ZENZIC

UK CAM Technology Growth Strategies

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United Kingdom

Contents /

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1. Executive Summary /

The United Kingdom has built a strong foundation in Connected and Automated Mobility (CAM), driven by high-calibre research, industry innovation, and sustained government support. This has positioned the UK amongst global leaders in testing, regulation, and early-stage deployment. To maintain its momentum -and realise the economic, safety, and mobility benefits of CAM - the UK now requires focused strategic backing and targeted investment.

The UK's CAM landscape shows a mix of **clear strengths** and **urgent capability gaps**. The sector benefits from strong foundations in skills, leading infrastructure, vehicle hardware, and elements of cyber-physical systems, while several areas essential to commercial-scale deployment remain underdeveloped. **Critical needs** include:

1. Advanced automated driving software
2. Robust digitalisation and AI capability
3. High-fidelity simulation and digital-twin environments
4. Robust cyber resilience for vehicle and infrastructure

From a UK **market point of view**, CAM-specific technologies are set for substantial expansion, growing from £530 million in 2030 to £2.35 billion by 2035, *driven primarily by* rapid growth in **software** (from £290 million to £1.40bn). **Hardware** also scales significantly, quadrupling in value over the same period (from £240 million to £950 million), but software is the dominant driver of capability and market value as systems become increasingly automated, connected, and digitally defined. The core value in CAM-specific technologies lies in high-complexity software and specialised hardware essential for automated mobility.

From a **maturity and growth potential point of view**, the strongest positioned individual technologies in the UK are:

- **Automated Driving Systems (ADS) Software:** Largest market opportunity; requires immediate focus to reinforce UK strengths and address near-term use cases.
- **Radar Technologies:** Strong UK design expertise provides a platform to accelerate next generation radar development, including 4D and Terahertz systems.
- **Drive-by-Wire (DbW):** Essential AV technology; the UK has a short window to evolve from retrofit solutions to integrated, higher volume systems.
- **Virtual Simulation & Digital Twins:** High growth potential, with strong UK IP that can support leadership in interoperability standards and advanced simulation tools.

All four technologies are at different points of maturity and have different challenges; however, all of them need industry R&D funding, skills and talent development, and outward international engagement. Skills and training provide long-term foundational impact, while R&D funding and international engagement deliver medium-term benefits, typically within three to five years.

Recommendations

1. A **strategic recalibration** of the UK's CAM ecosystem is required to close the gap between high-readiness software and lagging hardware, with a dedicated ***CAM Hardware Acceleration Fund*** recommended to support industrialising ASIL-D Drive-by-Wire systems and next-generation radar technologies so the UK can move from prototypes to certified, higher-volume production and reduce geopolitical supply risks.

2. To protect the UK's emerging leadership in virtual simulation and digital-twin technologies, industry should ***lead*** **the development of unified international standards** to avoid fragmentation, lower barriers for SMEs, and strengthen the UK's position as a global hub for high-fidelity verification.

3. Given the scale of overseas semiconductor investment, the UK's onboard compute strategy should pivot toward securing international supply partnerships while ***concentrating*** domestic resources on **Tier-2 quantum R&D** and the **software "intelligence layer"**.

4. CAM connectivity and cybersecurity need to shift from service-based approaches to ***product-led solutions***, to developing dedicated, resilient V2X communication networks and UK-led cybersecurity products. It is essential to extend vehicle awareness beyond onboard sensors, ensure secure operation, and build public trust in CAM systems.

5. Finally, with nearly 20,000 new CAM roles expected by 2030, **a *multi-year* skills investment programme** is essential to build the software, data, and cybersecurity capabilities required to sustain next-generation vehicle systems and ensure long-term competitiveness.

2. Introduction /

The United Kingdom's Connected and Automated Mobility (CAM) sector has reached a critical strategic inflexion point. Over the past decade, a robust foundation of academic innovation and government-backed R&D has positioned the UK as a leading global hub for autonomous technology. However, as the industry transitions from experimental trialling to commercial deployment in 2026, shifting global economic conditions necessitate a refined, coordinated intervention strategy to secure long-term sovereign advantage.

This report utilises the Automotive Council UK's strategic technologies and introduces the CAM Technology Petals framework to delineate the causal relationship between foundational 'Capabilities & Enablers'—such as AI and skills—and 'Next Generation Vehicle Systems'. By mapping the UK supply chain across 16 critical technologies, we identify a widening readiness gap among them. While software domains exhibit high market readiness, critical hardware components and infrastructure monetisation models require urgent intervention to reach the 70% maturity threshold necessary for industrial resilience. Strategic gaps persist in Onboard Compute and Communication Infrastructure, where international competition and monetisation challenges are most acute.

The UK CAM supply chain is projected to achieve a market value of £1.82bn by 2030, rising to £8.98bn by 2035. CAM specific Software demonstrates high market value £290m, 55% of CAM technology value. CAM specific Hardware components is expected to lag in 2030 at £240m, 45% of CAM technology value. The gap is projected to widen towards 2035.

To unlock an estimated £34 billion in real economic impact, the UK must deploy a mix of Direct Funded Actions—such as industry R&D and niche manufacturing CAPEX—and Coordinating Actions like international engagement and regulatory standard-setting. Success is predicated on more than financial scale; it requires deep strategic commitment across the ecosystem to ensure resources generate high-value employment.

3. Strategic Technologies for Future Automotive in the UK /

The Automotive Council UK has, for over a decade, maintained a set of strategic priorities that the Automotive Council UK and the industry use to identify development areas and gaps, understand maturity levels, and map capabilities, among other things.

For the Advanced Propulsion Centre (APC) and Zenzic, they have been used as a reference to support projects and investments, as well as to communicate the priorities and the interdependencies within the automotive industry to encourage collaboration and discussions.

The priorities have continuously evolved and changed, and today they have a much wider context and are more interlinked than when they were first developed. Rather than specific technologies, the priorities are domains and capabilities that will aid the automotive council's vision of "a thriving, growing and highly productive UK Automotive Sector".

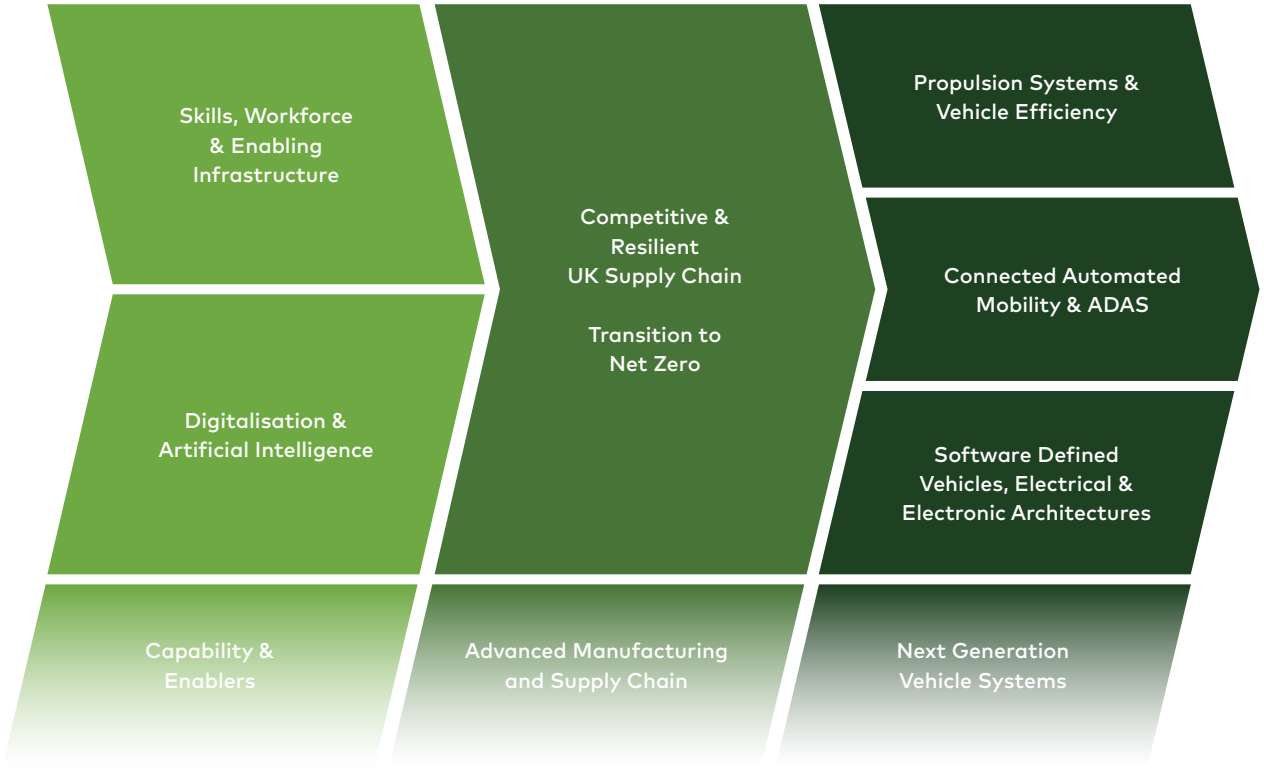
The Automotive Council strategic technologies provide a structural framework for the UK automotive industry, distinguishing between foundational inputs ('Capabilities & Enablers') and strategic technological outputs ('Next Generation Vehicle Systems'), as shown in Figure 1.

The framework is systematically partitioned into three foundational pillars critical for fostering industrial growth:

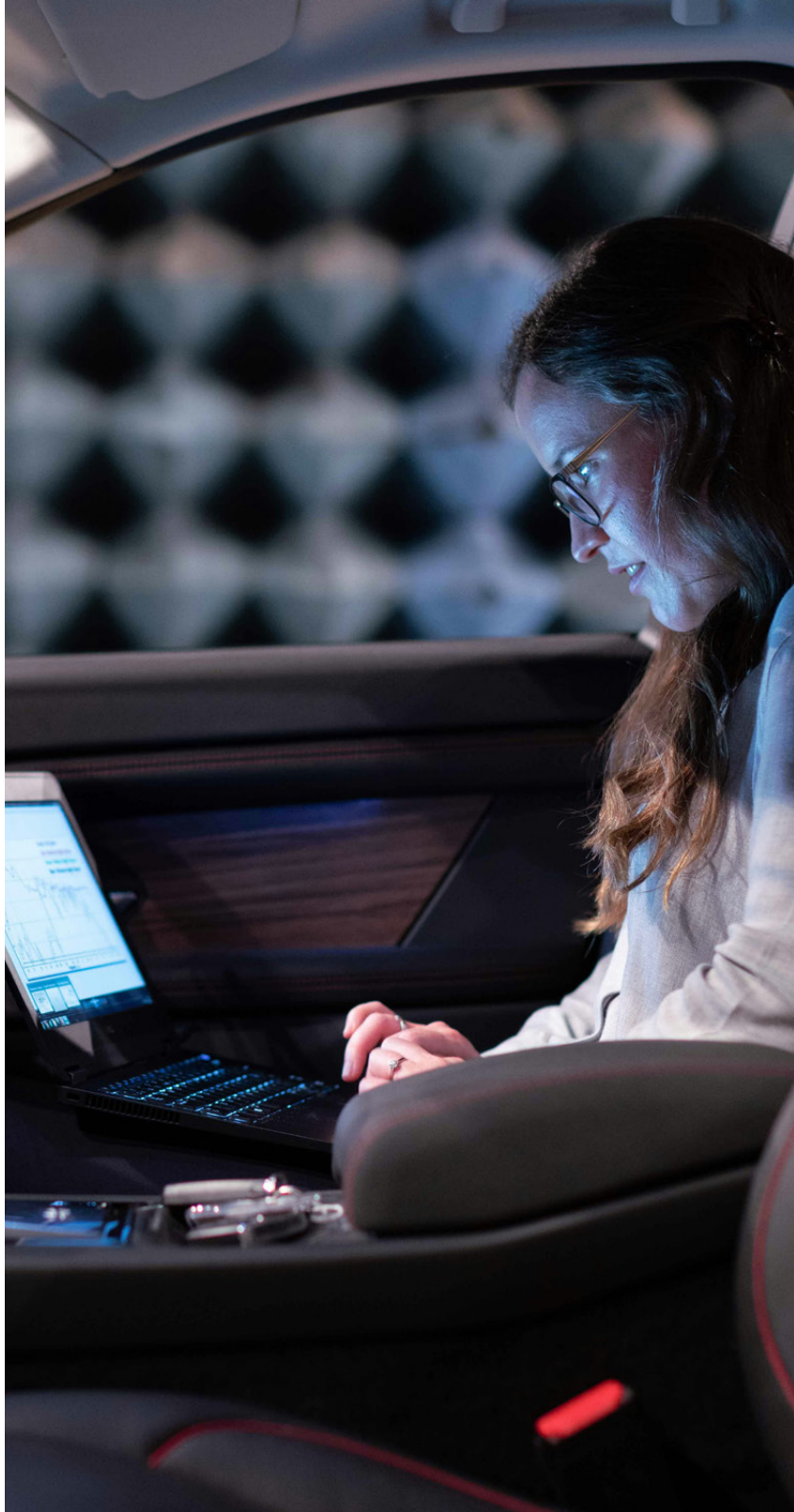
- **Capabilities & Enablers:** This pillar constitutes the foundational input, encompassing essential prerequisites such as Skills, Workforce & Leading Infrastructure, and the transformative technologies of Digitalisation & Artificial Intelligence.
- **Advanced Manufacturing and Supply Chain:** Representing the core operational focus, this element is dedicated to cultivating a Competitive & Resilient UK Supply Chain while concurrently managing the pivotal Transition to Net Zero.
- **Next Generation Vehicle Systems:** This pillar defines the core product and technological output, specifically detailing advancements in Propulsion Systems & Vehicle Efficiency, CAM & Advanced Driver-Assistance Systems (ADAS) and the comprehensive evolution of Software Defined Vehicles, Electrical & Electronic Architectures.

This report is solely focused on the area of CAM and does not include ADAS, however, the relationship between these two areas is understood to be fundamentally causal and symbiotic, where the strength of the capabilities dictates the feasibility and ambition of the next-generation systems.

Figure 1: Automotive Council UK strategic technologies



Source: Automotive Council UK



3.1 The causal relationship between capabilities & enablers and next generation vehicle systems

The 'Capabilities & Enablers' pillar in Figure 1, comprised of Skills, Workforce & Leading Infrastructure and Digitalisation & Artificial Intelligence (AI), is the foundational prerequisite for all future automotive innovation and the successful transition to 'Next Generation Vehicle Systems'.

Digitalisation & AI are the most direct enablers, facilitating all three Next Generation Systems:

CAM & ADAS: Provides the sophisticated AI (AV Stack) and advanced data processing essential for autonomous function.

Software Defined Vehicles (SDVs): Drives the industry's pivot from hardware manufacturing to software-centric value creation, enabling over-the-air (OTA) updates and model-based systems engineering.

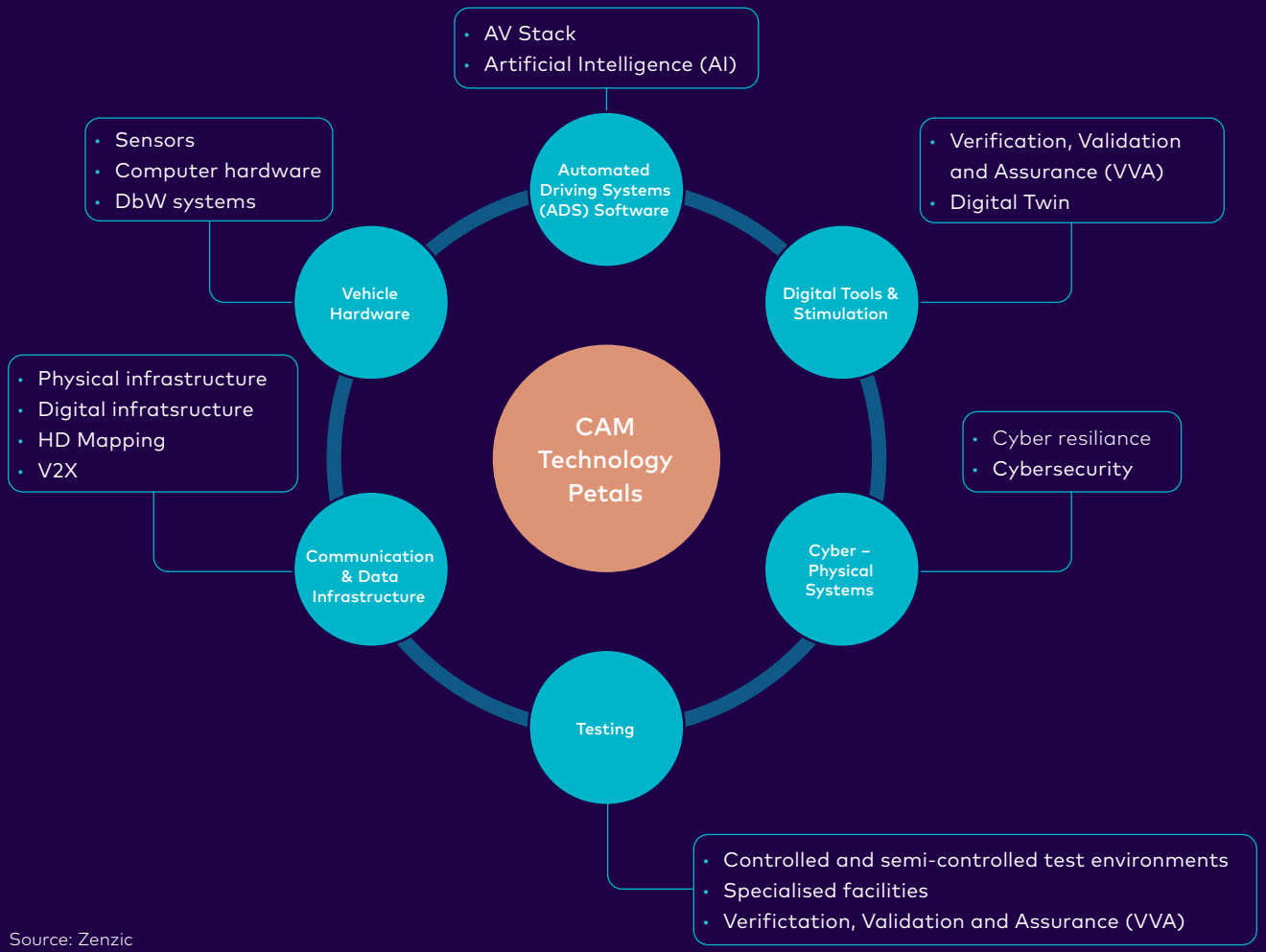
Propulsion Systems & Vehicle Efficiency: Utilises digital modelling, simulation, and predictive AI to optimise energy management—a necessity for achieving Net Zero objectives.

The second foundational element in Figure 1, **Skills, Workforce & Leading Infrastructure**, provides the requisite human and physical capital. Developing and maintaining complex systems like CAM and SDVs requires a modern workforce proficient in software engineering, data science, and cybersecurity, moving beyond traditional mechanical skills. This shift also necessitates advanced physical infrastructure, such as high-performance computing and testing facilities, to support Simulation and Digital Twin development.

In essence, 'Capabilities & Enablers' represent the mandatory investment inputs (people, tools, and digital technology) that directly produce strategic product outputs ('Next Generation Vehicle Systems'). Sustained investment in these enablers is critical for the UK supply chain's long-term competitiveness.

3.2 The elements of the CAM Technology Petals

Figure 2: CAM-specific Technology Petals



Source: Zenzic

Complementary to the Automotive Council's strategic technologies structure, Figure 2 presents the CAM Technology Petals framework. This framework precisely specifies the six most critical CAM technological components required for the development and operational deployment of CAM systems: foundational **Vehicle Hardware**, the **Automated Driving Systems (ADS) Software** (which incorporates Artificial Intelligence applications), robust **Cybersecurity**, comprehensive **Communication & Data Infrastructure** (inclusive of High-Definition (HD) mapping), advanced **Digital Tools and Simulation** capabilities, and mandatory **Testing** (encompassing physical validation).

Each element in detail contains the following technologies and capabilities:

Vehicle Hardware
Vehicle hardware constitutes the physical foundation for autonomous function, enabling environmental perception and command execution. A sophisticated, redundant sensor suite—including LiDAR (3D depth), Radar (all-weather distance/speed), and Cameras (visual and semantic data)—provides a comprehensive environmental view. Essential for actuation are Drive-by-Wire (DbW) systems, which replace traditional mechanical controls with electronic interfaces. DbW facilitates autonomous control over steering, braking, and acceleration, thereby translating software logic into immediate physical action.

Automated Driving Systems (ADS) Software
The automation (AV Stack), often termed the "Intelligence Layer," serves as the central processing unit of the autonomous vehicle (AV). This modular system translates sensor data into actionable driving commands via three core functions: Perception (AI-driven sensor data interpretation), Localisation and Mapping (precise vehicle positioning), and Planning and Control (behaviour prediction and safe trajectory formulation). AI is fundamentally embedded, ranging from deep learning for sensor processing to reinforcement learning for real-time decision-making. Furthermore, AI is increasingly deployed in the Verification, Validation, and Assurance (VVA) development cycle for model optimisation and anomaly detection.

Cybersecurity
Cyber resilience is a comprehensive concept critical to CAM safety and efficiency. It extends beyond mere defence against cyberattacks to address the mitigation of operational failures (e.g., power or communication loss) that could compromise safe service delivery. For connected applications, including Software Over-the-Air (SOTA) updates and connectivity-dependent Autonomous Vehicle functions, robust cybersecurity is paramount. Achieving this requires rigorous assessment of the underlying communication infrastructure, encryption, and bandwidth.

Communication & Data Infrastructure
This domain is critical for extending a CAM vehicle's operational awareness beyond its onboard sensors. Vehicle-to-Everything (V2X) communication facilitates the data exchange necessary to establish a "digital horizon," enhancing safety and mitigating congestion through connectivity with vehicles, infrastructure, and pedestrians. The continuous improvement of software and training of AI models relies on efficient data infrastructure, primarily cloud storage, to manage the massive datasets generated by autonomous vehicles. Furthermore, HD Mapping provides centimetre-level precision for accurate self-positioning, significantly reducing the real-time computational burden on the vehicle's embedded sensors.

Digital Tools & Simulation
Digital tools and simulation technologies are indispensable for the VVA of CAM systems. These tools facilitate comprehensive digital testing within virtual environments, substantially mitigating the inherent risks and costs associated with real-world trials. Specifically, simulation creates controlled virtual scenarios to test and refine autonomous driving logic, while a Digital Twin provides a dynamic, real-time virtual replica of a physical vehicle. Their collective application accelerates development cycles, enhances safety standards, and optimises performance through continuous, iterative refinement in a controlled setting.

Testing
Physical testing is mandatory to guarantee the safety, reliability, and public acceptance of AVs. It involves the rigorous evaluation of CAM components, systems, and full vehicles in both controlled and real-world environments. Testing encompasses both development refinement and final sign-off, providing necessary evidence for homologation. Environments span specialised component laboratories, controlled tracks, and public roads, the latter being essential for uncovering real-world "edge cases" challenging to reproduce through simulation. Physical testing environments also provide an environment in which digital models can be validated to the boundaries of their capability.

4. The UK CAM Supply Chain /

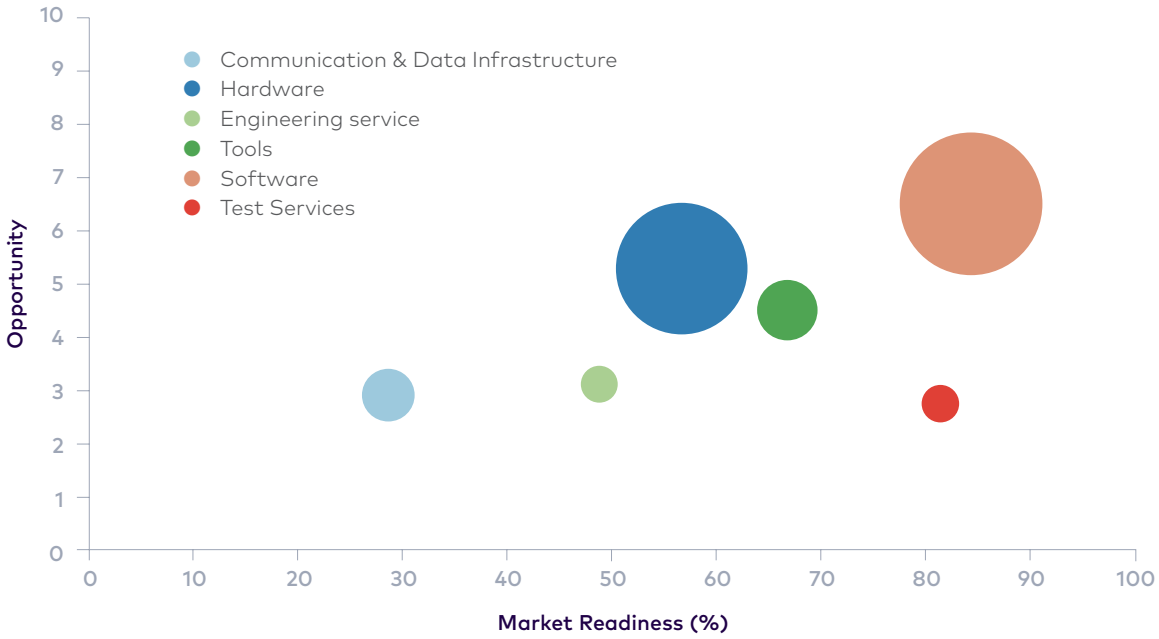
Unlike a traditional automotive supply chain, the CAM supply chain is not linear and consists of several categories which are not technologies, e.g. operators. However, all the CAM technology petals can be mapped across the CAM supply chain categories, although some petals are divided over more than one supply chain category, for example Digital Tools & Simulation petal sits across Engineering Services category as well as Tools category.

4.1 Supply chain status

Figure 3 illustrates a projected view of the UK supply chain's status in **2030** by charting **Market Readiness (%)** against the **Opportunity Index**, where the size of the bubble represents the **Market Value**.

- **Market Readiness:** Represents the percentage of companies that reported having a market-ready product in 2024/2025, as measured in the Supply Chain Report (Zenzic, 2025).
- **Opportunity Index:** An average index derived from the growth of turnover, growth of exports, and UK anchoring.
- **Market Value:** The estimated total market value (GBP) in 2030, based on projections from the Society of Motor Manufacturers and Traders (SMMT) 2023. Further details are available in Section 4.2.

Figure 3: Status of UK supply chain 2030



Source: UK CAM Supply Chain Report (Maturing the UK CAM Supply Chain 2024/25) from Zenzic.

For a successful supply chain, the following targets are ideal:

- **Market Value:** Larger is better.
- **Market Readiness:** Should ideally be over 70%.
- **Opportunity Index:** Should ideally be above 5.

Both high **Market Value** and high **Market Readiness** are essential. Different interventions can then serve as the "pulling driver" to further augment the **Opportunity Index**.

Software and **Hardware** have market values **four to five times larger** than other categories, underscoring the urgent need to prioritise technology development in these two areas.

Other Categories

- **Tools:** Far behind in market value but demonstrates good market readiness and medium opportunity. A specific opportunity exists in providing tools for **simulation**, **test**, **and analysis**.
- **Communication & Data Infrastructure:** Is in a difficult position, with **weak opportunities and low market readiness**. Building a viable business case and monetising the technology is currently challenging. However, as a critical component for the future of CAM, the infrastructure must expand (potentially to a dedicated CAM infrastructure, as reliance on consumer connectivity is unsustainable). Longer-term opportunities (2030-2035) exist for connectivity-focused solutions.
- **Test Services:** Exhibits very high market readiness, but projected market value and opportunity are low. This sector must find a **competitive USP** and deliberately focus on **international expansion and marketing** to increase both value and opportunity beyond the domestic market.
- **Engineering Service:** Has decent market readiness but low overall opportunity and small market value. This suggests that **a relatively small intervention** could correct the situation, though intervention decisions should be made on an **individual, circumstance-dependent basis**.

Top Priority Categories

1. **Software:** Possesses the largest market value, the highest market readiness, and the greatest opportunities. Key focus areas moving forward include data, AI, safety, and security, with digital scalability reinforcing software as a leading opportunity.

2. **Hardware:** Has the second largest market value but registers only 57% market readiness (below the ideal 70%) and a weaker-than-ideal opportunity index (just above 5). Despite this, specialised component design and manufacturing remain a UK strength, offering an opportunity to strengthen the domestic supply chain and achieve global differentiation. Furthermore, hardware is critical to CAM development, demanding continued focus due to geopolitical dynamics.

4.2 CAM Market value

The size of the CAM market was comprehensively analysed by the SMMT in 2023 (SMMT, 2023). This calculation used Zenzic supply categories across eight use cases (Zenzic, 2025) and SMMT's vehicle volume forecasts per use case. SMMT estimated the total value for a CAM vehicle, detailing the split across supply chain categories and CAM-specific technology (the additional hardware and software required for Level 4+ automation). As expected, hardware and software possess the highest market values (see Table 4). However, focusing solely on these categories for investment is insufficient. As discussed in Section 2.2, a well-functioning CAM ecosystem requires all elements to be self-sustainable and work in parallel to generate the desired synergy and value. Achieving a functional CAM ecosystem, rather than an advantage in a single area, is key to unlocking an estimated £34 billion in real economic impact. (SMMT, 2023).

Table 2: CAM Market Size split by CAM Technology Petals

Category	Market Size 2030	Proportion	Market Size 2035	Proportion
Total CAM vehicle market[1]	£1.82bn		£8.98bn	
Total Hardware / Software	£1.23bn / £313m	68% / 17%	£6.32bn / £1.45bn	70% / 16%
Total CAM (specific) Technology	£530m	30% of a CAM vehicle	£2.35bn	26% of a CAM vehicle
CAM Hardware	**£240m**	45% of CAM technology size	**£950m**	40% of CAM technology size
CAM Software	**£290m**	55% of CAM technology size	**£1.40bn**	60% of CAM technology size
Test Services	**£54m**	3%	**£181m**	2%
Communication & Data Infrastructure	**£36m**	2%	**£90m**	1%
Engineering Services	**£18m**	1%	**£90m**	1%
Tools	**£18m**	1%	**£90m**	1%

Source: SMMT "Connected and Automated Mobility: The UK Economic and Market Opportunities – 2023"

[1]Total value includes additional Supply chain categories not analysed in this report (Finance, RTO, Insurance and Legal, and Other)

Hardware & Software Value Trends

- **Total hardware proportion is set to grow** due to an increasing number of CAM vehicles, particularly those with high hardware costs (e.g., **mining and construction vehicles**). While total software proportion is set to decrease.
- The proportion of **CAM technology value per vehicle is decreasing** over time, despite rising vehicle numbers. This is primarily attributed to **economies of scale**.
- **CAM hardware value will see a proportional decrease** specifically because:
  - The overall cost of CAM technology is expected to drop, and **hardware costs are projected to decrease faster than software costs**.
  - The proportion of **CAM software value will increase**. This trend is true for all vehicles but is particularly pronounced in CAM vehicles due to their **heavy reliance on software**.

5. The UK CAM Technologies /

The six CAM technology petals (Figure 2) can be split into sixteen [CAM] technologies. Each technology is at a different technology and maturity stage; figure 4 shows each CAM technology against **maturity** and **growth potential**.

- **Maturity** (1-9) is based on a combination of:

Technical maturity

- TRL 1-9

Product Availability

- Minimum viable products (1)
- Several established suppliers (9)

Market fit

- CRL 1-9

For the leading commercialisation applications of each technology.

- **Technology Maturity (TRL)**
  - For mature technologies (e.g., **radar and camera**), the assessment focuses on the maturity of their newest automotive applications (e.g., **4D radar and neuromorphic camera**).
  - Maturity should ideally fall within the **mid-range (4.5–6)**. High maturity suggests **limited opportunity for new suppliers**, while low maturity indicates **uncertainty and unproven technology**. Conversely, low maturity also presents a significant scope to be an **early entrant and potential market leader** with the right technology and timing.

- **Growth Potential (1–100)**
  - The rating for growth potential is based on a comparison of current **UK capabilities** (strengths, weaknesses, opportunities, and threats) against **international capabilities**.
  - It also considers the current state and outlook of the technology, including **R&D, innovation, and investment**.

Figure 4: CAM technologies potential

Source: Author generated

Best positioned *technologies* are located within the circle in other words virtual simulation tools and digital twins, ADS as well as radar and drive-by-wire. Borderline technologies are technologies just inside the ideal remit, but either slightly too mature such as connectivity and cybersecurity or slightly too immature like safety case/audit, or with slightly lacking growth potential which is the case for physical testing environments.

In the next section (5.1) the top four technologies with the best overall opportunities i.e., virtual simulation tools and digital twins, ADS, radar and DbW, will be described in a little bit more detail in a descending order of potential.

2025

Digital twin
TRL 5-7

Widely used but no standardisation

Focus: Improving Fidelity and Interoperability

5.1 Virtual simulation tools and Digital twins

As L4 Autonomous Vehicles approach wider commercialisation, addressing edge cases becomes crucial. The imperative need to test these and other potentially dangerous situations in a safe environment is driving demand for virtual simulation.

Furthermore, focus on trust and reliability is expanding from a regulatory perspective to include ethical considerations (e.g., deontology and utilitarianism), for which virtual simulation is vital for exploring.

Technology Drive: There will be a strong drive towards detailed, physics-based models for rigorous virtual verification of edge cases. AI tools will become standard for automating tasks and improving VVA process efficiency.

UK Opportunity: The UK has high growth potential in simulation tools and digital twin technology. Leveraging its strong IP and innovation base, the UK can lead in developing simulation standards to promote interoperability and avoid vendor lock-in.

2025

SAE Level 2
TRL 8-9

SAE Level 3
TRL 5-7

SAE Level 4
TRL 3-4

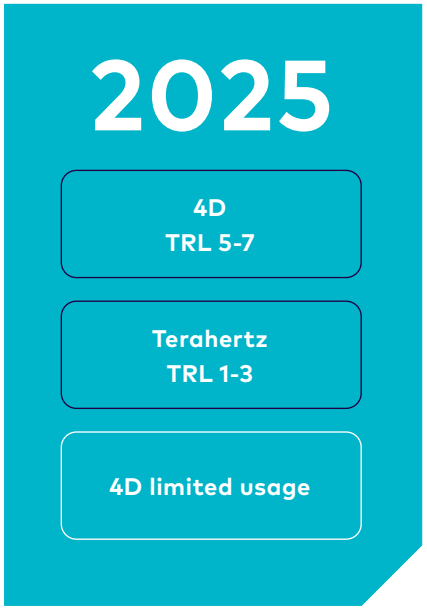
SAE Level 5
TRL 1-2

5.2 Automated Driving Systems (ADS)

The **Autonomous Driving Systems (ADS)**, commonly known as the **AV stack** or ADS stack, is the software that enables AV functions. It serves as the decision maker of the CAM vehicle. The AV stack processes sensor data, makes decisions, plans, and controls the vehicle via several layers of core functions.

While no single technology is more critical than another for realising a CAM vehicle, the AV stack is arguably one of the **most critical technologies to own** strategically.

The UK currently benefits from **several well-established AV developers** who hold competitive positions in specific niche areas. These positions and use-cases must be **monitored and encouraged** to prevent loss of advantage and ensure continued technological evolution.



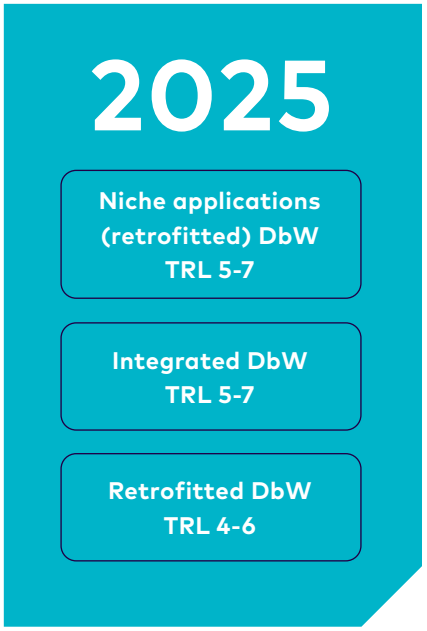
5.3 Radar

Radar is a mature technology, even within the automotive sector, due to its widespread use in ADAS. However, advanced radar versions are frequently developed in well-funded sectors outside automotive, such as defence and healthcare.

Key Developments

- 4D-Imaging Radar: This sophisticated radar, originating from other applications, adds a fourth dimension, elevation (height), to the current "3D" data. The technology is currently being deployed by select Chinese car OEMs for CAM vehicles and is in the portfolio of European Tier 1 suppliers. We anticipate mass deployment towards 2030.
- Terahertz (THz) Radar: This radar uses higher frequencies (e.g., 150 GHz and 300 GHz) and shorter wavelengths, offering higher resolution and improved range resolution (currently used in airport security and medical imaging). While not yet certified for road use, THz radar could provide better weather and range resolution than current automotive systems.

The UK holds a unique position in radar design that should be leveraged, particularly regarding the introduction of these advanced radar types into the automotive sector.



5.4 Drive-by-Wire (DbW)

Drive-by-Wire (DbW) systems are theoretically both hardware and software, acting as the critical link and translator between the AV software and hardware to autonomously control steering, braking, and acceleration.

Current Status and Opportunity

- **Retrofitted DbW:** Current retrofitted systems are generally only viable for prototypes requiring a safety driver, as they lack the necessary redundancy.
- **Near-Term Opportunity:** The immediate opportunity lies in developing retrofitted systems with sufficient redundancy to be used on multiple platforms and vehicle types.
- **UK Niche:** The UK has an opportunity to develop ASIL-D compliant DbW systems for low-volume vehicles, advancing their **TRL to high (8-9)** for niche applications.

Long-Term Outlook

- **Decreasing Retrofit Demand:** The long-term growth opportunity for retrofit systems will decrease as factory-fitted systems gain demand with increasing CAM vehicle volumes.
- **Foundational Technology:** This foundational technology will achieve a consistently high **TRL (8-9)** and become a standard, natively integrated component in all CAM vehicles.

6. Strategies and Interventions /

Coordinated Strategy
The UK CAM sector, supported by significant innovation and public funding over the last decade, stands at a critical juncture on the cusp of commercial introduction and wide-scale deployment. To maintain this trajectory and unlock the **estimated £34 billion in real economic impact** (SMMT, 2023), the UK requires a renewed, coordinated strategy and targeted investment.

A coordinated strategy and targeted interventions are necessary to develop the UK CAM supply chain and its technologies, ensuring support aligns with both domestic **capability and growth opportunity**.

From a strategic perspective, CAM technologies can be grouped into three categories, each presenting unique challenges and requiring distinct interventions:

1. **Strategically Valuable:** Technologies vital to have domestically for supply chain resilience, primarily due to geopolitical reasons. An example is onboard compute (semiconductors/chips). AV development is also valuable for competitive and security reasons.
2. **Strategically Important:** Technologies not critical for domestic supply but necessary for AVs to function safely and reliably on public roads. Examples include V2X communication and cyber resilience.
3. **Fundamental:** Technologies without which an AV would not function. Examples are DbW systems and sensors.

Interventions
Interventions can be categorised into direct funded actions and coordinated actions.

Table 3: Type of Intervention

Direct Funded Actions:	Coordinating Actions:
I. Academic R&D funding (research councils)	VI. Skills and training, talent development
II. Industry R&D funding (Innovate UK)	VII. Inward international engagement
III. Procured targeted R&D with clearly defined targets and outputs	VIII. Outward international engagement
IV. Niche manufacturing funding (CAPEX)	IX. Supplier and procurement development
V. Industrialisation centres to bridge R&D into manufacture	X. Regulations and standards

A coordinated strategy requires grouping challenges and applying tailored interventions:

- **Low TRL (High Value):** Technologies and categories that are highly valuable but currently have low Technology Readiness Levels need tailored **R&D programmes and dedicated funds**.
- **Strong International Competition:** This challenge requires a broad intervention set, including **R&D funds, talent development, outward international engagement, and supplier/procurement development**.
- **Limited Manufacturing Capability:** This challenge demands a distinct set of interventions, specifically **support for industrialisation and low-volume manufacturing facilities**.

The simplified view below outlines the recommended strategy, interventions, and **potential outcomes** for the top technology categories: Virtual simulation tools and Digital twins, ADS, Radar and Drive-by Wire.

6.1 Virtual simulation tools and Digital twins

Strategy

- More research to enhance existing capabilities and improve fidelity of simulations
- Lead development of simulation standards for tool interoperability

Interventions

1. Academic and Industry R&D funding
2. Skills and training, talent development
3. Outward international engagement
4. Supplier and procurement development
5. Regulations and standards

Outcomes

- World competitive platforms and libraries from UK suppliers to support the CAM development toolchain, enabling more efficient testing, e.g., test earlier
- Supporting simulation standards development to enhance tools interoperability, avoiding supplier lock in and promoting competition in the market.

6.2 ADS

Strategy

- Focus on automotive supplier development for near term use cases
- Engage international markets/ OEMs and target immediate use cases
- Continue to promote current technology capability demonstrations in target applications
- Establish relationships with international OEMs present in target applications
- Target near market opportunities with international OEMs

Interventions

1. Academic and Industry R&D funding
2. Skills and training, talent development
3. Outward international engagement
4. Supplier and procurement development
5. Regulations and standards

Outcomes

- Strong relationships with automotive suppliers servicing several commercial operational deployments in off-highway and segregated applications
- A foothold in the global market to secure further contracts for higher volume deployments
- Leveraging early deployments to advance standards for AV development and deployments.
- Building public trust in AVs for future public road deployments in UK.

6.3 Radar

Strategy

- Build up UK design capability and IP particularly for next generation sensor types
- Target development and supply for next generation sensors
- Develop strategic alliances with global OEMs to secure supply contracts
- Expand current product offering for current and next generation sensors
- Evaluate joint ventures opportunities to accelerate product offering
- Accelerate product development to achieve first-to-market and leading supplier of next generation sensor

Interventions

1. Academic and Industry R&D funding
2. Niche manufacturing funding (CAPEX)
3. Industrialisation centres to bridge R&D into manufacture
4. Skills and training, talent development
5. Outward international engagement
6. Supplier and procurement development
7. Regulations and standards

Outcomes

- World leader in the next generation technology e.g., 4D/ Terahertz retaining IP that will attract further inward investment
- Expand product offering from UK suppliers with first-to-market products
- Local and international suppliers present in the UK
- Industrialisation capability in UK
- Niche volume manufacture with potential for further growth after product market penetration

6.4 Drive-by-Wire

Strategy

- Address early low volume ASIL-D system market opportunities internationally for near-term use cases
- Start generating revenue while addressing higher volume
- Industrialise early ASIL-D systems for immediate opportunities

Interventions

1. Industry R&D funding
2. Niche manufacturing funding (CAPEX)
3. Skills and training, talent development
4. Outward international engagement
5. Supplier and procurement development
6. Regulations and standards

Outcomes

- ASIL-D systems in operation in the global market
- UK drive-by-wire suppliers generating revenue to expand product offering to further vehicle types /makes /models
- World leader in ASIL-D drive-by-wires in UK

The primary interventions recommended are **"industry R&D funding"**, and **"skills and training/talent development"**, followed by **"outward international engagement".** These measures operate on differing timelines:

- **Long-Term Impact:** Initiatives focused on skills and training are designed for foundational growth with outcomes realised over an extended horizon.
- **Medium-Term Impact:** Industry R&D funding and international engagement are positioned to deliver measurable benefits more rapidly, typically within a **three-to-five-year window**.

Resource Allocation and Optimisation

While these interventions are neither weighted nor ranked, the greatest potential for high-yield results across any given technology lies in a comprehensive approach that funds all recommendations simultaneously.

However, practical constraints necessitate a tailored assessment for each technology. This evaluation should determine the specific intervention—or strategic combination thereof—that will maximise impact relative to available budgetary resources.

7. Summary and Conclusion /

7.1 Summary

Analysis of the UK CAM supply chain status reveals that the categories of **Software and Hardware** possess market values four to five times larger than all other categories and must be prioritised for development.

In regard to market readiness, **Software** demonstrates the highest market readiness, while **Hardware** currently lags, sitting below the ideal 70% market readiness threshold (at 57%). Interventions must focus on correcting this imbalance, strengthening the domestic supply chain, and ensuring supply chain readiness and resilience, particularly given rising geopolitical dynamics.

However, focusing on specific technologies, there are a mixture of key growth opportunities (assessed by maturity and growth potential) in:

- **Automated Driving Systems (ADS) (SW):** Possessing the largest market value (£290m SW) and opportunity, with immediate focus needed on reinforcing strengths and targeting near-term use cases.
- **Radar (HW):** Leveraging the UK's unique position in radar design to accelerate the introduction and development of next-generation technologies like 4D and Terahertz radar.
- **Drive-by-Wire (HW & SW):** Critical technology for the operation of an AV. The UK has a small window of opportunity (before others catch up) to build on its existing skills and experience in retrofit DbW to move into integrated systems in high volume.
- **Virtual Simulation Tools and Digital Twins:** High growth potential, leveraging the UK's strong IP base to lead in developing interoperability standards. Although not directly in the category of hardware or software, this enabler is both a strength and shows strong market growth potential.

7.2 Conclusion

The UK CAM sector stands at a critical juncture, transitioning from a decade of innovation-driven growth to the complexities of large-scale commercial deployment. Despite established strengths in software and academic R&D, structural gaps in hardware readiness, infrastructure monetisation, and global supply chain positioning pose threats to the realisation of a projected £34 billion in real economic impact.

Based on the evidence presented in this report, the following five formal recommendations are proposed to address identified systemic vulnerabilities.

1. **Strategic Recalibration of Hardware Industrialisation**
   Current analysis reveals a significant disparity between Software (high market readiness) and Hardware, which currently sits at 57% readiness—substantially below the 70% threshold required for a self-sustaining ecosystem.

   Recommendation: The Department for Business and Trade (DBT) and industry stakeholders should establish a dedicated CAM Hardware Acceleration Fund. This must prioritise Capital Expenditure (CAPEX) for niche manufacturing and industrialisation centres focused on ASIL-D compliant Drive-by-Wire (DbW) systems and next-generation 4D/Terahertz radar.

   Rationale: Moving beyond prototypes to certified, high-volume production is essential to mitigate geopolitical supply chain risks and secure a first-to-market advantage in high-value sensor and actuator IP.

2. **Institutionalisation of Interoperability Standards for Simulation**
   While the UK holds significant growth potential in virtual simulation and digital twins, the absence of industry-wide standards risks vendor lock-in and fragmented development. These inefficiencies threaten to stifle innovation and impede the commercialisation of domestic expertise. Addressing this challenge requires a coordinated international effort; however, the UK can secure a competitive advantage—maintaining its leadership—by leading the standardisation movement and establishing itself as a global hub for licensing and technical training. The impact of market fragmentation through the absence of standards disproportionally affects SMEs through increased operational costs and additional barriers to entering the supply chain and therefore impeding the creation of high-skilled jobs.

   Recommendation: Industry consortia, supported by the Automotive Council UK, should lead the international development of Unified Simulation and Digital Twin Standards. Interventions must focus on enhancing the fidelity and interoperability of physics-based models.

   Rationale: Standardised virtual verification services mitigate the costs and risks of physical trials, accelerating the path to L4 autonomy by allowing for more efficient testing of complex edge cases.

3. **Pragmatic Re-alignment of Onboard Compute Strategy**
   The UK faces an insurmountable barrier in competing with the trillions of pounds of investment in North American and Chinese semiconductor manufacturing.

   Recommendation: The strategy should pivot toward Secured International Supply Partnerships for high-performance computing (HPC) units while simultaneously establishing the UK as a Tier 2 leader in Quantum Computing R&D.

Rationale: Accepting a reliance on international compute hardware allows the UK to focus its resources on its comparative advantage: the software "intelligence layer" and future disruptive technologies like quantum-enabled navigation and sensing.

4. **Transition to a Product-Led Connectivity and Cybersecurity Framework**
   Infrastructure development currently suffers from low market readiness and a lack of clear monetisation models, making reliance on standard consumer connectivity unsustainable for CAM safety.

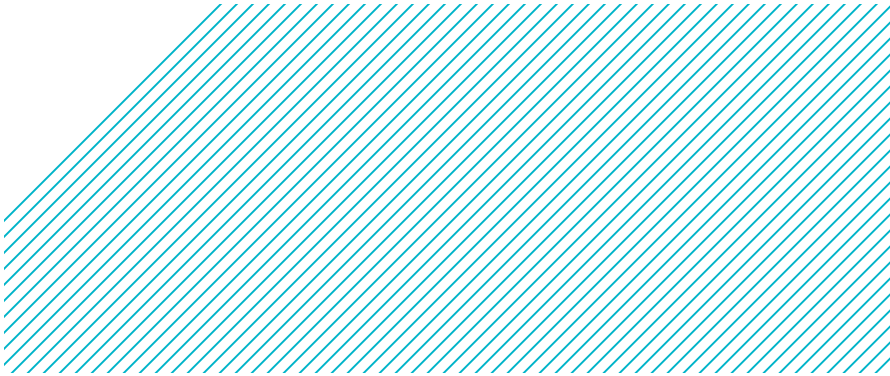
   Recommendation: Shift interventions from consultancy-based services toward the development of Digital Resilient Products and a dedicated CAM-specific V2X infrastructure.

   Rationale: Robust, dedicated communication networks are critical for extending a vehicle's digital horizon beyond onboard sensors. Establishing the UK as a leader in cybersecurity products—rather than just services—is essential for public trust and secure operational deployment.

5. **Accelerated Commitment to Employment and Skills Scaling**
   A workforce proficient in software engineering, data science and cybersecurity is an essential component of industrial capability that can achieve the desired economic outputs of the CAM market

   Recommendation: Government must commit to a multi-year funding strategy.

   Rationale: Proactive talent development is a long-term prerequisite for the "Next Generation Vehicle Systems" pillar; without it, the UK cannot sustain the high-performance computing and digital twin development necessary for global competitiveness.



7.3 Recommended Next Steps

The following steps are categorised by strategic priority, outlining the necessary actions and detailing which areas require support from **Collaborative R&D funding**.

A. High Growth and High Value Technologies (Software & Core Intelligence)

Technology Area	Strategic Action (Strategy & Interventions)	R&D Funding Requirement (DBT Focus)	Desired Outcome
Automated Driving Systems (ADS) Software	Focus on automotive supplier development for near-term use cases, promoting current technology demonstrations in target applications. Engage international OEMs present in target applications.	Requires **Academic and Industry R&D funding** to encourage continued technological evolution and retain advantage in dedicated use cases.	Strong relationships and securing a foothold in the global market via commercial operational deployments in off-highway and segregated applications.
Radar	**Build up UK design capability and IP** for next-generation sensor types, particularly 4D and Terahertz radar. Develop strategic alliances with global OEMs.	Requires **Academic and Industry R&D funding** alongside **Niche Manufacturing funding (CAPEX)** to accelerate product development and achieve first-to-market status.	The UK is a world leader in next-generation radar technology, retaining IP and attracting further inward investment.
Drive-by-Wire (DbW)	Address early low-volume ASIL-D system market opportunities internationally. Industrialise early ASIL-D systems for immediate opportunities.	Requires **Industry R&D funding** and **Niche Manufacturing funding (CAPEX)** to facilitate the industrialisation and development of low-volume ASIL-D compliant systems.	UK suppliers become world leaders in ASIL-D DbW, generating revenue to expand product offering.
Virtual Simulation Tools & Digital Twins	Lead development of simulation standards for tool interoperability to avoid vendor lock-in. Enhance existing capabilities and improve simulation fidelity through more research.	Requires **Academic and Industry R&D funding** to support research and competitive platforms/ libraries.	World-competitive platforms and libraries supporting the CAM development toolchain, and reduced vendor lock-in through standards development.

Source: Author generated

B. Foundational Hardware and Resilience

Technology Area	Strategic Action (Strategy & Interventions)	R&D Funding Requirement (DBT Focus)	Desired Outcome
Camera	Focus on next-generation Image Sensor Processor (ISP) and chips IP, specifically in **neuromorphic camera technology**, where the UK has emerging expertise.	Requires **Academic and Industry R&D funding** to develop next-generation ISP and chips IP that will attract further inward investment.	Develop next-generation ISP and chips IP that attracts further inward investment.
Lidar	Encourage spinouts from world-leading photonics groups to offer competitive technology. Form diverse strategic international supplier partnerships to minimise geopolitical supply chain disruption.	Requires **Academic and Industry R&D funding** to support the burgeoning ecosystem of Lidar developers and leverage cross-sector expertise.	A burgeoning ecosystem of Lidar developers with spinout presence, leveraging expertise from adjacent sectors.
Connectivity and Cybersecurity	Focus on developing digital resilient products and services solutions.	Requires **Academic and Industry R&D funding** to maintain the UK's worldwide leadership in security and support suppliers delivering digital resilient products.	UK suppliers are first-to-market with resilient products, establishing a mature cybersecurity consultancy service provider in the UK.
Safety Case/Audit	Establish common approaches and share best practices to accelerate CAM deployments.	Requires **Industry R&D funding** to enable UK experts to lead international process definitions and best practices.	UK experts leading international definitions to ensure safe AV deployments. UK is a trusted location for deployment and critical system validation.

Source: Author generated

C. Addressing Strategic Gaps and Infrastructure

Technology Area	Strategic Action (Strategy & Interventions)	R&D Funding Requirement (DBT Focus)	Desired Outcome
Onboard Compute	Establish strategic partnerships for a reliable supply. **Cement future Tier 2 capability in quantum computing**.	Requires **Academic R&D funding** to support R&D and preparation for the exploitation of the future quantum computing opportunity.	Reliable international supply of high-performance computing units; influence over supply to gain optimised units; and understanding/preparation for future quantum exploitation.
GNSS & IMU	Explore cross-sector entry into CAM, bringing together sectors like aerospace, defence, and surveying to share knowledge and identify technology transfer opportunities, for example, quantum navigation capabilities.	Requires **Industry R&D funding** to support exploring cross-sector opportunities in the CAM sector.	Clearly identified AV opportunities for world-leading cross-sectors and a strong presence of PNT/IMU capabilities in the CAM sector.
MBSE and Software Dev Tools	Build strategic partnerships with tool suppliers to ensure tool development meets the needs of UK CAM developers.	Requires **Industry R&D funding** to help support reliable partnerships with suppliers, influencing feature roadmaps to allow UK developers to innovate.	Reliable partnerships with suppliers allowing UK developers to innovate.

Source: Author generated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8. Glossary /

Abbreviation	Definition
ACS	Autonomous Connected System
ADAS	Advanced Driver Assistance Systems
AI	Artificial Intelligence
APC	Advanced Propulsion Centre
AV	Autonomous Vehicle
CAM	Connected and Automated Mobility
CI/CD	Continuous Integration and Continuous Delivery/ Deployment
C-V2X	Cellular Vehicle to Everything
DbW	Drive-by-Wire
E/E Integration	Electric and Electronic Integration
HD	High Definition
IMU	Inertial Measurement Unit

Abbreviation	Definition
MBSE	Model-based System Engineering
ODD	Operational Design Domain
OEM	Original Equipment Manufacturer
OTA	Over-the-Air
PNT	Position, Navigation and Timing
SDV	Software Defined Vehicle
SMMT	Society of Motor Manufacturers and Traders
SOTA	Software Over-the-Air
THz	Terahertz
V2X	Vehicle to Everything
V&V	Verification & Validation
VVA	Verification, Validation, Assurance

9. References /

SMMT. (2023). *Connected and Automated Mobility: The UK Economic and Market Opportunities*.

Zenzic. (2025). *Maturing the UK CAM Supply Chain 2024/25*.

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