **braking**
  - Harsh **acceleration**
  - Harsh **cornering**

- Mobile **phone** use (smartphone only)
- **Fuel** consumption
- **Seat belt** wearing (OBDs only)
- **Drink and drive** / fatigue (additional devices)
- **Driver state** (additional devices)
The example of OSeven Telematics

- OSeven is a pioneer technology company that is specialized in Driving Behaviour Analysis and Telematics Solutions.
- **Business**: Insurance (PAYD, PHYD, PAHYD), Fleet management, Rental and Leasing, Ride sharing, Taxi Hailing, Car pooling, Automotive, Banking.

**Platform components**
- User-friendly smartphone apps
- A state of the art backend infrastructure for big data analysis
- A web app for the visualization of the metrics and scores
- Sophisticated Machine Learning algorithms
- Driving Scoring Model for the evaluation of the driving behaviour

**Data flow in OSeven Platform:**
- Mobile App detects the start and stop of driving, without any user involvement
- Data from smartphone sensors is recorded and transmitted to OSeven backend (WiFi or 3G/4G)
- Data is analyzed via the OSeven algorithms to produce driving metrics and scores
- Results per trip and overall can be viewed by the driver in the smartphone app and by the corporate clients for their fleets in the web app

- Risk Exposure and Driving Behaviour indicators
- Unique value proposition to drivers, companies and society
Monitoring Driver Behaviour

- New vehicles can include distraction and drowsiness alerts as standard.
- Crash investigators could have access to eye tracking data through event data recorders.
- Smartphone apps developed by insurers should prevent drivers from using the phone.
- Ride-sourcing and delivery platforms sharing data on driving and riding time via the licence number for preventing gig economy sector from breaking the driving hours restrictions.
Driver Performance Telematics Feedback

- Feedback to the driver through the **Driver Performance Telematics** (vehicle or smartphone)

- **real time feedback**
  + avoid distraction
  - produce distraction

- safety performance **star rating**
  + engage in the long term
  + great motivation to improve driving behaviour
  + identification of need for re-training
  - demotivation in case of non progress
  - demotivation when non favorable comparison with peers

- The **feedback loop** should be optimized.
Data Crowdsourcing

- **Cyclists and Pedestrians** report:
  - safety problems (roads, behavior)
  - exposure (routes, traffic, etc.)
  - crash data (with injuries, material damage only)
  - star rating

- Not uniform nor systematic reporting practices though

- Feedback on **network safety performance**
  - useful for the cyclists
  - useful for the decision makers (all levels)
  - useful for business
Critical Issues (1/2)

- **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)
Critical Issues (2/2)

- Harmonisation and compatibility of:
  - data
  - metrics
  - data collection methodologies
  - data processing methodologies

- Define proper and properly the KPIs
- Clean properly the data
- Linking KPIs with respective interventions

- Control in-vehicle distraction devices
- Define safety policy focus (behavior, VRUs, infrastructure, traffic)
Technology Weaknesses

- Big Data is not only prone to many of the same errors and biases in smaller data sets, it also creates new ones.

- Big data creates privacy threats, especially with the risk of re-identification of individuals in datasets.

- Hacking is an important risk requiring advanced protection measures.

- Drivers using social driving apps may be distracted by new services (navigation, coaching, C-ITS alerts, infotainment, etc.).
Privacy Protection

- Explicit guidelines should be available to stakeholders concerning the protection of personal data, but also to offer reassurance on the legality of data collection and analysis.

- The use of strong de-identification techniques, data aggregation and encryption techniques are critical.

- Issues concerning video images used for close call analysis should be addressed.
Big Data versus Big Biases

- Every data set should be considered biased towards some user groups, trip purposes or in any other dimension.

- The consequences of using data which isn’t representative of the whole population should be assessed.

- There is a high risk for the drivers and the decision makers to be misled by the opportunistic analysis of seemingly low-cost data in absence of qualified data scientists and statisticians.
New Data Sharing Partnerships

- New data ownership frameworks will be developed along the lines of "A New Deal on Data".

- Partnerships enabling both the private and public sector can be created.
  - Work is required to define the scope and scale of data collection that is in line with public mandates.

- Open source or commercial solutions are developed to collect, harmonise and aggregate mobility data.

- Stakeholders should make road safety data freely available through such platforms.
Road Safety Technology Perspectives

- **Technology** can be the new road safety driver, through:
  - Public private partnerships
  - Clear problem analyses (well defined objectives)
  - Systematic effectiveness monitoring

- Great **need** for:
  - more data and knowledge
  - better exploitation of current and future data
  - broader geographical coverage

- Data **focus** on:
  - more accurate road accident data
  - exposure data and performance indicators
  - measures and policies effectiveness evaluation
Road Safety Digitalization Perspectives

- **Digitalization** opens great new data possibilities for:
  - road user support and guidance
  - evidence based public and private road safety decision making at all levels

- New great potential for **seamless data driven procedures** from safety problems identification to selection and implementation of optimal solutions

- New increased **net present value of road safety data**, available for (real-time) early problem detection and prompt and customized decision support
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