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Venturer



# **VENTURER Trial 1: Planned Handover**

**Summary of trial conduct and findings**

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# Venturer Team



Large business	
SME	
Local government	
Academia	
Supporting	

# VENTURER Trial Programme



<b>Summer 2016</b>	<b>Trial 1</b> – understanding planned handover of control between vehicle and driver.
<b>Spring 2017</b>	<b>Trial 2</b> – considering how an AV interacts with another road user and with junctions.
<b>Winter 2017/18</b>	<b>Trial 3</b> – focussing on the interaction between an AV and other road users, including buses, pedestrians and cyclists.



# Trial 1: Planned Handover



- **Handover of control from the vehicle (system driving in autonomous mode) to the driver to continue driving in manual mode.**
- **Planned handover occurs in a situation where the driver knows they might be alerted to take control in certain situations but not necessarily when.**

# Knowledge Context



Previous studies considered handover:

- After **longer driving periods**;
- At **higher speeds**;
- With **more experienced drivers**; and
- **Single handover requests**.

# Scope



**VENTURER tested multiple handover requests:**

- After **shorter driving periods;**
- At **different speeds;** and
- Drivers with **varying levels of experience.**

Experiments and research conducted by **University of the West of England (UWE), Bristol Robotics Laboratory (BRL) and BAE Systems.**

# Research Questions



Component of the handover process	Research questions
Takeover time	<p><b>How long did it take participants to make contact with the controls</b> (steering wheel, brake, and accelerator) after the handover request had been made? This guides the data collection and analysis of the experiments.</p>
Handover period	<p><b>During the handover period, is manual baseline driving performance achieved?</b> (i.e., the same manual driving performance as before the handover process).</p> <p><b>At what stage or time during the handover process is manual baseline driving performance achieved?</b></p> <p><b>How long does stabilisation last?</b> (i.e., for how long does the driver maintain manual baseline driving performance levels during the handover period?)</p>



# Platforms for Trial 1



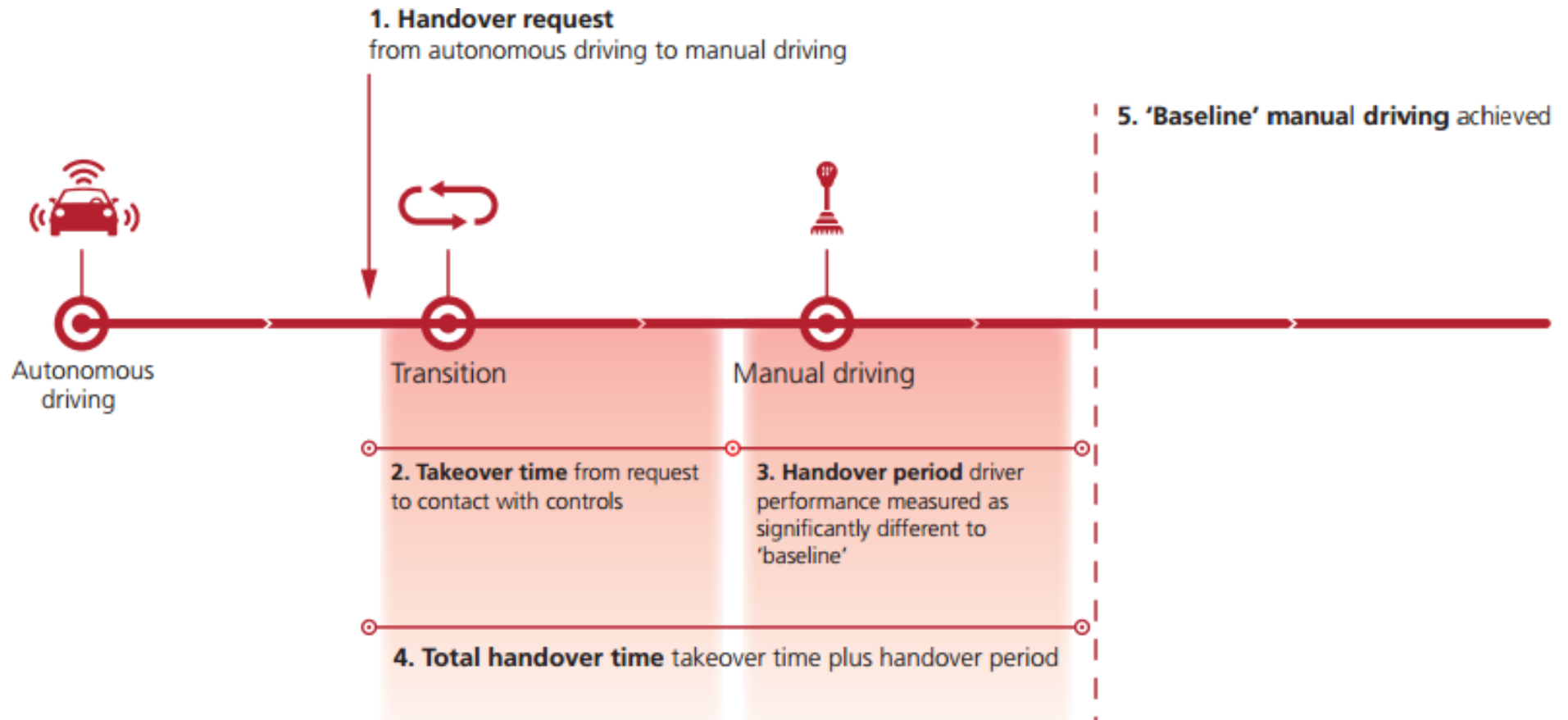
**UWE STISIM Simulator**



**BAE Wildcat**



# Handover event



# An example of an 'expert' handover in the Wildcat...



# Experiment Phases



- 1 Practice - familiarisation with driving controls and handover process**
- 2 Baseline 1 - manual driving for comparison**
- 3 Handover phase - transferring control from autonomous to manual driving mode. Multiple handovers occurred during this phase.**
- 4 Baseline 2 - manual driving for comparison**

# Findings



- **Takeover time** was found to be **in the region of 2.5-3 seconds** at **lower speeds** (e.g. 20 mph);
- Simulator - used **brake more** and **accelerator less** during **handover phases** than in the baseline condition; and
- Simulator - after handover tended to drive in a **safe lane position** at **speeds lower than 40 mph** but **greater deviation** at 50 mph.

# Findings



- Simulator – **drive slower** than the recommended speed limit **for up to 50 seconds** after **handover** (markedly slower during initial seconds); and
- Wildcat – **drive slower up to 10 seconds** after **handover** (longest possible recording time before e.g., slowing for a bend).

***Overall, findings suggest more cautious driving behaviour during handover with some potentially less safe control at higher speeds.***

# Some Key Conclusions



- **Wildcat findings validate simulator experiments;** and
- Experiments established that **handover is achievable**, but **not necessarily desirable**.



**Particular thanks to:**

**Chris Alford (UWE), Phil Morgan (Cardiff) who led the trial design and conduct**

**Pete Bradley (Atkins) for presentation slides**

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