

WP.1 UNECE: Eighty-fifth session
Geneva, September 2022



Human Factors for Automated Vehicles: Prioritizing Human-Centred Design & VRU Safety

Dr. Peter C. Burns



Outline

- Overview of human factors
- Human factors concepts
- Human-Centred Design – definition and benefits
- Examples of human-factors issues for automation
 - Crash case study
 - Representative vulnerable road users (VRU)
 - Branding and marketing of ADAS
- Summary

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 Concepts

- **Doyle's Catch** - Because the capabilities of automation can be demonstrated under some conditions, it should be straightforward to extend that more widely **NOT** (Woods, 2016).
- Humans do not perform well in the role of automation monitor, supervisor or back-up for automation failures (Sheridan, 1995).
- Human errors are consequences not causes (Reason, 2003).
- Billings' Human-Centered Automation principles (Billings, 1997):
 1. Humans must be involved
 2. Humans must be informed
 3. Humans must be able to monitor the automation
 4. Automation must be predictable
 5. Automation must monitor the human (input/ state)
 6. Intent must be dually communicated between automation and human.



Human-Centred Design

Definition – an approach to design that focuses on the users, their needs and requirements, by applying human factors knowledge and techniques (ISO 9241).

70% to 80% of new product development that fails does so not for lack of advanced technology but because of a failure to understand users' needs (Von Hippel, 2007).

Benefits

- Improves user experience (UX).
- Increases performance and usability - makes products and services easier to use, which reduces training, documentation and support needs (and costs).
- Builds appropriate trust.
- Boosts sales/ competitiveness - customers are more likely to buy a product that meets their needs and prefer ones that are more effective.
- Reduces development time and costs.
- Makes products more accessible
- Reduces human errors and makes products safer.

Example 1



Credit: Colin Ryan /Facebook

Example 2: VRU Targets for testing



Euro NCAP Adult and Child Pedestrian Targets



VRUs in Reality



Vehicles will encounter very different VRU behaviours, shapes and sizes in different environmental conditions.



TC tested 4 target configurations:

1. Child Euro NCAP pedestrian target (EPTc)
2. EPTc with hat and long pink coat
3. EPTc with long dark coat
4. EPTc with long dark coat and backpack



AVSC Best Practice for Interactions Between ADS and VRUs

A Program of SAE ITC

- Design for foreseeable non-compliant and less predictable behaviors by VRUs (e.g., children).
- Test for variations in shape, color, density, texture, lighting variation, environmental conditions, etc.
- VRUs should expect an ADS to follow traffic code.
- Compliance with traffic code may vary among VRU types and they may behave differently by location.
- Distracted VRUs may have different behaviors or be more likely to disobey traffic rules.
- The kinematics of certain VRUs allow them to change direction very quickly.
- Humans can change their trajectory with no external indications.



Example 3 – Branding and Marketing of ADAS

Perception	Assistance	Driving
<ul style="list-style-type: none"> • <i>Safety Sense 2.0</i> • <i>Active Safe</i> • <i>Smart Sense</i> • <i>Eyesight</i> • <i>ACTIVSENSE</i> 	<ul style="list-style-type: none"> • <i>Driver Assist</i> • <i>Driver Assistance</i> • <i>Pilot Assist</i> • <i>Active Driving Assistance Pro</i> • <i>ProPILOT Assist</i> • <i>Driver Assistance Plus</i> 	<ul style="list-style-type: none"> • <i>Super Cruise</i> • <i>Ultra Cruise</i> • <i>Autopilot</i> • <i>Drive Pilot</i> • <i>Full Self Driving</i> • <i>Blue Cruise</i> • <i>Co-Pilot 360</i> • <i>Drive Wise</i> • <i>Driver Confidence</i>

- Lack of standard names
- Misleading and inaccurate system names are common
- Interfaces and ADAS capabilities vary as much as the names

Key Messages

- The neglect of human factors is already an issue and risks will increase with automation.
- Human-centred design for automation is a win-win requirement.
- VRUs do not all look and act the same.
- 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