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A review of risk factors associated with elderly, truck and office worker drivers for automated driving applications

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Introduction (1/2)

- **Human factor** is responsible for up to 94% of traffic accidents and thus has a substantial role in the accident occurrence.
- As a result, human factor, as well as other road and vehicle environment components, should be thoroughly explored to **mitigate road accident injuries and fatalities**.
- For that purpose, this research aims to **identify risk factors** that affect driving performance and road safety for three distinct groups of drivers; elderly, truck drivers and office workers.



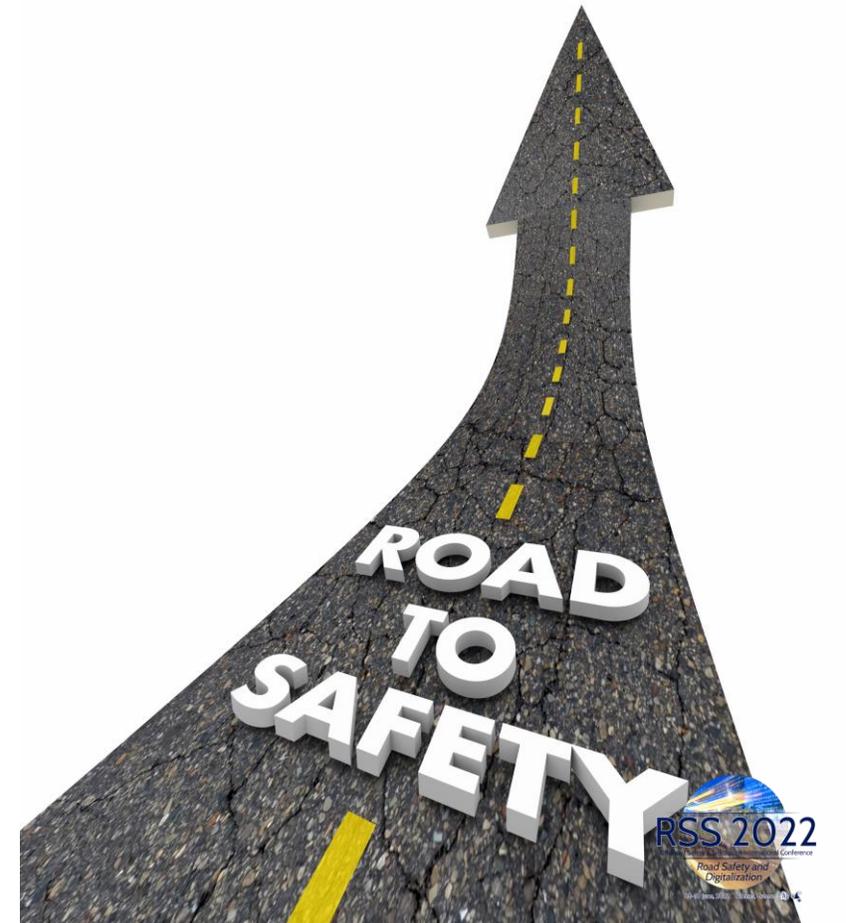
Introduction (2/2)

- **Intelligent transportation systems** could improve human factor, congestion, and energy efficiency in the future.
- The key principles for "**safety through automation**" were proposed by the Forum of European Road Safety Research Institutes (FERSI).
- Specifically, the necessity of "**Human-Centred Design**", in which all conceivable user profiles should be considered while developing Autonomous Vehicles (AVs), is a vital principle for automation safety.



Study Aim

- The current study focused on three specific "use case" drivers:
 - Elderly Driver
 - Truck Driver
 - Office worker Driver (i.e., working and driving simultaneously; feasible at higher levels of automation)
- With the total aim of identifying risk factors that affect road safety and driving performance.
- This review also aims to highlight the risk factors that should be considered in future safety analyses for Automated Driving (AD) applications.



Methodology (1/2)

- The considered use case drivers, parameters as well as the entire work were inspired by research conducted within **the EU H2020 HADRIAN project**.
- **HADRIAN** aims at developing an innovative Human Machine Interface (HMI) that will provide seamless interaction (named "fluid") between the driver and the automated vehicle.

HADRIAN

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

<https://hadrianproject.eu/>



HADRIAN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 875597.



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Methodology (2/2)

- The literature search was conducted on the **leading databases** with published studies and most of them are published in scientific journals after peer-review process.
- The second step was to **view the title and the abstract**, and judge if it was suitable.
- The third step included the major criterion was that the **results** to be statistically significant and the methodology to be rational.
- More than **100 studies** were included in the review, and a total of 300 were screened.

Literature search on databases

View title and abstract -
Judge the topic relevance

Acceptance criteria for the
screened study

*Steps of literature review
methodology.*



Results (1/2)

- The obtained factors were **divided into two or three categories** depending on the use case.
- In the case of **older drivers**, the factors were divided into three categories: i) Age-related Impairments, ii) Age-related Medical Conditions, and iii) Age-related Medication.
- Risk factors of **truck drivers** were divided into the following categories: i) Driver-related Factors, ii) Work-related Conditions, and iii) Driving Conditions.
- Factors affecting **office workers** were classified as follows: i) Working-related Conditions, and ii) Driver Behaviour.



Results (2/2)

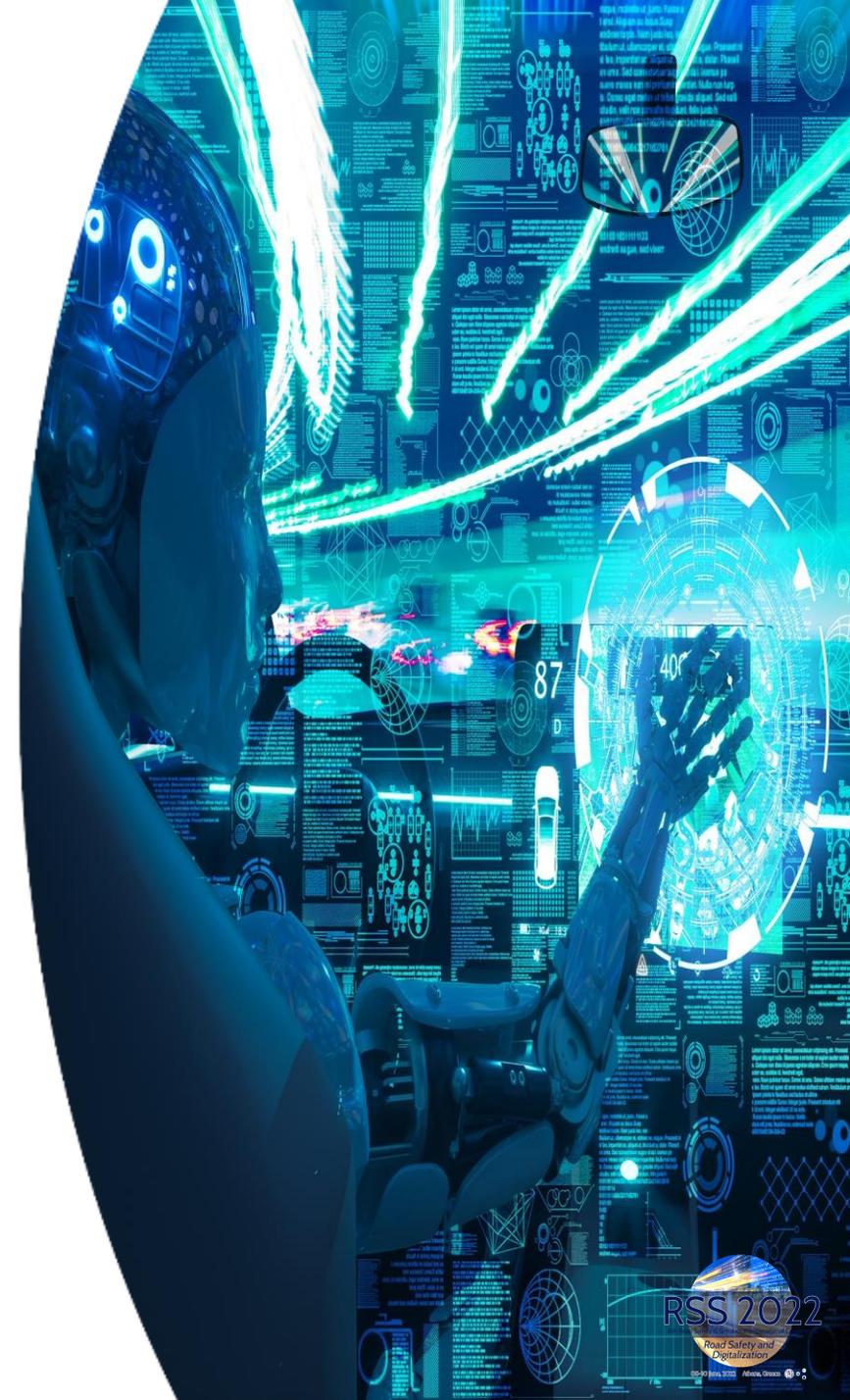
- The **obtained risk factors** from this study are listed in this Table.
- The **extensive findings** can be found in the full-text review.



1. Elderly Drivers	2. Truck Drivers	3. Office Worker Drivers
<u>1.1 Age-related Impairments:</u> <ul style="list-style-type: none"> • Mental Workload • Inattention • Distraction • Reaction Time • Fatigue • Cognitive Functions • Headway & Speed • Joint Flexibility • Vision • Emotions 	<u>2.1 Driver-related Factors:</u> <ul style="list-style-type: none"> • Age • Driving Experience • Distraction/ Inattention 	<u>3.1 Working-related Conditions:</u> <ul style="list-style-type: none"> • Distraction • Inattention • Stress • Fatigue
<u>1.2 Age-related medical conditions</u>	<u>2.2 Work-related Conditions:</u> <ul style="list-style-type: none"> • Fatigue • Working Hours • Sleep Duration • Sleep Disorders • Nighttime Driving • Obesity • Heavy Vehicle Configuration (Single Or Double Type Of Trailer) • Company's Safety Policy 	<u>3.2 Driver Behaviour:</u> <ul style="list-style-type: none"> • Speeding • Risk-Taking
<u>1.3 Age-Related Medication</u>	<u>2.3 Driving Conditions:</u> <ul style="list-style-type: none"> • Road Type 	

Extension to AD (1/3)

- At the **intermediate SAE automation levels** (i.e., SAE levels 2, 3) prior to the highly automated, the driving task will still require driver interventions.
- Apart from the Take-Over Requests (TORs), there will be sections within the commuting routes that **AD will not be available** and the reviewed risk factors will be present.
- Special focus should be given to **TORs** which will be a new task for AV users and should be investigated more profoundly in terms of risk factors since human factors will still be present during TORs.



Extension to AD (2/3)

➤ Special focus and further investigation should be implemented for the following risk factors during **TORs**:

- **Distraction/Inattention**: the drivers will be more probable to be distracted with NDRTs and inattentive during the TORs when AD is enabled.
- **Stress**: Emotion of stress will probably be external to driving tasks and this requires further research.
- **Fatigue**: Fatigue will be a critical risk factor for the drivers. The driver could be fatigued or even fall asleep during AD.
- **Driving Experience**: Driving experience will probably be a determinant factor for the whole performance of the TOR maneuver.



Extension to AD (3/3)

- At **SAE levels 4 and 5**, there are no human interventions and hence the obtained risk factors do not coexist.
- An **ideal hypothesis** for AD would be that by removing human factor from the task of driving, the elimination of accident risk will be accomplished.
- Though, a **more realistic assumption** is that human error will be replaced by accidents caused by imperfect automated systems.



Exploitation

- **AV manufacturers** could focus on reducing these risk factors with technological aid such as driver monitoring, or a system that intervenes with driving corrections, especially for AD up to SAE level 3.
- **Human factor** should be in the research spotlight even at AD levels 2 and 3 in order to mitigate its contribution to road accidents.
- AV manufacturers should also concentrate more on **elderly drivers** due to the fact that driving will be more attractive for them.
- **Researchers** can easily find the literature gaps by exploiting this review.





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