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D3.3: Final Selection of Use Cases

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Acronyms and definitions

Acronyms	**Definitions**
CCAM	Cooperative, Connected, and Automated Mobility
OEM	Original Equipment Manufacturer
ODD	Operational design domain
WP	Work Package
MTME	MTME
AV	Automated vehicle
KPIs	Key Performance Indicators
UC	Use case
TNC	Transportation network companies
EU-CEM	European Common Evaluation Methodology
HMI	Human-machine interface
AD	Automated driving
TRL	Technological Readiness Level

1. Executive summary

The deliverable 3.3 ‘Final selection of use cases’ corresponding to Task 3.3 ‘Use case development’ within Work Package 3 ‘CCAM Scan & Innovation Radar’ details the final selection of use cases for the CCAM-ERAS project. The selection process is designed to ensure the project's relevance, impact, and long-term viability of the project by focusing on real-world applications, commercial potential, job creation, and addressing labor market and training challenges.

The development of the use cases involved a collaborative effort not only within the consortium, but also with the engagement of a wide array of stakeholders through workshops and ensuring coordination and synergies with other CCAM-related projects. This multidisciplinary approach underscores the project's commitment to co-creation, ensuring the final use cases are robust and relevant. The project also remains adaptable to incorporate emerging trends and innovations in CCAM development.

The corresponding task reviewed past and ongoing EU-funded CCAM projects to synthesize diverse approaches and insights, providing a foundation for understanding the potential impacts of CCAM solutions. Key projects analyzed include MODI, ORCHESTRA, i4Driving, AWARD, ULTIMO, and Move2CCAM. These projects collectively illustrate the diverse applications and impacts of CCAM, from freight logistics to public transport, and provide valuable lessons for the CCAM-ERAS project.

- MODI: Focuses on accelerating the introduction of CCAM vehicles for logistics, addressing barriers to the roll-out of automated transport systems.
- ORCHESTRA: Established a common understanding of multimodal traffic management concepts and solutions, coordinating traffic management across different modes and areas.
- i4Driving: Aims to create a new industry-standard methodology for virtual assessment of CCAM systems, focusing on human road safety baselines.
- AWARD: Focused on enabling an overall autonomous logistic chain through safe and efficient connected and automated heavy-duty vehicles in real logistics operations.
- ULTIMO: Addresses the deployment of automated vehicles (AVs) in public transport, aiming to unlock the integration of AVs into cities with on-demand and door-to-door services.
- Move2CCAM: Develops detailed use cases to provide insights into the impact of CCAM on future jobs and education, and to create a practical impact assessment tool.

The CCAM-ERAS project established a framework for selecting six key use cases, balanced between passenger and freight transportation. The selection process involved various distinct criteria, including real-world applications, commercial viability, job creation potential, and addressing labour market and training challenges. These use cases were chosen to represent a broad spectrum of CCAM scenarios and to align with past and ongoing CCAM initiatives. The final CCAM-ERAS use cases that are described in detail within this deliverable are:

- Ground transportation for last-mile delivery: focuses on automated solutions for distributing parcels and groceries to customers' doorsteps.
- Bus depot: involves automation in public transportation OEMs, operators, and logistics within bus depots.

- Port/Terminal: centres on logistical functions such as access control, charging, loading/unloading, and logistics planning in port and terminal operations.
- Public (shared) transportation: covers demand-responsive transport in urban areas, night transportation, and complementing rail transport in rural areas.
- Private (shared) transportation: includes robotaxi services and autonomous private hire or taxi market operations.
- Shared transportation targeting specific groups: offers mobility services tailored for people with disabilities, the elderly, and individuals in rural or low-accessibility areas.

These descriptions include the type of transportation, vehicle type, level of automation, connectivity, capabilities, sensors, and operational design domain (ODD), adapting the recommendations described in the European Common Evaluation Methodology, developed by the FAME project.

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2. Objectives and activities

In an era marked by rapid technological advancement, the integration of Cooperative, Connected, and Automated Mobility (CCAM) technologies is poised to fundamentally reshape the landscape of transportation, impacting not only infrastructure and mobility patterns but also the very fabric of employment, society, economy, education and skills. As such, the CCAM-ERAS project, through its Deliverable D3.3, 'Final Selection of Use Cases,' within Work Package 3 (WP3) – CCAM Scan & Innovation Radar, seeks to establish a robust foundation for understanding and navigating these transformative changes. Task 3.3, 'Use Case Development,' is pivotal in this endeavor, aiming to translate the broad implications of CCAM, identified through the initial scan within WP3, into tangible and realistic scenarios that illuminate the future of jobs and education.

The priority in terms of developing practical, real-world use cases stems from the recognition that CCAM's potential impact extends far beyond theoretical frameworks. These use cases will serve as critical bridges connecting past and ongoing CCAM-related projects, such as MODI, ORCHESTRA, i4Driving, MOVE2CCAM, AWARD, and ULTIMO, with the specific needs and challenges of future workforce development. By focusing on areas closely aligned with these established initiatives, D3.3 ensures that the insights gained are both relevant and actionable. The developed use cases will form the cornerstone for subsequent work in WP5, where detailed scenarios further developing the use cases will be crafted to guide the development and enhancement of skills essential for the evolving job market. Moreover, these scenarios will serve as invaluable tools for directing research activities in WP4, providing a clear and focused lens through which to examine the broader implications of CCAM. This comprehensive examination will yield a nuanced understanding of how CCAM technologies will reshape educational requirements and transform the labor market. Recognizing the importance of diverse perspectives, the development of these use cases will be a collaborative effort, engaging a wide array of stakeholders. Workshops were organized, bringing together representatives from the T3.1 workshops and use case-specific stakeholders, ensuring a broad spectrum of insights.

Having MaaSLab lead the task ensures coordination and synergies by creating connections with the use cases in the Move2CCAM project. CINOP identified necessary information for WP5, CORTE provided input on road transport-related use cases, ITSN linked tasks across WP3, UoW contributed by providing industry input, and SAAM supported the partners and brought several use cases to the projects. What is more, the approach adopted for T3.3 that leads to the production of this deliverable was to involve all CCAM-ERAS partners in the development of the final use cases, as the output of this work will be used as input for all subsequent work of the project. The multidisciplinary approach adopted for D3.3, involving all CCAM-ERAS partners, underscores the project's commitment to creative co-creation, ensuring that the final use cases are robust and relevant. Furthermore, the project remains adaptable, allowing for the incorporation of emerging trends and innovations, ensuring that the use cases remain forward-looking and reflective of the dynamic nature of CCAM development. Ultimately, D3.3 aims to provide a solid foundation for understanding and preparing for the transformative impact of CCAM on jobs and education, ensuring that the workforce is equipped to thrive in the evolving landscape of mobility.

3. Identification of use cases from other projects

3.1. CCAM-related research and innovation projects

As part of our comprehensive exploration of Cooperative, Connected, and Automated Mobility (CCAM), we have identified and reviewed past and ongoing EU-funded projects that have developed CCAM use cases. This aims to synthesize the diverse approaches, insights, and outcomes from these projects, providing a robust foundation for understanding the potential impacts of CCAM solutions on future jobs, education, and societal dynamics. By examining these established use cases, we seek to draw valuable lessons and best practices that will inform our own development efforts. Other related CCAM projects: MODI, ORCHESTRA, i4Driving, MOVE2CCAM, AWARD (terminals and long-distance freight transport) and ULTIMO (urban and public transport). One of the main databases that were used for the identification of use cases was the FAME Knowledge Base that includes a data repository on CCAM-related research and innovation projects (https://www.connectedautomateddriving.eu/projects/findproject/).

3.1.1. MODI

MODI is a Horizon-EU-funded project that started on October 1st, 2022, and is expected to finish by March 31st, 2026. The overall objective of the project is to accelerate the introduction of CCAM vehicles for logistics through demonstrations and to overcome barriers to the roll-out of automated transport systems and solutions in logistics. The project focuses on the interaction between vehicles and logistics processes, traffic safety, security, optimal utilisation of infrastructure capacity and environment, and recommendations for the optimal design or adaptions of infrastructure and harmonised regulations to support automated transport. The project's initiative demonstrates what is needed to have automated freight transport on an entire corridor through five European countries.

The project is comprised of five use cases, each describing a part of the logistics supply chain. The project focuses on understanding and overcoming the regulatory barriers and infrastructure shortcomings on the motorway corridor for public roads. The confined areas are terminals located by Rotterdam, Hamburg, Gothenburg, and Moss ports. The terminals focus on challenges like access control, charging, loading/unloading and handover from public to confined areas, and drayage in mixed traffic between a terminal and local warehouse. In addition to the demonstrations, MODI provides sustainable business models for the logistics sector, demonstrating that CCAM vehicles can lead to greater profits, especially when driving in a coordinated way.

3.1.2. ORCHESTRA

ORCHESTRA is a Horizon-EU-funded project that started on December 1st, 2020, and finished on November 30th, 2024. The ORCHESTRA project established a common understanding of multimodal traffic management concepts and solutions, with and across modes, for various stakeholders and multiple contexts. It defined a Multimodal Traffic Management Ecosystem (MTME) where traffic management in different modes and areas (rural and urban) are coordinated to contribute to a more balanced and resilient transport system, bridging current barriers and silos. Support MTME realisation and deployments through the provision of tools, models, and guidelines – including support for connected and automated vehicles and vessels (CAVs).

The project aimed to provide European policymakers, public authorities, transport providers, and citizens with both new knowledge and technical and organisational solutions to enhance collaboration and synchronising of operations within and across transport modes, enhancing safety and reducing emissions. The project required insight and knowledge from a multidisciplinary perspective, from different transport domains, from diverse representatives, from transport operators and industry to policymakers, including citizens, communities, and scientists.

Therefore, to help the project achieve its goals and share the results, The project has engaged various Community of Practice Experts within their domain. The CoP is established to support and advise the project by participating in meetings, workshops, and interviews. Use cases on living labs took place in an airport (Malpensa, Italy) and an industrial area (Heroya, Norway).

3.1.3. i4Driving

i4Driving is a Horizon-EU-funded project that started on October 1st, 2022, and is expected to finish by September 30th, 2025. The vision of i4Driving is to lay the foundation for a new industry-standard methodology to establish a credible and realistic human road safety baseline for the virtual assessment of CCAM systems. The two central ideas proposed are a multi-level, modular and extendable simulation library that combines existing and new models for human driving behaviour in combination with an innovative cross-disciplinary methodology to account for the huge uncertainty in both human behaviours and use case circumstances.

This rigorous treatment of uncertainty is crucial to assessing how much of our confidence in model inputs, parameters, and structure is justified. It also explicitly explains how experts from different disciplines judge the outcomes and how justified the underlying assumptions really are. The consortium combines all the expertise needed to develop this methodology (e.g., traffic engineering, human factors, data, and computer science).

The experimental means to gather the evidence beyond the state-of-art needed to realistically simulate (near) accidents in multi-driver scenarios (access to many data sources, advanced driving simulators, and field labs). The project has a strong international network to collaborate with and harmonize our approach with academic and professional partners in, e.g., the US (NADS facility), Australia (UQ advanced driving simulator and TRACSLab connected driving simulator facilities), China (Tongji Univ. 8-of driving simulator and large-scale field lab) and Japan (NTSEL).

Finally, the project has all the relevant partners to be able to test and apply the methodology (Universities and research labs, OEMs and Tier 1, vehicle regulators, type-approval authorities, standardization institutes, and insurance companies). i4Driving is aimed to offer a proposition for the short and the longer term: a set of building blocks that pave the way for a driving license for CCAM.

3.1.4. AWARD

AWARD (terminals and long-distance freight transport) is a Horizon-EU-funded project that started on January 1st, 2021, and finished on June 30th, 2024. The final goal of AWARD was to enable an overall autonomous logistic chain through safe and efficient connected and automated heavy-duty vehicles in real logistics operations. The project envisions: a) innovation - contributed to accelerating the deployment of innovative connected and automated freight transport solutions in Europe; b) safety - increased the overall safety and efficiency of freight operations of individual trucks or fleets through innovative connected and automated driving systems; c) competitiveness - supported the uptake of new business models to introduce the automation of logistics operations and reduce their costs, which strengthens European competitiveness in the transport and logistics industries; d) replicability - evaluation of use cases, and a deep analysis of the current regulatory framework will feed some policy recommendations to replicate the pilots in other logistics operations. Further, the project developed and operated safe autonomous transportation systems in a wide range of real-life logistic use cases and scenarios.

The main objective of the project was to pave the way for the roll-out of driverless transportation in a wide variety of applications, whatever the weather conditions are. This is demonstrated by running a range of real-world hub-type missions, each with one or more autonomous driving fitted vehicles. The knowledge gained from these operations is designed to validate that the solution functions, scales and adds value for hub operator or fleets. The project contributed to a key step for a fully integrated freight management system. To achieve this goal, the following project objectives are defined: a) ensuring that the project's solutions will address logistics needs; b) developing a safe and scalable autonomous driving system able to manage harsh weather conditions, qualified for heavy-duty vehicles; c) improving efficiency of logistics operations with autonomous heavy-duty vehicles; d) performing innovative autonomous heavy-duty vehicles missions in real logistics operations, v) providing insights and recommendations on the standardisation and harmonisation of certification processes and type approval.

The main impact of this project is systemic. The processes and the various operations carried out throughout the global supply chain will change drastically. The progressive automation of loading/unloading operations and the introduction of autonomous vehicles will profoundly challenge many of the drivers of the supply chain ecosystem. Global climate issues justify accelerating this transition towards a massively automated supply chain. The COVID-19 crisis urges automated logistics not only to ensure the continuity of supplies but also to limit the risks of contamination. We should also add that this economic crisis highlights the urgent need to implement more resilient operations to face the structural constraints connected to the consequences of global warming and, above all, the growing scarcity of oil.

3.1.5. ULTIMO

ULTIMO (urban and public transport) is a Horizon-EU-funded project that started on October 1st, 2022, and is expected to finish by September 30th, 2026. The current transport sector finds itself at a crossroads regarding the deployment of automated vehicles (AVs). During the past few years, many projects and initiatives have tested and deployed AVs in public transport, but the large-scale roll-out of commercially viable automated shared fleets has yet to be realised. By taking a holistic approach to AV deployment that considers all elements in a cross-sector business environment, the project aims to truly unlock the integration of AVs into cities with on-demand and door-to-door services that will allow for more sustainable, accessible and inclusive mobility. The project builds on top of past experiences and projects, focused on tackling obstacles that are hindering large-scale AV uptake, including economic challenges.

The project has deployed AVs in three sites across Europe, each with multiple multi-vendor vehicles per site. The aim is to target the operation without a safety-driver on board, in fully automated mode and with the support of innovative user-centric passenger services. Innovative transportation models are designed for a long-term sustainable impact on automated transportation in Europe, around the globe and on society. The composition of the project ensures the interoperability between multiple stakeholders by making the adoption of new technology at minimum costs and maximum safety, while the integration of the ongoing experiments of previous AV-demonstrator projects ensures the highest possible technical and societal impacts from the very beginning of the project – and even long after its completion.

The project is centered around eight main objectives, which are: a) validate integrated shared CCAM systems and services for people and goods across Europe; b) develop open-source application programming interfaces (APIs) for seamless integration of vehicles and fleet management into MaaS and LaaS systems; c) reach large-scale, multivendor deployments in all sites, using the most adapted vehicle for each transport use case; d) set the basis for a common and reusable model for High-Definition (HD) maps; e) provide automated passenger services for safety and service quality; f) develop and validate cross-sectoral business models; g) improve interaction with road users and infrastructure for improved safety and h) realistic, long-term transition planning design for the deployment of AVs in MaaS and LaaS.

3.1.6. Move2CCAM

Move2CCAM (MethOds and tools for comprehensive impact Assessment of CCAM solutions for passengers and goods) is a Horizon-EU-funded project that started on September 1st, 2022, and is expected to finish by June 30th, 2025. The primary objective of the project is to develop well-rounded, detailed use cases that not only provide valuable insights into the impact of CCAM on future jobs and education but also guide further research and development activities within the project. This ensured a comprehensive and collaborative approach involving key stakeholders and partners. Furthermore, the project explores and understands the implications and impacts of integrating CCAM solutions into the mobility system. This includes passenger and freight solutions, defining use cases, business models, and key performance indicators (KPIs) through co-creation activities, and developing a practical impact assessment tool. The framework of the impact assessment tool defines the structure and components of a sophisticated software platform designed to assess the potential impacts of various CCAM interventions, policies, and projects. The tool developed within the project evaluates impacts across multiple domains, including mobility, human health, land use, environment, economy, equity, safety, and network efficiency. By systematically integrating these dimensions, the tool provides a comprehensive, data-driven approach to assessing the potential benefits and challenges of CCAM adoption in diverse regional contexts.

A distinctive feature of the tool is its application in three prototypical regions across Europe, which also serve as the demonstration sites where the co-creation activities have taken place: Helmond (Netherlands), GZM (Poland), and the North Aegean Islands (Greece). These regions serve as 'testbeds' that collectively represent a microcosm of the European Union's transportation challenges and opportunities. Helmond, a medium-sized city with advanced cycling infrastructure and regional interconnectivity, exemplifies a progressive approach to CCAM adoption through Smart Mobility Living Labs and ongoing AV demonstrations. The region's focus on enhancing mass transit accessibility and last-mile logistics aligns well with the tool's goal of assessing CCAM's integration within existing sustainable mobility frameworks. GZM, in contrast, is a large Polish metropolitan area encompassing densely populated urban centres like Katowice alongside peri-urban and regional areas that rely heavily on private vehicles. Given its high levels of economic activity and corresponding transport-related emissions, the region presents a compelling case for evaluating CCAM's role in reducing congestion and environmental impact. GZM's early-stage exploration of CCAM solutions, such as automated drone deliveries, underscores the need for structured assessment methodologies like the tool to guide strategic decision-making and policy development. The North Aegean Islands introduce yet another unique perspective by offering a geographically dispersed, low-economic-activity environment with significant social challenges, including the presence of ethnic minorities and vulnerable populations, particularly in Lesvos. Unlike the other two regions, which focus on efficiency and sustainability in dense urban settings, the North Aegean Islands highlight the role of CCAM in improving accessibility and inclusivity for underserved populations. By analysing mobility patterns among diverse demographic groups -including women, disabled individuals, and low-income residents - the tool's framework ensures that CCAM solutions are evaluated not only for technological feasibility but also for their social equity implications. This multi-regional application provides a nuanced, well-rounded representation of how CCAM can function across Europe's varied mobility landscapes.

3.2. CCAM-related use cases

Building upon the foundational desk-based review of past and ongoing EU-funded CCAM projects discussed in the previous section, this section delves into a focused analysis of selected use cases that exemplify the diverse applications and impacts of CCAM. These use cases, drawn from initiatives like past and ongoing CCAM-related research and innovation projects, represent a spectrum of CCAM deployments, ranging from urban public transport to long-distance freight logistics. By examining these concrete examples, the aim is to shed light on the practical implications of CCAM technologies and extract key insights. The selection process prioritized use cases that offer clear, tangible outcomes and demonstrate innovative approaches to addressing real-world mobility challenges. Through a discussion of these use cases, a contextual framework for understanding the broader societal dynamics influenced by CCAM is developed that sets the stage for subsequent analysis and development within the CCAM-ERAS project.

3.2.1. MODI use cases

A total of five freight transportation use cases (UC) were identified within MODI that are described below.

1. UC Netherlands - Port Operations

Description: This use case focuses on the use of a mix of manually driven trucks and Level 4 (L4) automated vehicles at a port terminal in Rotterdam, involving drayage operations from the terminal to a nearby warehouse via public roads. The L4 trucks operate autonomously within the terminal but in manual mode on public roads.

2. UC Germany - Transition from Motorway to Confined Area

Description: The focus is on transitioning automated trucks from motorways to confined industrial areas, passing through busy urban roads in Hamburg. This includes driving through mixed traffic environments and utilising C-ITS services for efficient and safe interaction with other road users.

3. UC Sweden - Access Control, Loading/Unloading, and Charging

Description: This use case focuses on hub-to-hub transport on public roads, also including automated access control, loading/unloading operations, and charging for L4 trucks at a logistics hub in Gothenburg. The aim is to demonstrate seamless operations of automated vehicles on public roads and in a controlled environment.

4. UC Norway - Port Traffic, Public Roads, and Border Crossing

Description: This use case explores the automation of freight transport from the Swedish border, across public roads, to the port of Moss in Norway. It involves crossing national borders and integrating automated operations with customs processes and handling different traffic situations with perception technologies and V2X communication.

5. UC CCAM Test Corridor

Description: This use case involves the assessment of the readiness of L4 automated driving along the logistics corridor from Rotterdam to Oslo. The focus is on identifying critical pain points and infrastructure requirements along the corridor.

Table 1 focuses on logistics and transportation improvements through automated vehicles. The impacts are primarily centred on cost reduction, operational efficiency, traffic flow enhancement, and improved cross-border transport. The use of L4 automation is expected to streamline logistics operations, especially in complex environments like ports, urban areas, and cross-border regions.

Table 1: MODI use cases

Use Case Name	Description	Primary Actors	Secondary Actors	Impact
UC Netherlands - Port Operations	Mix of manually driven trucks and L4 automated vehicles for drayage operations from a port to a nearby warehouse.	L4-enabled trucks, manual trucks	MODI coordination system, Port terminal operators	Reduced operational costs, increased logistics efficiency, lower emissions, safety improvements.
UC Germany - Transition from Motorway to Confined Area	Transition of L4 automated trucks from motorways to industrial/urban areas in Hamburg with mixed traffic.	L4-enabled trucks	Urban and port infrastructure, Traffic management systems	Improved traffic flow, better integration of automated vehicles in urban settings.
UC Sweden – Hub-to-hub transport	Hub-to-hub on public roads, including automated access control, loading/unloading, and charging operations at a logistics hub in Gothenburg.	L4-enabled trucks	Logistics hub infrastructure, Charging stations, Warehouse operators	Reduced turnaround times at hubs, enhanced operational safety, improved logistics handling.
UC Norway - Port Traffic, Public Roads, Border Crossing	Automated transport from the Swedish border to Moss port in Norway, integrating with customs processes	L4-enabled trucks	Customs authorities, Border control systems, Public road infrastructure	Improved cross-border efficiency, reduced wait times, better customs compliance.

UC CCAM Test Corridor	Assessment of L4 automated driving along a logistics corridor from Rotterdam to Oslo, identifying infrastructure needs.	L4-enabled trucks	Corridor infrastructure, Traffic management systems, National road operators	Faster adoption of L4 vehicles, identification of infrastructure gaps.

3.2.2. ORCHESTRA use cases

A total of six use cases (UC) were identified within ORCHESTRA that are described below.

1. Multimodal Traffic Orchestration
    - Description: This use case involves the orchestration of multimodal traffic to optimize the utilization of transport networks. It includes coordination across different modes of transport (e.g., road, rail, water, air) to ensure efficient and resilient traffic management, particularly in urban and rural settings.
2. Demand Capacity Balancing
    - Description: This use case focuses on balancing the demand for transport with the available network capacity. It involves dynamic adjustments in real-time to prevent congestion and ensure smooth traffic flow across multiple transport modes.
3. Critical Zone Management
    - Description: This use case involves managing zones within the transport network that are identified as critical due to high demand or limited capacity. The objective is to prevent traffic bottlenecks and enhance safety by implementing measures such as access control, priority management, and dynamic pricing.
4. Cross-Mode Traffic Coordination
    - Description: This use case focuses on the coordination of traffic across different modes of transport to handle disruptions or optimize traffic flows. It includes re-routing traffic across different modes (e.g., shifting from road to rail) when necessary to maintain network efficiency.
5. Automated Decision Support for Traffic Management
    - Description: This use case explores the use of automated systems to support decision-making in traffic management. It involves the integration of data from various sources (e.g., sensors, real-time traffic data) to predict traffic patterns and recommend actions for traffic orchestration.
6. Resilient Traffic Orchestration
    - Description: This use case deals with ensuring the resilience of traffic management systems against unexpected events such as accidents or natural disasters. It includes anticipatory

planning, real-time monitoring, and adaptive response strategies to maintain transport network functionality.

These use cases are integral to developing a comprehensive multimodal traffic management system that can handle the complexities of modern transport networks. They involve a combination of real-time data management, cross-modal coordination, and resilience planning to achieve a balanced and efficient transport system. Table 2 covers use cases focused on improving multimodal traffic management through orchestration and automation. The cases emphasize balancing demand and capacity, managing critical traffic zones, coordinating across different transport modes, and using automated decision-making tools. The ultimate goal is to create a resilient and efficient transport network that can handle disruptions and optimize traffic flow across various modes of transport.

Table 2: ORCHESTRA use cases

Use Case Name	Description	Primary Actors	Secondary Actors	Impact
Multimodal Traffic Orchestration	Orchestrating multimodal traffic across road, rail, water, and air to optimize network utilization.	Traffic Orchestrator, Transport Providers	Fleet Operators, Network Users, Transport Authorities	Reduced congestion, optimized transport network utilization, improved traffic flow across modes.
Demand Capacity Balancing	Balancing transport demand with available network capacity in real-time to prevent congestion.	Traffic Orchestrator	Network Users, Transport Service Providers, Infrastructure Managers	Prevents traffic bottlenecks, ensures efficient use of available capacity, improves network resilience.
Critical Zone Management	Managing critical transport zones to prevent bottlenecks and ensure safety through dynamic control.	Traffic Orchestrator	Fleet Operators, Local Authorities, Network Users	Increased safety in high-demand zones, reduced traffic congestion, smoother transport flows.
Cross-Mode Traffic Coordination	Coordinating traffic across multiple modes to handle disruptions and optimize flow.	Traffic Orchestrator	Transport Service Providers, Infrastructure Operators, Emergency Services	Reduced impact of disruptions, enhanced resilience in multimodal networks, improved coordination.
Automated Decision Support for	Using automated systems to support traffic	Traffic Orchestrator	Data Analysts, IT Systems,	Faster, more informed decision-making, reduced traffic incidents,

Traffic Management	management decisions by analysing real-time data and predicting patterns.		Transport Operators	enhanced network efficiency.
Resilient Traffic Orchestration	Ensuring transport system resilience in response to unexpected events like accidents or natural disasters.	Traffic Orchestrator	Emergency Services, Infrastructure Managers, Local Authorities	Increased resilience to disruptions, faster recovery from incidents, improved public safety.

3.2.3. i4Driving use cases

A total of seven use cases (UC) were identified within i4Driving that are described below.

1. Driving Simulator Analysis
    - Description: This use case involves analysing human driving behaviour in complex manoeuvres at high speeds within a safe, simulated environment.
2. Test Track Low-Speed Analysis
    - Description: This use case involves analysing human driving behaviour at low speeds in real-world scenarios on test tracks.
3. Inspector Assessment for ADS Safety
    - Description: An inspector from a technical service or certification department assesses whether an Automated Driving System (ADS) behaves as safely as a human driver, follows local traffic rules, and ensures smooth traffic flow.
4. Combination of Human and Vehicle Behaviour Models
    - Description: This use case focuses on integrating models of specific driving manoeuvres observed at the vehicle level with human driver behaviour to enhance public confidence in ADS systems.
5. MiRA Incorporation into Traffic Modelling
    - Description: The Minimum Required Attention (MiRA) is incorporated into traffic modelling, focusing on interactions with Vulnerable Road Users (VRUs) such as pedestrians, cyclists, and e-scooters.
6. V2X Communication vs. Human Driving Behaviour
    - Description: This use case involves analysing the potential of Vehicle-to-Everything (V2X) communication against human driving behaviour, especially in urban scenarios.

7. Insurance Scenario-Based Accident Analysis
    - Description: This use case involves calculating accident frequencies for human drivers and comparing them with Autonomous Drivers (ADS), focusing on mixed-driving environments and accident severity mitigation.

Table 3 focuses on evaluating human and automated driving behaviours to enhance the safety and performance of Automated Driving Systems (ADS). Key impacts include improved safety protocols, trust in ADS, traffic coordination, and optimized insurance frameworks.

Table 3: i4Driving use cases

Use Case Name	Description	Primary Actors	Secondary Actors	Impact
Driving Simulator Analysis	Analysis of human driving behaviour in complex, high-speed manoeuvres within a safe simulation environment.	Human drivers	Driving simulator systems, data analysts	Improved understanding of high-speed driving, enhanced ADS design, safer manoeuvres.
Test Track Low-Speed Analysis	Analysis of low-speed human driving behaviour in real-world test track scenarios.	Human drivers	Test track operators, data recording systems	Improved low-speed safety protocols, better incorporation of human behaviour into ADS.
Inspector Assessment for ADS Safety	An inspector evaluates if Automated Driving Systems (ADS) behave as safely as human drivers.	Inspector, ADS system	Local traffic management systems, certification bodies	Increased trust in ADS safety, enhanced regulatory standards for ADS.
Human and Vehicle Behaviour Combination	Combines models of specific driving manoeuvres and human behaviour for improved ADS integration.	Human drivers, ADS systems	Researchers, public road users	Improved ADS prediction of human behaviour, smoother transitions between human and automated driving.
V2X Communication vs. Human Driving	Analyse V2X communication compared to human driving, particularly in urban settings.	Human drivers, V2X-equipped vehicles	Urban traffic infrastructure, V2X communication systems	Reduced congestion, better traffic coordination, increased safety in

				urban environments.
Insurance Scenario-Based Accident Analysis	Accident frequency and severity comparison between human drivers and ADS in mixed driving environments.	Insurance companies, ADS systems	Human drivers, traffic data analysis tools	Lower accident rates, better insurance policies for ADS, reduced legal and liability concerns.

3.2.4. AWARD use cases

A total of four freight transportation use cases (UC) were identified within AWARD that are described below.

1. Loading and Transport with Automated Forklift

- Description: This use case focuses on the highly automated movement of lattice boxes with forklifts, both indoors and outdoors. The operation involves handling and transporting goods within a controlled environment, requiring both the automation of the movement and the loading processes.

2. Hub-to-Hub Shuttle Service

- Description: This use case involves the highly automated transport of lattice boxes between two hubs, which includes traversing public roads as well as restricted areas. The scenario focuses on long-distance shuttle services that leverage automation to enhance efficiency.

3. Automated Baggage Tractor on an Airport

- Description: This use case focuses on highly automated airside baggage transport operations at an airport. It involves indoor and outdoor movements, including operations in hangars, tunnels, and service roads, requiring precision and safety in a busy airport environment.

4. Trailer Transfer Operations and Automated Ship Loading in a Port

- Description: This use case deals with the automation of trailer movements in a port setting. The focus is on optimizing the transfer of trailers to ships, involving precise manoeuvring and integration with port logistics systems.

Each of these use cases involves specific challenges related to the operational environment, such as interactions with other vehicles, human operators, and infrastructure. The requirements for these use cases are geared toward ensuring safety, reliability, and efficiency in real-world logistics operations under various conditions, including adverse weather and mixed-traffic scenarios.

Table 3 presents use cases related to the AWARD project, primarily focused on automation in logistics and transport operations. The cases include the use of automated forklifts for warehouse transport, hub-to-hub shuttle services across public and restricted roads, automated baggage transport in airports, and the automation of trailer transfer operations in ports. Each case highlights the potential for improving operational efficiency through automation.

Table 4: AWARD use cases

Use Case Name	Description	Primary Actors	Secondary Actors	Impact
Loading and Transport with Automated Forklift	Automated movement of lattice boxes using forklifts, for both indoor and outdoor operations.	Automated forklifts	Warehouse operators, Fleet Management System (FMS)	Increased warehouse efficiency, reduced labour costs, improved safety in material handling operations.
Hub-to-Hub Shuttle Service	Automated shuttle service between two hubs, including travel on public roads and restricted areas.	Automated heavy-duty vehicles	Logistics hub operators, Fleet Management System (FMS), Road traffic systems	Reduced operational costs, increased transport reliability, better coordination between logistics hubs.
Automated Baggage Tractor at Airport	Automated baggage transport operations at an airport, including indoor and outdoor movements.	Automated baggage tractors	Airport logistics staff, Fleet Management System (FMS)	Faster baggage handling, reduced human error, improved operational efficiency and on-time departures.
Trailer Transfer Operations and Automated Ship Loading	Automation of trailer transfer operations within a port, including integration with ship loading systems.	Automated trailer-moving vehicles	Port operators, Fleet Management System (FMS), Ship loading systems	Enhanced port efficiency, reduced turnaround times, improved coordination between land and sea transport.

3.2.5. ULTIMO use cases

A total of five passenger transportation use cases (UC) were identified within ULTIMO that are described below.

1. Door-to-Door Public Transport for Persons with Disabilities
    - Description: This use case focuses on providing door-to-door public transport services using automated vehicles tailored for persons with disabilities, particularly those with mobility impairments. The aim is to enhance accessibility by ensuring that AVs are equipped with necessary features such as automatic ramps, secure wheelchair spaces, and user-friendly interfaces that can be operated independently by persons with disabilities.

2. On-Demand Automated Shuttles for Rural Areas
   - Description: This use case involves the deployment of on-demand automated shuttles in rural areas where conventional public transport is sparse or unavailable. The objective is to provide reliable, flexible, and accessible transport options for rural residents, including those with reduced mobility or other special needs.
3. Fully Accessible Automated Minibuses in Urban Settings
   - Description: This use case addresses the integration of fully accessible automated minibuses into urban public transportation networks. The focus is on ensuring these vehicles can accommodate passengers with a variety of needs, including those who are visually or hearing impaired. The minibuses will include features like tactile and audible notifications, braille signage, and real-time communication with public transport systems.
4. Multimodal Transport Integration for All Users
   - Description: This use case focuses on the seamless integration of automated vehicles with other modes of transport (e.g., trains, buses, bicycles) to create a multimodal transport network that is inclusive and accessible to all users, including those with disabilities. The goal is to ensure that the transition between different modes of transport is smooth and user-friendly, with minimal physical or cognitive barriers.
5. Co-Created Transport Solutions with Citizens
   - Description: This use case involves the active engagement of citizens, particularly those from vulnerable or underrepresented groups, in the co-creation of transport services. The process includes workshops, hackathons, and interviews to gather insights and develop solutions that meet the real-world needs of all users, ensuring that the services are designed with inclusivity at their core.

Table 5 focuses on enhancing accessibility and inclusion in public transport by automating services and co-creating solutions with citizens. The impact is increased independence for disabled users, improved mobility in rural and urban areas, and better integration of automated vehicles into multimodal networks.

Table 5: ULTIMO use cases

Use Case Name	Description	Primary Actors	Secondary Actors	Impact
Door-to-Door Public Transport for Persons with Disabilities	Provides door-to-door transport using AVs tailored for persons with disabilities, equipped with features like automatic ramps and secure wheelchair spaces.	Persons with Disabilities (PWDs)	Automated Vehicle (AV) Systems, Public Transport Operators (PTOs)	Increased resilience to disruptions, faster recovery from incidents, improved public safety.

On-Demand Automated Shuttles for Rural Areas	Deployment of on-demand AV shuttles in rural areas where conventional transport is sparse, offering flexible and accessible options for residents.	Rural Residents, including elderly and persons with reduced mobility	Public Transport Operators, Local Authorities, Fleet Management Systems	Improved rural mobility, better access to services for underserved communities, reduced isolation.
Fully Accessible Automated Minibuses in Urban Settings	Integration of accessible automated minibuses into urban networks, accommodating passengers with sensory impairments through features like tactile and audible notifications.	Urban Commuters, including individuals with sensory impairments	Automated Minibus Fleet, City Transport Authorities	Improved urban mobility, enhanced independence for impaired users, better integration into public transport.
Multimodal Transport Integration for All Users	Seamless integration of AVs with other transport modes to create an inclusive multimodal network, minimizing barriers for all users.	General Public, including individuals with special needs	Transport Service Providers, Public Transport Operators, Urban Planners	Better multimodal connectivity, smoother transitions between transport modes, enhanced accessibility.
Co-Created Transport Solutions with Citizens	Active engagement of citizens, especially vulnerable groups, in co-creating transport services through workshops and hackathons to ensure inclusivity.	Citizens, including vulnerable groups (e.g., elderly, disabled, economically disadvantaged)	Public Transport Operators, Urban Planners, Technology Providers	More user-centric transport solutions, improved public engagement, better representation of user needs.

3.2.6. Move2CCAM

A total of three passenger transportation and seven freight transportation use cases (UC) were identified within Move2CCAM that are described below.

1. Passenger transportation
    a. Self-driving cars
    b. Self-driving taxis/pods
    c. Self-driving bus and minibus

2. Freight transportation
    a. Delivery drones (general goods)
    b. Delivery drones (exclusively for medicines)
    c. Delivery bots/pods
    d. Delivery vans
    e. Long-distance haul
    f. Passenger transportation for mobility-impaired people and hospital transportation
    g. Garbage collection

The Move2CCAM use cases were identified using co-creation activities with individuals (citizens) and stakeholders (organizations) in the eight participating countries (CY, DE, ES, FR, GR, NL, PL, UK). Each use case was classified using the characteristics listed below.

- Ownership
- Location served
- Distances covered
- Type of service
- Vehicle type
- Vehicle size
- 'Comfort' Vehicle inside (space and seat configuration)
- Provision for people with mobility restrictions
- Energy
- Main users
- Trip purpose
- Frequency
- Parking
- Time of day
- Surveillance
- Maintenance service
- Payment
- Services

Particularly, the use cases are summarized in Table 6 - 17 below, where each table comprised of a different use case.

Table 6: Self-driving cars

	CY Description	GR Description	PL Description
Scenario name	self-driving	self-driving	self-driving streetcar with bike/baggage transport
Individual/family or collective use	individual/family	individual/family	land/rail
Ownership	private	private	autonomous streetcar
Locations served	anywhere	anywhere	city centre
Distances covered	short-medium-long	Short	collective
Type of service	always available (private)	always available (private)	private/public
Vehicle type	private vehicles	private vehicles	on planned root
Vehicle size	4-5 people	4-5 people	urban
'Comfort'': Vehicle inside (space and seat configuration)	ample legroom; extra space for shopping bags	ample legroom; extra space for shopping bags	medium/long
Provision for people with mobility restrictions	space for mobility aids	space for mobility aids	scheduled
Energy	electric, ICEVs	electric, ICEVs	large
Main users	anyone; people with disabilities or mobility-impaired	anyone; people with disabilities or mobility-impaired	bicycles/baggage (with passengers on board)
Trip purpose	shopping/doctor's appointment	shopping/doctor's appointment	citizens
Frequency	always available (private)	always available (private)	citizens
Parking	residence, off-site parking locations	residence, off-site parking locations	scheduled
Time of day	any time (private)	any time (private)	all day
Surveillance	CCTV	CCTV	
Escort	cheaper than ICEV	cheaper than ICEV	
Price	N/A	N/A	

Table 6 consists of the different settings identified for the self-driving car use case. It can be concluded that self-driving cars tend to be for individual use and ownership. It was also found that self-driving cars are intended for short-distance trips in some countries (GR, CY), whereas in others (PL), they can also cover long-distance trips. In all countries was proposed electric cars with maximum capacity 4 to 5 people and ample legroom or extra space for shopping bags. The autonomous car should be used for everyone or by people with disabilities or mobility impaired.

Table 7: Self-driving taxis/pods

	CY Description	NL Description	DE Description	GR Description
Scenario name	self-driving taxis/pods	self-driving taxi	self-driving e-hailing	self-driving taxi
Individual/family or collective use	collective	individual or shared use	individual	collective
Ownership	transportation network companies (TNC)	private organization	service	private
Locations served	anywhere	door to door	anywhere up to 10km, depending on service coverage	n/a
Distances covered	short-medium (taxi service)	short and medium, up to 15 km	depending on service coverage	n/a
Type of service	scheduled; online payment	individual or shared use	on-Demand	n/a
Vehicle type	private vehicles	car	AV electric car	taxi pod
Vehicle size	3-4 passengers	small, 2-4 passengers	small (4 passengers)	small
'Comfort'': Vehicle inside (space and seat configuration)	ample legroom; extra space for shopping bags	enough leg space, noise cancelling, place to work	extra space for luggage	n/a
Provision for people with mobility restrictions	space for mobility aids	N/A	integrated ramp for wheelchair	n/a
Energy	electric	Electric	electric	n/a
Main users	anyone; people with mobility problems; elderly; people who do not own a vehicle; tourists	individuals/families	all citizens	citizens

Trip purpose	any trip purpose; doctor's appointment; deliver groceries/medicines; from/to airport	N/A	door-to-door transportation	transport
Frequency	on demand	always available	always available	daily
Parking	service always running	N/A	no parking needed	n/a
Time of day	as needed	any time	anytime	n/a
Surveillance	human attendant inside	N/A	CCTV	n/a

Table 7 consists of the different settings identified for the self-driving taxi/pods use case. It can be concluded that the self-driving taxi/pods tend to be both collective an individual instead of self-driving cars which had individual ownership. Regarding the served location were proposed different location depends on the survey area as anywhere, door to door or anywhere up to 10km, depending on service coverage. The type of service differs depending the survey area from scheduled, online payment, Individual or shared use to on demand. In all countries small electric cars were proposed with maximum capacity 2 to 4 people and ample legroom or extra space for shopping bags or luggage. All the vehicles should have provision for people with mobility restrictions such as Integrated ramp for wheelchair or space for mobility aids. Also, the self-driving taxis/pods should be used by everyone, any time of the day, on demand or always available for door-to-door transportation or for any purpose like doctor's appointment; deliver groceries/medicines; from/to airport etc. At the end the transportation should be supervised by a human or by CCTV.

Table 8: Self-driving buses

	CY Description	**DE Description**	**FR Description**	**GR Description**	**UK Description**
Scenario name	self-driving bus	self-driving shuttle bus to train station	rural to urban self-driving shuttle/Bus	self-driving bus	self-driving bus
Individual/family or collective use	collective	collective	collective	collective	collective
Ownership	TNC or part of public transportation fleet	public	regional public transport	public	public

Locations served	urban areas	suburbs and rural areas to closest train station	cities	within the city	local area, less than two-hour journeys, connecting towns and rural areas to train stations and bigger cities
Distances covered	short-medium (door-to-door service)	up to 5km to main train/bus station	10Km to 50Km	short	relatively short/mediu m distances, up to two-hour drive
Type of service	specific service hours; online payment	on-Demand	scheduled	scheduled	scheduled but with more routes and stops than current services
Vehicle type	mini-bus, shuttlebus	AV Shuttle Bus	bus/shuttle/convo y pods	autonomo us bus	bus
Vehicle size	up to 10 passengers	medium (10-15 passenger s)	medium	n/a	similar to current UK local buses (27-40 passengers)
'Comfort'': Vehicle inside (space and seat configuration)	ample space for mobility-impaired people	space for wheelchair s and baby carts	extra space shopping bags & Bikes	n/a	not mentioned
Provision for people with mobility restrictions	ramps for boarding/alighti ng	integrated ramp for wheelchair	space for wheelchairs/mobil ity aids	ramps	yes, particularly elderly with mobility issues and less likely to be able to drive themselves

Energy	electric	electric	electric	n/a	not mentioned
Main users	anyone; people without any other means of transportation; children; elderly	all citizens	all citizens	n/a	people from areas that are less well connected, elderly, people without a driving license, people travelling at less sociable hours e.g. airport or returning from night out
Trip purpose	any trip purpose; medical appointments; school trips	commuting and leisure	work, leisure, study, shopping, services, tourism	transport of workers & citizens	wide range of purposes but could particularly alleviate non-drivers' reliance on taxis for short journeys in rural areas
Frequency	on demand (door-to-door service)	very regular (every 10 to 15 minutes)	regular	regular	regular and 24 hours, with more frequent and reliable routes than current public transport by bus in certain areas
Parking	bus stops (<1 min); bus depot	service always running	at access points	n/a	service will be

	(long duration parking)	during the day			constantly running
Time of day	scheduled	any time	daytime	daytime	anytime
Surveillance	human attendant inside	cctv	video	human	not mentioned
Payment					payment through card on the bus, low fares, with some sort of gate/barrier to prevent fare evasion
Escort	more expensive than traditional bus service; free service for certain groups				
Price	Yes				

Table 8 consists of the different settings identified for the self-driving bus use case. It can be concluded that self-driving buses tend to be part of public transportation fleet and could serve in urban/suburban areas. They could cover every distance from short distance (door to door service) up to 50km. Regarding the type of service most of the participants were proposed to be scheduled and some to be on demand with online payment method. All the vehicles should be small, electric with capacity up to 15 passengers with ample legroom or extra space for shopping bags or luggage, space for wheelchairs and baby carts, ramps for elderly with mobility issues, who are less likely to be able to drive themselves and also have provision for people with mobility issues such as ramps for boarding/alighting. This service should be available for everyone with regular trips, including on demand transportation. At the end the self-driving buses should be supervised by a human or CCTV.

Table 9: Self-driving minibuses

	PL Description	**NL Description**	**NL Description**	**SP Description**
Scenario name	self-driving minibus. last mile transport	mini-bus	mini-bus for mobility-restricted users and disabled people	city scheduled route with flexible stops. mini-van sharing
Individual/family or collective use	collective	collective use	collective use	collective

Ownership	public/private	public organization	public organization	outsourced private service
Locations served	to transfer centres, areas with low population density	hub to work / home	door to door	anywhere along the scheduled route
Distances covered	up to 200 km	<3 km	short and medium, up to 15 km	routes from 5 to 15 km
Type of service	scheduled/on demand	scheduled	always available (collective)	scheduled frequency every 15’
Vehicle type	minibus	minibus	minibus	mini van
Vehicle size	10-20 passengers	medium to large, 9-20 persons. less spaces when wheelchair gets in.	medium, max. 12 people	small (4 – 6 passengers)
‘Comfort’’: Vehicle inside (space and seat configuration)	space for baggage	easy to get in and out, at least 2 entrances.	easy to get in and out	extra space for shopping bags
Provision for people with mobility restrictions	n/a	space for wheelchair	space for multiple wheelchairs	space for wheelchairs and mobility aids
Energy	electric	electric	electric, charged during travel	Electric
Main users	citizens	commuters	elderly and people with a disability	all ages, inside the city and town
Trip purpose	daily travel	n/a	n/a	all types: working, shopping, leisure…
Frequency	on demand	regular	always available	24/7, scheduled by local administration. ideally every 15’
Parking		n/a	n/a	don´t need park, only stops for raising and

				lowering passengers
Time of day	on demand	daytime	daytime	all day
Surveillance	n/a	direct contact possible with emergency services	direct contact possible with emergency services	CCTV and GPS system
Maintenance service				outsourced private service
Payment				credit card, app. travel card, cash, subscription

Table 9 consists of the different settings identified for the use case of self-driving minibuses. It can be concluded that self-driving minibuses tend to be part of public organization or an outsources private service. They have to cover every distance from short distance (less than 5 kms) up to 200km. Regarding the type of service most of the participants were proposed to be scheduled (frequency every 15minutes) and some to be on demand. All the vehicles should be small, electric with capacity up to 20 passengers. This service should be available for everyone, especially for elderly and people with a disability, including on demand transportation, for all purposes.

Table 10: Self-driving pods

	SP Description	FR Description	NL Description
Scenario name	uni-personal pod sharing	residential taxi/pods	self-driving pod
Individual/family or collective use	individual	individual	individual/family
Ownership	provided by private company	local administration	private
Locations served	anywhere up to 10 km	cities	door to door
Distances covered	up to 10 km	10km around home or care residence	all distances, including long travels
Type of service	on demand	always available or scheduled	shared vehicle, privately owned
Vehicle type	pod	cars/pods	pod, possibility to platooning
Vehicle size	small (1 passenger)	small	small, 2-4 passengers
'Comfort'': Vehicle inside	extra space for working or shopping bags	space for bags	good view

(space and seat configuration)			
Provision for people with mobility restrictions	1 each 10 pod is adapted. selected by call	space for wheelchairs/mobility aids	n/a
Energy	electric	electric	electric (one use case mentioned hydrogen)
Main users	all ages, inside the city	people not autonomous (senior, kids, disabled, patients)	individuals/families
Trip purpose	all types: working, shopping, leisure	services/care/social activities/leisure/sport	n/a
Frequency	always available	can be ordered or scheduled	always available, but shared use
Parking	pod-only parking spaces in city centre and shopping/leisure areas	n/a	designated parking spaces, like valet parking
Time of day	all day	daytime	any time
Surveillance	CCTV and GPS system	video	n/a
Maintenance service	provided by private company		
Payment	credit card, app, subscription		

Table 10 consists of the different settings identified for the self-driving pods use case. It can be concluded that self-driving pods tend to be part of private company's fleet or local administrator. They have to cover every distance from short distance (door to door service) up to 10km inside the cities. Regarding the type of service was proposed to be scheduled on demand and the vehicles should be small up to 4 passengers of all ages with main use inside the city. Also, the self-driving pods should be used by everyone, any time of the day, on demand or always available for door-to-door transportation or for any purpose like Services/Care/Social activities/Leisure/Sport etc. At the end the transportation should be supervised by a human or by CCTV and GPS system.

Table 11: Delivery drones (general goods)

	CY_f1 Description	**GR_f1 Description**	**GR_f2 Description**	**FR_f1 Description**	**GR_p2 Descriptio n**

Scenario name	delivery drones	delivery drones	delivery drones	homecare delivery drones	delivery drones
Air vs land	air	n/a	collective use	air	individual
Type of vehicle	flying drones	delivery bot/drone	within the village/rural area	drones	private
Type of area	urban	n/a	rural	rural	anywhere around lesvos
Used by single company or collective use	collective	collective use	collective use	collective use	long
Ownership	owned by delivery companies	private	government	homecare operators	on demand
Locations served	cbd in urban areas	all locations of the city especially hospitals		rural or remote geographies	drone
Coverage	within a city	city	a village	10-30km around service points (homecare/healthcare)	n/a
Distances covered	short	medium up to 40km	short/within the village	short/medium	n/a
Type of service	on demand	on demand	on demand	on demand	n/a
Vehicle size	small	n/a	small	small	n/a
Type of products delivered	products/goods	it will be used for the delivery of small parcels, documents, medical material inside a hospital, or for the delivery of food and beverages in close	medicine	food/medicines/care products	

		destinations of small distance.			
Main users (senders)	companies	delivery companies/courier, employees from the public sector, medical staff, restaurants/cafes, etc	municipality of western Lesvos	Homecare	private courier companies, people with mobility problems, people that are in a case of emergency
Main users (receivers)	individuals in cbd areas	individuals or organizations	individuals with special needs/mobility issues	senior/disabled/patients	
Frequency	on demand	on demand	on demand	when needed	daily
Time of day	as needed	24/7 all week	n/a	as needed	24/7

Table 11 contains the different settings identified for the delivery drones use case. Delivery drones tend to be flying drones which can make deliveries in urban and rural areas or across small islands. The use of drones should be collective and not owned by a single company. The ownership differs depending on the country, from owning at a delivery company, being owned by the government to private or owned by the service provider operator. They must be able to provide services at all locations, urban and rural areas, especially at hospitals inside cities. The drones have to be able to deliver products/goods/food, medicines and also some of them should be able to be used for the delivery of small parcels, documents, and medical material inside a hospital or for the delivery of food and beverages in close destinations of small distance. Primary users (senders) could be delivery companies/couriers, employees from the public sector, medical staff, restaurants/cafes, municipalities, homecare services, private courier companies, people with mobility problems or are in case of emergency. Also, the primary users (receivers) should be individuals in CBD areas, organizations, individuals with special needs/mobility issues or Senior/Disabled/Patients. In the end, transportation should be available 24/7.

Table 12: Delivery drones (exclusively for medicines)

	PL_f1 Description	**PL_f2 Description**	**DE_f2 Description**	**SP_f4 Description**
Scenario name	drones for medicine delivery	a drone to deliver drugs	drone medicine delivery	drones for medicine delivery

		ordered online (e-prescription)		
Air vs land	air	air	air	air
Type of vehicle	drones for medicine delivery	drones for medicine delivery	autonomous drone	drones
Type of area	urban/rural	urban/rural	suburbs and rural areas	rural areas or geographically isolated areas
Used by single company or collective use	individual	individual	single company	collective use
Ownership	private/public	private/public	owned by pharmacies	owned by local administration
Locations served	all locations - between hospitals	door-to door	all locations within the town	remote parts of a region
Coverage	urban, suburban, rural	urban, suburban, rural	town	a region
Distances covered	short/medium	short/medium	short (range of 5km)	short/medium
Type of service	on demand	on demand	on demand	on demand
Vehicle size	medium	small	very small	small
Type of products delivered	drugs, organs, samples for research	drugs	medicines	medicines or goods to be delivered with urgency
Main users (senders)	hospitals	pharmacies	pharmacies and hospitals	pharmacies, hospitals
Main users (receivers)	hospitals/laboratories	citizens, elderly, disabled	individuals with impaired mobility	individuals in isolated areas and with mobility restrictions
Frequency	on demand	on demand	on demand	on demand
Time of day	as needed	evening/as needed	as needed	as needed

Maintenance service				provided by private company
Payment				credit card, app

Table 12 contains the different settings identified for the delivery drones, exclusively for medicines, use case. Delivery drones tend to be flying autonomous drones specially constructed for medicine delivery. They should be able to deliver at urban/rural/suburban areas and especially at geographically isolated areas. They could be used by single companies, individuals or collective use and the ownership should be private/public, owned by local administrators or owned by pharmacies and could deliver/transport drugs, organs, samples for research, medicines which have to be delivered with urgency. Primary users (receivers) should be hospitals/laboratories, citizens, elderly, disabled (Individuals with impaired mobility) or based on the last COVID-19 lessons individuals in isolated areas and with mobility restrictions and be delivered as needed.

Table 13: Delivery bots/pods

	DE Description	NL Description	FR Description
Scenario name	self-driving food/groceries delivery bots	delivery bot	intra manufacturing plant delivery pods
Air vs land	land	land	land
Type of vehicle	autonomous bot	autonomous bot	autonomous delivery robots
Type of area	rural	urban	production plants
Used by single company or collective use	single company	collective use	used by manufacturing company
Ownership	owned by single delivery company	single delivery company	manufacturing company
Locations served	all locations within the town	all locations within the city	intra manufacturing plant
Coverage	town	city	storage to production stations
Distances covered	short (range of 5 km)	short	<1km

Type of service	on demand	regular	scheduled or on demand
Vehicle size	very small	very small	small/medium depending on parts transported
Type of products delivered	groceries, food, and convenience items	small packages, possibilities for medicines	parts or industrial production
Main users (senders)	supermarkets, stores, and restaurants	organisations	logistics
Main users (receivers)	individuals	individuals	production operator
Frequency	on demand	3 times per day	on demand or scheduled
Time of day	as needed	morning, midday, evening	as needed

Table 13 contains the different settings identified for the delivery bots/pods use case. The transportation should be made by land in rural/urban areas or production plants. The bots/pods could have collective use or used by single/manufacturing companies with range up to 5kms. They should be able to deliver groceries, food, convenience items, small packages, possibilities for medicines or parts for industrial production. Primary users (receivers) could be supermarkets, stores, restaurants, organization or logistic companies. Also, the main users (receivers) could be individuals or product operators with on demand, scheduled or 3 times/day deliveries at morning, midday, evening or whenever needed.

Table 14: Delivery vans

	ES Description	**UK Description**
Scenario name	last mile delivery by vans	consolidated delivery services
Air vs land	land	land
Type of vehicle	electrical van	vans (table 10)
Type of area	urban	any, including rural
Used by single company or collective use	collective use	collective use by different companies
Ownership	owned by single delivery company	owned by one company who would manage it

Locations served	all locations within the city	across the uk
Coverage	a city or a village	country-wide, door to door
Distances covered	up to 5 km	not mentioned
Type of service	on demand	on demand
Vehicle size	small van	medium/large
Type of products delivered	fragile items	all kinds of deliveries product deliveries, including food, groceries, small items, medicine
Main users (senders)	individuals or organizations	companies delivering goods (amazon, groceries, ups, dominos), pharmacies, retailers (e.g. tesco's)
Main users (receivers)	individuals or organizations	individuals particularly those with mobility issues/isolated etc
Frequency	on demand	on demand
Time of day	daytime	as needed
Maintenance service	provided by private company	
Payment	credit card, app	

Table 14 contains the different settings identified for the delivery vans use case. The transportation could be made by land by electric vans of any size at any area. The type of service identified as on demand to deliver fragile items of all kinds of deliveries product deliveries, including food, groceries, small items, medicine by individuals or organizations such as companies delivering goods (amazon, groceries, UPS, dominos), pharmacies, retailers (e.g. Tesco's).

Table 15: Long-distance haul trucks

	DE Description	**CY Description**	**ES Description**
Scenario name	delivery vans in train	delivery trucks/pods	long distances freight trucks
Air vs land	land	land	land
Type of vehicle	autonomous delivery van and roro train	autonomous trucks	hydrogen truck
Type of area	regional	urban - rural	long distances
Used by single company or collective use	collective by delivery companies	collective	single company

Ownership	service for delivery companies	owned by delivery companies	owned by private company
Locations served	delivery stations in main cities	urban - rural (during off-peak hours)	all over the country
Coverage	a region	one or multiple regions	country
Distances covered	long (above 50km)	medium - long	long distances
Type of service	hauling of av delivery vans	on demand	on demand
Vehicle size	medium to large	medium duty or heavy-duty trucks	large
Type of products delivered	packages	goods	freights
Main users (senders)	haulage companies and train companies	companies	companies
Main users (receivers)	haulage companies	organizations	companies
Frequency	daily	on demand (off-peak hours)	every day on demand
Time of day	as needed	off-peak; evening	as needed
Maintenance service			provided by private company
Payment			company expenses

Table 15 contains the different settings identified for the long-distance haul use case. The transportation could be made by land by autonomous delivery van/hybrid trucks and RoRo train at long distance regional, urban – rural areas. The service could be used collective or single by companies and be owned by them. The service location differs from delivery stations in main cities (urban – rural areas) to all over the country. The haul could deliver packages, goods or freights at need at any hour. Primary users (senders and receivers) could be haulage companies and train companies.

Table 16: Passenger transportation for mobility-impaired people and hospital transportation

	ES_p4 Description	ES_p5 Description	FR_p1 Description	FR_p4 Descriptio n
Scenario name	ambulance for patients in rehabilitation	4-wheel electric mobility scooter	seniors/disabled/ patient/kids transportation	on-site hospital transportat ion

Individual/family or collective use	individual	individual	individual/collective	individual/ collective
Ownership	outsourced private service	provided by private company	home/healthcare operators	hospital
Locations served	hospital, health centres, rehabilitation clinic, sports medicine	anywhere up to 5km	home to care/services/shopping centres	on campus
Distances covered	short distances (inside cities and nearby towns)	up to 5km	10km to 50km	<2km
Type of service	on demand	on demand	scheduled	scheduled
Vehicle type	ambulance	4-wheel scooter	bus/pods/cars	shuttle/pods/cars
Vehicle size	small (2-4 passengers)	small (1 passenger)	medium/small	medium/small
'Comfort": Vehicle inside (space and seat configuration)	space for medical equipment	extra space for shopping bags	extra space shopping bags	extra space for equipment
Provision for people with mobility restrictions	adapted ambulance. space for wheelchairs/mobility aids	adapted	space for wheelchairs/mobility aids	space for mobility aids
Energy	electric	electric	electric	electric
Main users	patients and their support persons or families	older people or people with reduced mobility	people not autonomous (senior, kids, disabled, patients)	patient/medical staff/helpers/admins
Trip purpose	medical treatment	shopping or leisure	service, care, leisure or shopping	healthcare
Frequency	on demand, during the day	on demand, during the day	2 morning and 2 afternoon	regular or on demand
Parking	hospital or health centres	pod-only parking spaces in city centre and	n/a	hospital parking

		shopping/leisure areas		
Time of day	daytime	daytime	daytime	as needed
Surveillance	human attendant inside	cctv and gps system	video	video
Maintenance service	outsourced private service	provided by private company		
Payment	free for users, paid by local administration	credit card, app, subscription		
Services			emergency services	emergency services
Escort			volunteers or civic workers	

Table 16 contains the different settings identified for passenger transportation for mobility-impaired people and hospital transportation use case. The service should be provided by outsourced private services, private company, home/healthcare operators or hospitals and be short distance up to 5 kms or long distance from 10km to 50km. The transportation differs based on the country and could be made by ambulances, 4-wheel scooter, busses/pods/cars/shuttles which will be all electric, for medical treatment, shopping or leisure, service, care, leisure, shopping or healthcare purposes.

Table 17: Garbage collection trucks

	SP_f1 Description	**SP_f5 Description**
Scenario name	garbage collection / street cleaning vehicle	robot for picking fruits dropped on the floor
Air vs land	land	land
Type of vehicle	self-driving electric truck	electric
Type of area	urban	rural
Used by single company or collective use	collective use	single company
Ownership	owned by local administration	owned by private company
Locations served	scheduled routes within the city	rural areas
Coverage	a city and a town	farmlands
Distances covered	routes from 15 to 30 km within the city	medium
Type of service	scheduled by local administration.	on demand

Vehicle size	large	medium
Type of products delivered	garbage and water	fruits
Main users (senders)	staff from local administration	farmers
Main users (receivers)	staff from recycling plant	farmers
Frequency	every day	on demand
Time of day	night-time	as needed
Maintenance service	outsourced private service	provided by private company
Payment	free for users, paid by local administration	company expenses

Table 17 contains the different settings identified for garbage collection use case. The service should cover urban and rural areas, be collective or single use and be made by land. The service should be owned by local administration or single companies and the distance which they have to cover differ areas from inside the city to farmlands. They should collect garbage and water inside the cities or fruits at farmlands and the service could be used from staff of recycling plants or by farmers at the last case. The collections should be made every day at night when we are referring at cities and on demand as needed for farmers.

4. Selecting CCAM-ERAS use cases

4.1. Framework of CCAM-ERAS use cases

To ensure the relevance and applicability of the CCAM-ERAS project, a framework was established for selecting the CCAM-ERAS six key use cases. These use cases, balanced between passenger and freight transportation with three in each category, will guide the project's activities. Recognizing the constraints of a limited selection, a thematic approach was adopted to maximize diversity and represent a broad spectrum of CCAM scenarios. Instead of focusing on highly specific applications, it was opted for broader 'families' of use cases. This strategic choice not only ensures a wider representation but also enhances the project's alignment with past and ongoing CCAM initiatives that evaluate large-scale demonstration and deployment pathways. Furthermore, this approach positions CCAM-ERAS centrally in the assessment of socio-economic impacts and the identification of necessary skills for successful CCAM deployment, enhancing the legacy of the project.

4.2. Process of selecting criteria

The thorough selection of use cases for the CCAM-ERAS project hinges on a comprehensive framework of twelve distinct criteria, each designed to ensure the project's relevance, impact, and long-term viability. Foremost among these is the emphasis on real-world applications at specific site locations. This criterion underscores the project's commitment to grounded, practical research, ensuring that the developed use cases are not merely theoretical constructs but are firmly rooted in tangible, observable scenarios. By focusing on real-world applications, CCAM-ERAS ensures that its findings are directly applicable to the challenges and opportunities encountered in actual deployment settings. Furthermore, complementing this emphasis on practicality is the criterion that the selected use cases must have the highest likelihood of adoption and be the first to be commercialized. This criterion reflects the project's focus on identifying and exploring the most promising and commercially viable CCAM technologies, ensuring that the research contributes to the rapid and effective deployment of innovative solutions. By prioritizing use cases with high commercial potential, CCAM-ERAS aims to accelerate the transition to a more efficient, sustainable, and connected transportation ecosystem.

A critical consideration in the selection process is the potential for creating new jobs. This criterion recognizes the transformative impact of CCAM on the labour market, emphasizing the need to explore use cases that not only introduce new technologies but also generate employment opportunities. By focusing on job creation, CCAM-ERAS seeks to ensure that the transition to CCAM is inclusive and beneficial for workers across various sectors. Moreover, equally important is the ability to highlight the need for new skills. This criterion underscores the project's commitment to addressing the educational and training requirements associated with the deployment of CCAM technologies. By identifying the skills gaps and training needs, CCAM-ERAS aims to provide valuable insights into the development of educational programs and workforce development initiatives.

Furthermore, the project prioritizes use cases that lead to labour market and training challenges. This criterion reflects the project's recognition of the potential disruptions and adjustments associated with the adoption of CCAM, emphasizing the need to proactively address these challenges through targeted interventions and support mechanisms. By focusing on labour market and training challenges, CCAM-ERAS aims to facilitate a smooth and equitable transition to a CCAM-driven economy. The economic viability of the chosen applications is also paramount, with a focus on use cases that show economic advantage or disadvantage. This criterion ensures that the project's findings are grounded in sound economic analysis, providing a clear understanding of the financial implications associated with the deployment of CCAM technologies. By considering both the potential benefits and costs, CCAM-ERAS aims to support informed decision-making and promote the adoption of economically sustainable solutions.

Beyond economic considerations, the selected use cases are expected to offer societal benefits. This criterion reflects the project's commitment to ensuring that the deployment of CCAM technologies contributes to broader societal goals, such as improved safety, accessibility, and environmental sustainability. By focusing on societal benefits, CCAM-ERAS aims to promote the development of CCAM solutions that are not only technologically advanced but also socially responsible. Ensuring long-term relevance, the use cases must be forward-looking and adaptable to anticipated future developments. This criterion recognizes the dynamic nature of CCAM technologies and the need to anticipate and respond to emerging trends and challenges. By focusing on forward-looking use cases, CCAM-ERAS aims to ensure that its findings remain relevant and applicable in the long term.

What is more, aligning with the broader research landscape, alignment with the most relevant projects is a key criterion. This criterion fosters synergies with ongoing initiatives and leverages existing knowledge, ensuring that the project's findings are grounded in the latest research and best practices. By aligning with relevant projects, CCAM-ERAS aims to contribute to a cohesive and coordinated approach to CCAM development. The potential for scaling to broader applications or larger geographic areas is also considered. This criterion reflects the project's commitment to maximizing the impact and reach of its findings, ensuring that the developed use cases can be effectively scaled and replicated in diverse contexts. By focusing on scalable use cases, CCAM-ERAS aims to promote the widespread adoption of innovative CCAM solutions.

Practical considerations include the need to have sufficient data information that can feed into the economic models. This criterion ensures that the project's analysis is grounded in robust data and evidence, enabling the development of reliable and accurate findings. By emphasizing data availability, CCAM-ERAS aims to enhance the credibility and applicability of its research. Finally, access to people/organizations involved is crucial for facilitating collaboration and ensuring effective implementation. This criterion recognizes the importance of stakeholder engagement and collaboration in the development and deployment of CCAM technologies. By fostering partnerships with relevant stakeholders, CCAM-ERAS aims to ensure that its findings are effectively translated into practical solutions and real-world impact.

A discussion on the selection criteria took place during the second general assembly meeting of the consortium in November 2024 to ensure that the input of all partners is incorporated in the development of the CCAM-ERAS use cases. The selection criteria were ranked by the consortium as shown in Figure 1 illustrated below.

Figure 1: Use cases selection criteria

4.3. Preliminary list of CCAM-ERAS use cases

4.3.1. Selecting use cases

First, all the use cases from the past and ongoing CCAM-related research and innovations projects were categorized and classified into similar use cases (passenger and freight transportation) as shown below in Table 18 for the passenger transportation use cases and in Table 19 for the freight transportation use cases.

Table 18:Grouping similar use cases – passenger transportation

	Move2CCAM	AWARD	i4Driving	MODI	ORCHESTRA	ULTIMO
Autonomous (robo) taxis	x					
Autonomous cars (including pods)	x					
Autonomous bus (including mini-bus, serving rural/urban)	x					x
Autonomous public transport for	x					x

people with disabilities or mobility-impaired						

Table 19: Grouping similar use cases – freight transportation

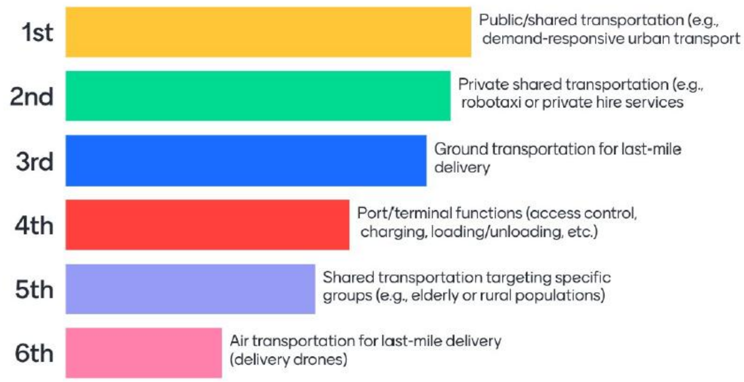
	Move2CCAM	AWARD	i4Driving	MODI	ORCHESTRA	ULTIMO
Delivery drones (including exclusively for medicines)	X					
Last (or first) mile parcel distribution (bots or vans – ground transportation)	x					
Automated transportation for handling parcels/goods (between or within hubs)		x		x		
Automated long distance (haul) trucks	x			x		
Automated transportation related to port terminals		x		x	x	
Garbage collection	x					

4.3.2. Use case development

An activity was developed for the use case development during the workshops series (regarding the transport value chain perspective, societal perspective and regulation and policy perspective) that took place during Q4 (November 26th, 2024, in Brussels) as part of the task 3.1 “In-depth scan of CCAM implications”. The participants and the stakeholder community (developed in the context of WP2) were asked to rate the potential impact of the preliminary list of CCAM-ERAS use cases in four different sectors. Specifically, the twenty-eight participants of this activity, were asked to rank the preliminary CCAM-ERAS use cases on transportation sector, manufacturing/ construction sector, education sector and economy sector, as illustrated in Figure 2 – 5 below.

Figure 2: Use case impacts on Transportation Sector

Rate the potential impact of the following use cases on the **Transportation sector**. Use the scale (1 = highest impact and 6 = lowest impact).

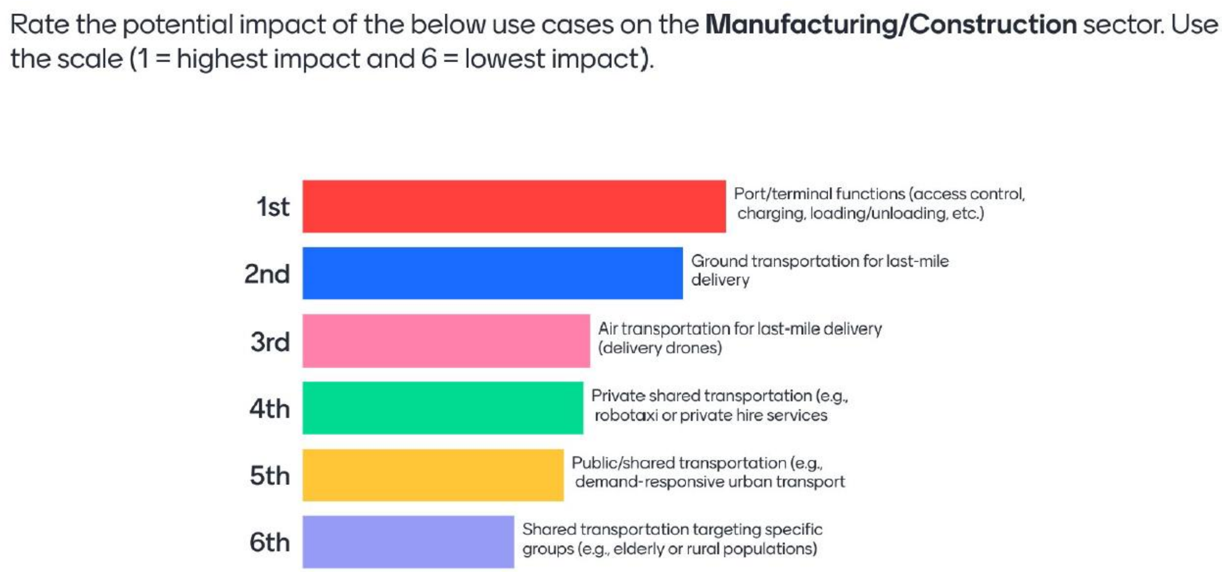


The prioritization of use cases within the transportation sector, as evidenced by the ranking provided, reveals a clear emphasis on passenger-centric solutions, particularly those involving public and shared mobility. As anticipated, public/shared transportation, exemplified by demand-responsive urban transport, emerged as the highest-impact use case. This prominence is logical, given its capacity to move a significant volume of passengers, potentially leading to substantial reductions in congestion and improvements in overall urban mobility efficiency. The widespread adoption of such systems could transform the way people navigate cities, offering flexible and accessible alternatives to private vehicle ownership. Following closely in second place is private shared transportation, encompassing robotaxi and private hire services. This use case reflects the growing interest in on-demand, automated personal transport solutions. While not as broadly applicable as public transit, its potential to optimize individual journeys and reduce the need for personal car ownership positions it as a significant disruptor in the transportation landscape. The convenience and flexibility offered by robotaxi services could appeal to a wide demographic, leading to a notable shift in urban transportation habits.

In the realm of freight transportation, ground transportation for last-mile delivery secured a third-place ranking. This highlights the critical role of efficient and sustainable delivery systems in modern logistics. The potential to decrease the total number of trips, as mentioned, is a key driver for this ranking, as optimized delivery routes and consolidated shipments can lead to significant reductions in fuel consumption and emissions. Moreover, the increasing demand for e-commerce and rapid delivery services underscores the importance of this use case in shaping the future of urban logistics. The fourth position is occupied by port/terminal functions, including access control, charging, and loading/unloading. This ranking underscores the importance of optimizing logistical hubs to enhance efficiency and reduce bottlenecks in the transportation network. The automation and streamlining of port and terminal operations can have a cascading effect, improving the flow of goods and reducing overall transportation costs.

Shared transportation targeting specific groups, such as the elderly or rural populations, ranked fifth. While essential for addressing the mobility needs of these demographics, its lower ranking reflects its more niche application compared to broader public or private shared transport solutions. Nevertheless, its societal impact in enhancing accessibility and inclusion should not be underestimated. Finally, air transportation for last-mile delivery, represented by delivery drones, ranked sixth. While technologically innovative, its lower ranking suggests that its immediate impact on the overall transportation sector is perceived to be less significant compared to ground-based solutions. This could be attributed to regulatory hurdles, limited payload capacity, and concerns about airspace integration. However, the potential for drone technology to revolutionize specific delivery applications, particularly in remote or hard-to-reach areas, should not be overlooked.

Figure 3: Use case impacts on Manufacturing/Construction sector

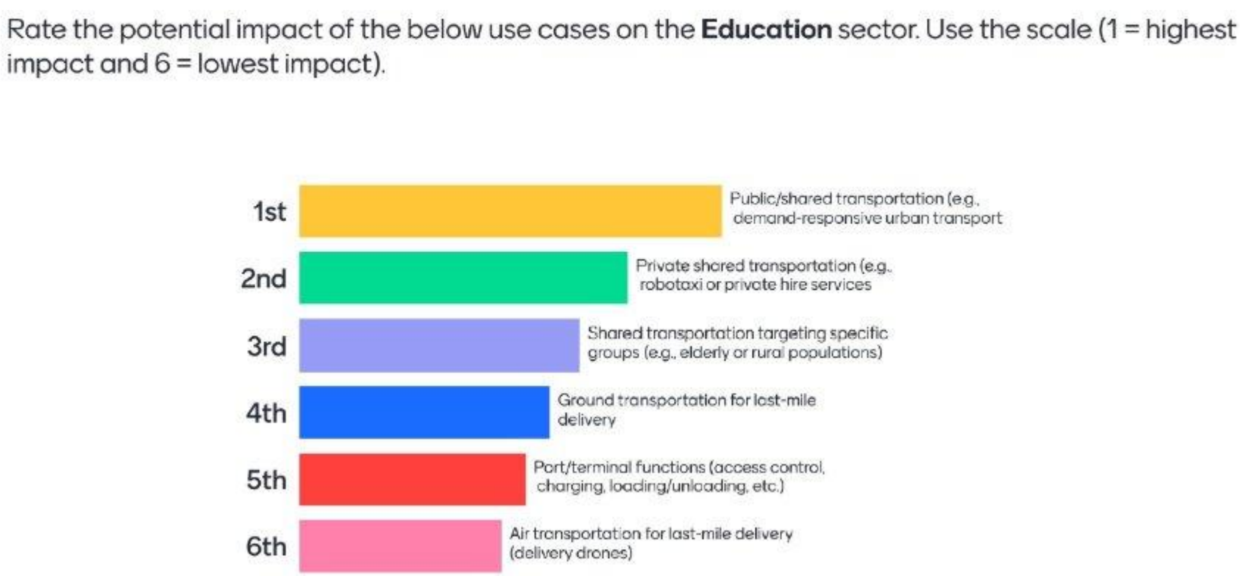


The ranking of use cases within the manufacturing and construction sector reveals a strong emphasis on logistics and freight-related applications, as anticipated. Port/terminal functions, encompassing access control, charging, loading, and unloading, emerged as the highest impact use case. This prioritization underscores the sector's reliance on efficient and streamlined logistical operations. Ports and terminals serve as crucial nodes in the supply chain, and optimizing their functions through automation and connectivity can significantly enhance productivity and reduce operational costs. The integration of CCAM technologies in these areas can lead to improved inventory management, faster turnaround times, and enhanced safety, all of which are critical for the manufacturing and construction industries. Following closely in second place is ground transportation for last-mile delivery. This highlights the sector's focus on optimizing the movement of goods from distribution centres to construction sites or manufacturing facilities. Efficient last-mile delivery is essential for ensuring timely access to materials and components, minimizing downtime, and improving overall project efficiency. The adoption of autonomous or semi-autonomous ground vehicles for last-mile delivery can lead to reduced transportation costs, improved delivery accuracy, and enhanced supply chain resilience.

Air transportation for last-mile delivery, represented by delivery drones, ranked third. While less immediately impactful than ground-based solutions, drones offer unique advantages for specific applications within the manufacturing and construction sectors. They can be used for delivering small components to hard-to-reach locations, conducting site inspections, and monitoring progress remotely. The potential for drones to enhance safety and efficiency in these areas is significant, particularly in large-scale construction projects or remote manufacturing facilities. As expected, passenger transportation use cases received lower rankings. Private shared transportation, encompassing robotaxi and private hire services, ranked fourth, suggesting a recognition of its potential role in facilitating workforce mobility and reducing transportation costs for employees. However, its direct impact on core manufacturing and construction activities is perceived to be less significant compared to freight-related applications.

Public/shared transportation, exemplified by demand-responsive urban transport, ranked fifth. While important for general urban mobility, its direct relevance to the manufacturing and construction sector is limited. The sector's focus on material logistics and supply chain optimization likely explains the lower ranking of passenger-centric use cases. Finally, shared transportation targeting specific groups, such as the elderly or rural populations, ranked sixth. This use case, while valuable for addressing specific mobility needs, is considered to have the least direct impact on the manufacturing and construction sectors. Its focus on social inclusion and accessibility is important, but its relevance to the core activities of these industries is limited.

Figure 4: Use case impacts on Education sector

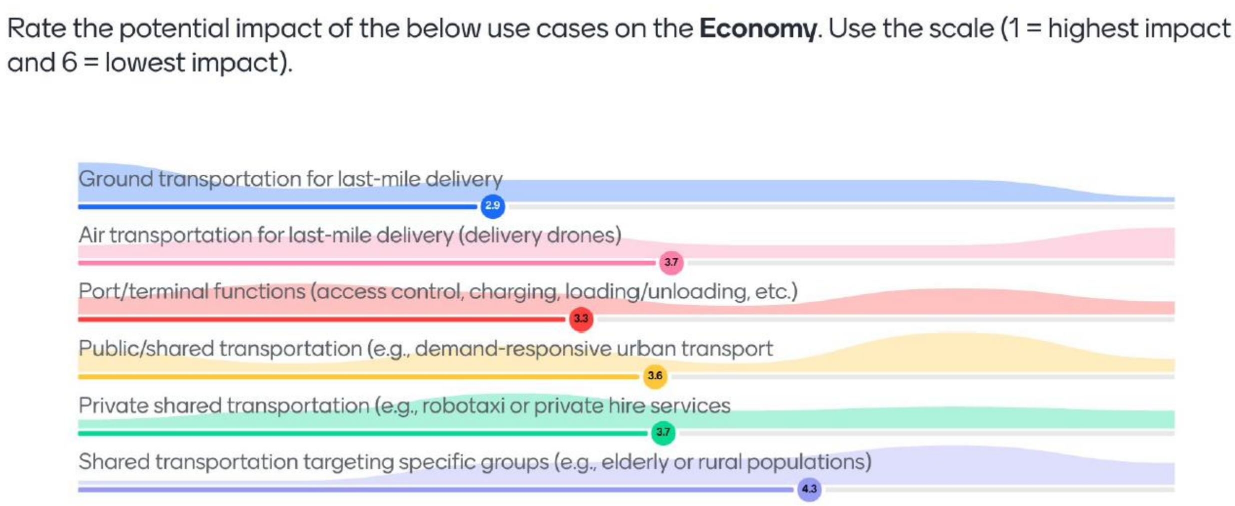


The ranking of use cases within the education sector reveals a distinct emphasis on accessibility and mobility, particularly as it pertains to students and educational institutions. Public/shared transportation, such as demand-responsive urban transport, emerged as the highest-impact use case. This reflects the critical role of accessible and efficient transportation in ensuring students can reach educational facilities, especially in urban areas. Demand-responsive systems can offer flexible and tailored solutions, accommodating diverse student schedules and needs, which is particularly important for students with disabilities or those living in areas with limited public transport options. Following closely in second place is private shared transportation, encompassing robotaxi and private hire services. This highlights the potential of personalized transport solutions to enhance student mobility, particularly for those with unique transportation requirements or those living in areas with limited public transit coverage. Robotaxi services can offer a convenient and reliable means of transportation, enabling students to attend classes, participate in extracurricular activities, and access educational resources.

Shared transportation targeting specific groups, such as the elderly or rural populations, ranked third. While seemingly less directly related to the general student population, this use case underscores the importance of inclusive mobility solutions that cater to diverse needs. For example, in rural areas, dedicated transportation services can enable students from remote communities to access centralized educational facilities. Similarly, specialized transport for students with disabilities can ensure equitable access to education. Ground transportation for last-mile delivery ranked fourth. While primarily associated with logistics, this use case has implications for education in terms of delivering educational materials, supplies, and equipment to schools and students. Efficient delivery systems can ensure timely access to resources, supporting effective teaching and learning.

Port/terminal functions, including access control, charging, and loading/unloading, ranked fifth. This use case, while less directly related to student mobility, highlights the importance of logistical efficiency in supporting educational institutions. For example, optimized port and terminal operations can facilitate the timely delivery of educational resources and supplies, ensuring smooth operations within the education sector. Finally, air transportation for last-mile delivery, represented by delivery drones, ranked sixth. While technologically innovative, its immediate impact on the education sector is perceived to be less significant compared to ground-based solutions. This could be attributed to regulatory hurdles, limited payload capacity, and concerns about airspace integration. However, drones could potentially play a role in delivering educational materials to remote or hard-to-reach areas, especially in emergency situations.

Figure 5: Use case impacts on Economy sector.



The ranking of use cases for the economy highlights a strong emphasis on logistical efficiency and the movement of goods, reflecting the direct impact these areas have on economic activity. Ground transportation for last-mile delivery emerges as the highest-impact use case. This reflects the critical role of efficient logistics in supporting economic growth, as optimized last-mile delivery can reduce transportation costs, improve delivery times, and enhance customer satisfaction. The potential for autonomous or semi-autonomous ground vehicles to streamline delivery processes is seen as a significant driver of economic efficiency. Following closely is air transportation for last-mile delivery, represented by delivery drones. While still developing, the potential for drones to revolutionize specific delivery applications, particularly in time-sensitive or hard-to-reach areas, is recognized as having a substantial economic impact. Drones can potentially reduce delivery costs, improve access to remote markets, and create new business opportunities.

Port/terminal functions, including access control, charging, and loading/unloading, ranked third. This underscores the importance of efficient logistical hubs in facilitating international trade and supporting economic activity. Optimized port and terminal operations can reduce bottlenecks, improve cargo handling, and enhance overall supply chain efficiency, leading to cost savings and increased competitiveness. Public/shared transportation, such as demand-responsive urban transport, ranked fourth. While primarily associated with passenger mobility, this use case has significant economic implications. Efficient public transport systems can reduce traffic congestion, improve productivity, and enhance access to employment opportunities, contributing to overall economic growth.

Private shared transportation, encompassing robotaxi and private hire services, ranked fifth. While offering potential benefits in terms of convenience and reduced transportation costs, its direct impact on the broader economy is perceived to be less significant compared to freight-related applications. However, the growth of the ride-sharing industry and the potential for autonomous taxis to disrupt traditional transportation models suggest that this use case could have a more substantial economic impact in the long term. Finally, shared transportation targeting specific groups, such as the elderly or rural populations, ranked sixth. While important for social inclusion and accessibility, its direct impact on the overall economy is perceived to be limited. However, improved mobility for these groups can enhance their participation in the workforce and access to essential services, indirectly contributing to economic growth.

4.4. Final list of CCAM-ERAS use cases

Table 20 shows the final list of six (6) CCAMERAS use cases for three (3) freight and three (3) passenger transportation use cases, mentioning the associated CCAMERAS project partner for each use case and any associated CCAM-related projects.

Table 20: Final list of CCAM-ERAS use cases

Use Case Name	Short Description	Associated CCAM-ERAS partner	Associated project (if applicable)
Freight transportation			

Ground transportation for last-mile delivery	Distributing parcels and/or groceries that can arrive at your doorstep	SAAM	LOXO
Bus depot	Service involving public transportation OEMs, public transportation operators and logistics, where the buses can be driven by wires within the depot	SAAM	AutoDepot prototype project
Port/terminal	Functions such as access control, charging, loading/unloading, transfer between modes, logistics planning	ITSN	MODI
Passenger transportation			
Public (shared) transportation	Functions such as demand-responsive in urban areas, night transportation, complementing rail transportation in rural areas	SAAM	ULTIMO
Private (shared) transportation	Robotaxi service, private hire or taxi market	SAAM	Selvkjørende
Shared transportation targeting specific groups	Service assisting people with disabilities, elderly, people located at rural or low accessibility areas	Blees	N/A

4.5. Description of CCAM-ERAS final use cases

During the development of Task 3.3 and the production of this deliverable, CCAM-ERAS has decided to use themes or families of use cases instead of extremely specific use cases to harmonize and standardize easier with use cases evaluated in ongoing and past CCAM-related projects.

A template or rather a framework is developed for the purpose of describing the CCAM-ERAS final use cases. The template for CCAM-ERAS final use cases includes three modules: a) describing the use cases, b) describing the operational design domain (ODD) of tested CCAM systems, c) describing the tested CCAM service concept.

The herein framework has adapted the recommendations described in the European Common Evaluation Methodology (EU-CEM), developed by the FAME project that provides guidance on how to set up and carry out an evaluation or assessment of direct and indirect (wider socio-economic) impacts of CCAM directed to different user groups, including non-users. Each use case includes information on the three modules. It is worth noting that some points may not be applicable on certain use cases.

The first module describes the corresponding use case using the following points:

- Passenger transportation or freight transportation use case?
- Vehicle type (passenger car, minibus / shuttle, large bus, truck etc.)

- Level of automation (e.g. SAE level 3)
- Automated driving system (e.g. for highways, traffic jam, parking, confined areas, urban and peri-urban transport)
- Connectivity (e.g. communication technology, communicated information)
- Capabilities of the system (preferably a short and precise description)
    - Dynamic driving tasks that the vehicle is able to perform and is not able to perform in automated mode
    - Type of sensors included, sensor ranges and operating angles
    - Target speed
    - Target time headway, possible time headway settings
    - Human-machine interface / HMI (e.g. take-over requests – how and when these are given to the driver, activation/deactivation – how these are indicated, what is required from the driver, AD mode status - how it is indicated)
        - Activation by user
        - Deactivation by user
        - Automated driving (AD) mode status
        - Take-over request
    - Minimum risk manoeuvre (e.g. park on the side of the road, stop in lane)
- Technology Readiness Level (TRL 1-9)
    - Need for safety driver or other safety procedure (e.g. teleoperation) needed due to low TRL

The second module describes the ODD of tested CCAM system by providing information in what kind of conditions/situations the CCAM system can and cannot operate in terms of the following points:

- Road type: type of public road or closed area
- Infrastructure elements: intersection types, rail-road crossings, separation of driving directions/lanes, slope of road, tunnels, presence of roadside parking, connectivity
- Traffic rules and control: traffic sign types, traffic lights, overtaking allowed, speed limit
- Quality of infrastructure: lane markings, traffic sign readability, road surface (potholes, longitudinal ruts)
- Weather and road conditions: precipitation, temperature, road surface (standing water, snow, ice)
- Traffic conditions: traffic volume, road works, presence of pedestrian and cyclists on lane
- Lighting conditions: daylight, darkness, street/road lighting

The third module describes the tested CCAM service concept using the following points:

- Type of service (e.g. private transport, taxi, public transport, on-demand transport with fixed/flexible schedule and fixed/flexible route)
- Vehicle ownership model (e.g. privately owned/owned by a company/owned by a public body)
- Vehicle use model (e.g. private/shared ride)
- Area of operation (e.g. city centre, built-up area, rural area, inter-regional)
- Description of service (use case) from user's perspective

- Business model (if available), including costs for the user

4.5.1. Ground transportation for last-mile delivery

Table 21: Ground transportation for last-mile deliveries - Describing the use case

Passenger or Freight Transportation	Freight transportation
Vehicle type	Autonomous utility vehicle, designed for urban and peri-urban freight transportation
Level of automation	SAE Level 4: Full autonomy, with no need for human intervention during normal operation within predefined operational domains (e.g., mapped urban routes)
Automated driving system	Automated driving system for urban and peri-urban transportation, primarily designed for last-mile delivery
Connectivity	Utilizes wireless communication technologies for remote monitoring, route planning, and real-time data transfer. The system can communicate vehicle status, navigation updates, and safety alerts to both the vehicle operator and relevant traffic management systems
Capabilities of the system	
Dynamic driving tasks	Handling unexpected road conditions not accounted for in the mapping, driving in complex or unsupervised environments (e.g., off-road or in highly congested urban areas with unpredictable traffic)
Sensors	Includes LIDAR, radar, ultrasonic sensors, and cameras. Sensor ranges vary, with LIDAR capable of detecting objects up to 200 meters away. The operating angles cover 360° around the vehicle for full situational awareness
Target speed	Typically operates at speeds up to 40-60 km/h in urban areas, depending on traffic and weather conditions
Target time headway	Time headway is typically set at 2-3 seconds in low-traffic environments but can be adjusted depending on road conditions
Human-machine interface	
Activation by user	The user can activate the vehicle’s autonomous driving mode via a mobile app or dispatching system
Deactivation by user	The user can deactivate the autonomous system at any time via the app or manually through the vehicle interface
Automated driving mode status	The system indicates the current AD mode status through a visual display on the vehicle or app interface

Take-over request	If human intervention is required, a clear alert is issued through the app, along with visual and auditory warnings inside the vehicle
Minimum risk manoeuvre	In case of failure or system uncertainty, the vehicle will execute a "minimal risk manoeuvre," such as pulling over safely to the side of the road, stopping in lane, and activating hazard lights for visibility
Technological readiness level	TRL 7: Prototype has been demonstrated in a real operational environment, with limited deployment and ongoing testing. A safety driver is not required in fully mapped environments. However, a remote teleoperation procedure is in place for manual intervention if needed during unexpected situations or system errors in more complex or dynamic environments

Table 22: Ground transportation for last-mile deliveries - describing the ODD

Road type	Primarily urban and peri-urban public roads, with some restricted or closed areas designated for specific freight transport routes. These roads are often well-mapped and suited for last-mile delivery tasks
Infrastructure elements	The infrastructure includes intersections with standard traffic lights and roundabouts. There are no railway crossings for LOXO's typical routes. Roads are separated by clear lane markings with minimal use of one-way streets. Road slopes are generally moderate, and the vehicle operates in flat terrain. Tunnels and steep hills are avoided in most operational routes. The presence of roadside parking is minimal, and the vehicle has connectivity with traffic management systems for real-time updates
Traffic rules and control	The vehicle adheres to standard urban traffic rules, including compliance with traffic lights (red, yellow, green), stop signs, and pedestrian crossings. Overtaking is generally not permitted within urban environments unless clearly marked. The vehicle complies with city and residential zone speed limits, typically ranging from 30-50 km/h, depending on local regulations
Quality of infrastructure	Infrastructure quality is high, with well-maintained lane markings and clear, readable traffic signs. The road surface is typically smooth with some minor imperfections, though the vehicle's sensors are designed to detect potholes, ruts, and other small obstacles. The vehicle is equipped to handle minor irregularities, though it is optimized for routes with well-maintained surfaces
Weather and road conditions	The vehicle is designed to operate in various weather conditions, including light rain, snow, and mild temperature variations. However, extreme conditions such as heavy snow, ice, or standing water may

	affect its performance. In such cases, the system is programmed to either slow down or stop safely. It is not optimized for heavy snow or icy conditions without additional intervention
Traffic conditions	The system is optimized for moderate traffic volume and low-density environments. It is able to detect pedestrians and cyclists in its path, stopping or adjusting its speed as necessary. The vehicle is also capable of navigating through areas with occasional roadworks, with temporary changes to routing and speed limits. In highly congested traffic or during road construction, manual intervention or a temporary detour may be needed
Lighting conditions	The vehicle is designed for both daylight and nighttime operations. It is equipped with sensors and cameras that provide visibility in darkness, particularly in areas with street lighting. The system can function effectively under standard urban lighting conditions, but its performance may be reduced in poorly lit areas or under complete darkness without streetlights

Table 23: Ground transportation for last-mile deliveries - describing the tested CCAM service concept

Type of service	On-demand transport service for freight, specifically designed for last-mile delivery in urban and peri-urban areas. The service operates with a flexible schedule and route, depending on user needs and delivery requirements
Vehicle ownership model	The vehicles are owned and operated by LOXO AG, a private company specializing in autonomous freight transport solutions
Vehicle use model	Shared vehicle use model. The autonomous vehicles are used for cargo deliveries and are not for personal or passenger transport
Area of operation	The area of operation is primarily urban and peri-urban areas in and around Fribourg, focusing on the last-mile delivery segment. The service is optimized for built-up areas but can extend to rural areas if needed, within predefined routes
Description of service from user's perspective	From the user's perspective, LOXO AG offers a reliable, autonomous delivery service that allows businesses to schedule freight transport for goods within the city. The user (typically a business or delivery company) can request the vehicle to pick up and deliver goods using an easy-to-access mobile app or platform, track the vehicle's real-time progress, and receive notifications once the delivery is completed. The service is designed to be efficient, environmentally friendly, and cost-effective compared to traditional delivery methods

Business model (if available)	LOXO AG's business model revolves around providing an autonomous freight transport service as a last-mile delivery solution for businesses. Pricing is typically based on distance, delivery time, and the weight/volume of the cargo being transported. Customers pay a fixed rate per delivery or subscribe to a package for regular deliveries. The exact cost to the user varies depending on the size of the delivery, the route, and the delivery urgency, but it is positioned as a competitive alternative to traditional logistics options. The service aims to reduce costs and increase efficiency by cutting down on the need for human drivers while providing real-time tracking and automated service

4.5.2. Bus depot

Table 24: Bus depot - Describing the use case

Passenger or Freight Transportation	Bus circulation on depot without driver (freight transportation)
Vehicle type	Large bus
Level of automation	SAE level 4 (but automated system on infrastructures)
Automated driving system	Automated bus depot. Automated system must be capable of driving ~100 buses per hour on one depot
Connectivity	I2V – Infrastructures to vehicles
Capabilities of the system	
Dynamic driving tasks	Driving tasks are not determined by the vehicles and their on-board intelligence, but by the sources of the various sensors installed in the infrastructure and by the central automated management system of the bus depot (AutoDepot)
Sensors	Lidar, radar, cameras (infrastructure), cameras (on-board). Angles depend on infrastructure conditions
Target speed	3km/h (speed on a vehicle in a depot is not an objective, because the buses do not have to go back into operation)
Target time headway	Not an objective
Human-machine interface	Once the vehicle has arrived at the depot, the driver activates the automated mode. The central system (AutoDepot) confirms that the vehicle has been taken control of, and the driver leaves the vehicle. The vehicle then runs in automated mode, controlled by the central system. If the vehicle is blocked, for example due to an unknown situation, it can be remotely controlled by the operations centre (teleoperation).

	When the vehicle leaves the depot, the central system validates the vehicle's exit, and the driver can then take over manual driving of the vehicle to get on the public transport lines
Minimum risk manoeuvre	In the event of an unknown situation, obstacle detection or problem, the vehicle stops, and the operations centre is informed
Technological readiness level	TRL 4 (proven feasibility). Goal of the “AutoDepot prototype project”: TRL 6

Table 25: Bus depot - describing the ODD

Road type	Private area (bus depot of transport company)
Infrastructure elements	Outside private roads, inside circulation (building), parking. Sensors on infrastructures
Traffic rules and control	Priorities to be given according to depot rules (yield or stop) but managed by the infrastructure. Speed: 3km/h. No overtaking
Quality of infrastructure	Digitized infrastructure. Good quality, controlled surfacing. Vehicle trajectories should be offset between passages to control rutting
Weather and road conditions	Rain, snow and ice possible (for outdoor parts)
Traffic conditions	Low traffic volume (other buses and transport company vehicles). Pedestrians (transport company employees). No cyclists
Lighting conditions	Daylight, darkness (outside), building lighting (inside)

Table 26: Bus depot- describing the tested CCAM service concept

Type of service	Bus circulation on depot (fixed routes), without driver
Vehicle ownership model	OEM project partner (for prototype development)
Vehicle use model	Public transport companies’ property
Area of operation	Public transport companies bus depots
Description of service from user’s perspective	Optimize costs for companies and avoid driver shortages. Hours spent driving around depots are non-productive, since they are not used by public transport users (customers). With the automation of bus depots, these hours can be made more valuable to users.

Business model (if available)	10 years before return on investment for companies, depending on the current level of vehicle compatibility (which increases every year, even without prototype development).

4.5.3. Port / terminal

Table 27: Port / terminal - Describing the use case

Passenger or Freight Transportation	Freight transportation
Vehicle type	Battery-electric trucks with L4 functionality
Level of automation	DAF, VOLVO and EINRIDE. The truck(s) from EINRIDE is automated by design (no driver's cabin and can be remotely operated) - L2-L4
Automated driving system	confined areas, drayage (from port/terminal to warehouse), hub-to-hub. Highways and urban areas are also addressed in the MODI project; however, it would probably be out of scope in the CCAM-ERAS Port/Terminal use case.
Connectivity	V2X
Capabilities of the system	
Dynamic driving tasks	Intersection, roundabout, right turn, left turn, mixed traffic, gate access, automated charging, automated loading/unloading – handover between automated/manual mode
Sensors	Still in testing phase
Target speed	Target speed in confined areas will be limited (in line with the site guidelines for all traffic), while speed at drayage and hub-to-hub will aim towards the local speed limit. Target speed to be decided based on safety testing
Target time headway	TBD
Human-machine interface	TBD
Minimum risk manoeuvre	TBD
Technological readiness level	DAF/VOLV will be operated with a safety driver onboard. EIN vehicle will have remote operation monitoring and support. Solution for automated loading and de-loading of pallets monitored and partly operated by the remote operator (TRL7). Terminal port booking, allocation and parking (TRL8). Autonomous electric charging includes planning, allocation, and

	confirmation of slots on-premises (TRL8). Driving in confined areas (TRL7)

Table 28: Port / terminal - describing the ODD

Road type	confined area and interface with public road
Infrastructure elements	Full ODD to be decided
Traffic rules and control	Full ODD to be decided
Quality of infrastructure	Full ODD to be decided
Weather and road conditions	Demos will take place in summer and autumn weather (no snow). Should be able to handle rain
Traffic conditions	N/A in confined areas. However, mixed traffic with pedestrians and other vehicles. Drayage and hub-to-hub might involve road works etc
Lighting conditions	Demos in confined areas will most likely happen in daylight

Table 29: Port / terminal - describing the tested CCAM service concept

Type of service	N/A. Freight operations
Vehicle ownership model	Owned by a company
Vehicle use model	N/A. Logistics
Area of operation	N/A. Confined areas. Limited distance on public road (drayage and hub-to-hub)
Description of service from user's perspective	Automated driving integrated with port/terminal operations
Business model (if available)	will be investigated

4.5.4. Public (shared) transportation

Table 30: Public (shared) transportation - Describing the use case

Passenger or Freight Transportation	Passenger transportation

Vehicle type	Up to 15 minibuses / shuttles
Level of automation	SAE Level 4
Automated driving system	Peri-urban / rural transport
Connectivity	V2X communication information
Capabilities of the system	
Dynamic driving tasks	SAE Level 4 capabilities within a Dynamic Responsive Transport (DRT) system in a rural area with speeds up to 70 km/h. When the vehicle is blocked the teleoperator is able to manoeuvre the vehicle at distance
Sensors	under NDA
Target speed	Speed limit, max 70 km/h
Target time headway	N/A
Human-machine interface	No driver / safety driver
Minimum risk manoeuvre	Stop in lane and remote manoeuvre to side of the road by teleoperator
Technological readiness level	Medium/high TRL (TRL > 6). No safety driver and supervision/teleoperations

Table 31: Public (shared) transportation - describing the ODD

Road type	Public road (100+ square km area)
Infrastructure elements	Every possible road element
Traffic rules and control	Every type of traffic rule, speed limits up to 80 km/h
Quality of infrastructure	Every quality of infrastructure
Weather and road conditions	Every weather and road conditions but limited to heavy rain and snow fall as well as ice
Traffic conditions	Every possible traffic condition
Lighting conditions	Every possible lightning condition including nighttime driving

Table 32: Public (shared) transportation - describing the tested CCAM service concept

Type of service	On-demand public transport with flexible schedule and flexible route
Vehicle ownership model	Owned by public transportation operators
Vehicle use model	Shared rides
Area of operation	Rural including cross-border CH-FR
Description of service from user's perspective	24/7 public transportation service
Business model (if available)	TBD

4.5.5. Private (shared) transportation

Table 33: Private (shared) transportation - Describing the use case

Passenger or Freight Transportation	Passenger transportation
Vehicle type	Retrofitted passenger car
Level of automation	ADS designed for level 4, but under testing and still supervised by safety operator
Automated driving system	ODD covers all roads up to 90 km/h including urban suburban and highways
Connectivity	4G and GPS, but only non-safety critical
Capabilities of the system	
Dynamic driving tasks	ODD covers all aspects of the DDT in the operational area
Sensors	Cameras alone as the primary subsystem, and radar/lidar alone as the secondary subsystem covering 360° view
Target speed	90 km/h - speed limit in the operational area
Target time headway	N/A
Human-machine interface	
Activation by user	The driver activates the ADS by pressing a button on the steering wheel. Signature auditory sound that AD mode is activated

Deactivation by user	Cancel button on steering wheel, steering input or pedal operation. There is also a failsafe emergency button to disengage the SDS. Signature auditory sound that automated driving mode is deactivated
Automated driving mode status	Autonomous mode is indicated in the centre display
Take-over request	The system is designed to be an L4 system and will not request take-over
Minimum risk manoeuvre	The ADS has several levels of MRM relating to several different levels of degradation of the ADS's core functionality. These MRMs range from in lane stopping to safely pulling over. However these are not fully implemented in the current version of the ADS and thus the safety operator is the ultimate risk mitigation for a degraded ADS
Technological readiness level	N/A, however safety operator is necessary

Table 34: Private (shared) transportation - describing the ODD

Road type	Public roads ranging from small residential streets to 4 lane highway. Speeds up to 90 km/h
Infrastructure elements	Can handle all types of infrastructure elements found in the operational area including intersections, lighted intersections, roundabouts, single lane and double lane roads with and without lane markings, roadside parking and more. Railway crossings are not supported
Traffic rules and control	Can handle all traffic rules in the operational area
Quality of infrastructure	only limitation is that the ADS only supports paved roads, but there is only paved roads in the operational area
Weather and road conditions	precipitation, temperature, road surface: Snow and rain as well as wet and snow covered roads are supported with no specific temperature limit. Large snow piles or very slippery conditions can pose challenges
Traffic conditions	The ADS supports moving in all kinds of traffic and congestion. including all types of road vehicles, pedestrians and cyclists. Minor road works can be handled, but major roadworks might require remapping
Lighting conditions	No limitations

Table 35: Private (shared) transportation - describing the tested CCAM service concept

Type of service	Public transport, on-demand and shared service
Vehicle ownership model	Vehicles are owned by Holo (private company)
Vehicle use model	Shared
Area of operation	Suburban area with mix of residential, industrial and commercial zones
Description of service from user's perspective	The Service is autonomous, shared and on-demand and it is called "Selvkjørende". In a dedicated app, customers can book a ride from any point to any point with the 22km2 operational area. Customers will be directed to the nearest PUDO and be picked up as soon as possible. They can follow the progress of the trip and estimated ETA all through the process. The service is shared so someone who is going in the same direction might be picked up along the way
Business model (if available)	The service is part of public transportation and is thus subsidized. For the initial public service period the service is free, but it will eventually be priced somewhere between a public transport ticket and a taxi ride

4.5.6. Shared transportation targeting specific groups

Table 36: Shared transportation targeting specific groups - Describing the use case

Passenger or Freight Transportation	Passenger transportation
Vehicle type	Passenger car / minibus / shuttle
Level of automation	SAE Level 4 with limited ODD
Automated driving system	Areas with limited traffic, simple traffic situations. Dedicated spaces like busways. The vehicle moves around the planned area and/or routes according to the needs of the passengers in an automated manner with remote supervision
Connectivity	It is necessary to ensure stable data transfer, for two-way communication (contact with passengers), verification of vehicle behaviour, camera viewing, and issuing commands to the vehicle in critical situations
Capabilities of the system	

Dynamic driving tasks	The vehicle moves in an automated manner on designated traffic lines, with the ability to avoid static obstacles. It matches speed to traffic and space. Automatically operates stops
Sensors	TBD
Target speed	50 km/h
Target time headway	8-12 h of operation
Human-machine interface	
Activation by user	No way for a passenger to manage the vehicle, other than selecting a stop, e.g. via an app
Deactivation by user	N/A
Automated driving mode status	Set by remote or local operator
Take-over request	Only by a remote operator or through a special device held by the local operator/steward in charge of the vehicles during daily operations
Minimum risk manoeuvre	Safe stopping in a way that does not obstruct the passage - if there is a possibility on the side of the road
Technological readiness level	Vehicles should be supported by a remote operator who will supervise the correctness of operations, ready to issue commands or, as a last resort, take control. The operator will be in charge of several to a dozen vehicles and will take action in unforeseen or dangerous situations (e.g., vandalism, passengers falling asleep, brawls). It is envisaged that a steward will be able to support vehicles and passengers with special needs, for example, in a selected area

Table 37: Shared transportation targeting specific groups - describing the ODD

Road type	road and closed area (hospitals, universities etc.)
Infrastructure elements	Simple intersections, with uncomplicated rules (no trams or many infrastructure elements). Without tunnels, railroad crossings. Slope of the road up to +-20%. Mainly areas where it is uneconomical or impossible to implement large buses, and where there are transportation needs, especially for people with disabilities
Traffic rules and control	The vehicle does not need to read traffic signs, as it is programmed for given routes and behaviour can be adjusted to meet space

	requirements. The speed should not exceed 50 km/h, and in terms of traffic signals, integration with controllers giving the vehicle priority is preferred. The vehicle does not need to overtake other vehicles, but to avoid obstacles standing or moving very slowly, such as pedestrians
Quality of infrastructure	A minimum lane of 2.5m is expected. It is permissible for a vehicle to use painted lanes, but they are not necessary. Road surface - asphalt, paved, level. Transverse restrictors are permitted
Weather and road conditions	The vehicle should be able to operate in good conditions, comparable to the driver. Without heavy rain, snow, and dense fog
Traffic conditions	Traffic volume average, road works - acceptable, with remote operator control in case of sudden changes, planned lane closures - programmable
Lighting conditions	All acceptable

Table 38: Shared transportation targeting specific groups - describing the tested CCAM service concept

Type of service	focus on public transport/shared transport on demand, but also with possibility to operate with fixed route and schedule
Vehicle ownership model	public transport company, city municipality – ownership or leasing. In case it can be also the service provided by private companies to municipalities
Vehicle use model	pooling and public transportation
Area of operation	clean city zones in the centre, rural areas, new settlements on the outskirts of cities, areas where is needs to support the moving of the people with disabilities
Description of service from user's perspective	The service should be able to be ordered via a customized mobile app or by phone or ordered by the transportation organizer. The passenger receives the nearest possible pick-up point and pick-up time (or departure information in the case of a fixed line). He or she uses in a similar way to public transportation, paying for a ticket
Business model (if available)	it depends on the municipality needs. Vehicles can be sold and managed by the city (transport operator/organization), leased, or as a service for municipalities. It should be part of public transportation, so the end user cost should be similar

5. Next Steps and Conclusion

5.1. Next Steps

This deliverable regarding the use cases feeds directly the rest of the WPs of the project. Particularly, this deliverable identifies the use cases for WP5 'Schemes for development and enhancement of skills'. Further, the CCAM-ERAS use cases will be used for the evaluation followed in WP4 'Analysis of the effects of CCAM' focusing in evaluating employment effects, skills forecasts, economic and societal effects. The use cases will be the focus of further development in WP5, whereby they will be used to develop a number of scenarios that will serve as the basis for the development of schemes for development and enhancement of skills, as well as used as a tool to guide the research activities conducted under WP4.

5.2. Conclusion

In summary, this deliverable discusses the selection of use cases that represents a pivotal step towards shaping the future of connected, cooperative, and automated mobility (CCAM). Through a thorough and collaborative process, we have identified six core use cases that include both passenger and freight transportation, each showcasing a diverse range of real-world applications. These use cases are not only designed to be commercially viable but also to address critical labor market challenges, including job creation and skills development. By integrating insights from past and ongoing CCAM-related projects and engaging a wide range of stakeholders, we ensure that these use cases are aligned with the latest industry trends and emerging technologies. The balance between passenger and freight scenarios also ensures that the selected use cases offer tangible pathways for large-scale deployment and integration into existing transportation systems.

As the CCAM-ERAS project progresses, these use cases will serve as foundational pillars for future research and development activities. The final selection aligns with the project's goal to evaluate innovative and scalable mobility solutions that can transform urban and rural landscapes, enhance transportation efficiency, and contribute to a sustainable, equitable future. Furthermore, by emphasizing inclusivity, accessibility, and co-creation with citizens and stakeholders, the project ensures that the resulting solutions meet the needs of diverse populations, including those with mobility restrictions or residing in underserved areas. This holistic approach will enable the project to provide actionable insights that will shape policy and educational frameworks, ultimately fostering a workforce ready to thrive in the CCAM-driven mobility ecosystem.