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Human Factors for Automated Vehicles: Prioritizing Safe and User-Centred Design

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Outline

- Introduction to human factors
- Human factors challenges for automation
- Solutions - knowledge, procedures and tools
- Key messages





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AV

Human Factors

Human factors is a multidisciplinary science that **applies knowledge of human abilities and limitations to the design and evaluation** of technology for improved safety and usability. It should be involved throughout the development and deployment of new technologies and systems – in their design, implementation and evaluation.

- **Safety**
- **Performance**
- **Usability**
- **Interaction design (UI)**
- **User experience (UX)**
- **Physical ergonomics**



Human Factors continued

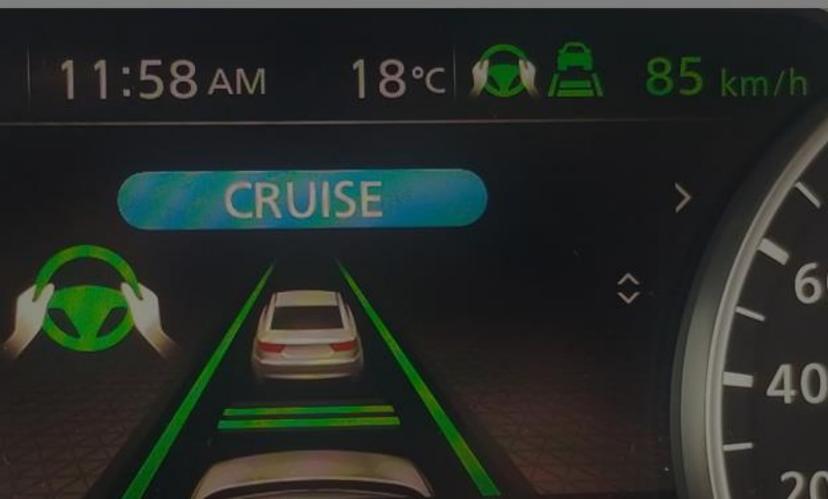
- Is not “common sense” nor is it a single “human factor”
 - interaction of multiple components where a systems approach is needed
- Term “Human Error” is misunderstood and misused
 - Often used as a bin for anything not otherwise explained....if not road or vehicle, then...
 - Often see 80-90% estimate for improvement of safety with ADS
 - This ignores the interactions of 3 main factors (road users, vehicle, road-traffic environment)

Human error, when it does occur, should not be seen as a cause but rather a symptom of a system which needs fixing (Dekker, 2003)

Expert Audit of Automation HMI

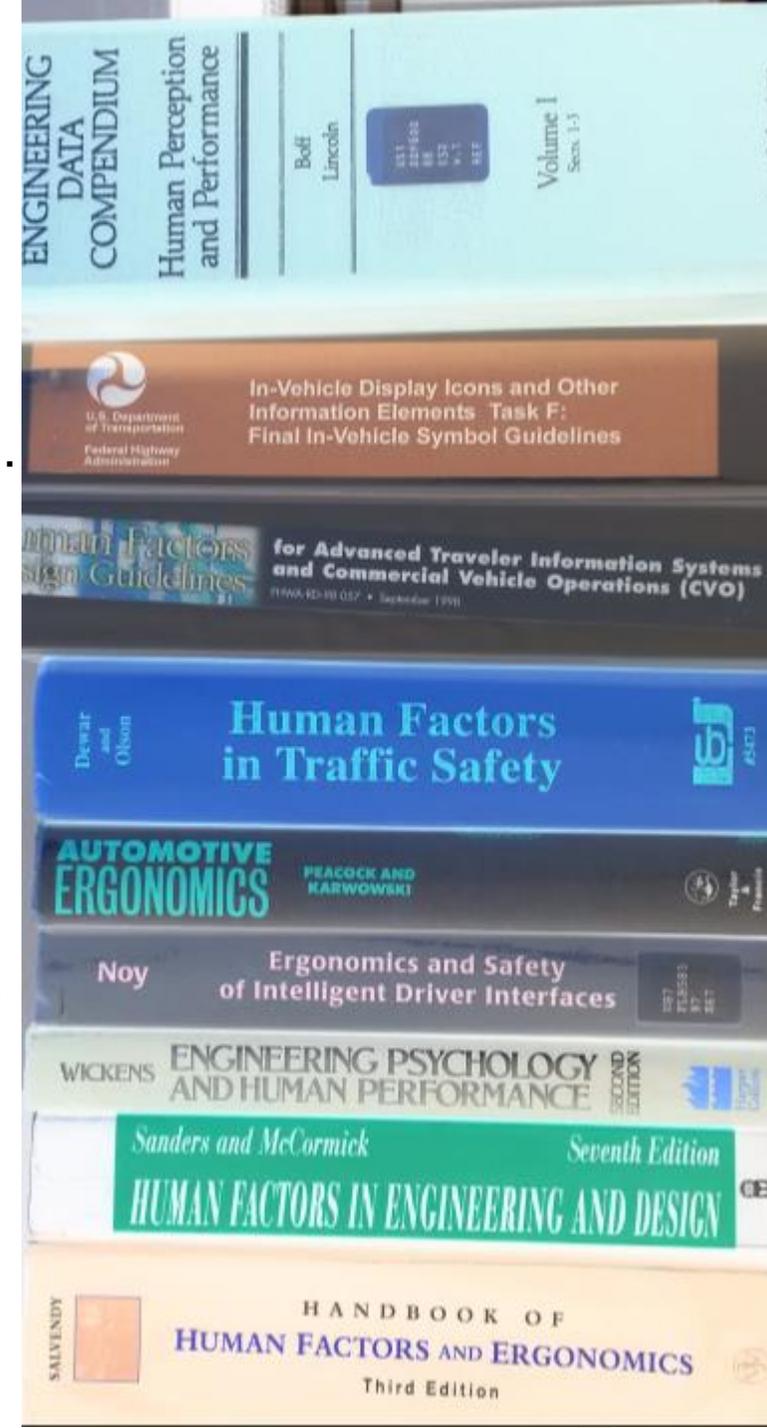
Confusing, unpredictable and distracting

- Unknown functionality and operational design domain (ODD)
- Finding the controls and displays and identifying functions
- Easily confused with other controls
- Current system status, or change in status, never clear
- Takeover requests are only implied
- Requires drivers to look away from the road



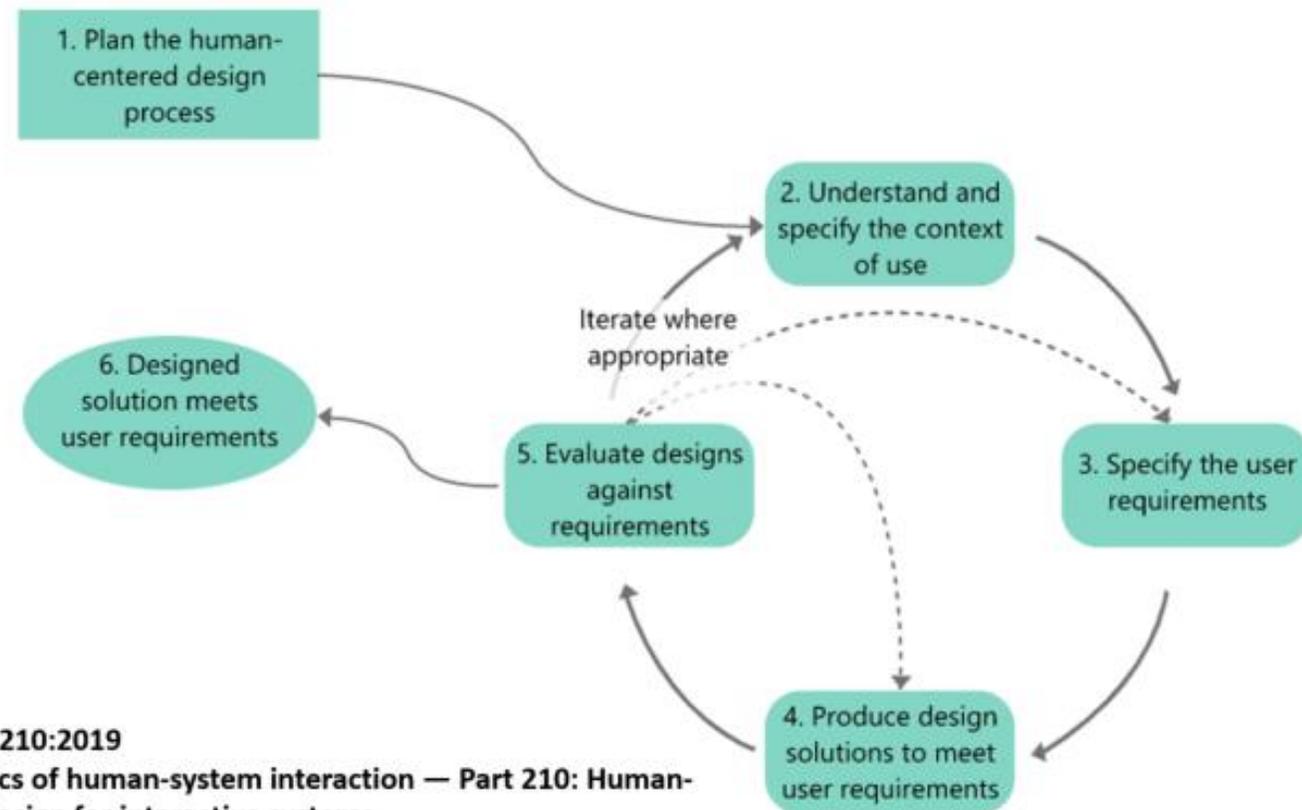
Established Body of Human Factors Knowledge

- Human-Machine Interface (HMI) design
 - Displays – optimal fonts, symbols, colour contrasts, coding, grouping...
 - Controls – shape, operation, stereotypes and conventions...
- Labelling and warnings design
- Human-systems integration/ User-centred design
- Physical ergonomics (anthropometry and biomechanics, forces, comfort, reach envelopes, eye- ellipse, H-point etc)...
- Human error, workload, situation awareness, psychophysiology and operator state...
- Research tools and methods



Human Factors Process Requirements

- Established procedures to define intended users, user needs, use cases and interfaces
- Identify use-related hazards and categorize critical tasks and develop and implement risk mitigation or control measures
- Consult relevant body of knowledge, guidelines and standards, prototype and verify design with user testing (real users) ... repeat
- Document the whole process with sign-off from human factors experts
- Track system performance post production in the field
- This focus on process rather than design and performance requirements allows more freedom to innovate



ISO 9241-210:2019

Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems

Key Messages

- The neglect of human factors is already an issue and risks may increase with more complex automated driving systems
- There is a need to promote better:
 - human centered design of the vehicle and its interfaces;
 - safe interaction between the automated vehicle (AV) and other road users; and
 - consumer awareness and understanding of AVs including accurate depiction of the capabilities and limitations of AVs in marketing.
- While more research is needed, a substantial body of knowledge is available to address many of the human factors design needs for automated driving systems, but a process is needed to ensure it is applied more effectively