ZENZIC

UK Connected and Automated Mobility Roadmap to 2035 – Opportunities for CAM

Why CAM?

June 2025

zenzic.io

United Kingdom

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Acknowledgements /

Thanks to CCAV and the CAM Creators for guiding and shaping this work since the start of the first roadmap and through the workshops throughout the year.

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Special thanks to Francis McKinney, Teodora Demirova, Helena Perslow and Tim Pockney for the support throughout the project.

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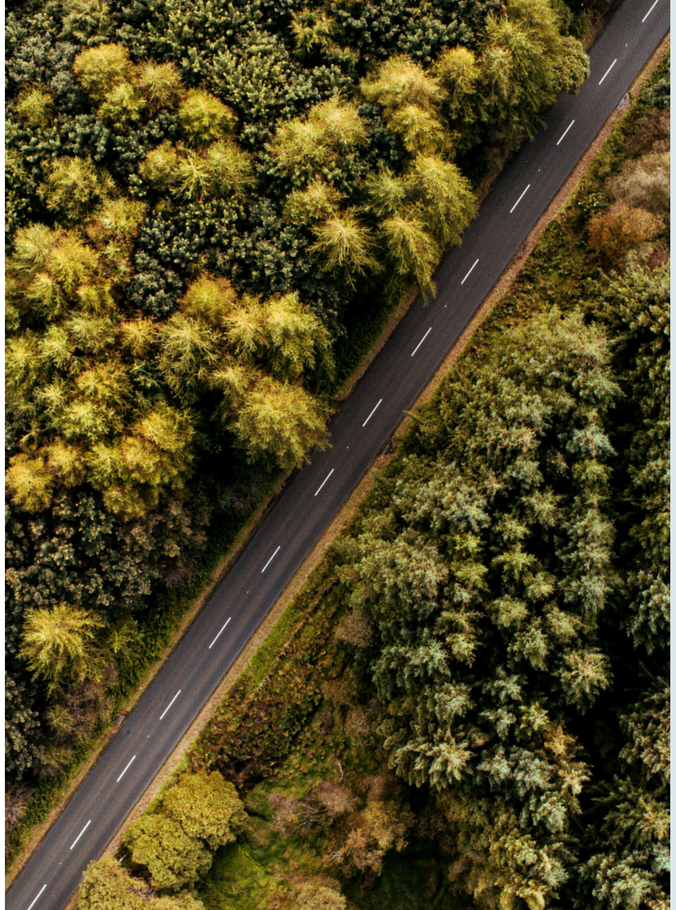

UK Connected and Automated Mobility Roadmap to 2035 – Opportunities for CAM / **Zenzic**

Acronyms /

Abbreviation	Definition
AD	Automated Driving
ADAS	Advanced Driver Assistance System
AI	Artificial Intelligence
ALKS	Automated Lane Keeping Systems
AV	Automated Vehicle
BEV	Battery Electric Vehicle
CAM	Connected and Automated Mobility
CAV	Connected and Automated Vehicle
DCAS	Driver Control Assistance Systems
DDRT	Digital Demand Responsive Transport
EV	Electric Vehicle
GLOSA	Green Light Optimal Speed Advisory

Abbreviation	Definition
IoT	Internet of Things
IVS	In-Vehicle System
KSI	Killed or Seriously Injured
LiDAR	Light Detection and Ranging
NUiC	No User in Charge
R&D	Research and Development
SAV	Shared Automated Vehicle
TCO	Total Cost of Ownership
UiC	User in Charge
V2V	Vehicle to Vehicle
V2X	Vehicle to Everything
VMT	Vehicle Miles Travelled

1.0 / Executive Summary

Zenzic's Connected and Automated Mobility (CAM) Roadmap to 2035 provides a comprehensive guide to the UK CAM sector. The roadmap takes a three-layered approach covering the 'why', 'what' and 'how' of CAM in the UK.

The 'why' layer explores the challenges and drivers currently present in the UK's transport sector and the resultant opportunity for CAM in meeting these needs across a range of use cases and stakeholders.

This report provides a narrative on the benefits and opportunities of the UK CAM sector, assessing how it could help with resolving challenges across the current transport landscape for both public and private stakeholders. It explores how CAM enables and integrates with future transport solutions, and subsequently how this can be realised (the 'what' layer).

This work is informed by a literature review and qualitative research of primary sources, insights gathered from two workshops with industry stakeholders across the private and public sectors, and complementary interviews with selected stakeholders.

1.1 CAM Opportunities

The CAM opportunities are categorised into two groups, each aligned with the drivers and challenges they aim to address:

- Primary Opportunities – these represent areas where CAM has the greatest potential to deliver transformative impact and substantial benefits; and
- Secondary Opportunities – for these areas, CAM serves as an enabler, assisting in tackling broader challenges or reinforcing key drivers.

Primary Opportunities
Vision Zero, maintaining and enhancing safety across transport ecosystem
Addressing driver shortages across bus and freight sectors
Supporting economic growth
Combating social exclusion due to poor or limited transport options, including challenges in rural mobility
Meeting and changing customer expectations
Advancing inclusive access and mobility options for people of all capacities and life stages
Facilitating infrastructure maintenance and quality

Secondary Opportunities
Reducing congestion in urban environments
Improving air quality, reducing emissions and supporting Net Zero objectives
Addressing the cost of transport
Improving kerbside demand management
Enabling the use of active travel

1.2 Example Use-Cases

- **CAM DDRT:** On demand shuttles with flexible routes and novel layouts, which can collect multiple passengers, could reduce the cost of operating rural services and improve frequency and reliability of services.
- **CAM Freight:** Connected and automated heavy good vehicles (HGVs) and light good vehicles (LGVs) could improve the speed and reliability of deliveries for the freight sector whilst addressing the driver shortage in the sector and reducing shipping costs.
- **CAM industrial machinery:** Connected and automated working vehicles such as airport ground vehicles, agriculture or mining increase efficiency and productivity of workplaces as well as improving worker safety.
- **CAM Taxis:** A fleet of connected and automated taxis could provide on-demand transport, allowing travellers to request adapted vehicles with accessibility features such as lowered floors and wheelchair space. This could improve mobility for disabled people while enhancing convenience and efficiency for all users.
- **CAM Bus Services:** Connected and automated buses could enhance public transport by providing reliable, frequent, and cost-effective services. These buses could operate on fixed or flexible routes, improving accessibility and efficiency, particularly in underserved areas.
- **CAM-Enhanced Private Vehicles:** Privately owned vehicles equipped with advanced sensors and driver assistance systems (ADAS) could enhance road safety by preventing collisions and reducing human error. These vehicles could offer improved situational awareness, automatic emergency braking, and lane-keeping assistance, leading to safer and more efficient journeys.

2.0 / Overview

2.1 Background

Zenzic's Connected and Automated Mobility (CAM) Roadmap to 2035 provides a comprehensive guide to the UK CAM sector. The roadmap takes a three-layered approach covering the 'why', 'what' and 'how' of CAM in the UK. The 'why' layer provides the challenges and drivers currently present in the UK's transport sector and the resultant opportunity for CAM in meeting these needs across a range of use cases and stakeholders.

This report provides a narrative on the benefits and opportunities of the CAM sector, assessing how it can help with resolving transport challenges across the current transport landscape for both public and private stakeholders. It explores how CAM enables and integrates with future transport solutions, and subsequently how this can be realised (the 'what' layer).

Figure 2.1: Overview of the integrated UK CAM Roadmap to 2035

WHY? Trends and drivers	WHAT? Products, services and solutions (Key CAM areas)	HOW? Products, services and solutions (Key CAM areas)
Rising expectations and the need for easy access and convenient options	Off-highway (without public access) vehicles and services	Early commercial service models ready for investment
A more sustainable, environment-friendly transport solution	Freight & logistics vehicles and services	Commercial deployment pilots
Public transport options and requirements for rural areas	Personal mobility vehicles and services	Commercial service models ready for investment
Government agenda for Levelling Up and growing the CAM supply chain in the UK, with development or new technologies	Public transport vehicles and services	Monitoring and refinement followed by expansion in CAM deployment areas
	Verification, validation and assurance services	Connected and automated vehicles (CAVs) framework in place
Labour shortages creating a shortage in the availability of drivers for vehicles	Infrastructure and data services	Framework for the life cycle of CAM services
		Framework for the federated data architectures
Developing and maintaining skills in the UK		Vehicle-to-everything (V2X) connectivity and data availability
Strong international competition to stay on the forefront of driving innovation		Creation of integrated systems and services
		Seamless passenger connectivity
Safer and securer travel options		Identification of training and skills required for the CAM sector
		Cost-effective technology/product solutions (e.g. for sensors, HD mapping, road infrastructure)

Source: Executive summary to UK CAM Roadmap 2035 (Zenzic, 2023)

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2.2 Project approach

Current challenges and opportunities in the transport sector were identified through:

- A literature review and qualitative research of primary sources
- Two workshops with industry stakeholders from across the private and public sectors
- Complementary interviews with selected stakeholders

2.3 Report structure

Each primary opportunity has been described in individual sub-sections and these have the following format – A description followed by examples of the driver, challenge and how CAM can aide with that, followed by examples of hypothetical /potential use-cases and timelines.

These use-cases are to support the narrative of the benefits and opportunities of the CAM sector, illustrating how CAM could address the user challenges faced by both individuals and businesses. Each use case outlines a scenario demonstrating how CAM solutions could meet the needs of various stakeholders and unlock opportunities.

An indicative timeline is provided to estimate the level of development of supporting CAM technologies. These timelines are developed based on existing roadmaps, such as:

- The UK Connected and Automated Mobility Roadmap to 2035, March 2023
- UK Transport Vision 2050, February 2024;
- Mobility of People System Level Roadmap, 2024;
- Mobility of Goods System Level Roadmap, 2024.

2.4 Categorisations of the Trends & Drivers

The CAM opportunities are categorised into two groups, each aligned with the drivers and challenges they aim to address:

- Primary Opportunities – These represent areas where CAM has the greatest potential to deliver transformative impact and substantial benefits. CAM technologies and services offer a significant value to users, operators and policymakers. They have the potential to directly address the critical challenges, such as improving road safety and transport connectivity and supporting economic growth and productivity offering significant value to users, operators, and policymakers.

- Secondary Opportunities – For these areas, CAM serves as an enabler, assisting in tackling broader challenges or reinforcing key drivers. While the impact may be more limited or indirect, CAM can still play an essential role by enhancing existing systems, supporting incremental improvements, and facilitating progress towards strategic transport goals.

2.5 Interdependencies of drivers, challenges and opportunities

The successful deployment and integration of CAM in the UK will be shaped by a range of dependencies and uncertainties. These factors influence how CAM can support addressing key transport challenges and delivering societal and economic benefits. Zenzic has closely engaged with the UK CAM sector to better understand the requirements, challenges and opportunities for the market and developed the "Scaling up by 2035: Opportunities for the UK CAM sector" report (Zenzic, 2024). The report highlights key opportunities and challenges to enable CAM technologies and services to be deployed at scale in UK roads by 2035.

The rate of CAM adoption remains somehow uncertain, with progress dependent on technological advancements, business models development, regulatory readiness, public acceptance, and the pace of infrastructure development. For example, while recent legislative efforts, such as the Automated Vehicles Act 2024, aim to provide a regulatory framework for self-driving vehicles, there remains uncertainty regarding the commercial availability of these vehicles.

To support the narrative on the benefits and opportunities of the CAM sector, an illustrative use case and an indicative timeline is presented for each identified primary CAM opportunity.

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3.0 / Primary Opportunities

3.1 Vision Zero: Maintaining and enhancing safety across transport ecosystem

Vision Zero is the aim to eliminate all traffic fatalities and severe injuries. In 2023 there were 29,711 killed or seriously injured (KSI) incidents on UK roads resulting in 1,624 fatalities (DfT, 2024) According to the Occupational Road Safety Association (ORSA), 94% of collisions are caused by human error, and 25% of these involve somebody that is driving because of their work.

CAM offers the opportunity to leverage technology advancements to directly improve safety for all road users. According to The Society of Motor Manufacturers and Traders (SMMT), between 2019 and 2030, CAM could reduce incidents by 47,000, saving 3,900 lives on UK roads (SMMT, 2019).

At the same time, it should be acknowledged that CAM vehicles will still be involved in collisions, especially in a mixed CAM/human environment. Improvements in advanced driver assistance features, and Driver Control Assistance Systems (DCAS) features like Automated Lane Keeping Systems (ALKS) can improve road safety ahead of a rollout of full autonomy. For example, the Automotive Council UK estimates that driver assistance features could reduce accidents by up to 15% by 2030 (APC, 2024).

Opportunities for CAM

Mobility Drivers and Challenges	CAM Opportunity
• **Human error:** Most crashes are caused by human error. The three most common causes of a car accident are as a result of the driver's failure to look properly, recklessness, and a failure to judge the other person's path or speed. (NimbleFins, 2025) • **Adverse driving conditions:** error can be exacerbated by weather and lighting conditions, stress, exhaustion, intoxication and distractions. • **Limited real time information:** Real time information on obstructions, delays and hazards for drivers is limited, reducing their ability to make decisions to avoid dangerous situations.	• CAM vehicles are designed to follow the rules of the road: operating in predictable ways, making safe decisions and improving traffic flow. • CAM vehicles could instantaneously detect and react to emergency situations from all directions through their array of sensors and expanded view of the road. • CAM could replace or assist drivers who are distracted or in a condition where they are more prone to mistakes. • With advancements in technology CAM vehicles could operate vehicles more safely than human drivers in various environmental conditions, such as poor weather and lighting, reducing weather-related accidents. • Vehicle-to-Everything (V2X) connectivity enables vehicles and infrastructure to interact, enhancing situational awareness and preventing collisions (CCAV, 2022). • CAM vehicles are typically programmed for route optimisation, and can be rerouted in crises, and emergency vehicles can be prioritised.

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Example Use Case

Use Case Scenario	Outcome
Addressing distracted driving on a busy urban street: a distracted driver fails to notice a red light at an intersection. A CAV is approaching from another direction. • The CAV automatically applies emergency braking and adjusts its trajectory to avoid the collision. • The vehicle simultaneously alerts nearby vehicles through V2X communication to slow down and prepare for sudden changes in traffic flow.	The CAV's proactive response prevents a potentially fatal collision caused by the distracted driver. All road users and pedestrians benefit from lower risks of collision, reducing KSI incidents and disruptions to travel.

Timeline

Widespread Integration of ADAS Features

2025

Vehicle to vehicle connectivity between different vehicles (owned by different provider)

Vehicle to infrastructure connectivity between roadside infrastructure, vehicles and applications utilised to run service

Enhanced V2X Infrastructure

2035

Ubiquitous connectivity for the services enables with connectivity

Connectivity with electric charging infrastructure

Ubiquitous connectivity for the services enables with connectivity

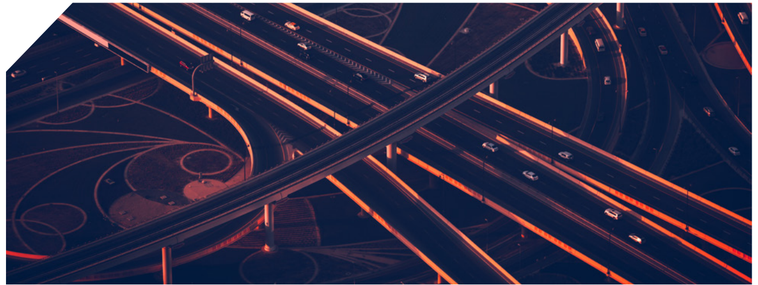
3.2 Addressing driver shortages across bus and freight sectors

An ageing workforce and high employee turnover rates have impacted resilience and operations across both bus and freight sectors. In 2022 the DfT reported a peak 9.5% shortage of local bus drivers in Great Britain during the COVID-19 pandemic. A survey by Chartered Institute of Logistics and Transport (CILT) found employee turnover rates as high as 50% in some companies (CILT, 2022). The same survey revealed an increasing average age of drivers: 51 years old in 2022. Between 2020 and 2021 the number of drivers aged under 30 decreased by two thirds (Driver Require, 2022). Although this was an atypical time for the industry, driver shortages continue to be an issue.

CAM can directly improve the driving experience with Advanced Driver Assistance Systems (ADAS), creating additional driverless service offerings, meeting rising consumer expectations.

Opportunities for CAM

Mobility Drivers and Challenges	CAM Opportunity
• **High turnover rates:** Driving jobs can lose appeal due to unsociable working hours, time away from home, stress and high levels of responsibility. • **Delayed licences:** The younger generation is obtaining driving licenses at a later stage in life or not at all, which consequently reduces the potential workforce. • **Ageing workforce:** Younger drivers are departing from driving occupations.	• CAM could improve attractiveness of the driving jobs by reducing the stress and responsibilities of driving. • CAVs could service routes in unsociable hours or in rural locations, improving working hours for drivers. • CAM could create a new ecosystem of jobs, particularly in fleet management, that can be highly attractive to the newer generation. • Adding additional services can support operators to allocate drivers to areas of highest demand.



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Example Use Case

Use Case Scenario	Outcome
A freight and logistics organisation is losing staff, and struggling to recruit drivers who will work through the night with cargo. The company is unable to offer competitive delivery charges to customers and demand is reducing. • The company deploys CAM HGVs for long distance freight haulage, driving between freight consolidation hubs. • Existing staff are retrained as operators, overseeing whole fleets of vehicles at one time.	CAM HGVs operate through the night when there is less traffic, reducing delivery times. A small team of operators are able to monitor the whole fleet, reducing the number of staff required during unsociable hours. Reducing operating costs enables the company to be more forward looking at innovation opportunities, to in-turn offer increasingly competitive services for the consumer.

Timeline

NUiC HGV Pilots, Platooning Trials

2025 Infrastructure Assessment and Planning

Deployment of NUiC Freight vehicle fleets

2035 Trial of autonomous freight corridors

3.3 Supporting economic growth

By enhancing productivity, improving network performance, and fostering innovation across various sectors, CAM can address economic challenges and contribute to a resilient economy.

A report by SMMT estimates that connected and automated vehicles could contribute approximately £66 billion per year to the UK economy by 2030 (SMMT, 2023). The same report projects the creation of an additional 420,000 jobs in the UK by 2030, with over 20,000 in automotive manufacturing. Covering sectors such as manufacturing, software development, cybersecurity, data analytics, and infrastructure development, CAM has the potential to create not just a depth, but a range of jobs.

Personal and shared CAVs could improve productivity by enabling work during travel, facilitated by novel vehicle layouts designed for remote working. Beyond passenger transport, CAM has significant off-highway applications, improving efficiency, safety, and cost-effectiveness in sectors such as construction, agriculture, mining, and defence.

Opportunities for CAM

Mobility Drivers and Challenges	CAM Opportunity
• **Slowed economic growth:** the UK's economic growth over the past five years has been mixed from a decline in 2020 associated with the COVID-19 pandemic, to a bounce back in 2021 before slowing again in 2023. • **Escalating operational expenses for businesses:** Rising inflation and operating costs (e.g. fuel) are increasing business overheads. Higher costs result in higher consumer prices. • **Access to job opportunities:** some job opportunities can be hard to access, such as to or from rural locations, or shifts outside of normal working hours.	• The growth of the CAM sector will require new skilled jobs. For example, CAM could create new jobs in manufacturing with workers required in the production of vehicles and technologies, as well as new jobs elsewhere in the supply chain (CCAV, 2022). • CAM could have many off-highway applications, reducing costs and improving operational efficiency and safety across industries such as construction, agriculture, mining, defence fostering economic growth. • CAM could provide additional transport services allowing affordable access to jobs, particularly to those who currently live outside of the urban centre and may heave poorer transport links to opportunities (DfT, 2023). • Freeing up staff needed for vehicle operation could allow them to complete other tasks, increasing overall productivity.

Example Use Case

Use Case Scenario	Outcome
Enabling the growth of the UK tech industry. A UK-based technology organisation specialises in developing advanced sensor systems for CAM vehicles. • The organisation invests in R&D to create radar systems, creating skilled jobs in the UK. • The organisation partners with a university to assist with research and offers training opportunities. • The organisation contracts a manufacturing facility in the UK to produce sensor components, creating jobs in engineering, assembly, and quality control.	Fostering UK based technology can strengthen the UK's leadership in CAM technologies, stimulating domestic manufacturing and supply chain resilience. It creates a pipeline for skilled workers through academic-industry collaboration.
Enhancing productivity and economic growth in airports through CAM airport ground vehicles. • Automated baggage tugs, aircraft pushback tractors, and passenger shuttles equipped with advanced sensors, GPS, and AI algorithms optimise ground handling operations such as luggage transport, aircraft positioning, and passenger transfers, reducing manual labour needs and minimising delays. • UK-based companies invest in R&D to develop and refine CAM technologies for airside operations, driving innovation and fostering the creation of highly skilled jobs in engineering, automation, and AI-driven software development.	CAM could improve efficiency in airport processes, allowing for faster, more precise ground operations with reduced human intervention. Adoption of CAM technology drives economic growth, supporting local manufacturing, creating skilled jobs, and contributing to GDP through increased efficiency in aviation logistics and passenger services. Potential introduction of training and upskilling programmes would ensure a future-ready workforce capable of managing advanced airport mobility technologies.

Timeline

Pilot Programmes and Early Deployment for Autonomous Airside Machinery

Scaling Up Autonomous Operations

2025 Increasing use of AI **2035**

3.4 Combating social exclusion due to poor or limited transport options, including challenges in rural mobility

Residents in rural and suburban neighbourhoods often have limited alternatives to private car use due to underdeveloped and inefficient transport systems, particularly in rural areas where public transport options are scarce, infrequent, or unreliable. The reduction or removal of unprofitable bus services is causing a further loss in network coverage leading to access issues for services and opportunities (UTG, 2024).

High reliance on private cars in rural areas could be mitigated through the introduction of demand-responsive, shared CAM services (CCAV, 2023). Expanding demand-responsive CAM solutions could help address gaps in public transport provision, improving accessibility in remote areas. Rural communities provide a more favourable domain for the adoption of CAM services to connect commuters with nearby urban centres and improve first/last-mile connectivity with transport interchanges (WYCA, 2021).

It should be acknowledged that viability of these services will depend on developing sustainable business models. In many cases, targeted subsidies or government procurement support may be necessary to ensure their success.

Opportunities for CAM

Mobility Drivers and Challenges	CAM Opportunity
• **Access to public transport:** rural areas often lack frequent/reliable connections to the wider public transport network e.g. train stations. • **Connectivity to essential destinations:** less immediate access to services such as healthcare, education or employment in rural areas. • **Financial viability of rural transport services:** Reduced customer base in rural areas and longer journeys mean operating public transport services are often not financially viable.	• CAM ride sharing services could provide opportunities for first/last mile connectivity to transport interchanges such as rail and bus stations for passengers to complete their onward journeys. Improved connectivity to the wider transport network could help reduce the need for private car ownership and increase social mobility for those without a car. • Rural bus routes could be operated by demand-responsive CAM services, which could allow for improved frequency and reliability of services with optimised routes. Real time data availability could increase convenience and confidence in using public transport services. • CAM services could connect users with essential destinations which may lie outside the existing public transportation network or be expensive/difficult to access. • CAM services could provide a viable transport option in lower-demand areas with the associated driver overhead savings supporting the business case to introduce on demand transport in rural areas.

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Example Use Case

Use Case Scenario	Outcome
In a rural neighbourhood, provision of on demand connected and automated shuttles. • These shuttles operate on-demand via a mobile application and/or a centre. • These shuttles are shared and scheduled dynamically to optimise vehicle utilisation and minimise costs • These shuttles intergate with the local traffic management and other transport schedules.	• Residents gain reliable on-demand access to travel. • Lower long-term operating costs compared to the traditional bus services and fewer empty vehicle miles through dynamic shared rides. • Usage data and travel patterns can be utilised to improve the schedule planning and resource allocation

Timeline

Pilot Programmes Introducing Electric Autonomous Shuttles

2025 Implementation and Enhancement of Real-Time Traffic Management Systems

Scaling Up Autonomous Shuttle Fleets

2035

3.5 Meeting rising and changing customer expectations

Customers' expectations are shifting with rising service accessibility expectations around ticketing, integration and customer care. They are also more conscious of their carbon footprint before travelling. This change is partially driven by a combination of evolving passenger needs, technological advancements, and a growing emphasis on sustainability.

CAM technologies are well-positioned to meet the evolving expectations of customers, particularly regarding convenience, reliability, and integrated services. However, there may also be a hesitancy to adopt these new technologies when first implemented.

Opportunities for CAM

Mobility Drivers and Challenges	CAM Opportunity
• **Ease and integration of travel:** customers are more interested in a seamless experience when using transport, such as the ability to plan, book and pay for multiple transport modes in one place. • **Vehicle functionality:** as technology becomes more advances and connected, consumers will begin to expect greater levels of functionality from vehicles and associated platforms and services. • **Environmental awareness:** more people are becoming conscious of their environmental impacts, seeking travel options with lower carbon impact.	• CAM technologies allow for more informed journeys, providing passengers with real-time updates on vehicle locations, traffic conditions, and service availability, enabling informed travel decisions and improving journey reliability. Enhanced connectivity supports these capabilities, leading to better passenger experiences. • By analysing travel patterns and preferences, CAM systems could offer personalised travel options, such as preferred routes or modes of transport, aligning with individual customer needs and expectations. This customer-centric approach would strengthen connections with users. • Custom designed CAM vehicles could allow for enhanced comfort and convenience of carrying out activities whilst travelling. For example, a driverless pod would allow for productive time during travel. • CAM services can incorporate electric vehicles (EVs), which seamlessly fit with the push for EVs.

Example Use Case

Use Case Scenario	Outcome
In a city, customers demand convenient transportation solutions that reduce environmental impact and enhance the travel experience. • A fleet of electric automated buses operates in the city, replacing older diesel buses. • Travellers needs to make their connection to the railway station. A travel app allows them to see and pay for options for first and last mile travel. They choose the CAM bus as this grants them a larger carbon saving over a ride hailing service. • They are informed by their app that there is space on the bus for themselves and their luggage and are assured of the arrival time based on current traffic conditions, providing confidence they will make the connection. • The bus receives information about an unexpected traffic incident on route and automatically adjusts its routing to ensure a timely arrival for the rail connection.	• Seamless travel and access to information reduces stress when switching modes. • Reliable journeys, personalised services, and environmental accountability build trust and loyalty. • Optimised routes and dynamic fares improve cost-effectiveness. • Reduced emissions through electric automated vehicles and multi-modal transport.

Timeline

Pilot Programmes Introducing Electric Autonomous Buses

Scaling Up Autonomous Bus Fleets

2025 Implementation and Enhancement of Real-Time Traffic Management Systems

2035

3.6 Advancing inclusive access and mobility options for people of all capacities and life stages

As the UK's population continues to age - with over 65s projected to make up 25% of the population by 2050 (ONS, 2019) - and as people live longer, healthier and more socially active lives, the demand for accessible, reliable and flexible transport is growing rapidly. Simultaneously, individuals with limited mobilities and disabilities face persistent challenges navigating transport systems that are often not designed with inclusivity in mind.

Challenges such as poor connectivity, high costs, non-inclusive vehicle design, and limited transport options - especially in rural and off-peak context - undermine independence, increase social isolation and restrict full social participation.

CAM presents an opportunity to create a future of transport that actively promotes equity and inclusion. Offering accessible vehicle designs, real-time service information, and on-demand availability, CAM can expand mobility options, offering greater freedom and autonomy with safer, more flexible journeys to accommodate changing physical and cognitive needs.

Opportunities for CAM

Mobility Drivers and Challenges	CAM Opportunity
• **Accessibility and inclusion:** Many UK transport systems remain inaccessible, particularly for people additional mobility requirements Common issues include a lack of step-free access, limited space for mobility aids and unreliable support services. A 2024 survey found 93% of respondents faced challenges with trains, and over half lacked confidence planning trips due to inaccessible information. (Oak tree mobility, 2024) • **Equality legislation:** The Equality act 2010 in the UK requires transport providers to make reasonable adjustments for accessibility. While this legal framework drives progress. A parliamentary report found that many services still fail to meet the basic recommended accessibility standard, emphasising the gap between legislative intent and practical implementation. (House of Commons, 2025) • **Need for independent travel:** Independent travel is vital for personal freedom, access to services and social participation. Yet research suggests widespread impact: 79% of disabled people travel less often, and experience longer journey times due to existing transport barriers. (NCAT 2024)	• CAMs do not require traditional vehicle layouts and provides an opportunity to offer innovative seating styles and arrangements. Automated shuttles designed with low floors, wide doors, and wheelchair accessibility features can facilitate easier boarding and alighting. CAM services can also reach underserved areas through flexible, demand-responsive models, improving transport access. CAM services can enable greater autonomy for those who cannot drive or struggle with conventional public transport. Features with user-personalised interfaces, and automated routing can support safe, unassisted travel. • With CAM services; new interfaces, service models, and vehicle hardware can ensure legal obligations translate into real-world inclusivity.

Example Use Case

Use Case Scenario	Outcome
In a suburban area with limited public transport options, a person with mobility impairments struggles to access essential services like healthcare, education, and shopping. • A fleet of CAM taxis operates in the area. Travellers are able to request an adapted vehicle which has accessibility features such as lowered floors, and space for a wheelchair. • The vehicles offer door to door service, without the need to navigate additional public transport systems. • The user is updated of vehicle availability, journey progress, route and arrival time on a dedicated app, increasing confidence during the journey.	• Removing physical and logistical barriers to transport. • Offering a personalised, and affordable travel option for disabled individuals. • Enhancing participation in social, economic, and cultural activities

Timeline

Pilot Programmes for Autonomous Accessible Vehicles

2025 Automated ride-hailing services / car-sharing models emerge, specific vehicle designs

Manufacturing of vehicles ready for NUiCs at scale

2035 Changes to vehicle designs where a driver is not required

3.7 Facilitating infrastructure maintenance and quality

Road quality across the UK is deteriorating, with potholes and surface wear becoming increasingly common due to rising traffic volumes, increasing weight of the vehicles and underfunded maintenance. The Annual Local Authority Road Maintenance (ALARM) survey reports that more than £14 billion is now needed to fix the backlog of carriageway repairs in England and Wales (AIA, 2025).

CAVs are equipped with sensors such as accelerometers, gyroscopes, LiDAR, cameras, and radar that can detect road anomalies like potholes, cracks, and roughness in real-time. The data collected by these sensors can be processed using machine learning algorithms to enhance the accuracy and reliability of road condition assessments (MDPI, 2024). Continuous monitoring enables timely and preventative maintenance interventions.

However, supporting CAM with Vehicle to Infrastructure (V2I) infrastructure, which could include road signs, traffic signals and sensors, is likely to be expensive. However, through improvements in condition monitoring and timely interventions facilitated by through CAM operations, the ongoing costs of road maintenance would fall.

Opportunities for CAM

Mobility Drivers and Challenges	CAM Opportunity
• **Extensive road network in the UK:** which requires monitoring and maintenance including strategic road network, secondary and local roads. • **Lack of data:** Unlike the strategic road network, most local roads do not benefit from sensor-based, real-time monitoring systems. This hinders the ability to detect faults early, predict failures, or priortise repairs based on risk.	• CAVs can detect and communicate road surface issues to a central system in real-time. This immediate reporting would allow maintenance teams to prioritise and address critical repairs promptly, enhancing road safety and quality. • Purpose built CAVs could repair road faults at the point of detection. This will allow faults to be resolved more quickly, improving the driver experience and preventing further damage, reducing repair costs in the future. • The extensive data on vehicle movements collected by CAM systems could identify roads that may require more frequent maintenance. This data-driven approach enables efficient allocation of resources and proactive infrastructure management.

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Example Use Case

Use Case Scenario	Outcome
A city implements a CAM-based system to enhance its road maintenance operations. • The city's public transportation fleet is upgraded with CAM technology, including advanced sensors capable of detecting road surface anomalies. • As these vehicles operate daily routes, they continuously monitor road conditions, identifying issues such as potholes or surface cracks. Detected anomalies are instantly reported to the city's infrastructure management system. • Maintenance crews receive precise locations and details of road defects, enabling swift and effective repairs.	• Proactive monitoring and timely repairs lead to better-maintained roads, enhancing safety and driving comfort. • Early detection and repair of road issues prevent more extensive damage, resulting in significant cost savings for the city's maintenance budget. • Data-driven insights allow for efficient deployment of maintenance resources, ensuring high-priority areas receive attention promptly.

Timeline

Widespread integration of V2I features

2025 Pilots for CAM-Equipped vehicles with advanced sensors

Enhanced V2X Infrastructure

2035 Ubiquitous connectivity for the services enabled with connectivity

4.0 / Secondary Opportunities

4.1 Reducing congestion in urban environments

Congestion levels across the UK have returned to pre-pandemic levels and are continuing to increase, placing renewed strain on road networks and impacting journey times. Tomtom's travel index found that congestion in the UK in 2024 had increased by 9% of 2023 levels, with a decline in average traffic speeds of 0.6mph (Tomtom, 2025)

This resurgence in traffic has also contributed to deteriorating air quality, making it increasingly challenging to meet environmental targets without significantly reducing the number of vehicles on the road.

Automated vehicles could offer a promising solution by optimising driving patterns, leading to more efficient fuel consumption and lower emissions. CAM vehicles could operate with greater precision than human drivers, minimising aggressive driving behaviours such as rapid acceleration and harsh braking, which are key contributors to fuel waste and pollution.

Opportunities for CAM

Mobility Drivers and Challenges	CAM Opportunity
• **Traffic delays in urban environments:** high volumes of private transport cause congestion, resulting in delays to passenger and freight journeys. • **Exacerbation of air quality:** Poor air quality is exacerbated by particulate matter from vehicle tyre wear, brake wear, and increased tailpipe emissions from internal combustion engine (ICE) vehicles.	• Through optimal driving performance and connectivity with traffic lights and other roadside infrastructure, CAM vehicles could smooth traffic flow. Minimising stop start driving also contributes towards a reduction in vehicle emissions. • Vehicle to Everything (V2X) infrastructure such as AI traffic signal system can improve traffic flow. • CAM could contribute to a reduction in overall vehicle miles travelled (VMT) with consumers potentially changing behaviours and reducing travel demand by promoting efficient and alternative options.

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4.2 Improving air quality, reducing emissions and supporting Net Zero objectives

The UK is aiming to achieve Net Zero by 2050. Transport accounted for 29.1% of the UK's total emissions in 2023, making it the largest emitting sector in the UK. The majority (91%) of emissions from domestic transport came from road vehicles. The UK has consistently exceeded World Health Organisation (WHO) guidelines for NO2 and PM2.5 (ClientEarth, 2022). Reducing emissions and improving air quality are therefore critical goals.

CAVs are expected to be predominantly electric, reducing the reliance on fossil fuels. Providing solutions which involve efficient route planning would also minimise environmental impact. CAVs are able to communicate with traffic signals, road sensors, and other vehicles, enabling more efficient routing and smoother acceleration/deceleration. This can reduce fuel consumption and decrease emissions through a better-managed traffic flow.

Opportunities for CAM

Mobility Drivers and Challenges	CAM Opportunity
• **Carbon emissions from private car use:** use of private transport increases the number of vehicles on the roads leading to greater transport emissions per person. • **Carbon emissions from fossil fuels:** as of 2025, majority private cars operate on non-renewable energy sources. • **Driving efficiency:** Human drivers do not operate vehicles in the most energy efficient ways: with stop-start driving and suboptimal braking.	• Mobility service platforms optimise supply and demand for passengers and drivers. Automated electric taxis could cut emissions by 87–94% compared to human-driven vehicles. • Eco-driving, which enables more efficient adjustment of the vehicle speed in alignment with traffic conditions, could be further optimised by CAVs, potentially lowering greenhouse emissions. • CAM solutions often incorporate electric vehicles (EVs), directly reducing the carbon footprint of individual journeys and supporting the UK's Net Zero objectives.

4.3 Addressing the cost of transport

While fuel duty rates have been frozen at or below 2010 levels, alternative public transport fares have continued to increase, in some cases above the rate of inflation. This creates challenges for incentivising more sustainable modes of transport in response to climate change concerns.

The upfront costs associated with purchasing CAVs are likely to be high. However, in the context of public transport CAM presents a significant opportunity to reduce long-term operational costs. With more streamlined fleet operations, CAM-enabled services could operate more efficiently and cost-effectively. The increased convenience offered by CAM public transport could also generate a significant interest and ridership. This could allow transport authorities and operators to lower ticket prices, or to use funds for other investments to improve transportation.

On the insurance front, premiums for CAVs may initially be higher due to the complexity of the technology and the uncertainty around risk exposure. However, as adoption increases, insurance costs are expected to decline, reflecting the lower risk profile.

Opportunities for CAM

Mobility Drivers and Challenges	CAM Opportunity
• **Increasing costs of public transport:** the cost of public transport fares may make services less attractive compared to private vehicles, and for some may be prohibitive. • **Increasing costs of living:** the rising cost of living in the UK has placed increasing financial pressure on households,. One of the most significant contributors is the cost of transport, which affects access to employment, education, healthcare and essential requirements.	• CAM could increase the flexibility and convenience of public transport modes, encouraging its uptake. • As CAM technologies become more advanced, smarter programming will reduce collisions, leading to not only enhancing road safety but could also deliver major cost savings across insurance, vehicle repairs etc.

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4.4 Improving kerbside demand management

Kerbside space experiences high competition between various demands including private car parking, deliveries, pickups, public space, and active travel routes. The use of the kerbside for various activities changes over time. This can take place gradually or rapidly. For example - depending on the day/time.

CAM services could support dynamic kerbside usage and booking, which optimises space utilisation throughout the day.

Opportunities for CAM

Mobility Drivers and Challenges	CAM Opportunity
• **High kerbside use by private cars:** high levels of private car use necessitate parking spaces at destinations. Private cars remain parked while owners attend to their activities. • **Single purpose kerbside bays limit opportunities:** the needs for kerbside space change throughout the day. However, currently, most kerbside spaces are marked for single uses such as for parking or loading which limits flexibility.	• When not in use or charging, shared CAM vehicles can be programmed to return to a depot or designated parking space. • CAVs are capable of parking more closely, saving space on the street or in carparks. • Kerb usage can be managed remotely, improving access to roads for a range of purposes.

4.5 Enabling the use of active travel

Active travel plays a crucial role in improving health, reducing the costs of physical inactivity for the NHS and supporting the UK's decarbonisation goals. Although cycling saw a surge during the COVID-19 Pandemic, participation has since declined.

CAM technology could enhance appeal of active travel, particularly cycling, by improving road safety through reduced collision risks. In the UK, between 2019 and 2023, vehicle collisions with cars accounted for approximately 46% of cycling fatalities, with over 80% of all cycling fatalities resulting from collisions with vehicles (DfT, 2024). CAM may also support the reallocation of road space to active travel modes further improving cycling safety and appeal.

Opportunities for CAM

Mobility Drivers and Challenges	CAM Opportunity
• **Perception of active travel safety:** cycling on roads, particularly where there is inadequate separation from vehicles, is perceived as riskier for cyclists and discourages active travel. • **Lack of dedicated infrastructure for active travel:** in many cases, cars are prioritised, and cycle routes are not continuous between residential and urban areas. • **Defaulting to private car:** individuals who already own a private vehicle often default to using it even for short journeys, as it is perceived as more convenient.	• CAVs equipped with Advanced Driver Assistance Systems (ADAS) are able to detect cyclists and pedestrians, reducing collision risks and enhancing safety for active travellers. Technologies such as Vehicle-to-Everything (V2X) and AI traffic signal system can prioritise safety for active travellers. • The driving style of CAM vehicles would be more predictable as they would follow the highway code and demonstrate consistent decision-making. Consistency in driving could make active travel users feel safer as they can better gauge how cars will behave around them. This approach could enhance safety in scenarios such as overtaking and determining priority at junctions. • A re-prioritisation of road space, supported by an uptake in CAM, could allow for more dedicated cycling and walking infrastructure, enhancing safety and encouraging uptake.

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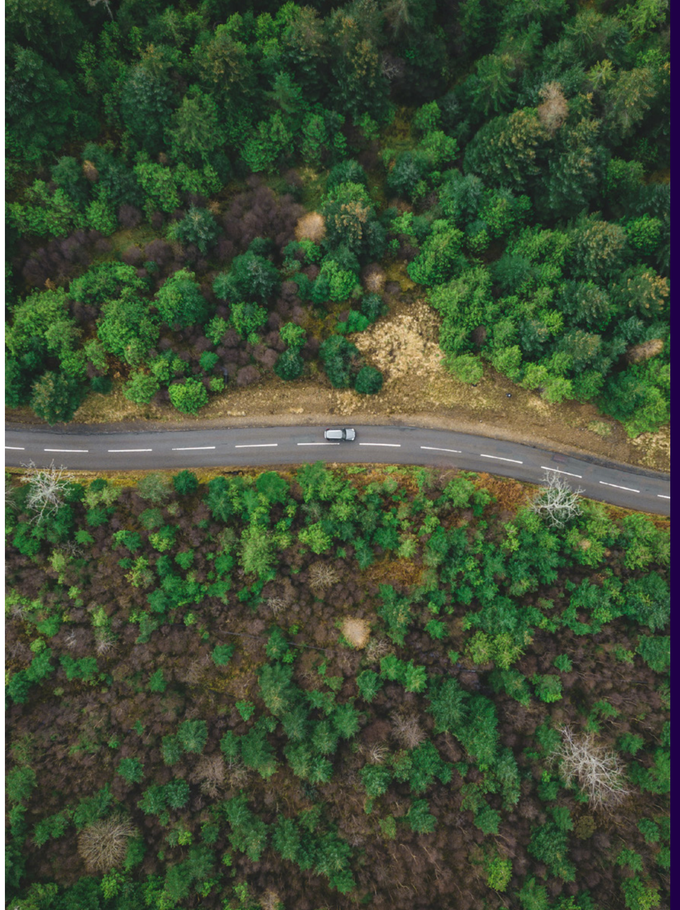
5.0 / How: Next steps to seize the opportunities

The UK's CAM industry has a significant opportunity to address critical transport challenges while driving economic growth. To achieve this, scalable use cases must align with the primary CAM opportunities outlined in this report.

Each CAM opportunity identified presents a potential pathway for real-world implementation through a range of targeted use cases.

The deployment and integration of CAM in the UK depends on various factors and uncertainties. These elements affect how CAM can address transport challenges and provide societal and economic benefits. Zenzic has closely engaged with the UK CAM sector to better understand the requirements, challenges and opportunities for the market and developed the "Scaling up by 2035: Opportunities for the UK CAM sector" report.



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The recommended next steps for the UK CAM sector:

Prioritise near-term use cases that demonstrate immediate value, particularly those that can be deployed with existing infrastructure and regulations.

Focus on scalable use cases that can be expanded across multiple regions and local authorities, such as demand-responsive transport (DRT) and automated freight, to maximise impact and investment returns.

Leverage CAM use cases which could boost economic growth, particularly by expanding off-highway CAM enabled services to enhance productivity and efficiency.

Provide clarity on long-term goals and use case direction, ensuring alignment with national transport and economic strategies while informing the future CAM roadmap.

Develop a structured approach to CAM implementation, aligning use cases with the seven primary CAM opportunities identified in this report to systematically define the 'what' layer and prioritise key opportunities.

Create a clear production strategy – support UK-based manufacturing of CAM hardware and software, ensuring domestic leadership in the industry.

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