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

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### **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
- 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.

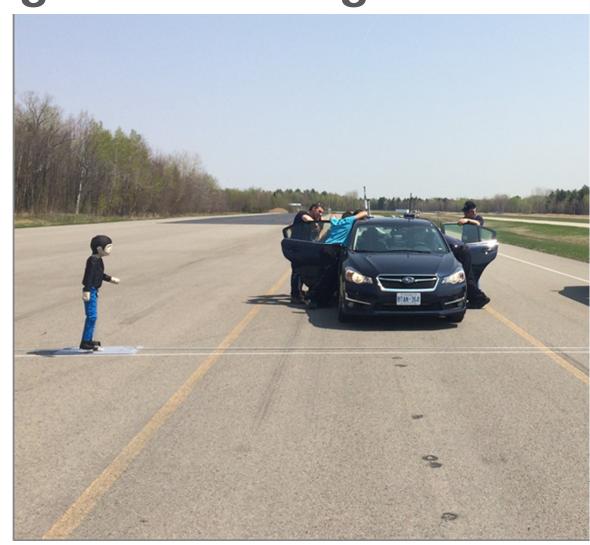




# **Example 2: VRU Targets for testing**



**Euro NCAP Adult and Child Pedestrian Targets** 



# **VRUs in Reality**











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

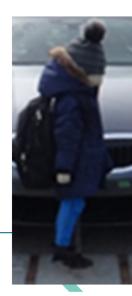
#### TC tested 4 target configurations:

- 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









#### Automated Vehicle Safety Consortium

# AVSC Best Practice for Interactions Between

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
• Safety Sense 2.0	Driver Assist	Super Cruise
<ul> <li>Active Safe</li> </ul>	Driver Assistance	Ultra Cruise
• Smart Sense	• Pilot Assist	<ul> <li>Autopilot</li> </ul>
<ul> <li>Eyesight</li> </ul>	Active Driving	Drive Pilot
• ACTIVSENSE	Assistance Pro	Full Self Driving
	<ul> <li>ProPILOT Assist</li> </ul>	Blue Cruise
	Driver Assistance Plus	• Co-Pilot 360
		Drive Wise
		Driver Confidence

- 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