Driving Impact: Althena's Roadmap for AI Business Opportunities in CCAM

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Trustworthy, explainable AI for safe and scalable automated mobility

AIthena is a Horizon and SERI-funded research initiative developing trustworthy, explainable and human-centred AI solutions for Cooperative, Connected and Automated Mobility (CCAM), with the aim of making AI-driven vehicle and transport systems safer, more transparent and easier for operators and regulators to adopt.

Artificial Intelligence is transforming how people and goods move. To unlock the societal and economic benefits of automated mobility we must combine high-performing AI with strong safeguards: transparency, privacy, ethics and accountability. AIthena builds the methods, tools and demonstrators that make AI in CCAM both effective and trustworthy so operators, citizens and regulators can adopt it with confidence.

AIthena has developed a portfolio of methods, tools and datasets to improve safety, robustness and transparency of AI in automated mobility. The project's exploitation plan maps these outputs into commercial and non-commercial pathways.

Key elements of the analysis performed during the project involved:

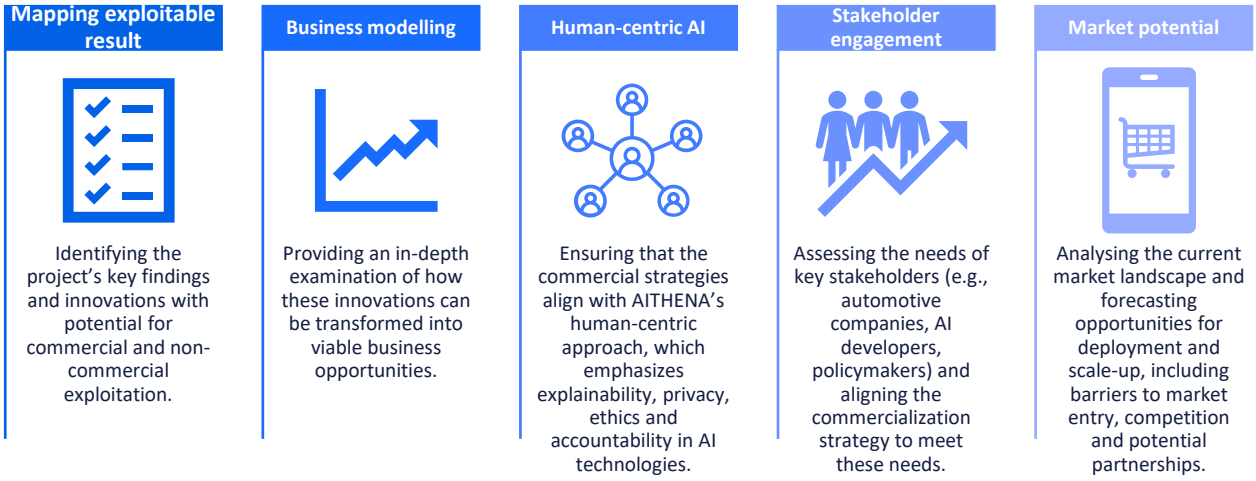


Figure 1: Key elements of the analysis

Context

Automation in road transport promises improved safety, lower costs and environmental gains, but real deployment faces barriers: public trust, regulatory complexity, technical robustness, interoperability and workforce shifts. AIthena positions trustworthy and explainable AI as a core

enabler to bridge these gaps.

Figure 2: Adoption Readiness Matrix

Market snapshot and trends

Automated and AI-enabled mobility is a rapidly expanding segment within the broader transportation market. Global forecasts point to robust growth in automotive AI and autonomous mobility-related revenues over the coming decade. Europe is an active region for CCAM (Cooperative, Connected and Automated Mobility) research, pilots and industrial activity; however, compared with the United States and China, large-scale commercial deployments (robotaxis, wide-scale driverless freight) remain limited and generally concentrated in targeted pilot zones and controlled operations. European actors are leveraging partnerships with global technology providers while focusing on safe, explainable and interoperable solutions to meet local regulatory and societal expectations.

Fragmented but advanced testing ecosystem: European activity is characterised by many national and municipal pilots, specialised testbeds and close cooperation between OEMs, Tier-1 suppliers and research centres.

Strong emphasis on safety, explainability and human-centric design as part of product value propositions.

Growing focus on logistics and structured commercial niches (hub-to-hub freight, automated shuttles, last-mile operations) where operational design domains (ODDs) are easier to contain and manage.

Increasing use of synthetic and simulated data, digital twins and virtual verification and validation to accelerate development while managing cost and privacy constraints.

Figure 3: Key European market characteristics

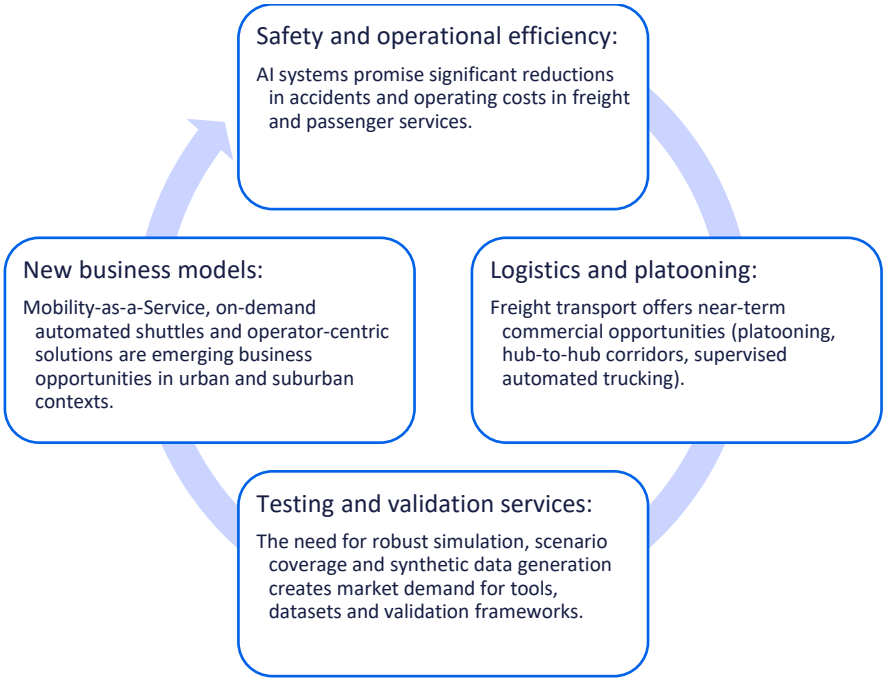


Figure 4: Market drivers and opportunities

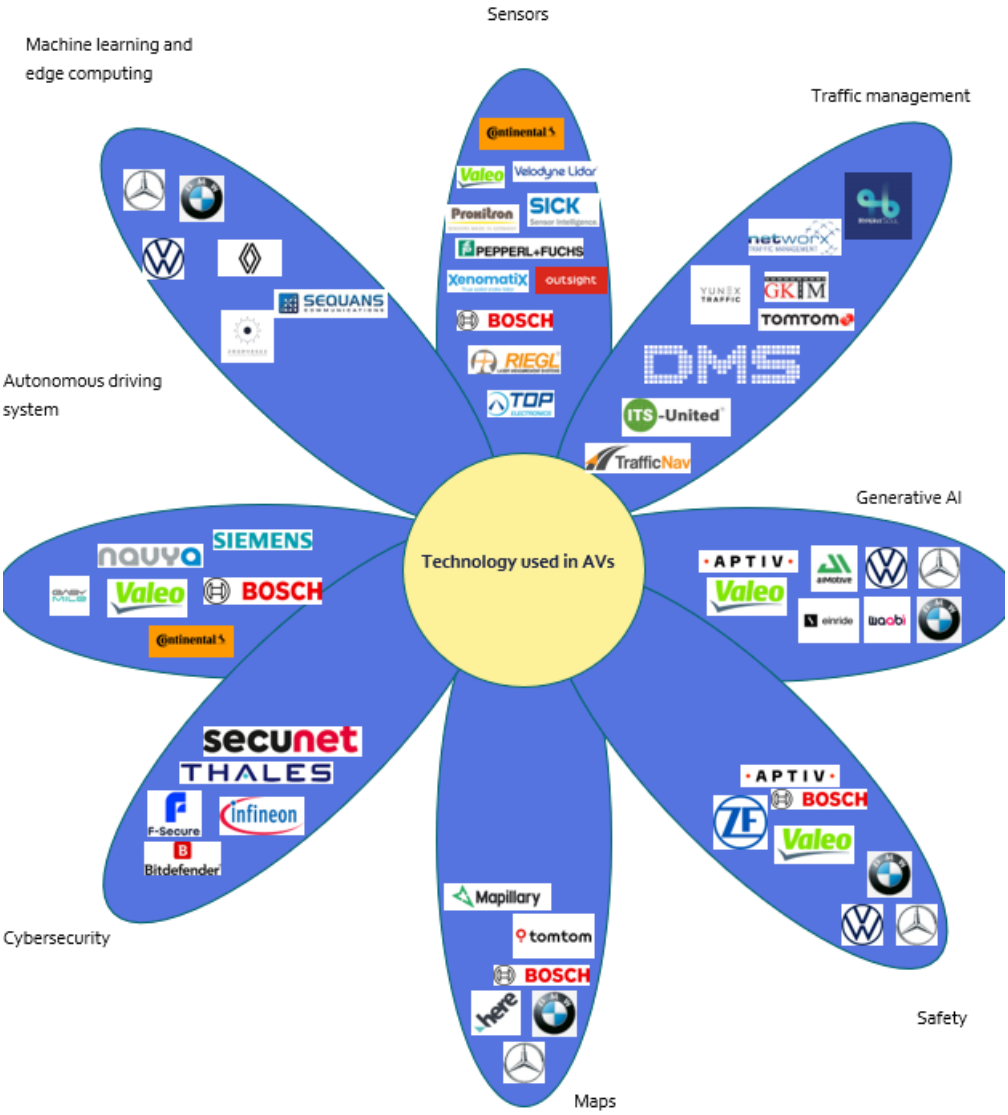


Figure 5: EU-based AV technology providers

Overview of the EU regulatory context

The EU regulatory framework for AI and automated mobility is maturing rapidly and includes several complementary strands that directly affect CCAM technologies:

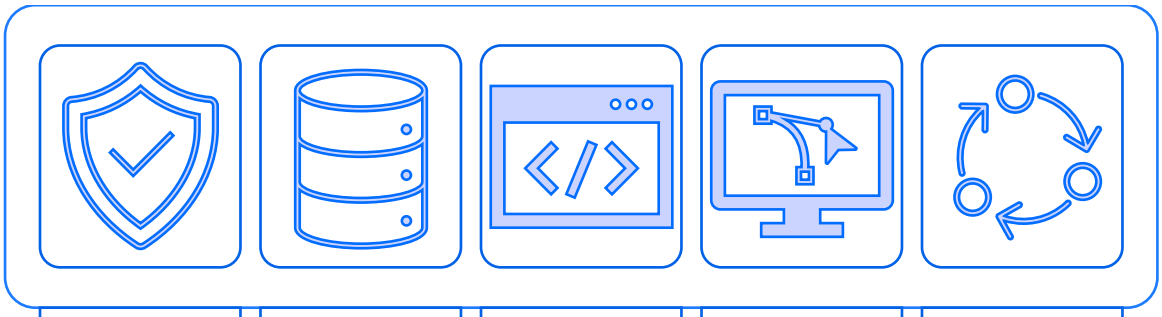
The EU AI Act:	**The EU AI Act (entered into force on 1 August 2024) establishes a risk-based classification for AI systems and imposes special, strict obligations for "high-risk" systems. These obligations include robust risk-management and data-governance requirements, extensive technical documentation and record-keeping, transparency and user-information duties, human-oversight measures, and conformity-assessment. The Act also create an EU governance framework and market surveillance / enforcement mechanisms (including CE-marking and notified-body oversight for certain high-risk systems).**
GDPR and data protection law:	The GDPR and related EU data-protection law remain the primary legal framework for personal data in CCAM. They require lawfulness, purpose limitation, data-minimisation, storage-limitation, integrity/confidentiality, and accountability, and place special restrictions on biometric and other "special-category" data (Article 9), which is often implicated by camera or sensor systems used for perception and identification. In practice, developers must apply privacy-by-design and carry out appropriate DPIAs; pseudonymisation/anonymisation and careful purpose scoping are key mitigations, but may not fully remove all legal obligations if identification remains possible.
Vehicle type-approval and safety regulations:	EU vehicle type-approval law has been updated to enable approval of advanced driver assistance and fully automated driving systems. Key measures include Commission Delegated Regulation (EU) 2022/2236 (amending Regulation (EU) 2018/858 to add technical requirements for small-series and driverless vehicles, and to address software update procedures) and Commission Implementing Regulation (EU) 2022/1426 (laying down uniform procedures and technical specifications for type-approval of Automated Driving Systems under the General Safety Regulation 2019/2144). These rules create an EU-level pathway for L3/L4 approvals (including small-series approval), but they are use-case and area limited (e.g. geofenced or defined routes) and require national implementation for routine, cross-border deployment.
CE marking and conformity assessment:	Under the AI Act, providers of high-risk AI systems must undergo the relevant conformity-assessment procedure before placing systems on the EU market, produce and retain comprehensive technical documentation, implement a quality management and risk-management system, and draw up an EU declaration of conformity. High-risk systems must carry a CE marking (physical or digital as appropriate) to indicate conformity with the AI Act, and Member States will designate notified bodies to conduct/oversee third-party assessments where required. Post-market monitoring and registration obligations also apply.

Figure 6: Regulatory Landscape for CCAM in the EU

While EU regulations set the overarching legal framework for CCAM, Member States currently differ significantly in how they implement those rules, in enforcement capacity, and in national road-traffic laws; differences that create practical obstacles for cross-border operations and the roll-out of pan-European services. The EU has introduced harmonised instruments (for example, the Implementing Regulation on type-approval of Automated Driving Systems (Reg. 2022/1426), the Data Act and the EU AI Act), but full practical harmonisation, notably of national traffic codes, operational authorisations, data-sharing arrangements and incident-reporting practices, is still incomplete and uneven across countries, which complicates routine cross-border services and limits large-scale deployments.

Ethical requirements, transparency, explainability and non-discrimination, map closely to legal duties for CCAM: explainability supports compliance and public trust but must be balanced with GDPR constraints (e.g. data-minimisation and purpose-limitation). AIthena addresses these trade-offs through a combination of privacy-preserving engineering and governance: privacy-by-design for data flows; explainability-by-design (model & data cards, decision summaries and explainability maps); privacy techniques including on-board anonymisation, redaction/aggregation and synthetic data generation to reduce exposure of personal data.

Key Exploitable Results (KERs)



Trustworthy AI Development and Governance

What: Human-centric methodology, ethical checklists, model and data cards and policy recommendations to ensure transparency, fairness and compliance.

Who benefits: Regulators, OEMs, system integrators, testers.

Data Generation, Management and Fusion

What: Synthetic and hybrid dataset generation pipelines, semi-automatic ground-truth tools and ML-DevOps data governance for traceability and dataset quality.

Who benefits: AI developers, benchmarking organisations, test labs.

AI Model Design and Explainability

What: Explainable perception and decision modules, uncertainty quantification methods and hybrid model architectures designed to produce human-understandable outputs.

Who benefits: OEM safety teams, validation labs, policymakers assessing safety cases.

Testing, Validation and Simulation Frameworks

What: XiL testbeds, benchmark datasets (e.g., MultiCorrupt), automated pipelines and KPI definitions for trust and safety validation.

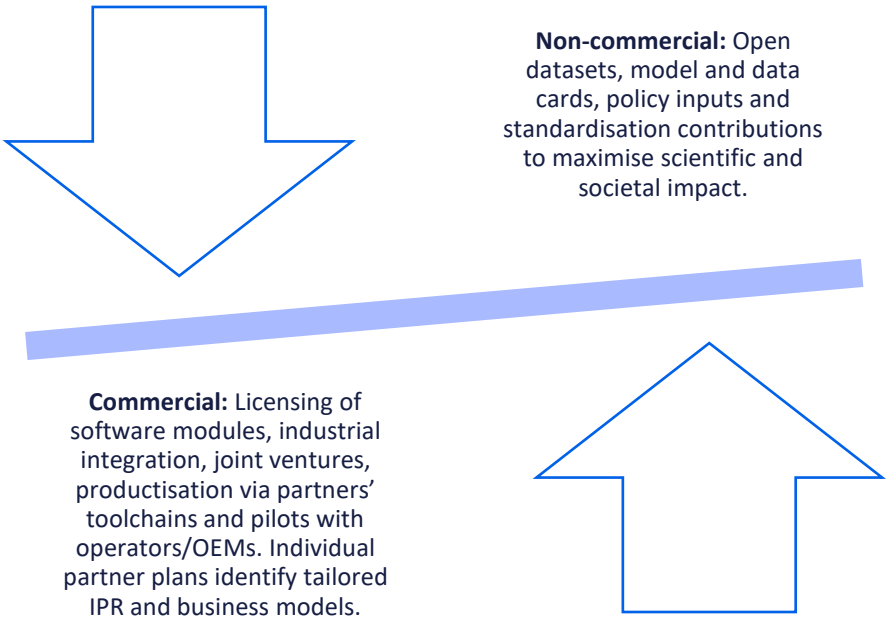
Who benefits: Test houses, certification bodies, system integrators.

System Integration and Operational Efficiency

What: Integration patterns, digital twin components and operational tools to deploy and monitor AI in CCAM fleets.

Who benefits: Fleet operators, traffic managers, platform providers.

Exploitation strategy



Non-commercial: Open datasets, model and data cards, policy inputs and standardisation contributions to maximise scientific and societal impact.

Commercial: Licensing of software modules, industrial integration, joint ventures, productisation via partners' toolchains and pilots with operators/OEMs. Individual partner plans identify tailored IPR and business models.

Main Findings and Recommendations

Trustworthy AI in CCAM is paramount

The project confirms that ethical, transparent and explainable AI is foundational for public acceptance and regulatory compliance in Cooperative, Connected and Automated Mobility (CCAM). Human-centric design and governance frameworks were central to the project's success.

High exploitation of Key Exploitable Results (KERs)

The categorisation and prioritisation of Key Exploitable Results during partner workshops demonstrated that Data Generation, Management & Fusion and Trustworthy AI Governance are the most impactful areas.
These KERs support the foundational infrastructure for safe, efficient and reliable AI deployment in CCAM

Technology readiness has advanced

The TRL (Technology Readiness Level) analysis shows a successful progression of technologies towards implementation (e.g., from TRL 3–4 to 6–7 in areas like digital twins, KPI frameworks and synthetic data generation)

Broad Stakeholder involvement and alignment

Consortium-wide engagement, across research, tech industry, public institutions and policy bodies, ensured diverse perspectives and wide applicability. This approach reinforced market relevance and regulatory foresight.

Balanced Exploitation Strategy

AIthena balanced non-commercial dissemination (open science, workshops, standards development) and commercial pathways (market entry plans, partner strategies), ensuring long-term viability and scalability

Figure 7: Summary of findings

Prioritise ethical and explainable AI in deployment

Future projects and industry adopters should integrate trustworthiness by design. This includes using AIthena's human-centric AI methodology and privacy-preserving tools to meet both EU AI Act standards and end-user expectations.

Advance Key Exploitable Results for commercialisation

Focus immediate post-project efforts on the most promising KERs:
- Data fusion and real-time perception systems
- Human-in-the-loop testing frameworks
- Synthetic data tools for rare-event training

Invest in regional adaptation and infrastructure

Address deployment imbalances between urban and rural areas. Policies and investment strategies must support infrastructure and connectivity in underserved regions to ensure inclusive adoption.

Strengthen cross-sectoral partnerships

Continued collaboration between OEMs, technology suppliers, researchers and regulators is essential. It fosters innovation and ensures scalable, regulation-aligned production.

Embed adaptation strategies

Stakeholders must use adaptation checklists developed during the project to align AI adoption with regulatory, societal and technological shifts. These include participatory design, trust-enhancing communication and infrastructure readiness.

Figure 8: Recommendations for commercialization and exploitation

Roadmap for Exploitation of AI and Automation in the Road Transport Sector

Roadmap for Exploitation of AI and Automation in the Road Transport Sector

1 Consolidation and standardisation

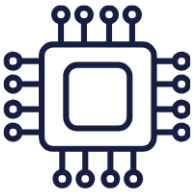
Objective: Build foundational trust, validate the technology and prepare market entry by aligning with emerging regulatory frameworks.

COMMERCIAL

- Develop pilot projects in collaboration with vehicle OEMs, transport operators, and tech providers.
- Validate early business models for AI components (e.g. perception, data governance, safety systems).
- Identify and engage first movers in freight (e.g. last-mile logistics) and urban mobility (e.g. AV shuttles).

TECHNICAL

- Advance AI components from TRL 6–7 to TRL 8–9 via real-world demonstration.
- Finalise modular toolkits and interfaces for interoperability across platforms and fleets.
- Prepare connected infrastructure mapping for future deployment (e.g., V2X, 5G edge).



LEGAL AND REGULATORY

- Align with EU's AI Act, GDPR, and sectoral legislation.
- Develop guidelines for compliance and accountability in AI deployments.
- Establish dialogue with certification bodies to shape future assurance and liability frameworks.

SOCIETAL

- Launch public awareness campaigns around the role and limits of AI in transport.
- Involve vulnerable users (e.g., elderly, cyclists, people with disabilities) in design testing.
- Develop user-friendly materials to explain AI transparency and explainability.

2 Market entry and operational deployment

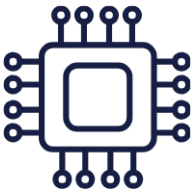
Objective: Transition from pilots to real-world deployment of technologies, tools and methodologies and consolidate commercial strategies with a strong focus on operator needs.

COMMERCIAL

- **Begin scalable deployment of AI modules in logistics, bus systems, and ride-hailing platforms.**
- **Promote AI tools for dynamic routing, predictive maintenance, and operational analytics.**
- **Introduce Digital Twins and remote operation platforms for training and monitoring.**

TECHNICAL

- **Deploy multi-sensor fusion systems, runtime safety mechanisms, and explainable decision-making frameworks.**
- **Integrate AI into fleet and logistics platforms, supporting real-time, adaptive behaviour.**
- **Implement cross-domain pilots that combine freight, passenger, and infrastructure data.**



LEGAL AND REGULATORY

- **Conduct conformity assessments and audits for high-risk AI applications.**
- **Develop sector-specific standards and test protocols (especially for logistics and AVs).**
- **Advance legal frameworks on shared liability and human oversight in autonomous systems.**

SOCIETAL

- **Evaluate public perception and usability of AI-enabled systems through UX testing and surveys.**
- **Train operators and planners in human-in-command protocols and override mechanisms.**
- **Engage communities in co-design and localised adoption strategies, especially in rural or underserved regions.**

3 Scale-up and ecosystem integration

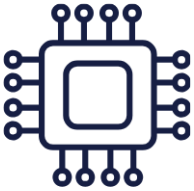
Objective: Achieve systemic AI integration in road transport, supported by infrastructure, legal certainty and societal acceptance

COMMERCIAL

- Enable fleet-wide deployment in long-haul freight, urban public transport, and on-demand services.
- Create business models around Explainability-as-a-Service, automated reporting, and ecosystem data sharing.
- Establish AI marketplaces and licensing schemes for SMEs and solution providers.

TECHNICAL

- Integrate AI with connected infrastructure (C-ITS), cloud-edge systems, and multimodal platforms.
- •Expand use of Digital Twins for operations, simulation, and emergency preparedness.
- •Coordinate multi-vehicle AI systems (e.g. platooning, convoy management).



LEGAL AND REGULATORY

- Harmonise standards across borders with EU-wide certifications and alignment with UNECE/ISO norms.
- Embed AI assurance and auditing frameworks into transport certification procedures.
- Institutionalise ethics and oversight boards within transport authorities and fleet managers.

SOCIETAL

- Deliver AI literacy and upskilling programmes for transport professionals and operators.
- Foster citizen-facing transparency via public dashboards on AI performance and decision rationale.
- Embed social impact monitoring into large-scale transport automation projects.