Grant agreement No. 101069852

Move2CCAM

Methods and tools for comprehensive impact Assessment of the CCAM solutions for passengers and goods

HORIZON-CL5-2021-D6-01

D1.4

KNOWLEDGE BANK

WP1 – Setting the ground: CCAM scenarios, business models and KPIs

Dissemination Level		
PU	Public	

Disclaimer

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

Due date of deliverable	Month 15 – November 2023
Actual submission date	Month 16 – December 2023
Start date of project	01/09/2022
Duration	30 months
Lead beneficiary	C M Monitor (Britain Thinks) Ltd
Contributors	C M Monitor (Britain Thinks) Ltd
Reviewers	BABLE UCL MOBY HKS CARTIF HEL GZM NAR

Disclaimer

The content of this deliverable does not reflect the official opinion of the European Union. Responsibility for the information and views expressed herein lies entirely with the author(s).

Copyright

Document history

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

Version	Date	Released by	Comments
0.1	27-10-2023	BABLE	First draft made by Chiara Galioto, revised by Hector
0.2	12-11-2023	BABLE	Screenshots from Knowledge Bank page are added together with the description of the case studies fac-sheets

Table of contents

Disclaimer 1
Disclaimer 2
Copyright 2
Document history 2
Table of contents 3
List of Figures 3
List of Tables 4
The Knowledge Bank 5
Article 1: KPIs and evaluation framework for CCAM 6
Article 2: CCAM challenges gathered from co-creation activities 11
Use cases 14
Conclusions and future steps 17

List of Figures

Figure 1 Homepage of Move2CCAM's website with drop-down menu

Figure 2 Knowledge Bank landing page inside Move2CCAM's webpage

Figure 3 Article page on the Knowledge Bank

Figure 4 Article page on the Knowledge Bank

Figure 5 Challenges identified during Move2CCAM activities related to AVs systems

Figure 6 and 7 Use Cases fact sheets on the Knowledge Bank page inside Move2CCAM's website

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

Figure 8 Example of Use Case fact sheet in the Knowledge Bank

List of Tables

Table 1 List of KPIs identified in Move2CCAM activities

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

The Knowledge Bank

The Knowledge Bank has been integrated as a new page under the project's resources in the Move2CCAM (https://move2ccam.eu/index.php/resources/knowledge-bank/), as shown in Figure **1** and Figure 2. This page aims to offer website visitors a dedicated space in which they can learn about the key insights from Move2CCAM's deliverables and outcomes.

The content available encompasses a wide range of topics, including a comprehensive review and detailed descriptions of various use cases and scenarios, in-depth insights into mobility and transport challenges, and an overview of key performance indicators (KPIs) co-created together with Move2CCAM's Satellites.

Beyond compiling information, this new page features an interactive component: an open blog entry within each individual page to gather feedback from visitors. Visitors will not just passively consume content; they'll be encouraged to actively engage by providing their real-time feedback, thoughts, and suggestions on the information presented. This feature underscores the project's commitment to continuous improvement and feedback from the Satellites and community beyond the project's timeline.

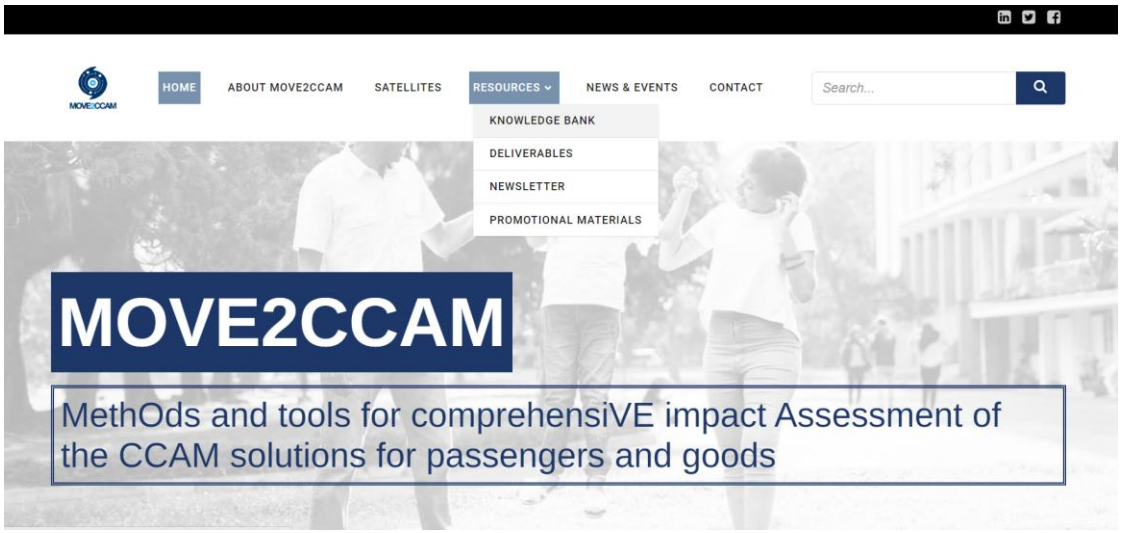
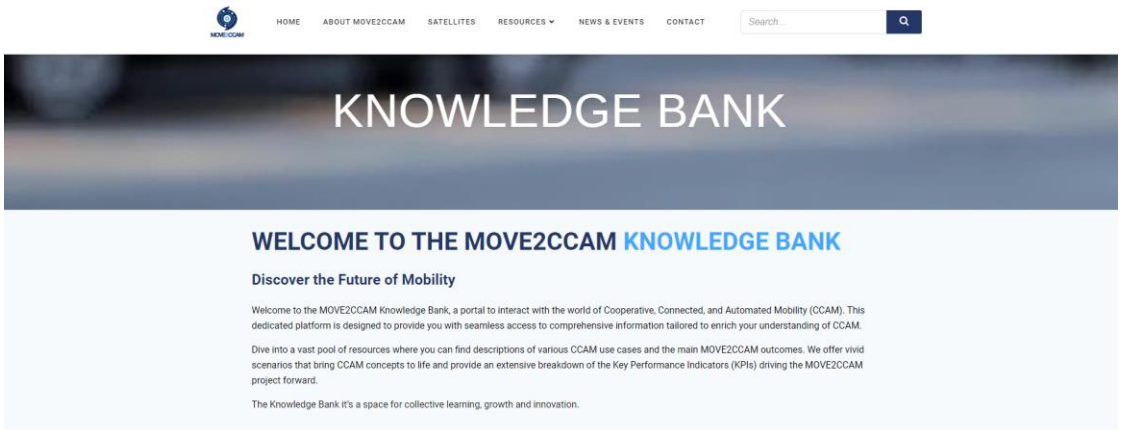


Figure 1. Homepage of Move2CCAM's website with drop-down menu



Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

Figure 2. Knowledge Bank landing page inside Move2CCAM's webpage

As a first article in the Move2CCAM Knowledge Bank, the "KPIs and Evaluation Framework for CCAM" article, as seen in **Error! Reference source not found.**, summarises the results from the co-creation activities 1 and 2 with citizens and Satellite organisations across the eight Move2CCAM regions. These results have been compiled and presented in D1.2 CCAM use cases, business model, scenarios and KPIs.

Article 1: KPIs and evaluation framework for CCAM

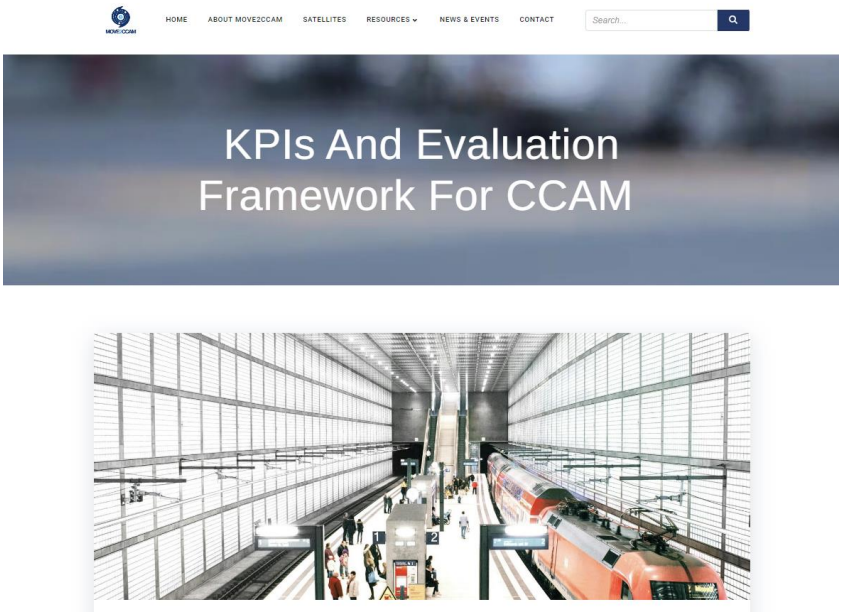


Figure 3. Article page on the Knowledge Bank

MOVE2CCAM aims to develop an assessment tool though Systems Dynamic Modelling (SDM). The tool will enable stakeholders to assess the implications of deploying CCAM solutions for future timeframes (2025, 2030, 2050). The model of the IAMT tool will comprise variables and cause-effect relations, reflecting the attitudes of the Move2CCAM Satellites towards different impact domains across several CCAM use cases. The domains evaluated are mobility, safety, public health, economy, environment, ethics, efficiency of road network and cybersecurity. The impact evaluation within these domains will be done through a set of indicators developed through the project's activities.

KPIs and Evaluation Process

The Systematic Dynamic Model (SDM) assesses the impact of CCAM (Cooperative, Connected, Automated, and Autonomous Mobility) solutions. To achieve this, an evaluation framework is created, consisting of dimensions, fields, indicators, and boundaries (like city level or CCAM solution type).

The evaluation framework follows four stages:

1. **Identification of Aspects**: the goal is to recognize which areas are influenced by CCAM solutions and how to evaluate them using indicators. Over 250 indicators were found through an extensive literature review, considering various dimensions such as mobility behaviour and the environment. This stage's output is a draft version of potential indicators.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

2. **Definition of Indicators:** descriptions of the indicators were organized and aspects such as the indicator's name, type, calculation method, and associated dimension were detailed. Project partners CARTIF and MOBY then analysed these indicators, selecting those clear and easy to measure, while removing redundant or unclear ones.

3. **Data Availability Identification:** the project identifies where the data for each indicator can be sourced. An excel file, designed in the prior stage, will help pinpoint data availability for each area and, if feasible, link directly to the raw data source.

4. **Validation of Indicators in Co-Creation Activities**: participants from different activities will highlight potential impacts and effects of autonomous vehicles. They're expected to produce a flowchart showing interconnected impacts from chosen CCAM solutions. A separate group will validate these indicators, ensuring they're suited for the project's objectives.

During the implementation of the first activities some challenges occurred for the implementation of this framework. The initial plan was to discuss these indicators during co-creation activities 1 and 2. Due to time constraints, this didn't happen, so the consortium devised the above-mentioned stages as a workaround. This research revealed that indicators sometimes have different names, and calculation methods, or aren't always clearly defined. Despite these challenges, the project seeks to provide a comprehensive system for assessing the effects of CCAM solutions.

The table 1 shows the project's identified 90 KPIs, which can measure both current and future scenarios in cities and regions. These indicators also assess the performance of mobility services compared to conventional vehicles. They can be calculated using various metrics, such as per inhabitant, passenger, distance, trip, or vehicle. The finalized list of these indicators, along with their definitions, will determine the approach for the project's impact assessment, the data required for each indicator, and the data's availability in the prototype areas.

Table 1 List of KPIs identified in Move2CCAM activities

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

Dimension	Field	Indicator
Environment	Air quality	Nitrogen oxide emissions
		Fine particle matter emissions
		Ozone concentration
	Climate Change	Greenhouse gases emissions
	Energy Consumption	Energy consumption
		Fuel mix
		Renewable energy penetration
	Noise	Noise level
Mobility behaviour	Travel & Transport demand	Distance travelled
		Daily trips
		Trip length
		Commuting distances to go to work
		Number of planned trips per hour
		Share of trips made during peak hours
		Travel & Transport purpose
	Travel time	Timing of travel
		Average trip duration
		Peak period for travelling
	Transport mode	Modal split / Transport mode share
		Number of multimodal trips
		Share of children walking or cycling to school
		Public transport use
		Number of users of public transport services
		Number of passengers with concession/subscription tickets in public transport
	Vehicle features	Average age of vehicles

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

		Average vehicle occupancy
		Average vehicle speed
		Four-wheel motorized vehicles
		Two-wheel motorized vehicles
		Number of freight vehicles
Network efficiency	Network capacity and traffic flow	Travel/transport demand
		Punctuality of transport services
		Delays in transport system
		Average speed on the road
		Congestion
	Travel time	Timing of travel
		Peak hours
		Total journey time
		Wait time
		Connecting time
		Parking search duration
	Accessibility	Public transport stops
		Distance between transport modes
		Access to transport services at any time
	ICT extent	Road equipped with a real-time ICT-based system
		Traffic alerts at real time
Land Use	Urban Land	Surface
		Population density
		Urban compactness
		Pedestrian areas
	Transport space	Space dedicated for motorized vehicles
		Space for the circulation of bicycles
		Space for parking

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

		Length of lines for public transport
Safety	Collision	Traffic accidents in the road
		Traffic accidents in the city
	Security	Cyber attacks
Health	Persons affected in traffic accidents	Number of fatalities due to traffic accidents
		Number of injuries due to traffic accidents
	Access to healthcare	Time required to reach the nearest health centre
		Travelling cost to reach the nearest health centre
	Access to services and leisure	Time required to reach the nearest shopping centre/supermarket
		Travelling costs to the nearest shopping centre/supermarket
		Time required to reach the nearest library
	Air pollution exposure	Days exceeding critical levels of emissions
		Population exposed to air pollution due to transport
	Quality of life	Number of elderly people feeling alone
		Time gained (avoided congestion, waiting time avoided, time liberated for use to work, entertainment, etc)
Equity	Transport accessibility to vulnerable groups	Share of public transport adapted to mobility - impaired groups

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

As a second article in the Move2CCAM Knowledge Bank, the "Challenges Gathered from Co-Creation Activities" article, as seen in Figure 4, summarises the overall contributions of participants regarding their local challenges in freight transportation and passenger mobility across the eight Move2CCAM regions. These results have been compiled and presented in D1.2 CCAM use cases, business model, scenarios and KPIs.

Article 2: CCAM challenges gathered from co-creation activities

Figure 4. Article page on the Knowledge Bank

The MOVE2CCAM project aims to develop a tool for assessing the impact of autonomous vehicles (AVs) on passenger and freight transport using systems dynamic modelling. To gather the data required for modelling the tool, the project has collected perceptions from different co-creation activities across eight European countries where project partners are located: UK, Spain, France, Germany, Cyprus, the Netherlands, Poland, and Greece. The project will engage a total of 8,768 citizens and 300 organizations, encompassing businesses, authorities, research entities, and NGOs in mobility, ICT, and health sectors.

Co-creation Activities & Their Findings

The first 2 co-creation activities focused on developing use cases (gathered on the Knowledge bank) for both passenger transportation and freight through autonomous vehicles and identify their own local transportation challenges. Activity 1 co-created with organizations and activity 2 with citizens. Both aimed to gather ideas about autonomous vehicles for the travel and mobility needs of organizations and the public, while identifying challenges, potential impacts, and deployment timelines.

Challenges Identified

As shown in Figure 1, eleven primary challenges surrounding the adoption and implementation of AVs in the different research countries were identified. Taking into account the total number of participants, from both organisations and citizens, Figure 5 shows the percentage of participants that identified this challenge.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

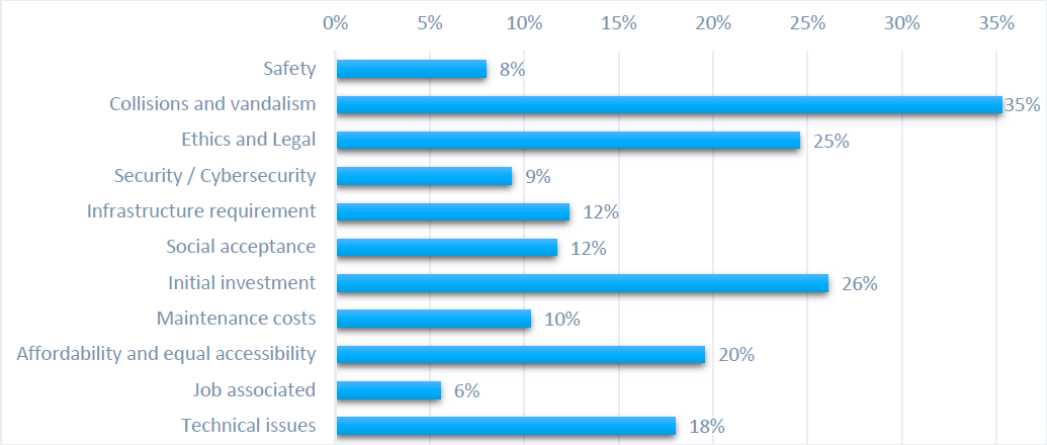


Figure 5. Challenges identified during Move2CCAM activities related to AVs systems

Each challenge is presented below, accompanied by its relevance across the eight countries:

Safety - Safety was highlighted as a critical concern for the development of autonomous vehicles. Participants emphasized potential risks like theft or harm to vehicle occupants, with elderly, children, disabled individuals, women, and immigrants identified as especially vulnerable. Helpdesk and road assistance were suggested as solutions for breakdowns or user needs. 8% of participants discussed safety concerns, with varying numbers reporting from different countries: 6 from the Netherlands, 4 from Greece, 3 each from Germany, Poland, and the UK, and 1 each from Cyprus, Spain, and France.

Collisions and Vandalism - Concerns circled around potential AV collisions and acts of vandalism. Issues like fare evasion due to the absence of onboard staff and the vehicle's hygiene were also broached. 35% of participants from activities 1 and 2 mentioned these concerns. Country-wise contributions are as follows: 26 from Greece, 21 from the UK, 15 from Spain, 11 each from Germany and the Netherlands, 10 from Poland, 6 from France, and 4 from Cyprus, Spain and France.

Ethic and Legal - This challenge encompass concerns about determining liability in the event of accidents with autonomous cars and deciding who should provide insurance. Questions were raised about the minimum age to use such cars and the need for legislative adaptations. Ethical dilemmas include deciding whom to prioritize in a collision. 25% of participants from activities 1 and 2 addressed these ethical and legal issues, with specific participation numbers from the UK (16), France and Greece (12 each), Germany (10), Cyprus, Spain, and Poland (5 each), and the Netherlands (4).

Security/Cybersecurity - Participants voiced concerns over the privacy and security risks associated with autonomous vehicles (AVs), especially regarding data collection for surveillance and the potential for hacking or cyber-attacks leading to vehicle malfunctions. 9% of participants across both activities highlighted these security and cybersecurity concerns. Specifically, this challenge was noted by participants from Greece (11), the Netherlands (6), Spain, Poland, and the UK (3 each), Germany (2), and France (1). No participants from Cyprus mentioned this issue.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

Infrastructure Requirement - Participants emphasized challenges for autonomous vehicles (AVs) in navigating complex urban designs prevalent in many European cities. Concerns were raised about AVs operating in areas where they might struggle to perceive their surroundings or where required infrastructure is lacking. Greater risks were associated with mixed traffic conditions than with a complete AV deployment. 12% of participants across activities mentioned challenges related to urban design or road infrastructure interactions. These concerns were voiced by participants from Greece (22), Germany (6), Spain, the Netherlands, and the UK (3 each), and Cyprus and Poland (2 each). No feedback on this was reported from France.

Social Acceptance - Participants discussed the potential rejection of AVs by citizens due to mistrust or lack of interest, as current transport needs might already be met by existing services. This could lead to reduced investment from vehicle manufacturers and a reluctance by municipalities to adopt AVs. 12% of participants across activities mentioned concerns related to the public's potential rejection of AVs. Feedback came from Greece (11 participants), the UK (5), Cyprus, Spain, and Poland (4 each), France (3), and Germany (2). There were no reports on this challenge from the Netherlands.

Initial Investment - Participants highlighted concerns about the high costs of autonomous vehicles, including the initial investments in infrastructure and sensors. This could also influence the pricing of transport services provided by these vehicles. There's a need for viable business models to ensure profitability for companies and affordability for the public. 26% of participants across activities identified high initial investment as a concern. Feedback came from Greece (20 participants), Spain (17), the UK (16), Germany (11), France (5), Cyprus (4), Poland (3), and the Netherlands (2).

Maintenance Costs - While some participants saw the potential for reduced maintenance costs, others were concerned about the novelty and associated repair costs of the technology. The average relevance of this challenge shows that 10% of all participants involved in activities 1 and 2 mentioned any question related to maintenance costs. The relevance of this challenge indicates that was reported by 16 participants from Greece, 5 from UK, 4 from Spain, 3 from Germany and France, 2 from Poland and 1 participant from Cyprus. Nobody from the Netherlands reported this impact.

Affordability and Equal Accessibility - Participants discussed concerns that the high costs of autonomous vehicles (AVs) might make them only accessible to the wealthy and emphasized the need for these vehicles to accommodate those with limited mobility. There were debates about where AV services should first be introduced. Rural residents felt AVs could address transportation gaps for vulnerable groups like the elderly and attract young people, potentially stabilizing rural populations. Yet, some believed decision-makers might prioritize urban areas for AVs due to higher rural implementation costs and the hesitance of older people to use them. 20% of participants touched on affordability and equal accessibility. Feedback was provided from the Netherlands (13 participants), the UK (11), Poland (9), Germany (8), France and Greece (5 each), and Spain (4). No feedback came from Cyprus.

Jobs Associated with AVs - Participants expressed concerns about job losses resulting from the introduction of autonomous vehicles (AVs). While some noted AVs could create new roles, these would likely be technical or specialized positions. 6% of participants raised concerns about job impacts, with feedback coming from Spain (4 participants), Germany, Poland, and the UK (3 each), and Cyprus and France (1 each). No feedback on this issue was received from Greece or the Netherlands.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

Technical Issues - Participants raised concerns about potential technical issues with autonomous vehicles, including technology failures, electronic malfunctions, battery life, GPS inaccuracies, and internet connectivity problems. They also emphasized the importance of punctuality, sufficient vehicle frequency, and the availability of charging stations. 18% of participants mentioned these technical challenges. Feedback was primarily from the UK (16 participants), Greece (11), Germany (9), Spain and Poland (6 each), with limited input from Cyprus and the Netherlands (1 each).

The varied concerns raised by participants from different European countries highlighted the differences in socio-cultural beliefs, economic realities, and infrastructure challenges that exist across the continent. Each country's unique history, culture, and socio-economic conditions play a pivotal role in shaping citizens' perceptions and apprehensions towards new technologies like AVs. For instance, a historically pedestrian-centric city might view AVs differently than a city designed around automobiles. Similarly, a country with a robust technology sector might emphasize cybersecurity concerns more than a country where infrastructure development is the primary concern. For these reasons, MOVE2CCAM uniquely addresses the myriad challenges surrounding autonomous vehicles (AVs) in Europe. By actively engaging diverse stakeholders from multiple countries, it captures a broad spectrum of concerns, from infrastructure to socio-economic implications. This inclusive, bottom-up approach ensures that solutions aren't just technically feasible but are also tailored to the socio-cultural and economic landscapes of each nation. Through its holistic analysis, stakeholder engagement, and emphasis on inclusivity and awareness, MOVE2CCAM offers a roadmap that is both adaptable and forward-thinking, turning challenges into opportunities for the successful integration of AVs.

Identifying these challenges served as a starting point for co-developing numerous use cases and consequently, the corresponding business models that would provide an answer to the local mobility and transport challenges.

Use cases

The Knowledge Bank website features a comprehensive collection of use cases (see Figure 6 and Figure 7), meticulously developed during the co-creation activities by participants of Move2CCAM. For each case study, the website provides a detailed fact sheet, which includes a thorough description, the specific goals targeted, and the underlying business model. This curated compilation serves as a valuable resource for stakeholders, offering insights and practical examples of the innovative approaches undertaken in the Move2CCAM initiative.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

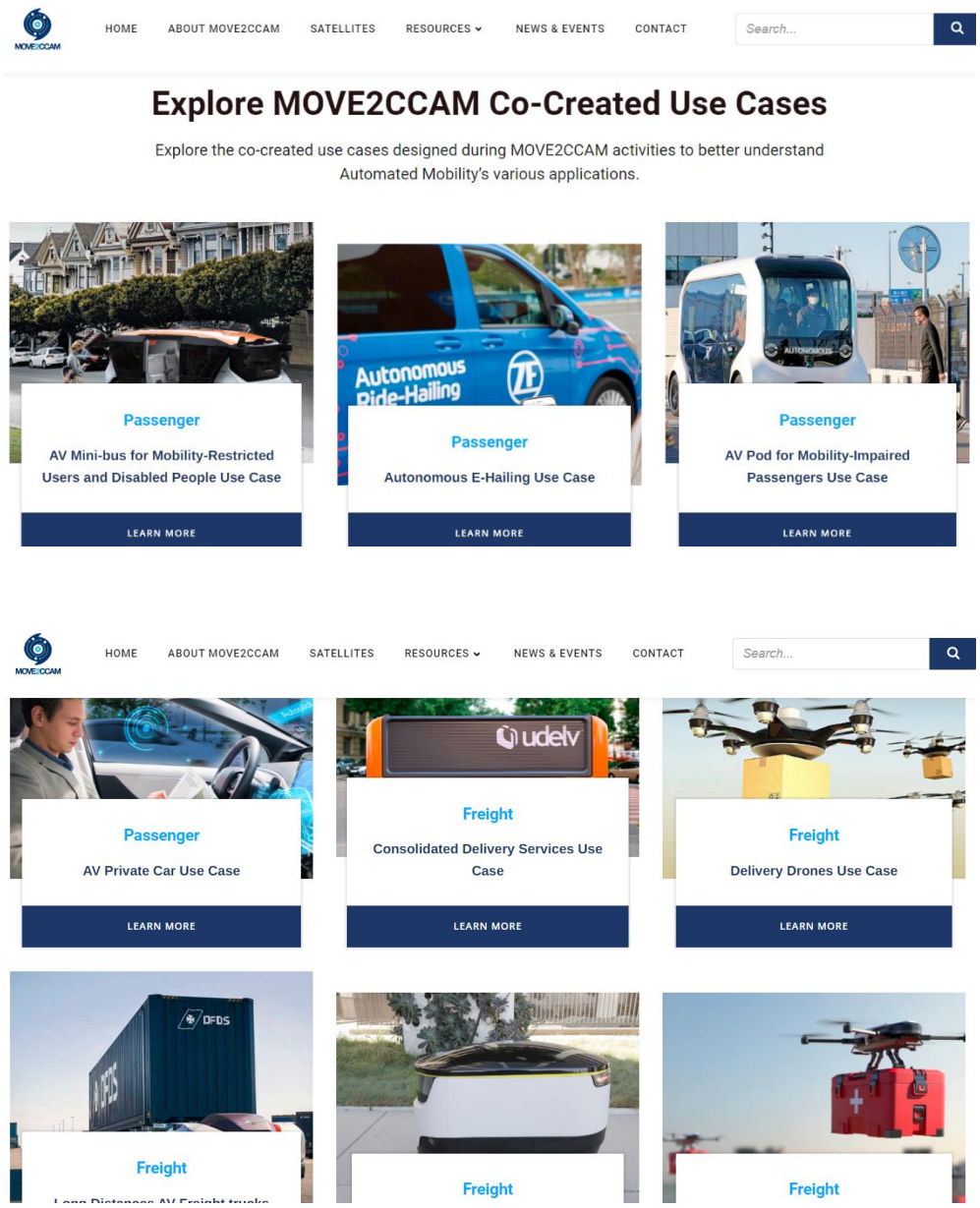


Figure 6 and 7. Use Cases fact sheets on the Knowledge Bank page inside Move2CCAM's website.

After clicking on one of the icons, the page redirects the visitor on each use case's fact sheet page. The fact sheets (Figure 8) present a comprehensive and engaging overview, including a thorough description, detailing the context and scope of the use case, and painting a vivid picture of how it integrates within the broader Move2CCAM initiative. The goals are clearly outlined, providing insight into the targeted outcomes and the impact they aim to achieve. Furthermore, the fact sheets delve into the business model underpinning the use case. This section is particularly informative, revealing the strategic approach adopted, and the resources and investments allocated.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

30.11.2023

Move2CCAM AV Pod for mobility-impaired passengers Use Case

3

This Use Case was co-created by citizens and organisations of the Move2CCAM project Satellites. Any information on this post is provided for research and informational purposes only and is not to be relied upon as a real-life implementation whatsoever.

Overview

Description: Pod vehicles with exceptional boarding features that will be able to transport impaired passengers to the preferred destination. The vehicle includes surveillance characteristics that will ensure a controlled ride for any.

Goal: The AV pod for mobility-impaired passengers service aims to increase and enhance accessibility, safety, and inclusivity in transport. This autonomous transport service, with its distinctive surveillance capabilities, ensures not only a controlled but also a secure ride for every individual onboard, offering them an embodiment of safe, independent mobility. By fostering a system that respects and facilitates unassisted travel for individuals, irrespective of their physical abilities, the service not only amplifies their autonomy in commuting but also fortifies a model of inclusive transit in the societal framework. Furthermore, the scheduled system underpinning the service ensures consistent, reliable, and punctual transportation, providing passengers, particularly those who might be habitually disenfranchised by conventional transport options, a steadfast and dependable mobility solution. Thus, through its endeavors, the service aspires to bring forth a future where technological advancements in transport are inherently synonymous with elevating accessibility, safety, and inclusivity for all segments of the population.

Co-created by: Citizens and organisations in France.

Potential business model

- **Revenue stream:** The service, owned by a private healthcare service provider company, will primarily create revenue through its transportation service. Offering two payment options; pay-per-use and a monthly subscription. The pay-per-use will combine variables such as duration of ride and travel distance to determine the price of the service.
- **Users/customers:** All genders users with restricted mobility, 12yo and above, residents of both rural and urban areas.

Photo credit: Toyota e-Palette

Move2CCAM is funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

Figure 8 Example of Use Case fact sheet in the Knowledge Bank

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

Conclusions and future steps

In conclusion, the integration of a new dedicated page into the Move2CCAM website marks a significant stride in enhancing visitor engagement and information dissemination within the project. This page is not just a repository of information; it's a dynamic space designed to facilitate easy understanding of Move2CCAM's outcomes through simple knowledge pages from CCAM insights to detailed use case explorations and KPI analyses.

More importantly, this page stands out for its interactive component – a feedback system that transforms visitors from passive recipients to active contributors. This feature aligns perfectly with the project's character of continuous improvement and community involvement. Ultimately, the Knowledge Bank embodies a live document that will continue to be populated during the project with additional findings of the reviewed topics such as information about CCAM solutions business and operational models, technology, data and infrastructure requirement and material that will be used as a basis to build on to achieve the following objectives.

https://twitter.com/Move2C/

https://www.linkedin.com/company/move2ccam/

www.move2ccam.eu

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.