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Artificial intelligence for Road Safety – AIRoS

an innovative and experimental data-driven approach towards vision zero targets

ASECAP DAYS
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SPEAKER

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AGENDA

01 COMPANY OVERVIEW

02 ROAD SAFETY OVERVIEW & AIRoS PROJECT

03 AIRoS: ACADEMY & INDUSTRY FUSION

04 NEXT STEPS

Company Overview

The Network

- **3.000 km**
  - 23%
  - 77%
- **47%** Italian Tollway Network
- **15/20** Italian regions crossed

Technologies

- **1.922** Highway Message Boards
- **5.000** Traffic Monitoring Cameras
- **1.600 km** covered by Tutor System

Organization

- **9** Regional Headquarters
- **2** Central Headquarters
- **10** Traffic Control Centers

Resources

- **700** internal operational personnel
- **1.500** external operational personnel
- **935** operative veichles

Traffic

- **> 49x10^9 km** travelled in 2023
- **2,5x10^6** daily transits

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Road Safety Overview

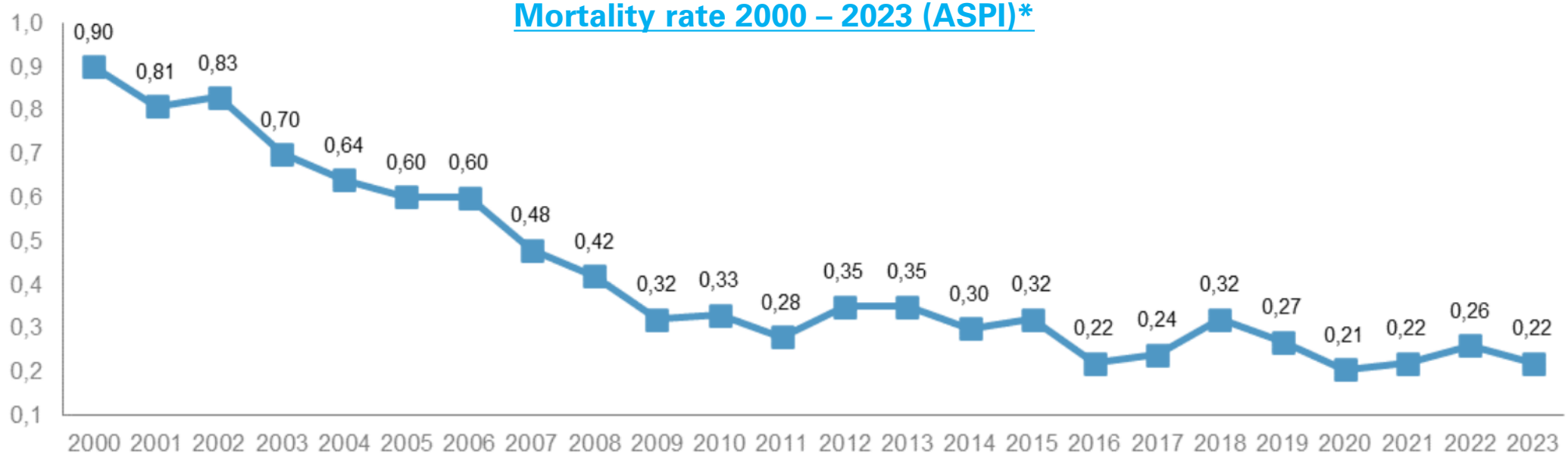
In the **first decade** of 2000 many safety **improvements occurred.**

- Improvement in **technical and regulation standards.**
- Automotive **technology improvements** and **use Tutor.**
- Robust and established **internal procedures.**

In the last 10 years, a **plateau** has occurred.
The need to **change the paradigm is necessary** towards the **vision zero.**

- New **improvement in technical and regulation standards.**
- Automotive **technology and AI use.**
- New methods to **take actions in advance** (**reactive → proactive**).

Mortality rate 2000 – 2023 (ASPI)*



* Mortality rate = number of deaths per 100 million km travelled

AIRoS Experimental Project

Our main concern is **safety** from every point of view.
Countless projects are underway for all the road safety topics.

Proactive **Road Safety Improvements** stream→ **AIRoS** (to help enable the change).

AIRoS

- ✓ integrates **academic studies**
- ✓ historical data
- ✓ **AI**
- ✓ **Cloud-based** capabilities → **hybrid AI model**

This facilitates the optimal **improvements planning** through simulated **multi-scenario** analysis.

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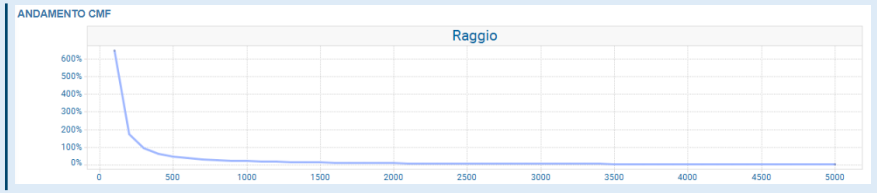
Collaborations & Overview

Academy

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

Prof. Montella's (**UniNa**) Study for the **CMF** (Crash Modification Factors) **definition**.



Industry

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10+ Years of **Historical Data** from ASPI Databases on Morphology, Accidents, Traffic, etc.

Network

AI

Network Discretization for Homogeneous segments with over 5k **Straight Lines and Curves**. Cooperation of Deterministic Clustering with **Data-Driven Clustering** using **Machine Learning** Algorithms.

Synergy of Academic and **Industry Expertise** (UniNa) with **Internal Expertise** (ASPI) in the State-of-the-Art (**SOTA**) Machine Learning Algorithm Ecosystem.

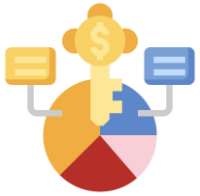
Crash Modification Factors (CMF)

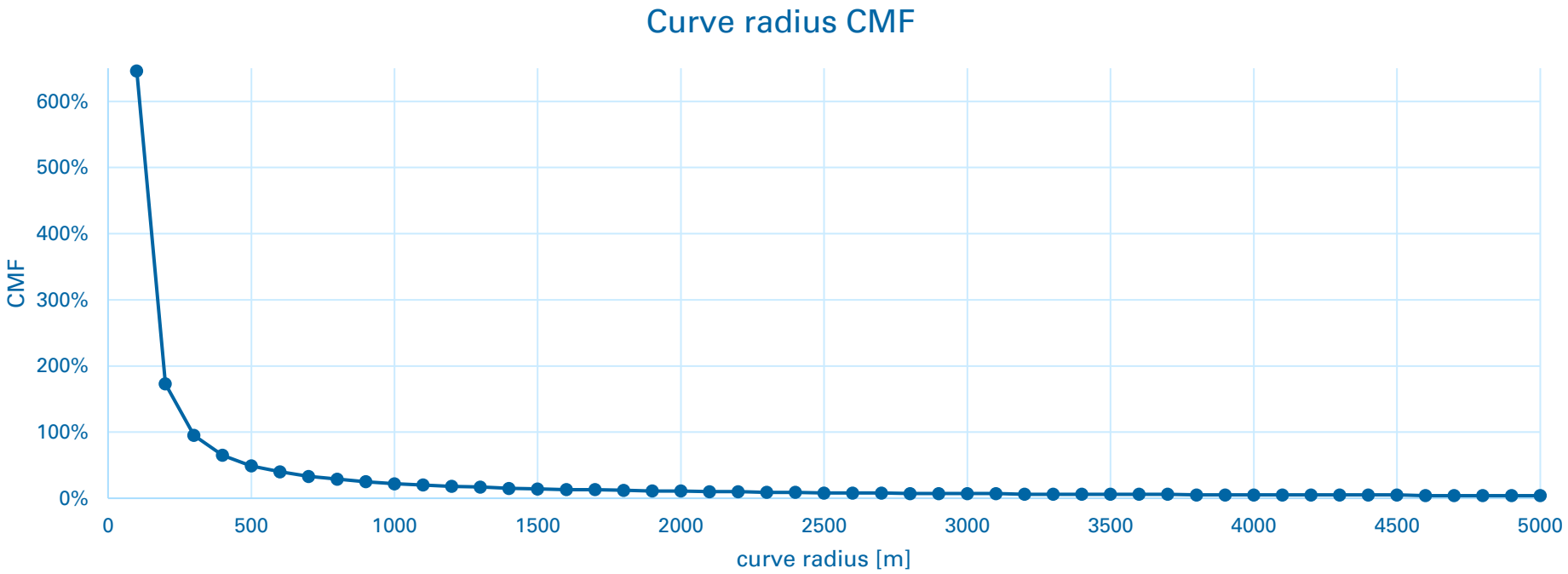
Academy
In partnership with
Università degli Studi di Napoli Federico II

Through cross-sectional analysis based on regression models and using the Safety Performance Functions (SPF), the CMF for each **p** characteristic is defined as follows

$$CMF_p = \frac{Crash\ Frequency\ WITH\ Treatment}{Crash\ Frequency\ WITHOUT\ Treatment} = e^{\beta_p \cdot (x_p - x_{p(base)})}$$

The CMFs allow the **identification** of the main **contributing factors** of the incident phenomenon.





Development and later use of **13 CMF** such as **road markings, curve radius, emergency lane** etc...

AIRoS Experimental Model & Insights

Time window
Historical: 2010-2023
Forecasting: 12 months
(with consolidated traffic forecasting models)

+5.000
generated segments
+50
generated Clusters

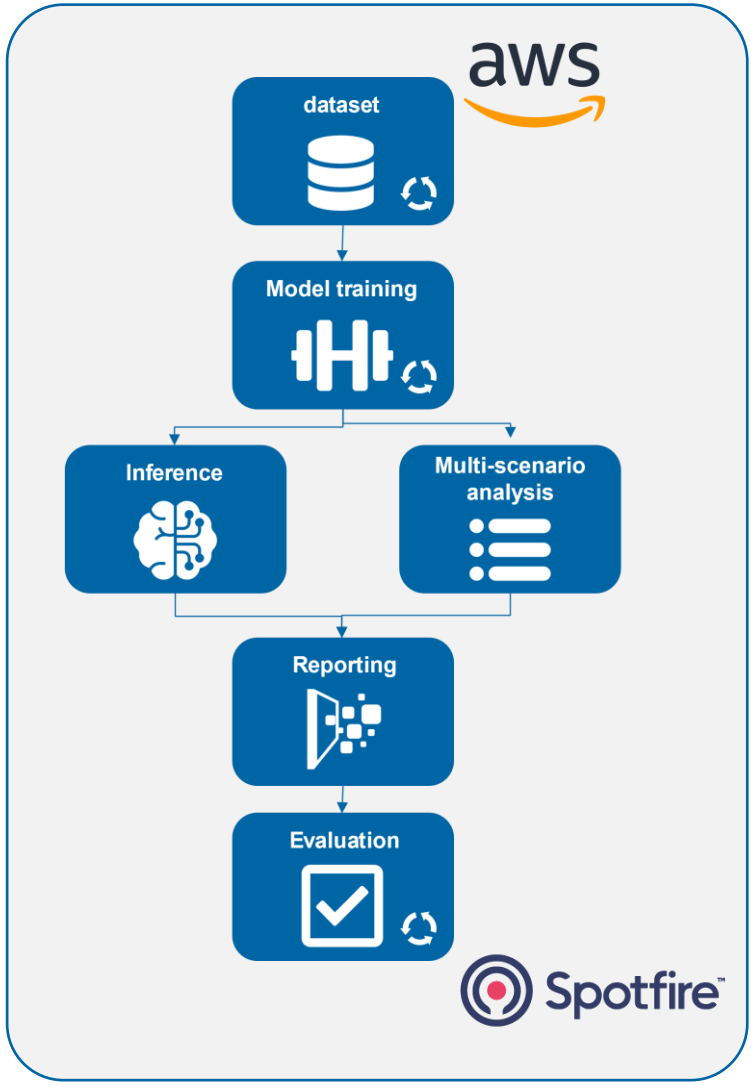
~5.000 km
Network length

+200M
Processed Scenarios

Performances
99,6% accuracy*

37 Features
including **13** CMF and features such as traffic forecasting, average speed, road configuration etc.

Hybrid Model
Combination of XGBoost, which integrates CMF and other features, linearly combined with an XGBoost model trained on synthetic data.



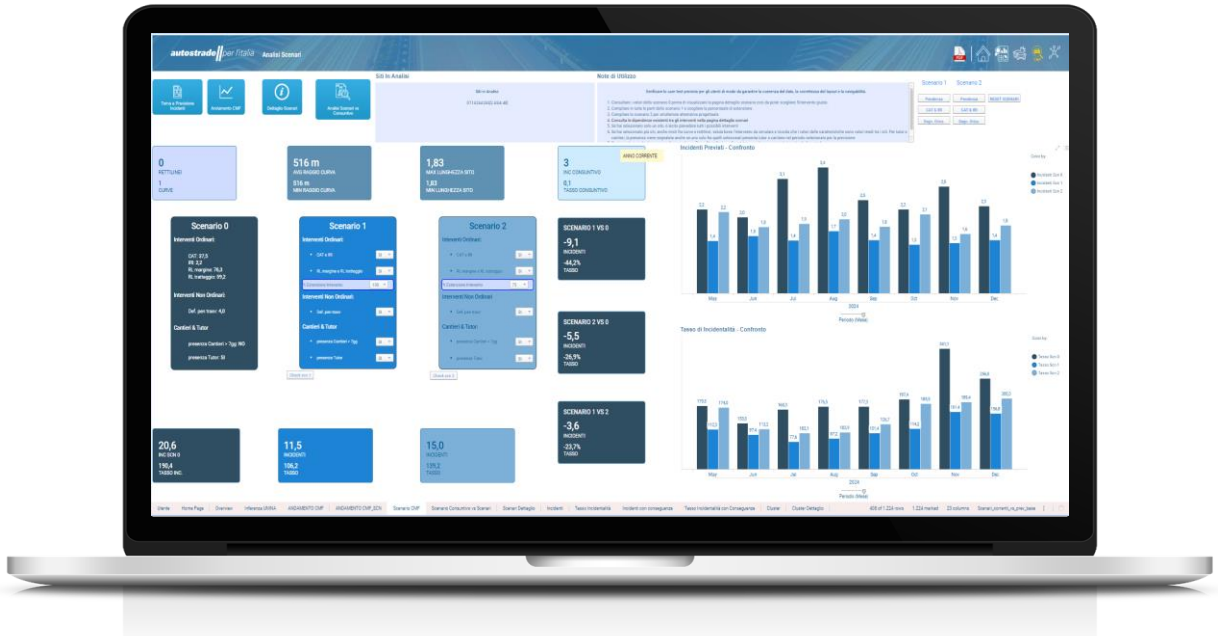
* gathered on test set FY2022

Experimental Application

Enabling multi-scenario analysis

A Dashboard available on **TIBCO Spotfire** allows historical data analysis and provides a toolbox to make data-driven decisions for **proactive improvement planning** through the use of the predictive framework and the **what-if scenarios available.**

Identifying the **key characteristics** to **focus** attention on and implement **improvement solutions**.



Over 300 experimental improvement actions planned

- High-performance asphalt pavement (high adhesion)
- Curves' special indicator signals
- Safety Tutor increased coverage
- Vertical signaling and lighting signaling enhancement

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Next Steps

In the pursue of **continuous improvement** the work on the system doesn’t’ stop.
The **main future features** will be:

- Model consolidation and fine tuning
- Extension to semi-closed network etc.
- CMF range broadening
  (e.g. roadworks configuration)

Thank You for Your Attention

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