Heligan
STRATEGIC
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Deep dive: Connected & Automated Mobility (CAM)

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Historical background

The UK CAM testbed was initially established in 2017 and has been further developed to expand testing and development capability. The strategy was commissioned by the UK Government (the Centre for Connected and Autonomous Vehicles) and Industry (the Automotive Council) and was initially awarded grant funding on a 50/50 basis totalling £200m.

The UK CAM strategy is to establish a world competitive testbed comprising 'Private' and 'Public' test facilities in a geographic cluster from Birmingham / Coventry to London incorporating the Oxford to Cambridge arc. This enables global customers to procure comprehensive testing and data analysis in proximity, supported by world-class facilities, capability, and qualified personnel. Its influence has spread since launch, but the core testbed cluster remains within this area. The funding competition was directed by Zenzic (Meridian Mobility Technology) part of Advanced Propulsion Centre and administered by Innovate UK.

The UK CAM testbed includes the world-class automotive proving grounds (HORIBA/ MIRA, Millbrook); leading CAM universities (Coventry, Warwick, Loughborough, Cambridge, Cranfield); a consortia of technology companies (JLR, Ford, AVL, Costain etc); former research institutes (eg Transport Research Laboratory); local authorities and involves cross-sector collaboration – infrastructure, automotive, autonomous driving, AI, robotics, telecommunications, IOT, insurance, legal, data analysis, cyber security etc.

The UK CAM testbed markets itself globally at key events (CES Las Vegas, Stuttgart, Japan) and the individual organisations collaborate as necessary to deliver bespoke testing solutions for global customers. The command and control for the UK CAM testbed is Zenzic and CCAV (Department for Transport and Department for Business and Trade).

The UK CAM ecosystem has created a 2035 UK technology roadmap informed by the Testbed, the consortium partners, global customers, the UK supply chain, Zenzic and CCAV. UK Government, industry and university investment funding in CAM has reached hundreds of millions of pounds and the 2035 future growth potential is projected at more than £40bn.

CAM regulatory environment

The leading CAM nations including the UK, US, South Korea, Singapore, China and Germany, are engaged in a race to develop and commercialise CAM technologies. Coincidentally, they are developing regulations and standards for CAM deployment. The successful development and commercial deployment of CAM will require cross-sector and multi-national collaboration. The European Commission is also engaged in the development of international regulations and standards.

In the UK, the Automated Vehicles (AV) Act 2024 is a landmark piece of legislation, designed to regulate the use of automated vehicles (AVs) on public roads and other spaces. Here is a concise summary of its key aspects and potential future developments:

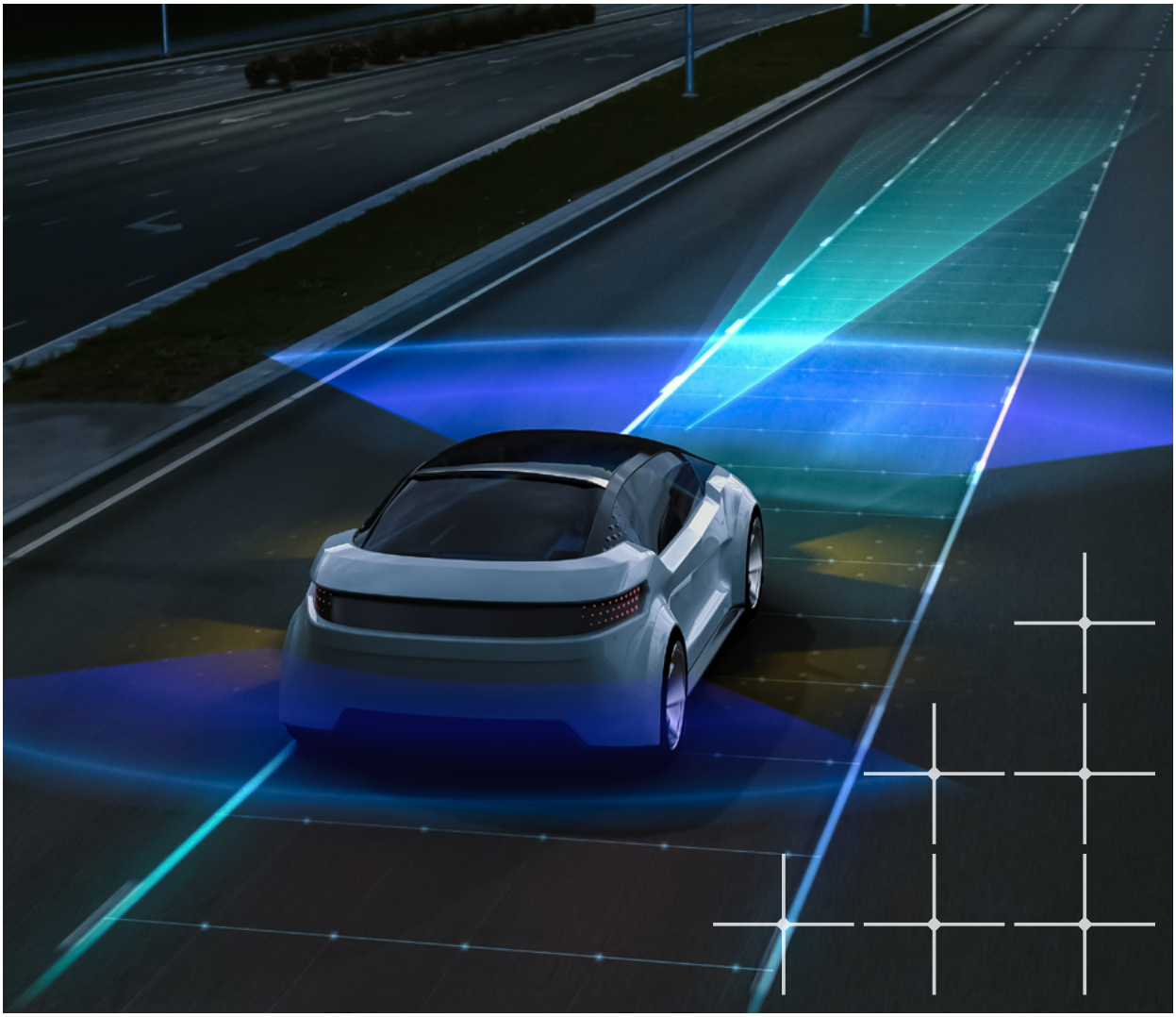
Key regulations of the AV Act 2024

- **Safety standards**
  Automated vehicles must meet rigorous safety checks and demonstrate a level of safety equivalent to or exceeding that of a competent human driver.
- **Approval and licensing**
  A new system for authorising and licensing AVs has been introduced, covering both fully autonomous vehicles and those with specific autonomous features.
- **Liability framework**
  The Act builds on previous legislation to clarify liability in accidents involving AVs, ensuring that insurers and manufacturers are held accountable where necessary.
- **Economic impact**
  The legislation is expected to unlock a £42 billion industry, creating 38,000 skilled jobs by 2035.
- **Road safety**
  By reducing human error, which accounts for 88% of road collisions, AVs are anticipated to significantly lower accident rates.

Potential future developments

- **Deployment timeline**
  Self-driving vehicles could be operational on UK roads as early as 2026, following successful trials.
- **Secondary legislation**
  The Act allows for the creation of additional regulations to address emerging challenges, such as data privacy, cybersecurity, and ethical considerations.
- **Global leadership**
  The UK aims to position itself as a global leader in AV technology, with ongoing trials and significant investments in companies like Wayve.
- **Public acceptance**
  Future efforts will focus on building public trust and addressing concerns about safety, congestion, and job displacement.

This legislation marks a significant step towards integrating automated vehicles into everyday life, with the potential to revolutionise transportation and enhance road safety.



CAM development projects: Public environments

Europe

Here are some of the leading initiatives:

1. **Wayve**
   Wayve is a UK-based start-up developing artificial intelligence technology for autonomous vehicles. Their goal is to create self-driving cars capable of navigating real-world environments without relying on pre-mapped routes or extensive sensor arrays. Currently, they are testing their self-driving technology on UK roads and have initiated a trial with Asda to autonomously deliver groceries to over 170,000 residents across 72,000 homes, marking the largest trial of its kind in the UK.

> Europe is at the forefront of developing connected and autonomous mobility (CAM) technologies, with numerous projects underway aimed at revolutionising transportation.
>
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2. **Project Cambridge Connector**
   This project involves thirteen self-driving vehicles providing passenger services around the Cambridge Biomedical Campus and the University's West Cambridge campus. Utilising a private 5G network to ensure service continuity, the vehicles are designed to complement existing city transport services. Initially, a safety driver is on board, with the aim for fully autonomous operation under remote monitoring in the future.

3. **Horizon Europe ULTIMO project**
   A collaborative effort across eight countries, the ULTIMO project is deploying driverless electric minibuses in Geneva, Kronach, and Oslo. Each location will have fifteen or more vehicles integrated with existing public transport services, aiming to operate in fully automated mode. The project focuses on providing on-demand, door-to-door services that are sustainable, accessible, and inclusive.

4. **Conigital – multi-area connected automated mobility**
   This initiative is establishing a remote driving control hub overseeing self-driving vehicles operating in Solihull and Coventry. The vehicles will provide both passenger and logistics services, supported by a 5G-based remote monitoring and tele-operation service to ensure safety and efficiency.

5. **CAVForth II**
   Building on the original CAVForth project, which launched the first full-size autonomous bus service in Scotland, CAVForth II is expanding trials to Cambridge and Sunderland, with the original Scottish route extended. The project involves more complex autonomous driving scenarios, including city centre traffic, and aims to enhance public transport through self-driving technology.

6. **Hub2Hub**
   This project focuses on developing a self-driving, zero-emission heavy goods tractor unit, potentially transforming the long-distance haulage sector. In partnership with major supermarket retailer Asda, the initiative aims to reduce costs and decarbonise one of the highest polluting industries: transport and logistics.

7. **FAME project**
   The EU-funded FAME project is enhancing automated driving solutions across Europe by improving the scalability, comparability, and complementarity of research and innovation projects. It aims to align research and innovation results on automated mobility, bringing them more visibility and making more efficient use of future funding.

US

The US hosts several prominent connected and autonomous mobility projects spearheaded by leading companies in the AV industry.

Here are some notable initiatives:

1. **Waymo**
   A subsidiary of Alphabet Inc., Waymo has been at the forefront of autonomous driving technology. In March 2025, Waymo expanded its commercial robotaxi services to Silicon Valley and Austin, Texas. In Silicon Valley, the service now includes areas such as Mountain View, Palo Alto, Los Altos, and parts of Sunnyvale. In Austin, Waymo partnered with Uber, allowing riders to hail its self-driving vehicles through the Uber app. This expansion is part of Waymo's broader strategy to scale its autonomous ride-hailing operations.

2. **Cruise**
   Owned by General Motors, Cruise has been operating fully driverless vehicles in urban areas like San Francisco. The company focuses on electrification, with its fleet being entirely electric. Cruise's flagship vehicle, the Origin, is a purpose-built, steering-wheel-free robotaxi designed specifically for autonomous operations. Backed by GM, Honda, Microsoft, and Walmart, Cruise controls its full tech stack, including sensors, simulation, and vehicle platforms.

3. **Aurora Innovation**
   Aurora is focusing on autonomous trucking, aiming to transform freight and logistics. The company has partnered with FedEx, PACCAR, and Volvo to pilot autonomous deliveries and is working toward fully driverless freight operations. Aurora's proprietary sensing technology, FirstLight LiDAR, enables accurate motion prediction, crucial for high-speed, long-range perception required in highway driving.

4. **Tesla**
   Tesla continues to develop its Full Self-Driving (FSD) system, aiming to transition from driver-assist features to full autonomy across its fleet. The company's extensive real-world testing and over-the-air software updates contribute to its advancements in autonomous driving capabilities.

5. **Nuro**
   Specialising in autonomous delivery vehicles, Nuro focuses on last-mile logistics solutions. The company has partnered with retailers like Kroger and Domino's to deploy its self-driving pods for goods delivery, emphasising efficiency and safety in urban environments.

These projects exemplify the diverse approaches and rapid advancements in connected and autonomous mobility across the United States.

CAM development projects: Defence

Connected and autonomous defence projects are at the forefront of military technology, integrating AI, robotics, and networked systems to enhance battlefield capabilities. Here are some of the leading projects globally:

US

Loyal Wingman / Collaborative Combat Aircraft (CCA) Programme
The US Air Force is developing AI-driven drones to operate alongside piloted aircraft like the F-35 and the Next-Generation Air Dominance (NGAD) platform. Boeing's MQ-28 "Ghost Bat" and Kratos' XQ-58A "Valkyrie" are key examples.

DARPA's Mosaic Warfare & AI-Enabled Battlefield Networks
A concept where small, modular platforms work together autonomously to outmanoeuvre larger forces. Includes the OFFSET (Offensive Swarm-Enabled Tactics) programme, which explores drone swarms.

Autonomous Ground Vehicles (RCV Programme & OMFV's)
The US Army is testing robotic combat vehicles (RCVs) and Optionally Manned Fighting Vehicles (OMFV) to support troops in combat.

Sea Hunter (Unmanned Surface Vessel – USV)
A fully autonomous warship developed by DARPA to conduct anti-submarine warfare and reconnaissance missions.

Project Convergence (Joint All-Domain Command & Control – JADC2)
A network connecting land, sea, air, space, and cyber assets for real-time data sharing across military branches.

China

JARI-USV (Autonomous Combat Vessel)
A small, unmanned combat ship capable of engaging surface and underwater threats.

Loyal Wingman UAV Programme (FH-97 & GJ-11 Drones)
China's response to the US CCA Programme, developing AI-powered stealth drones.

Sharp Sword & CH-7 Stealth UAVs
Autonomous drones designed for long-range surveillance and attack missions.

Russia

Uran-9 and Marker Combat Robots
Semi-autonomous ground combat vehicles equipped with weapons and AI-assisted targeting.

S-70 Okhotnik (Hunter) UAV
A stealthy, autonomous combat drone designed to work with Su-57 fighters.

Europe

Tempest (UK-led 6th Gen Fighter Program)
Includes AI co-pilots and optionally manned flight capabilities.

Eurodrone (Germany, France, Spain, Italy)
A European MALE (Medium Altitude, Long Endurance) drone designed for intelligence and strike missions.

Remote Carrier (Future Combat Air System (FCAS) – France, Germany & Spain)
Swarming UAVs supporting manned aircraft.

Other Notable Projects

Ghost Shark (Australia)
A fully autonomous underwater drone for surveillance and anti-submarine warfare.

Iron Beam (Israel's Laser Air Defence System)
While not fully autonomous, it integrates AI for real-time threat engagement.

SWiFT (India)
A fixed-wing drone prototype leading to India's Ghatak stealth UAV.

Major trends from the CAM Innovator's Event

11th March 2025, IET, London

- Progress on CAM regulations in the UK is steady through the implementation of the AV Act 2024 and secondary legislation is under consultation. Some countries are moving faster than the UK for example the US (Tesla, Waymo). The challenge is for the UK to influence and promote collaboration on the development of international standards and regulations.
- The flagship CAM commercialisation projects e.g. Harlander (Belfast Port & Sunderland) Sunderland have experienced significant challenges and while progress is being made certain aspects such as customer engagement, future funding, the business case and securing long-term operators are still uncertain. Both these projects involve autonomous buses for passenger transport. Operator and passenger engagement is positive once they have actually experienced the journeys, so there is a challenge to overcome perceptions and secure engagement. Scale-up is also anticipated to prove challenging.
- Progress of CAM in off-highway and mining is good. As is controlled environments such as airports and ports.
- Progress of CAM commercialisation in passenger vehicles is slower due to the speed of regulation and added complexities of road networks, infrastructure and complex transport systems.
- There is recognition that the announced increase in Defence spending could attract funding for technological development and operation of CAVs and UAVs.
- There was no specific mention or recognition of the role the Space sector and specifically satellite communications could play in assisting the delivery of the CAM technology roadmap 2035.

Key takeaways

Overall, the sense and mood of people at the CAM Innovator's Event was positive about overcoming of significant challenges in the way of delivering CAM. There was acceptance of the need to speed up the development of international regulations and standards, as well as a plea for more ambition and collaboration to identify large projects with higher potential returns on investment. In addition, there was a recognition of the need to manage risk but to go further and faster to secure the safety, efficiency and zero emission benefits from CAM. Increased collaboration between the CAM and Space sectors is likely to deliver competitive advantage and business growth for the UK. This will require leadership from government departments and agencies to inspire and encourage industry and academia to explore how space technological development can support delivery of the CAM technology roadmap.