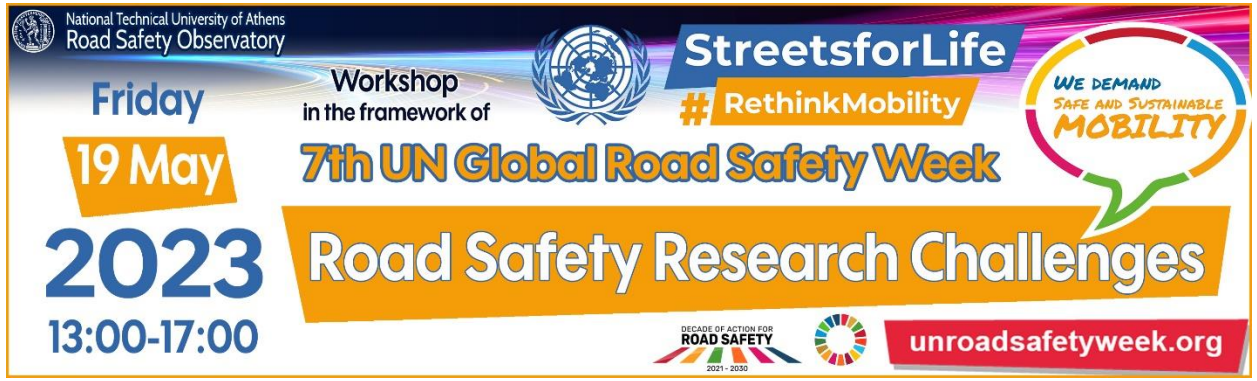

The HADRIAN project:

Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs

Marios Sekadakis

Transportation Engineer, PhD Candidate

Together with:

Christos Katrakazas, Marianthi Kallidoni, George Yannis

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Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs

The HADRIAN project

- HADRIAN: "Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs"
- 16 project partners from 9 EU countries
- Duration: 42 months (December 2019 - May 2023)
- Framework Programme: Horizon 2020 - The EU Framework Programme for Research and Innovation - Mobility for Growth

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virtual vehicle
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bast
ika | RWTH AACHEN UNIVERSITY
HORIZON 2020
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Background

- The HADRIAN project investigates and defines the driver role for automated vehicles using a holistic user centered approach that addresses shortcomings of current development and design processes to achieve high impact and wide-reaching acceptance of automated vehicles.
- Consortium performed 22 empirical studies in driving simulators across Europe and Turkey with overall 863 participants.
- Demonstrated HADRIAN innovations with 32 participants on test tracks and open road environment.

Driving Simulators

Demonstrators

Safety & Impact Assessment

- NTUA led and contributed in accomplishing a holistic Safety and Impact Assessment.
- The purpose of the Safety and Impact Assessment was to evaluate the improvements achieved through the HADRIAN Human Machine Interfaces (HMIs).
- To this end, an HADRIAN-tailored assessment methodology was developed focusing on Automated Driving (AD) for up to SAE Level 4 from a human-centered perspective.
- Special focus was given to take-over requests and AD-level transitions.

Assessment Comparison Context

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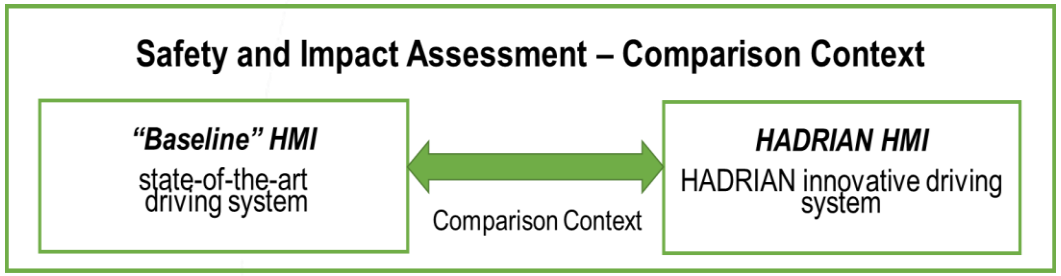
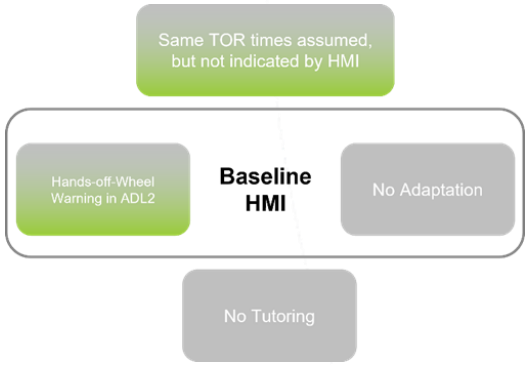
- The assessment analyzed the results from the experimental driving simulator studies.
- The HADRIAN HMI was compared with state-of-the-art in-vehicle systems, serving as "baseline" HMI.
- For instance, the HADRIAN "integrated fluid HMI" included the following functionalities:
  - 5 seconds time for take-overs in ADL2, 15 seconds time for take-overs in ADL3: the countdown information is displayed to the driver
  - Ensured time interval in which ADL3 driving is possible: the duration is displayed to the driver
  - Tutoring video before the drive, outlining the driving functions, correct system use, and driver responsibilities

and many more





Baseline HMI versus HADRIAN HMI

Assessment KPIs

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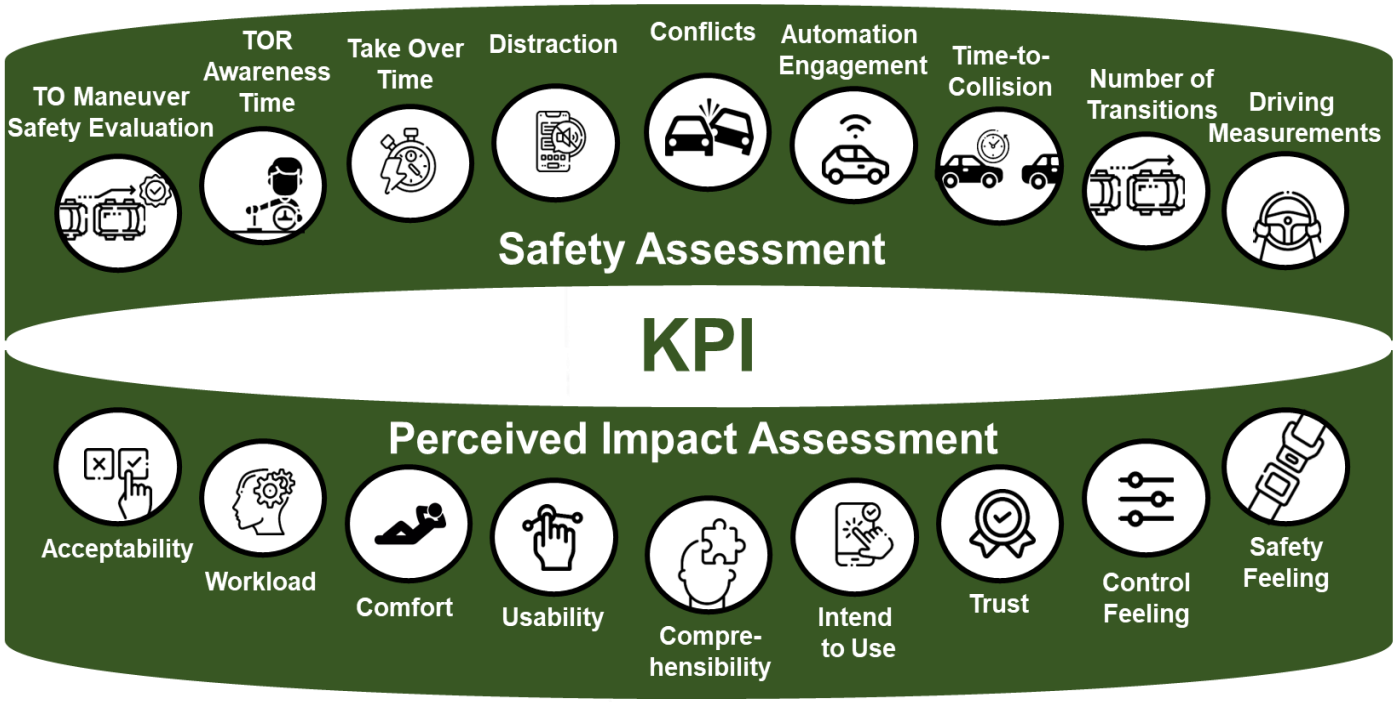
- The safety and impact assessment methodology shaped specific Key Performance Indicators (KPIs).
- 9 KPIs for safety and 9 KPIs for the perceived impact of drivers.
- The KPIs were estimated through driving, eye-tracking metrics, and subjective measurements obtained during the HADRIAN simulator studies.



Scoring Method

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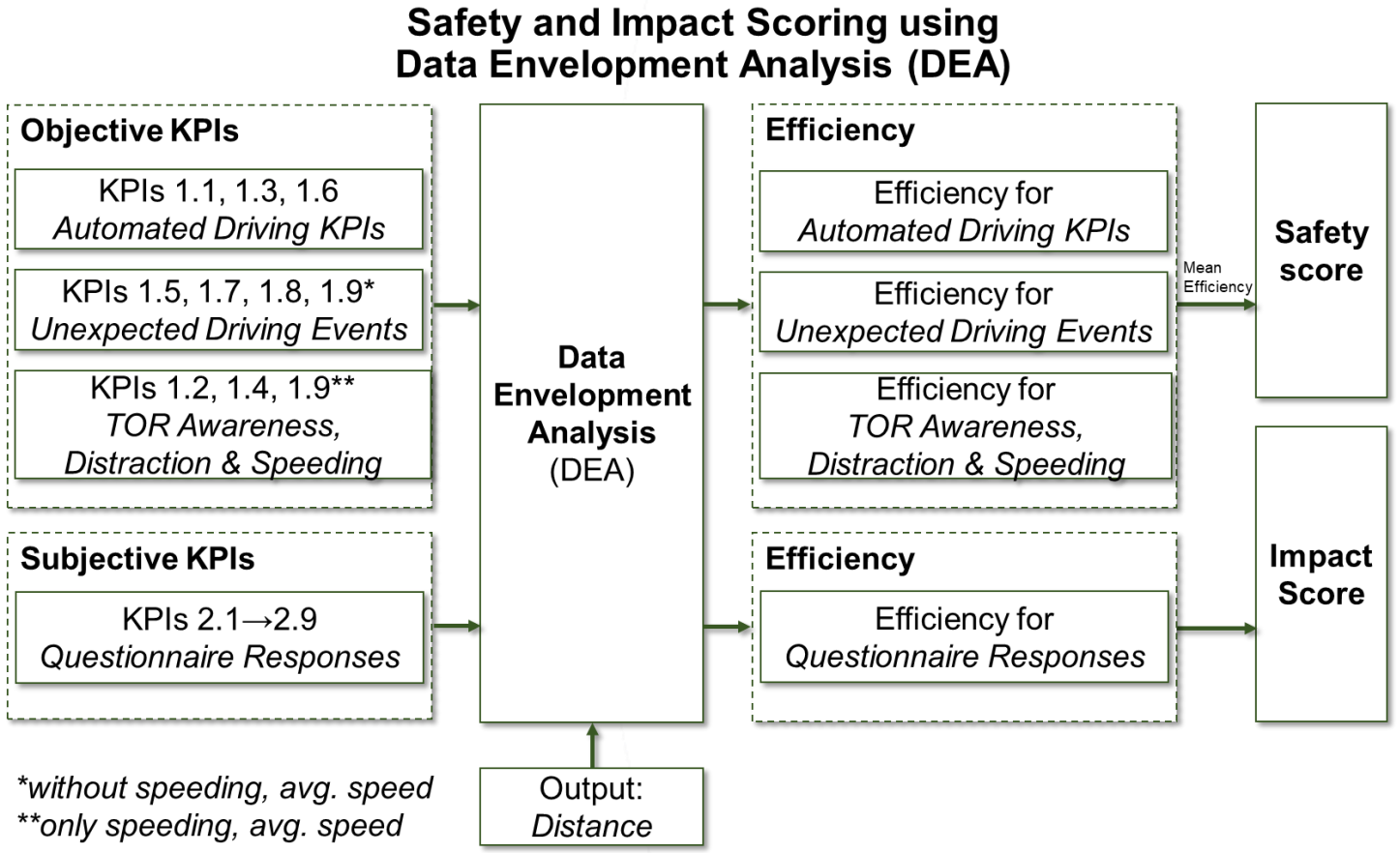
- Data Envelopment Analysis (DEA) was applied to obtain scores based on KPIs for both the "Baseline" and HADRIAN HMIs.
- DEA is used for efficiency and productivity analysis of similar units, widely used in business, economics, and management.
- The total safety score was calculated as the average efficiency of three homogeneous KPI groups for each driver.



Overall Scoring

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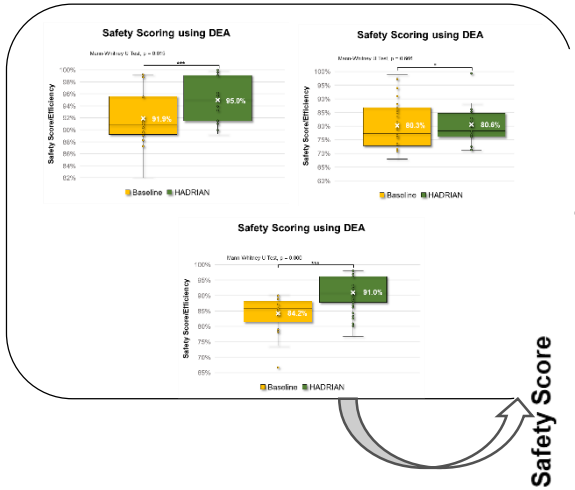
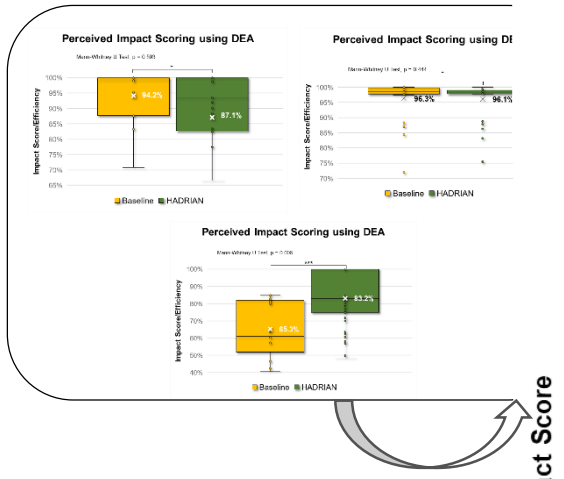
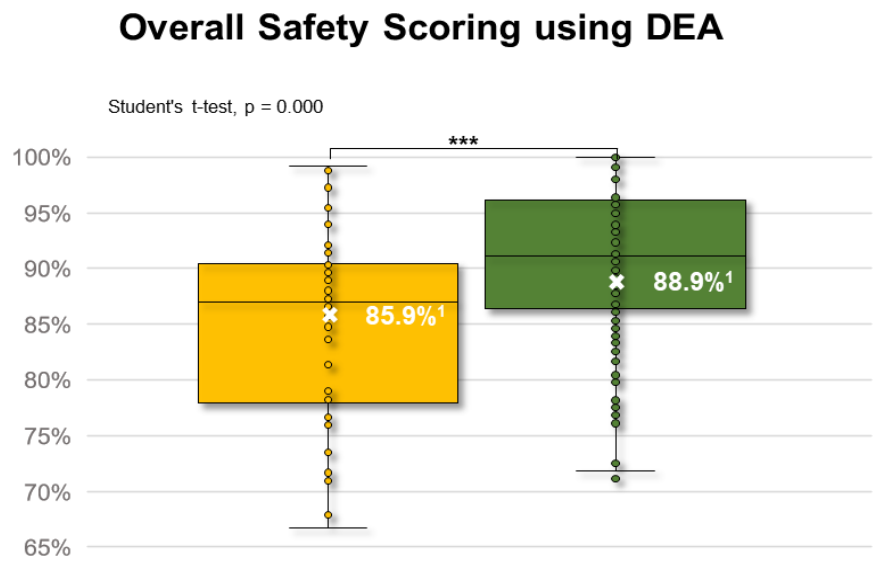
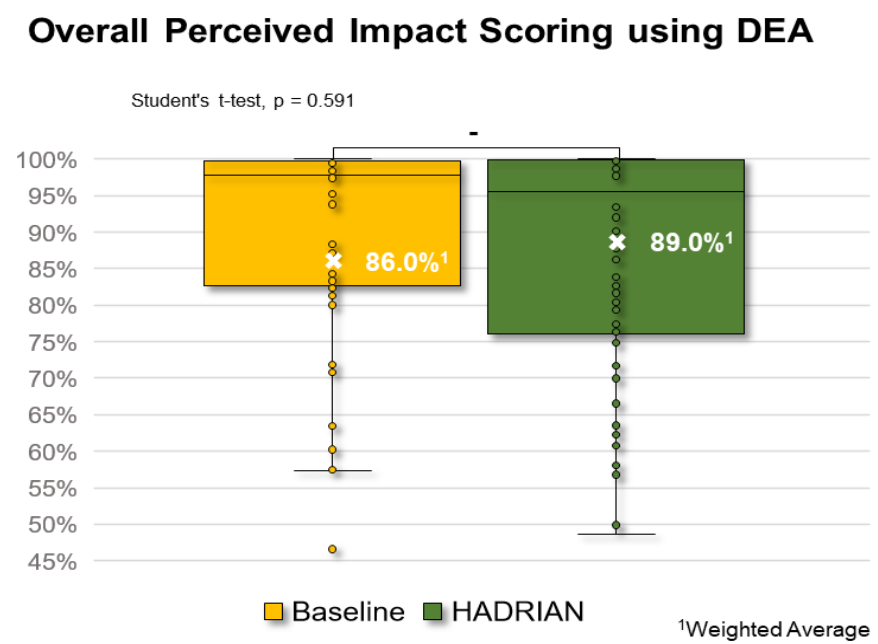
- The DEA scores of overall safety and perceived impact applied on 225 observations of 3 studies and are presented in boxplots:
  - The HADRIAN overall weighted safety score was improved by 3.40% compared to baseline HMI.
  - The HADRIAN safety score was revealed to have a statistically significant higher safety performance.
  - The overall weighted perceived impact score was improved by 3.46% with the HADRIAN HMI.









Cornerstones of HADRIAN HMIs

- The HADRIAN "Integrated fluid HMI" had a great improvement in takeover performance and distraction prevention as well as outperformed with less mental or cognitive effort, higher comfort in use, and control feeling.
- The HADRIAN "Visual HUD Support System" improved performance on limiting safety-critical events i.e., conflicts, TTC events, speeding and harsh cornerings and outperformed with higher comprehensibility, intent to use, and safety feeling.
- The HADRIAN "Haptic Feedback on the Steering Wheel" was found to be capable of reducing mainly harsh cornering events, conflicts and close TTC events as well as outperformed with higher usability, intent to use, and control feeling.

For accessing the full reports and publications of HADRIAN:

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Streets for Life

- **Safety and impact assessment** for all new AD systems and developments could evidence and optimize future road safety.
- **Human-centered design** of AD developments, similar to HADRIAN innovations, could ensure a more intuitive, safe, and user-friendly autonomous driving experience.
- HADRIAN contributes to propose **a clear policy to enhance safety**, based on the safety assessment, that provides guidelines and recommendations to AV manufacturers, regulators, and policymakers regarding the development and application of automated driving technology.

Scientific and Social Impact

- Contribution in understanding and assessing safe human-machine interface of highly automated driving functions and for safe and controlled transitions between automated levels.
- The safety and impact assessment could be exploited by HMI & AD stakeholders in order to apply similar human-centered assessment methodologies that evaluate the safety and perceived impact of human interaction with potential HMI configurations.
- Support of the "Vision Zero" objective by supporting AD development and preventing road accidents and human errors.

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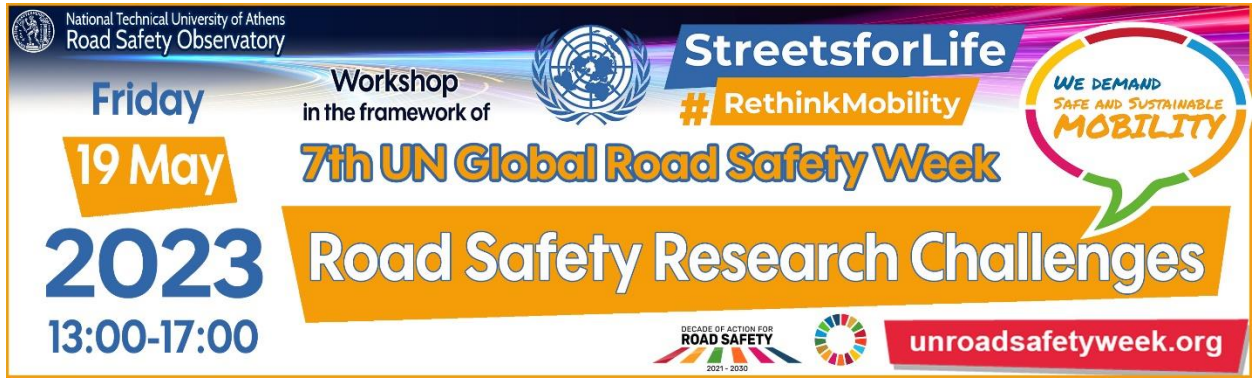
Future Challenges

- Concrete guidelines and regulations for introducing human-centered designs into autonomous vehicles to strengthen safety during driving.
- The development of safe smart vehicles that can respond to the complexity and dynamics of the road traffic environment.
- Special focus should be given to AD-level transitions.
- Investigation of road infrastructure and smart communication capabilities to assist the drivers during the AD level transitions.



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