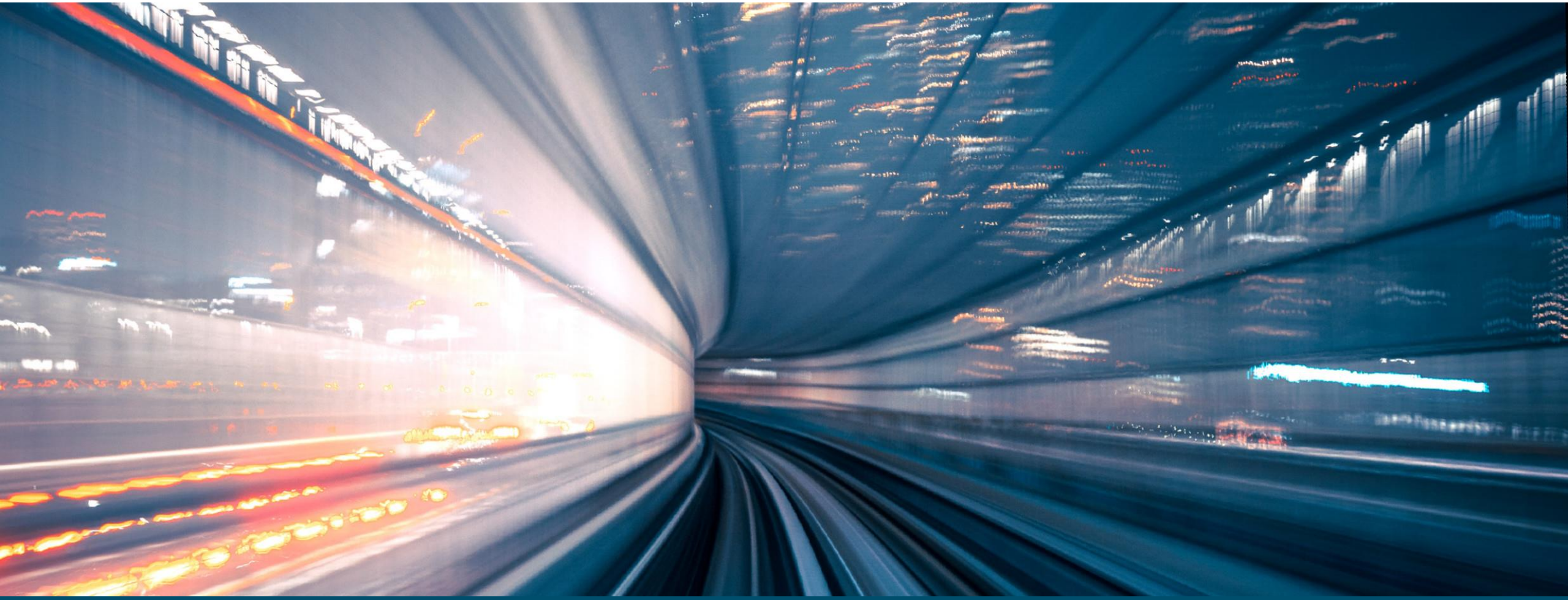
Centre for Connected & Autonomous Vehicles

HM Government

CCAV Engagement

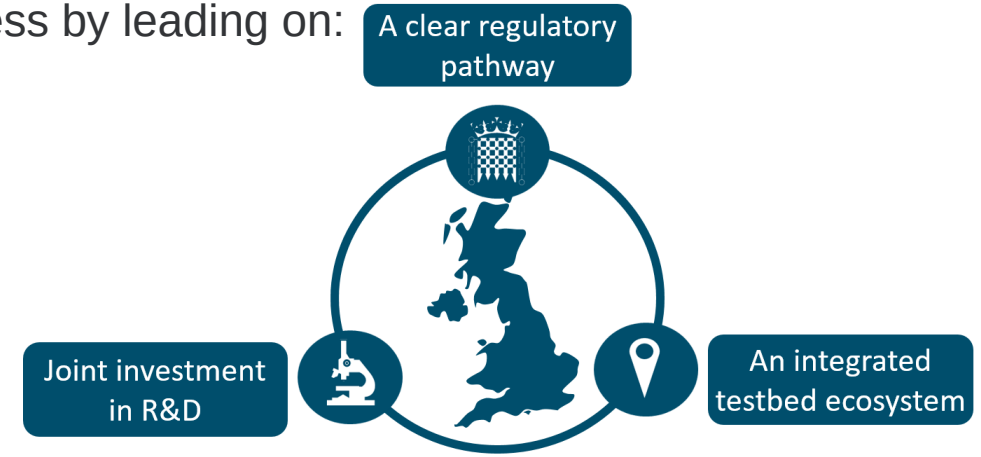
Commercialising Connected and Automated Mobility



March 22

Who we are

- The Centre for Connected and Autonomous Vehicles (CCAV) is a joint BEIS and DfT unit, established in 2015
- CCAV is an expert unit that is shaping the safe and secure emergence of connected and self-driving vehicles, making the UK the best place in the world to develop and deploy the technology while ensuring that all areas of society can benefit from its potentially transformative effects
- We have made good progress by leading on:



- The work undertaken by CCAV and its partners within Government has already ensured that the UK has a proven track record in leading connected and self-driving vehicle innovation
  - KPMG's 2020 Autonomous Vehicles Readiness Index rates the UK as world leaders in cyber security, policy readiness, early-stage tech and testing infrastructure
  - Sixth in the Consumer Technology Association 2019 International Innovation Scorecard

CCAV – Phase One

- A clear regulatory pathway
  - Automated and Electric Vehicles Act 2018 (insurance framework)
  - 3 year Law Commissions regulatory review - Future Primary Legislation
  - CAVPASS (comprehensive safety & cyber security assurance process)
  - Code of Practice (updated Feb 2019)
- Joint investment in R&D
  - £230m investment into R&D
  - Over 90 projects made up of 200 organisations
  - 81 collaborative R&D projects
- An integrated testbed ecosystem
  - £200m investment into testing
  - CAM Testbed UK & ZENIC

ZENZIC
SELF-DRIVING REVOLUTION

Self-Driving & Automated

- The Law Commission of England and Wales and the Scottish Law Commission have proposed that in order to draw a clear dividing line for when the human driver is no longer responsible for how the vehicle drives, there needs to be a legal threshold identified in law.
- They call that threshold '**self-driving**', which is about 'permitting the vehicle to drive itself'.
- This language has been found to be better understood by the public, and provides a more accurate understanding of the capabilities of the technology

We understand that **Automated** will continue to be used in technical and legal contexts, such as Automated Driving System (ADS), and that **Self-Driving** is used in more conversational/descriptive sentences and in all communication aimed at the public.

'Automated vehicle' will also remain the term for vehicles that are insured under the Automated and Electric Vehicles Act 2018.

Connected and Automated Mobility (CAM)

- Over the last few years CCAV has begun to use Connected and Automated Mobility (CAM) to describe our interest in bringing Automated Vehicles technologies safely and securely to the UK
- This move to include Mobility better aligns with Government goals, including the Future of Mobility/Transport Urban and Rural Strategies
  - Connected and Automated Mobility (CAM) captures our key interests and responsibilities in supporting the UK through the development and deployment of Connected and Automated (self-driving) vehicles and the roles and services they may fulfil.
  - We are, typically, interested in ground based, wheeled vehicles that are currently deployed with a human driver, and the technologies, skills and knowledge that will enable them to operate without human intervention.
  - We support activities that will increase safety, access to transport and efficiency in goods and passenger services, but will also impact on many other sectors, such as construction, mining, defence and insurance.

Why this focus and why now?

- CCAV has led over **90 collaborative R&D projects**, involving well over **200 cross-sector organisations** during 2014-2021. The projects involved the 2015 £100m Intelligent Mobility Fund, 2016 £100m CAM Testbed UK fund and other funds such as the Industrial Strategy Challenge Fund.
- These projects have created a **vibrant, cross-sector ecosystem** and CCAV has learnt a great deal about how to launch and deliver innovation funding.
- The world is experiencing a **transport renaissance** that is reshaping the movement of people and goods, powered by advances in **Automation, Connectivity, and Electrification (ACE).** As the Automotive Council's letter to ministers (6 September 2021) noted in its opening paragraph:
  - "the next 30 years will see vehicle design and manufacture revolutionised as the sector goes through not one but **two major disruptive technology transitions: net-zero and connected and automated mobility**. This transition brings with it **huge potential for the UK** and the Automotive Industry."
- From an industrial perspective, **the UK's position on CAM will determine our success** in future proofing the automotive sector in this country.

Commercialising CAM

- CCAV is working to secure the social, environmental, industrial and economic benefits from the commercial deployment of connected and self-driving vehicles, systems, and services, capturing their potential to unlock safer, cleaner, more inclusive and accessible transport for passengers and goods, and a globally competitive UK supply chain.

*Government vision for CAM (**draft**)*

"By 2025, the UK will begin to see deployments of connected and self-driving vehicles, improving ways in which people and goods are moved around the nation, and creating and early commercial market for the technology. This market will be enabled by a comprehensive regulatory, legislative and safety framework, served by a strong British supply chain, and used confidently by businesses and the public alike."

- To achieve this objective, **CCAV proposes a Commercialising Connected and Automated Mobility (CAM) programme over the three-year spending period**, FY 2022/23-2024/25.

Government's Role in Self-Driving Vehicles

Ensuring Safety & Security

Securing the Industrial & Economic Benefits

Making CAM work for Society

CAVPASS

Regulation to enable Self-Driving

Commercialising CAM

Social & Behavioural Research

Programmes

Projects

CCAV's Strategic Outcomes

CAVPASS

CAVPASS Workstreams

Vehicle technical Standards & Regulations

Vehicle testing, Approval, & in-service compliance

Safe Use

Advanced Trials

Enablers

Cyber Security

Ensuring Safety & Security

Regulation to enable Self-Driving

Domestic Legislation

New legislative framework

International Legislation

Safety Principles for Self-Driving

Securing the Industrial & Economic Benefits

Commercialising CAM

Deploying CAM

CAM Supply Chain

Skills & Outreach

Making CAM work for Society

Social & Behavioural Research

Outcomes – Commercialising CAM

- **Commercialising CAM** seeks to support the following outcomes
  - Scalable, **commercially sustainable deployments** of CAM technologies and services
  - Greener, more efficient, safer and more accessible journeys for **people and goods**.
  - **Early commercial markets** for UK CAM start-ups and SMEs (supply chain).
  - **Increased** large-scale **private investment** in the UK CAM sector supporting growth of the UK capability.
  - Strengthened **sovereign** UK CAM Supply Chain and **global export** opportunities
  - CAM is used **confidently, safely, and securely** by people and businesses
- Supporting the three CCAV STRATEGIC OUTCOMES
  - Ensuring Safety & Security
  - Securing the Industrial & Economic Benefits
  - Making CAM work for Society

Why this focus and why now?

- The Commercialising CAM programme seeks to intervene in the automotive sector by securing investment and intervention in the growing CAM Sector in two broad, key areas:

- Firstly, securing **commercialisable CAM deployment projects** to move goods and people throughout our neighbourhoods, cities, counties, and countries. Projects would be selected on the basis of potential to solve an existing customer requirement and having a demonstrable plan to become commercially sustainable. The projects will also provide substantial information, developing our understanding of the business case for deployment of CAM technology, the learnings from which we aim to share with transport commissioning bodies in order to mainstream automated vehicles into the optioneering process.

- Secondly, securing the building blocks of a successful, commercialised, **CAM ecosystem**: the elements that are necessary for the success of the commercialisation projects above and ongoing rollout**.** The programme will build strong domestic supply chains and enable globally competitive (and in some cases unique) capabilities that draw in businesses, investment and an actively engaged STEM workforce.

    - **Supply Chain Acceleration & Commercialisation.** The programme will support the UK CAM sector to accelerate its technological capabilities and scale up commercial operations, therefore improving its global competitiveness. It will focus R&D to solve the “last 20% problems” facing the supply chain and prepare companies as they look to deploy in the UK and expand into global markets.

    - **CAM market intelligence, expertise, and skills.** Essential enablers to embedding and realising the value of CAM Testbed UK and growing the UK sector: drawing on the technical expertise of Zenzic as a part-government funded, not-for-profit coordinating hub to deliver impactful research including updating the CAM Roadmap to 2030 and monitoring global challenges and opportunities facing the UK CAM sector, identifying and prioritising specific, actionable market failures for targeted government intervention; supporting the UK skills strengths, cited by industry as one of the most significant strategic challenges and drivers of UK investment (e.g., the ground-breaking Formula Student AI initiative).

Deploying CAM

- CCAV is keen to support developing solutions that solve transport problems in four priority Use Cases:
  - **Private Land** – Safe, secure and accessible self-driving services supporting innovative solutions that improve the safety, efficiency and decarbonisation of passenger and goods journeys on private land (land within which the public has restricted access)
  - **Low Speed Logistics** – Safe, secure and accessible self-driving services supporting innovative solutions that improve safety and efficiency of goods journeys in public spaces (areas which the public have unfettered access)
  - **Passenger** - Safe, secure and accessible self-driving services supporting innovative solutions that improve safety and efficiency of passenger journeys in public spaces (areas which the public have unfettered access)
  - **Human Driver in the Loop** – ADS technologies which could enhance the safety and efficiency of commercial operations whilst improving understanding of the interaction between the human driver, the ADS and other road users.

Deploying CAM – Proposed Grant Rates

- Projects grant claims should be between £0.5m and £9m and no more than 50% of the total project costs.
- Project grant funding must end by March 2025, although projects may continue, without further Government funding, into subsequent Financial Years.
- For these projects, which are nearer to market, eligible project costs will be capped at:
  - 45% if you are a micro or small organisation
  - 35% if you are a medium sized organisation
  - 25% if you are a large organisation
  - 100% if you are an RTO, capped at 15% of the grant total
  - 100% if you are a Local Authority or Transport Authority, capped at 25% of the grant
- Projects should consider the inclusion of local authorities and traditional transport operators / service providers in their proposals.
- Projects must demonstrate their route/development to commercial sustainability
- Projects must evidence due diligence around safety and security, evidencing “safety case” and engaging with government, local authorities, transport bodies, local communities, and blue light services when required

What is an SME?

Small and medium-sized enterprises (SMEs) are defined in the EU recommendation 2003/361
The main factors determining whether an enterprise is an SME are

1. staff headcount
2. either **turnover** or **balance sheet total**

Company category	Staff headcount	Turnover	or	Balance sheet total
Medium-sized	< 250	≤ € 50 m		≤ € 43 m
Small	< 50	≤ € 10 m		≤ € 10 m
Micro	< 10	≤ € 2 m		≤ € 2 m

Future of Mobility - Urban Strategy

- Deployments will need to bring together parties to deliver long term, beneficial services that support the nine Future of Mobility Urban Strategy Principles.
  1. ...must be safe and secure by design.
  2. … benefits of innovation … must be available to all …
  3. …active travel must remain the best option for short urban journeys
  4. Mass transit must remain fundamental ....
  5. …lead the transition to zero emissions.
  6. …reduce congestion ...
  7. …give the best deal to consumers
  8. …operate as part of an integrated transport system ....
  9. Data … must be shared … to improve choice and … operation of the transport system.

Future of Mobility - Urban Strategy

- The below tables show our proposed priorities in each of the four uses cases

	Private Land
1	Safety, security, & accessibility by design
2	Must improve efficiency or fulfill a logistic/passenger need (Carbon reduction is key)
3	The marketplace for mobility must be open to stimulate innovation and give the best deal to consumers.

	Low Speed Logistic Services
1	Safety, security, & accessibility by design
2	Must improve efficiency or fulfill a logistic need (Carbon reduction is key)
3	Must stimulate market competition & improve consumer choice

	Passenger Services
1	Safety, security, & accessibility by design
2	Must improve & integrate into existing transport systems while bringing benefit across the diversity of geographic, social, and economic sections of the UK
3	Active and mass travel must remain the best options where appropriate

	Driver in the Loop
1	Safety, security, & accessibility by design
2	Must improve the safety, efficiency and decarbonisation of the system
3	Connectivity must be a key element and should take multiple forms (eg. V2V, V2I, or V2X) using data to improve the system

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Private Land

No public access

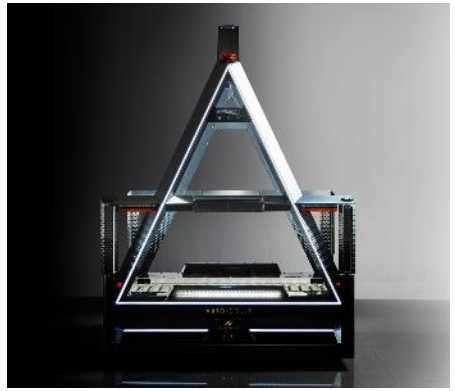
Self-driving deployments on Private Land as a potential early commercial use case.

Private Land – That which the public does not have unfettered access to.

Utilising key automated technologies in (much more) controlled environments to deliver significantly / suitably constrained missions without requirements to meet Road Traffic Act (1988).

Supporting safety, efficiency and decarbonisation goals.

Depot Operations – Moving vehicles around at the start and end of their operational duty
Airside Operations – Moving people and / or goods
(Controlled) **Campus Operations** – Moving people and / or goods



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Low Speed Logistic Services

Public Spaces

Small(er), slow(er) speed logistics operations as a first commercial deployment of CAM operating in public spaces.

These smaller vehicles are designed to have zero human occupancy, utilising new and novel vehicle designs for optimum payload.

Successful deployments in the US (Nuro) and announced public partnerships here in the UK highlight the opportunity.

Low Speed Logistics have the opportunity to change how people consider local journeys (groceries) and how parcels could move in the last mile (or so).

However, consideration must be given to potential impact on active travel and engagement with vulnerable road users.

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Passenger Services
Public Spaces

Low Speed Passenger services have been trialled across the UK (and globally) operating across almost all viable driving surfaces.

The UK has and will deploy trials of larger higher speed vehicles with (in future terminologies) a User in Charge, including 12m self-driving buses.

We seek to support the deployment of passenger services which:

1. Are safe, secure and accessible by design
2. Improve & integrate into existing transport systems, bringing benefit across the diversity of geographic, social and economic sections of the UK
3. Ensure active and mass travel remain the best options where appropriate

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Human Driver in the Loop

Public Spaces

ADS technologies in commercial vehicles could support commercial drivers; improving safety of the vehicles and those around them in all operations.

Focus on developing and delivering the ADS technologies that will enhance road safety of commercial vehicles, including on-board, off-board sensors and better information on risks and how they impact routing.

ALKS will soon be available for commercial vehicles, how do we make the UK roll-out the safest and most beneficial?

Other Companies exist…

Feasibility Studies <£1.5m

- **CAM as an additional Mass Transit Mode**
  - FS £250 - £500k grant no more than three projects.
  - Projects to complete by March 2023
  - Rural to sub-suburban – Under served areas with a difficult economic case for improved access to transport

- For these Feasibility Studies you could get funding for your eligible project costs of:
  - up to 70% if you are a micro or small organisation
  - up to 60% if you are a medium sized organisation
  - up to 50% if you are a large organisation
  - 100% if you are an RTO, RO, Local Authority or Transport for, capped at 30% of the grant

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CAM as an Additional Mass Transit Mode

Segregated infrastructure

Operating on segregated infrastructure (non-public roads) and on asphalt rather than rail, connected and automated mobility (CAM) technology could provide an effective mass transit solution for the UK that is competitive with traditional modes in certain circumstances. Enabling its use could support Government's aims to improve transport for the user and to commercialise CAM technologies.

<u>We will support research into potential real-life schemes</u>

CAM Supply Chain

Safety Security Technology Services Skills

- CCAV is looking to fund up to eight projects to support the continued development of the UK CAM Supply Chain.
- This fund will support the development of higher TRL capabilities in the CAM Supply Chain, cementing a sustainable capability here in the UK, whilst supporting safe and secure CAM deployments and growing global export opportunities.
- We will consider projects developing CAM related products and services in the following technology areas:
  - **Cyber Security**
  - **Simulation and Modelling**
  - **Verification and Validation** (inc test beds)
    - Engineering Services
  - **Automated Driving Vehicles (Physical)**
  - Communications & Data Connectivity
  - **Sensors & Perception Systems**
  - ADS Control hardware & software
  - **Redundant / Safety Critical Systems**
    - “by-wire” systems
  - Insurance

CAM Supply Chain

Safety Security Technology Services Skills

- Projects grant claims must be between £0.5m and £4m and no more than 60% of the total project costs.

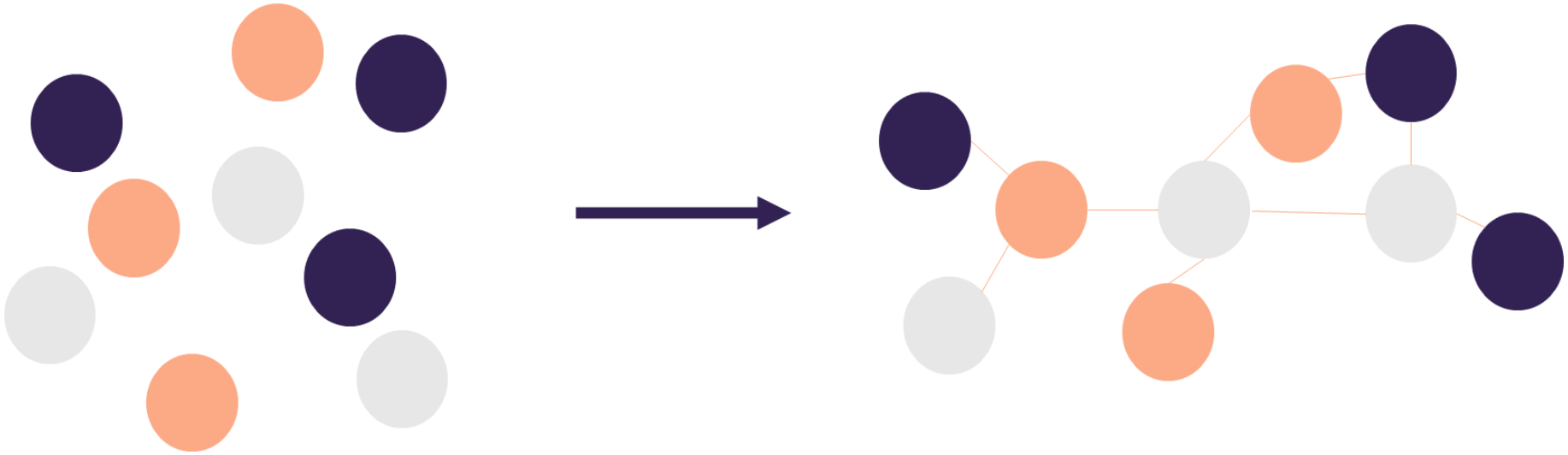
- Projects must finish by March 2025

- For Supply Chain Projects you could get funding for your eligible project costs of:
  - up to 70% if you are a micro or small organisation
  - up to 60% if you are a medium sized organisation
  - up to 50% if you are a large organisation
  - 100% if you are an RTO, RO, Local Authority or Transport for, capped at 30% of the grant

Growing a Supply Chain from an Ecosystem

Build on top of a diverse yet disparate set of UK capabilities to form a connected, effective and resilient supply chain which is capable of supporting commercialisable operational deployments.

1. Deliver resilience through ownership of critical supply chain elements
2. Unlock industrial and economic benefit through focussing on high-value opportunity areas



Growing a Supply Chain from an Ecosystem

Potential Activities

- Capturing high value R&D opportunities (Last 20%)
  - Moving state-of-the-art in technology forwards
- Support non-technical activities which deliver deployment environments
  - Insurance, testing, safety-cases…
- Form partnerships to support commercial sustainable deployments
  - Commercial relationships, partnering, collaboration
- Transfer adjacent sector technologies
  - Cross-sector projects
- Challenge-led EOI focus to solve industry barriers through research
  - Solve real industry problems and seize early opportunities
- Capturing CAM supply-chain export opportunities
  - Support UK organisations becoming part of the Global supply-chain

Supply Chain areas of opportunity

Category	Potential UK opportunity	Comments
Software	+++	In particular data, AI, safety and security
Comms and data infra (connectivity)	+++	Large opportunity for connectivity focused solutions
Tools	++	In particular simulation, test and analysis
Engineering services	++	Build of strength, focus on areas with (exportable) IP
Operators	++	In particular Operators to drive “the pull”
RTOs	++	
Insurance and legal	++	Building on traditional UK strengths
(New) OEM/ASDE	++	Potential opportunity in new vehicle segments rather than existing OEMs/segments
Test services	+	Linked to UK deployment and certification role
Niche hardware/understanding of hardware	++	Smaller scale hardware possible, significant challenges to scale. May need to think about critical hardware

Growing a Supply Chain from an Ecosystem

Questions:

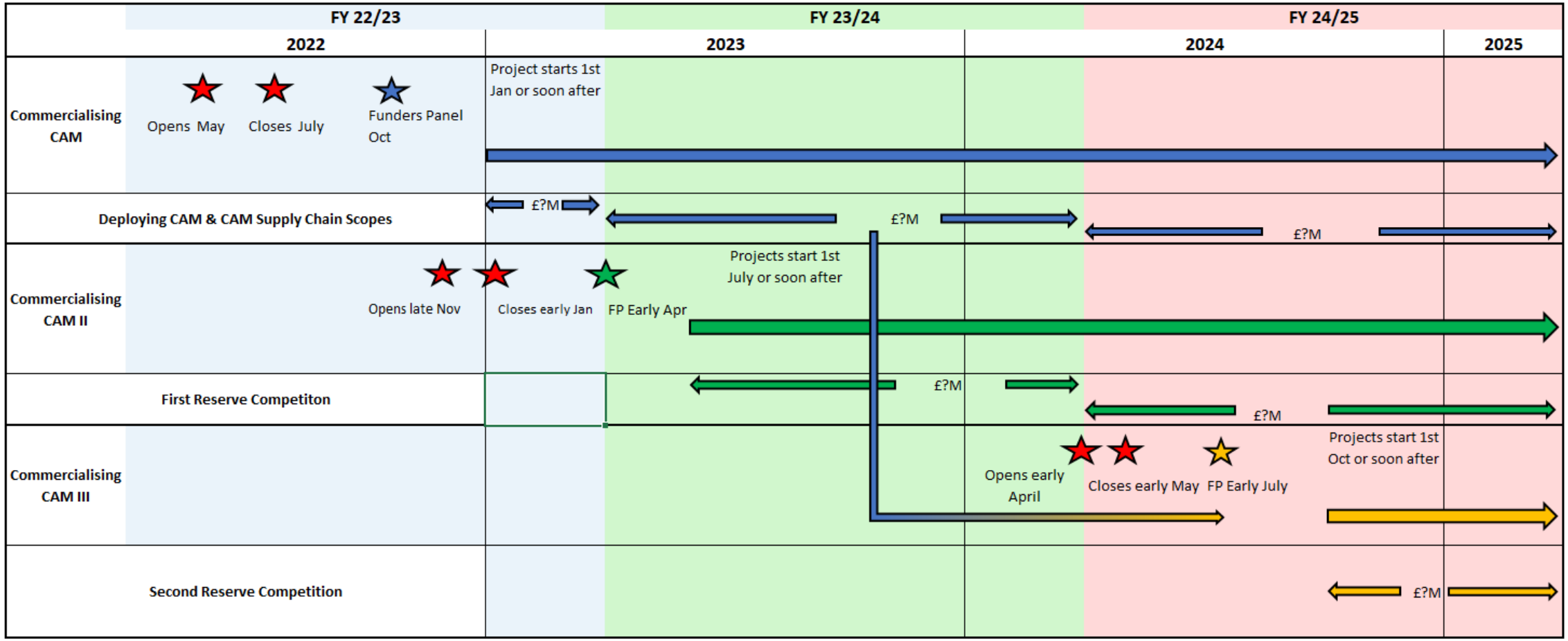
- What areas still require R&D to enhance safety and/or unlock deployments?
- What interventions will help resolve non-technical challenges?
- How can government support the forming of commercial partnerships across CAM
- What are the specific challenges you face in deploying CAM (or providing solutions to those who are deploying)
- What role do the “operators” or “end users” have in helping to form the CAM UK supply chain
- Where can UK organisations become critical parts of the Global supply chain (strong export opportunity)

CAM Skills & Public Outreach

Safety Security Technology Services Skills

- **Support to IMECHE and Formula Student AI**
  - Increasing availability of FS:AI vehicles and enabling sponsorship of Universities and Students to grow FS:AI to be a global leader, enhancing the offering of Formula Student and helping to embrace the new skills required by organisations in the CAM space.
  - Open to suggestions for who else we need to bring in to support success in this space
- **(Ecosystem) Skills Review**
  - Building on a number of extant reviews bring together a clear vision of where investment needs to be focussed to ensure the UK skills base is capable of supporting the commercialisation of CAM
- **Projects' Public Outreach**
  - A 100% grant funded pot to support projects engagement with the public through STEM outreach, supporting the development of public knowledge, trust, and buy-in to the benefits of CAM technologies and services **in addition to those proposed to support the project objectives**

Target Competition Timelines – Subject to Change



Delivery Partners

- **Innovate UK**
- **ZENZIC**
- **Innovate UK - EDGE**
- **Innovate UK – KTN**

Innovate UK

Innovate UK drives productivity and economic growth by supporting businesses to develop new ideas.

We connect businesses to the people that can help them, and fund businesses and research collaborations in all economic sectors, value chains and UK regions to accelerate innovation.

Funding Opportunities

- Industrial Strategy Challenge Fund (ISCF)
- Innovate UK Smart Grants
- Small Business Research Initiative (SBRI)
- Managed Programmes
- Knowledge Transfer Partnerships
- Innovation Loans
- Investor Partnerships
- Innovation to Commercialisation of University Research (ICURe)
- Catalysts (Biomedical and Energy)
- Future Leaders Fellowship
- International

UKRI Innovate UK

Innovate UK supports the following R&D categories:
- fundamental research
- feasibility studies
- industrial research
- experimental development

Not all funding options are open at any one time. Check website for latest opportunities.

https://apply-for-innovation-funding.service.gov.uk/competition/search?_ga=2.115831622.115414534.1616576710-389397812.1611493012

Zenzic supports the entire CAM UK Ecosystem

Insights

Guidance and insight into CAM Supply Chain opportunities

Market Horizon scanning and needs analysis

Strategic consensus for Ind:Gov through the UK CAM Roadmap

Global Thought Leadership of CAM companies

Alignment with CAVPASS programme

Innovation

Support CCAV programmes delivered through Innovate UK Deliver targeted innovation programmes. Find opportunities to align innovation programme to leverage greater impact. Unlock faster route-to-market strategies through existing UK capabilities such as CAM Testbed UK

Collaboration

Establishing CAM UK community which

Promoting the breadth of CAM in the UK and its unique "Stronger Together" collaboration

Raising interest for investment and partnerships

Raising profile internationally as part of Government platforms through close working with DIT

Effective Innovation relies on both Insights and Collaboration.

Zenzic has a supportive Mission for CCAV Funded programmes

The Zenzic Mission

Bring together industry, government, and academia across all relevant sectors to develop and deploy CAM in the UK.

Pre-Competition Support

- Targeting projects and interventions using Supply Chain insights
- Improving effectiveness of Industry bids through focus and insights
- Introductions & matchmaking to provide comprehensive Consortia

Ongoing Project support

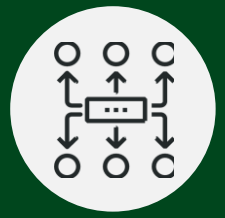
- Provide Stakeholder engagement across CAM UK to support projects
- Commercial Exploitation planning support, to ensure project outcomes are met
- In-project delivery advice and support

Post-Project Support

- Impact Measurement for both internal project and macro scale considerations
- Through-life exploitation support, helping to land projects into the CAM supply chain
- Cross-sector opportunity scanning to maximise impact

Zenzic provides engagement across the CAM UK Ecosystem and supports long-term exploitation of project outputs

What KTN do - Growth Through Innovation



Connecting

Finding valuable partners

Project consortium building

Supply Chain Knowledge

Driving new connections

Articulating challenges

Finding creative solutions

Funding

Awareness and dissemination

Public and private finance

Advice – project scope

Advice – proposal mentoring

Project - follow-up

Influencing

Promoting

Industry needs

Informing policy makers

Informing strategy

Communicating trends and market drivers

Supporting

Intelligence on trends and markets

Business Planning support

Success stories / raising profile

Navigating

Navigating the innovation support landscape

Promoting coherent strategy and approach

Engaging wider stakeholders

Curation of innovation resources

The Innovate UK EDGE Service

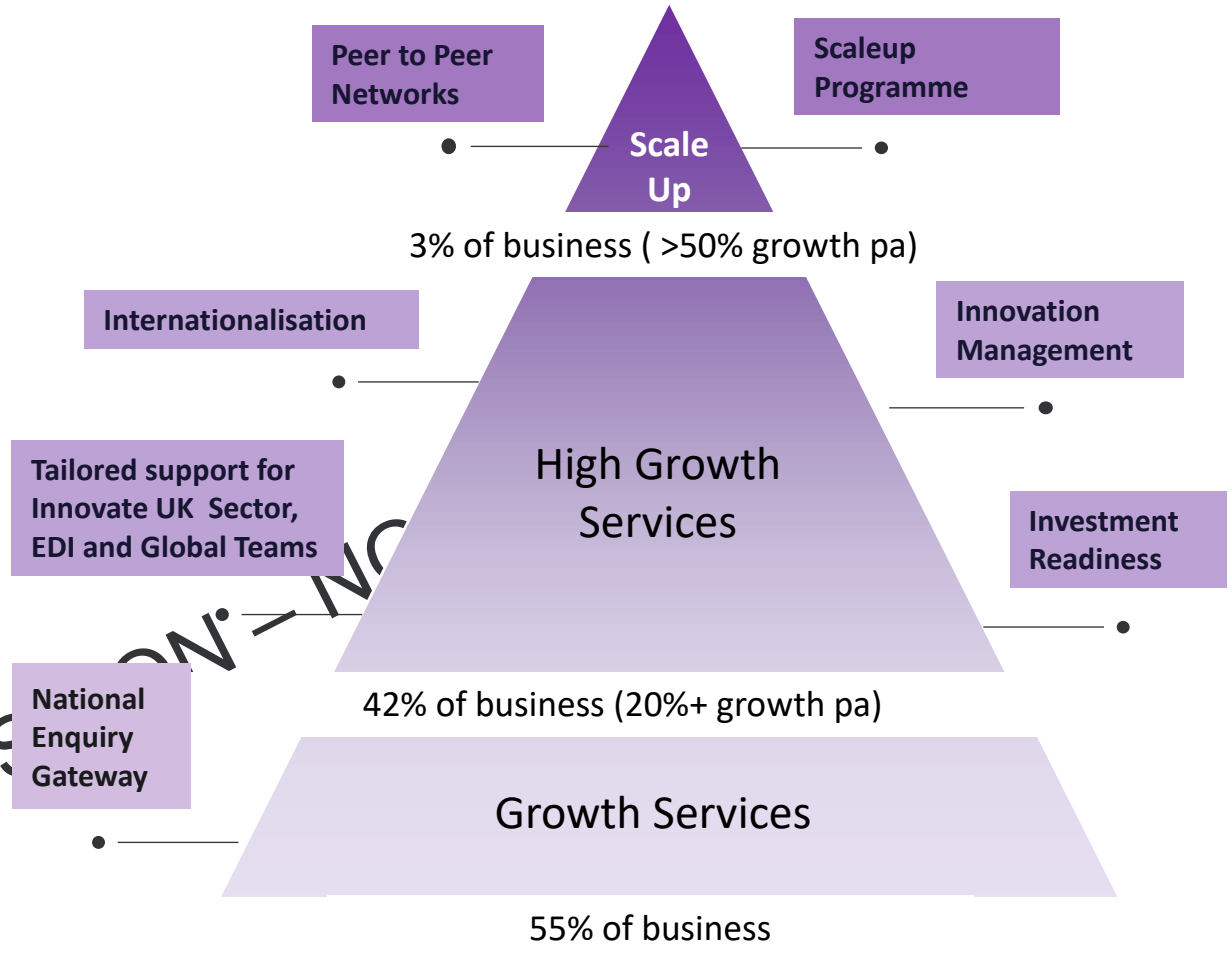
Bespoke growth and scaling support at the business end of innovation

Each business's leadership team collaborates with an innovation and growth specialist to hone its commercial strategy and identify targeted action

Manage innovation effectively | **Build investment readiness** | **Enter global markets**

Innovate UK EDGE Scaleup Programme is geared to businesses exhibiting the highest growth potential.

Its enhanced coaching, provided by an expert Scaleup Board and its extended connections, prepares clients for serious fundraising and international expansion to become the next champions for British innovation on the global stage.



270 innovation and growth specialists and 22 scaleup directors across the UK

All embedded in regional ecosystems

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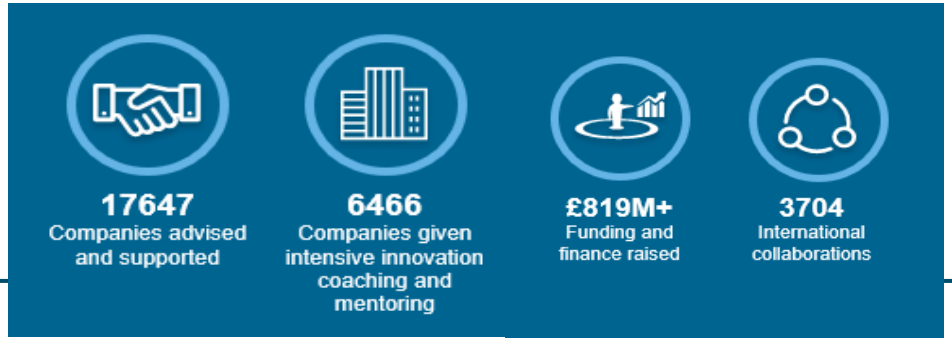

How do you get involved?

Centre for Connected & Autonomous Vehicles

HM Government

Further Information

If you'd like to discuss any of the topics in this slide deck and the proposed competition scopes please do not hesitate to contact David Webb and Ben Winter.

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