CulturalRoad

Cocreate, Embrace

Project deliverable D3.1

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EXECUTIVE SUMMARY

The CulturalRoad project aims to support the development of equitable, widely adopted Connected, Cooperative, and Automated Mobility (CCAM) solutions by integrating geographical and cultural diversity into both policy and technical design. As part of this effort, the project has developed a two-step Participatory Co-Creation Framework intended to guide policymakers, researchers, and practitioners in systematically incorporating diverse perspectives into CCAM planning and evaluation. This deliverable presents the methodology behind this framework and reports the results of its first step.

The first step of the framework focuses on structured engagement with key stakeholders through workshops conducted across all CulturalRoad demonstration sites. This document outlines the qualitative data collection and analysis procedures used, describes the scope and objectives of the workshops, and details how the approach supports related activities in WP1, WP2, and WP4. It further provides site-specific accounts of how the methodology was implemented, including the thematic focus adopted at each site, the types of stakeholders involved, and the principal findings emerging from the workshops.

The cross-country analysis indicates that stakeholders hold a balanced view of CCAM, discussing benefits and barriers at a comparable level, with governance and regulations emerging as dominant concerns across countries. CCAM is not primarily defined as an issue of technology as it is as a system-level change in mobility services and public transport. While psychological and ethical issues received limited specific attention, regulatory conservatism and Europe's perceived disadvantage over international competitors were frequently emphasised. In general, stakeholders believe that the success of CCAM depends on equitable implications, policy design, and integration into current mobility systems. This insight will be essential in shaping the second step of the framework, which will engage end users through focus groups and is reported separately in D3.2. The following key insights were observed in the different demonstration sites:

- Barcelona (Spain): Stakeholders perceive CCAM mainly as a governance and system-integration challenge, rather than a technological one. Acceptance is conditional on clear regulatory frameworks, interoperability, and coordination across public authorities. Value is expected to emerge only from well-defined, context-specific use cases supported by real-world pilots.
- Eilat (Israel): Stakeholders expressed a strongly positive and innovation-oriented view of CCAM, particularly regarding safety improvements and public transport modernisation. At the same time, ethical and regulatory frameworks are seen as insufficiently defined. Successful deployment is expected to depend on infrastructure readiness and close alignment with user needs.
- Karlsruhe (Germany): Discussions were marked by pragmatic optimism, with emphasis on deploying CCAM only where it adds clear value beyond existing public transport. Accessibility and inclusion were highlighted as essential but often overlooked design requirements. Fragmented governance and approval procedures were identified as key barriers to scalability and acceptance.
- Ljubljana (Slovenia): Stakeholders see CCAM as a potential tool to improve accessibility and address commuting challenges, particularly for vulnerable and suburban populations. However, limited experience and the absence of pilots lead to a cautious approach. CCAM is expected to complement public transport and be embedded in strategic mobility planning frameworks.
- United Kingdom (Oxfordshire and West Midlands): CCAM is primarily framed as a policy and system-integration issue, closely linked to transport planning and network management. Stakeholders stressed the need for alignment with existing strategies and national standards. Acceptance is seen as dependent on clear governance, safety assurance, and demonstrable public value

The findings show that the successful deployment of CCAM in Europe depends less on technological readiness than on coherent governance, regulatory clarity, and integration with existing mobility systems, with early stakeholder and user engagement being essential to ensure equitable, trusted, and context-

appropriate implementation. By documenting both the methodology and the outcomes of the first step, this deliverable establishes the foundation for a structured, reproducible co-creation process that can inform equitable CCAM development across diverse cultural and geographical contexts.

LIST OF ABBREVIATIONS AND ACRONYMS

Acronym	Meaning
AMB	Barcelona Metropolitan Area
AMN	Automated Mobility Network
ATM	Autoritat del Transport Metropolità
BSI	British Standards Institution
CCAM	Cooperative, connected and automated mobility
CAM	Connected and Automated Mobility
DX.X	Deliverable X.X
DTU	Technical University of Denmark
FG	Focus Groups
LA	Local Authorities
LTCP	Local Transport and Connectivity Plan
NMP	Network Management Plan
NUMP	National Urban Mobility Policy and Investment Program
OCC	Oxfordshire County Council
PDMM	Mobility Master Plan
PT	Public Transport
SEND	Special Educational Needs and Disabilities
SUMP	Sustainable Urban Mobility Plan
TfWM	Transport for West Midlands
UK	United Kingdom
WMLTP	West Midlands Local Transport Plan
WP	Working Package
WS	Workshops

1 INTRODUCTION

1.1 Purpose of the document

The CulturalRoad project seeks to ensure that Connected, Cooperative, and Automated Mobility (CCAM) solutions reflect cultural and geographical diversity. To support this, a participatory co-creation framework is developed and tested in the five demonstration sites of the CulturalRoad project: the United Kingdom (Oxfordshire and West Midlands metropolitan county area), Slovenia (Ljubljana region), Spain (Barcelona Metropolitan Area), Germany (Karlsruhe municipality), and Israel (Eilat municipality).

This Deliverable describes the progress made in Working Package 3 (WP3) in developing and implementing this participatory co-creation framework. WP3 started during Month 12 (M12 - April 2025) and is expected to terminate in M32 (December 2026). The Deliverable is structured as follows. This chapter describes the scope of the deliverable, the progress toward achieving its milestones and objectives, as well as the intended audience and the connected deliverables. The next chapter introduces in detail the methodological framework. Five chapters follow, each of which describes the implementation in each of the five demonstration sites. These chapters describe the general context in each demonstration site, the broader and specific goals of the cocreation exercise, the data collection methods, and concludes with a description of the results. It should be noted that, while these chapter following the same structure, some of the information describing the context of the demonstration site may differ. This is a reflection of the heterogeneity of data, scales, and contexts between demonstration sites. Finally, the last chapter introduces cross-country analysis and lessons learned. Simple statistics and quantitative analysis used for consistency checks and data quality control are presented in the Appendix.

1.2 Progress towards achieving the objectives

In M20 (December 2025), WP3 is expected to conclude two Milestones in addition to the current Deliverable. All these objectives have been concluded.

M3.1 Target groups identified: In CulturalRoad, target groups are groups of potential end users who share similar characteristics and, potentially, similar needs. This milestone sets the objective that all demonstration sites have to identify potential target groups of end users for the focus groups by M13. The Milestone was achieved in M12. Each demonstration site prepared by this date a list of potential users, as well as grouped them into one or more focus groups.

M3.2 First step of participatory planning completed: This milestone sets the objective that all demonstration sites had to conclude at least the first wave of workshops in their country by M19. The Milestone was achieved in Month 10. Each demonstration site had to submit anonymized translations of the workshops to DTU in the form of abbreviated transcripts. The controller – DTU – anticipated the deadline for this deliverable as it would have been otherwise necessary to either postpone D3.1 or submit this deliverable without any result, due to the short time between M3.1. and D3.1 in the original timeline.

1.3 Intended audience

This document is primarily intended for the public audience. Its main purpose is to inform both citizens and the European Commission about the progress of CulturalRoad, while also providing clear guidelines on how the co-creation framework was implemented, with a specific focus on reproducibility. In addition, the evidence presented here is meant to support both policymakers and the scientific community in gaining a deeper

understanding of the challenges involved in developing CCAM solutions in Europe, particularly in contexts shaped by geographical and cultural diversity.

1.4 Connection to other Deliverables and Working Packages

As discussed in the next chapter, this deliverable complements D1.3 and D3.2. Together, the three documents form a coherent set that complements and completes one another. More specifically, D1.3 (*Details of the survey, experiments, interviews and workshops, including the results from the travel survey*) outlines the methodologies used in the project from a general and scientific perspective. Building on that foundation, the present deliverable applies those methodologies to the first step of the co-creation framework. D3.2 (*Report on the Demonstration Sites deployment and lessons learnt*) will then complete the set by presenting the results of the second step.

In addition, this deliverable directly supports the activities in WP2 and WP4.

WP2: Psychological factors are initially explored in the focus groups. Consequently, aspects related to psychological factors and CCAM implementation should appear not only in D3.2 (*Results of the test of the Five-Pointed Star Rating System*) but also in D2.3 (*Definition of key matrices and diversity maps. Final recommendations for its application*).

WP4: WP4 focuses on implementing the Five-Pointed Star Rating System across all demonstration sites. Beyond contributing to the understanding of psychological factors, this work package is expected to draw on the analyses developed in WP3, helping translate the insights from CulturalRoad into concrete policy applications.

Both links to WP2 and WP4 rely largely on the outcomes of the second step, or on the combined results of both steps, of the co-creation framework. Consequently, this deliverable is most closely connected to D3.2, which presents these results and therefore completes the picture provided here.

2 METHODOLOGY

2.1 Participatory co-creation framework

The CulturalRoad project adopts a participatory a two steps co-creation framework, engaging industry, civil society, governmental authorities, and research institutes to identify stakeholders' actual needs and incorporate them into concrete deployment plans that are understood and accepted by all parties involved. The process is summarized in Figure 1. The first step of the participation process involves stakeholders in a series of dedicated workshops (WSs) to provide inputs for developing an effective and equitable Cooperative, Connected and Automated Mobility (CCAM) deployment and identifying the population segments most likely to be affected. In the second step, Focus Groups (FGs) are organized with representatives from each identified target group to ensure their needs are included in the deployment plans. These steps may be repeated multiple times to reach an agreement among the stakeholders.

Figure 1 – Participatory Co-Creation framework

Deliverable 1.3 (D1.3) 'Survey, experiments and the survey data in each city' is a companion to this section, and the two should be considered together to get a full grasp of the co-creation approach used in the CulturalRoad project. More specifically, Section 2 in D1.3 provides details on the organization of focus groups and workshops, with general indications about the sampling methods, recruitment strategies, question development, facilitations and arrangements, logistic, and data handling. However, the text in D1.3 is general, and meant for replicating the same process in different cities. In this Deliverable, we focus more concretely on the deployment of the First Step (the WS) and provide more details on how these aspects have been implemented at each demonstration site.

Details about the logistic, sampling methods, the selection criteria for the stakeholders, the goal of the co-creation exercise and the envisioned deployment of the framework presented in **Figure 1** for each demonstration site are discussed in each demonstration site-specific chapter, This chapter, focuses instead on detailing the questions used in the different demonstration sites, the goal of each question, and the labelling of the data.

2.2 Demonstration site specific goals

For each demonstration site, the approach proposed in **Figure 1** has been adapted to the local context. The following main goals have been identified previous organizing the workshop.

Table 1 – Demonstration Site Specific Goals

Demonstration Site	Goal
Barcelona	Update the CCAM deployment map for the region of Catalunya to account for the needs and perceptions of all stakeholders and end-users.
Eilat	Evaluation of the feasibility of CCAM deployment from Ramon Airport to key city locations, including last-mile air travel options, with a focus on identifying barriers faced by elderly individuals and people with disabilities as well as tourists.
Karlsruhe	Enhance acceptance of CCAM solutions by using virtual reality to explore expectations, needs, and information requirements of diverse users.
Ljubljana	Development of the white paper for CCAM guidelines focusing on mobility needs of vulnerable groups such as elderly individuals, people with disabilities, and students/commuters from suburban and rural areas. The paper will evaluate the potential for CCAM deployment in enhancing urban mobility, improving accessibility, and addressing key challenges in public transportation. It will explore the role of automated and connected vehicles in reducing congestion an enhancing sustainability.
United Kingdom	Development of a deeper understanding of local communities, their mobility needs and expectations for CCAM technologies, to inform: - Objective 1: Network Management Plan and future Local Transport & Connectivity Plans; support integration with internal traffic management systems and viable infrastructure

	planning; and contribute to the OCC Innovation Framework as a model for futureproofing. - Objective 2 : Feeding into national standards through the BSI CAV Safety Advisory Board and supporting the Department for Transport in the development of future CCAM guidance for the UK. - Objective 3: which sets out policies to promote safe, integrated, efficient and economic transport to, from and within the West Midlands Metropolitan conurbation, as well as plans to implement those policies. The Core Strategy has been approved and work is now underway on defining four area strategies to cover the metropolitan area.

After the goal was defined, a list of stakeholders and potential target groups was identified. When it comes to the workshop organization, given the heterogeneity of goals and stakeholders, the following three approaches were used for the first step of the co-creation framework:

- One-to-one Interview: Face-to-face (physical or in presence) interview with a single stakeholder
- Focus-group-like Workshops: small, structured discussion between a small group of stakeholders to gather people's opinions, experiences, or attitudes about a specific topics. These were conducted online or in presence, depending on the preferences of the involved stakeholders.

In multiple cases, a combination of one-to-one and focus-group-like workshops was used. This allowed on one hand to reach more stakeholders, on the other hand avoiding possible conflicts due to either the presence of competing stakeholders or relations of powers. In any case, all stakeholders were asked the same set of questions.

2.3 Workshop Preparation

As a guideline, once the workshop was organized, the following structure has been used. This does not apply to one-to-one interview, where instead the interviewer was providing a presentation of the project.

1. Before the WS:
    a. Participants are sent an online (consent forms, sign-in forms) form prior the workshop (minimum one day). If the workshop is physical, this can also be done on-site.
    b. Confidentiality of data: All information is confidential; however, the discussion will be recorded without identification of the speakers later in the transcribing. If someone denies, the session should not be recorded, instead the moderator assistant must transcribe the discussion. In the case of an online workshop, this may be declared in advance and signed digitally. It should be clarified that the information regarding the participants characteristics' (name, age, gender, car ownership, workplace/stakeholder) will be used in the project anonymously. When presenting the results, names will be anonymized. The same will apply to the type of stakeholder's name.
    c. In the case of a physical event, position the recording equipment in appropriate locations
2. Welcoming & Introduction (10 minutes)
    a. Introductions of the moderator, assistant moderator, and possibly participants (if they want).

   b. Distribute the consent forms, sign-in forms (if in presence).
3. Brief introduction of the research goal and of the CulturalRoad project. (10-15 minutes)
   a. Show the Cultural Road video (https://youtu.be/lzGzCMLEEKw)
   b. Short introduction of the Demonstration Site specific goals
   c. Possible Q&A about the project from the VP
   d. Introduction of the ground rules of the session declared by the moderator:
      i. Explain that all participants should be engaged in the discussion
      ii. Explain that the goal is to gather opinions/experiences. The participant are allowed to deviate from the script.
      iii. Ground rules for discussion (e.g., respect, open dialogue, let people finish)

- Activate the recording equipment, if all participants consent to be recorded.

4. Questions/Discussions (75-140 minutes, depending on number of participants)

- Closure: Thank participants (in this project, there is no incentive for participating in the study) and stop recording devices/phone and rename/save the audio file.

2.4 Workshop Script

A standard set of questions was established in agreement with all the partners. The script follows the structure and logic discussed in D1.3. It is divided into five topics. Each Topic has two questions. In addition, there are main, prompt, and probe questions. For each topic, its objective is clearly stated. A total of seven main questions were set.

An additional sixth topic was added but left as optional due to both timing constraints and partial overlaps. The script was translated by each local team at each demonstration site in the local language and adapted. The topics and main questions have essentially been kept the same in each demonstration site. However, prompt and probe questions had often been reduced and adapted to better fit the local context. Similarly, the decision to include the last topic was left to the local organizing committee.

The questions in the text are purposely general, so that stakeholders are free to focus on what is important for them and not biased from narrow or specific questions. While local modifications were needed to consider the specifics of each context, the basic structure and goals of the script remained the same in each demonstration site to compare results.

Table 2 – Reference Script used in all Demonstration Sites

Workshop	Main Questions	Prompt Questions	Probe Questions	Objective
Topic 1: Engagement	**T1Q1: AM Involvement** How familiar are you with the autonomous mobility? How is your organization involved in autonomous mobility?	• What experiences or news have shaped your view on automated mobility? • Are there specific projects or use cases you're aware of?	• How familiar are you with CCAM pilot programs in your region?	Allow stakeholders in the workshop to know the position of the other stakeholders
Topic 2: Accessibility and barriers	**T2Q1: External Challenges** What do you think are the main challenges in deploying autonomous mobility?	• What are the main political barriers? • What are the main societal barriers? • What are the main barriers for business?	• How could we approach these aspects in upcoming end-user sessions?	Identify external barriers (and enablers) for CCAMs. Specific focus on political and societal barriers.
	T2Q2: External Opportunities What do you think are the main opportunities in deploying autonomous mobility?	• What are the main opportunities for the society? • What are the main opportunities for policy makers? • What are the main opportunities for business? • How might cultural or economic diversity influence CCAM uptake? **[ask if it has not been discussed in T2Q1 or T2Q2]**	• How do U.S. and Asia's approaches to CCAM affect operators differently and compared to European approaches?	
Topic 3: Technology	**T3Q1: Technological Challenges** For autonomous mobility deployment which technological challenges do you expect?	• And how is it in your specific organisation/ case? • Are there specific technologies (e.g., autonomous driving, remote control) that you or your colleagues are hesitant about?	• What support (e.g., training, public education) might reduce fear or resistance to CCAM?	Explore what are the expected technological benefits and challenges due to automation in the transport sector.
	T3Q2: Technological Opportunities of using CCAM What do you think are the technological benefits of automation in the transport sector?	• And how is it in your specific organization/ case? • What kind of regulations or incentives might support safer CCAM adoption?	• How would you rate your organization's level of trust in CCAM technologies? • Do you think generational or cultural differences affect how people embrace or resist CCAM technologies? **[ask if it has not been discussed in T3Q1 or T3Q2]**	

Topic 4: Public Transport and CCAM	**T4Q1: Role of PT** What is your view on the integration of autonomous mobility and public transport?	• How could autonomous mobility change urban/ semiurban mobility? **[ask if it has not been discussed in T4Q1]** • What are your thoughts on shared CCAM services (e.g., shuttles, robotaxis) compared to privately used ones?	• How does trust and safety perception differ between shared and private CCAM? • Do you believe people in your region would prefer shared or private CCAM? • Which types of trips or environments (e.g., city centres, peri-urban areas) are more suited for shared/non-shared autonomous mobility services? • Would offering multiple vehicle sizes/types improve accessibility?	Explore stakeholder views on CCAM integration with public transport.
Topic 5: Exit	**T5Q1:** We are at the end of today's event. Is there anything that you would like to add to the conversation, and was not discussed?	• If you had to prioritize one action for policy makers or service providers, what would it be? • Are there specific policies, tools, or support structures you think are missing right now? • What would your organization need in order to actively contribute to or support future CCAM initiatives?	• Would your organization consider participating in further development steps, like pilot testing or strategy workshops?	Identify closing thoughts
Extra Topic: Ethics and governance	**ExtraQ1:** What are the biggest legal or ethical concerns you associate with CCAM implementation?			Trust concerns, and ethical/legal issues.
	ExtraQ2: How can public institutions and service providers build long-term trust in CCAM systems?	• What roles do safety standards or certifications play in your confidence?	• Would you personally trust a CCAM system today for daily use? Why or why not?	

2.5 Data Sharing

Data were shared as anonymized abbreviated transcripts. The process was following the procedure described in D3.1. Additional details about the data preparation, the procedures for transcribing the data, and for the coding, are described below.

Data Preparation and Transcription

All workshops and interviews were audio-recorded with participants' informed consent and subsequently transcribed. Transcripts were produced in English, German, Spanish, Hebrew, and Slovenian and later translated into English by bilingual researchers familiar with project terminology. Each transcript included metadata on location, participant role, date, and language to facilitate later cross-site comparison. All personally identifiable information was removed, and the resulting transcripts were analysed using Atlas.ti Version 2025.

Qualitative Data Analysis

The workshop material was analysed using the Framework Method enriched by Thematic Analysis (Krueger, 2015; Jon, 2018). This combined strategy provided both analytic transparency and cross-case comparability, essential for a multi-country study, and the conceptual flexibility needed to explore the psychological and socio-cultural mechanisms underpinning equitable adoption of CCAM solutions.

Following the Framework Method, analysis began with familiarisation through repeated reading of workshop notes and translated transcripts. An initial codebook was developed deductively from the project's theoretical constructs but during the coding process, new inductive codes were created whenever participants introduced novel or context-specific insights. This hybrid process allowed theoretical categories to be refined through lived experiences and local narratives.

Data quality

To ensure that data can be used to extract patterns, some occurrence and frequency tests for quotes and labels across countries were performed, and are presented in the Appendix. Overall, it should be stressed that for Qualitative Data analysis the volume of data is usually to small to perform statistical analysis that carry value on their own. However, the occurrence analysis is more focused on showing that topics and labels appeared in comparable shares across all countries. This entails that each demonstration site equally contributes to the conclusions and results presented in this workshop.

3 BARCELONA

3.1 Introduction to the Demonstration Site (DS)

Table 3 – Barcelona DS card

Population	5.07 million (Catalunya, 2025) (Barcelona Metropolitan Region, 2024)
GDP per capita	€46,000
Geographical context	Dense urban core surrounded by medium/low-density rings; varied terrain between the Coastal Depression and Pre-Coastal Mountains.
Transport context	Extensive multimodal network (bus, metro, tram, suburban and regional rail). 3.1 million daily trips in Barcelona city; 59% PT share.
CCAM maturity	Low/medium; pilots include ERIKA autonomous bus, LogiSmile last-mile automation, WeRide, 5GMED and 5GCroCo.
Related research aspects	CCAM integration into public transport, freight logistics, SUMPs, and strategic mobility planning.
DS type	Regional demonstration site covering 164 municipalities under ATM's mobility governance.

The Barcelona Demonstration Site corresponds to the Barcelona Metropolitan Region (hereafter, the Barcelona region) (see Figure 2), one of the eight functional territorial areas defined in the Catalan Spatial Plan. It is the most populated and economically dynamic area in Catalonia: despite accounting for only 10% of the territory, it concentrates 68% of the population. In 2024, the region hosts approximately 5.07 million inhabitants, placing it among the ten largest metropolitan areas in Europe and the second densest after Paris, with an average of 2,056 inhabitants/km² across 2,464 km².

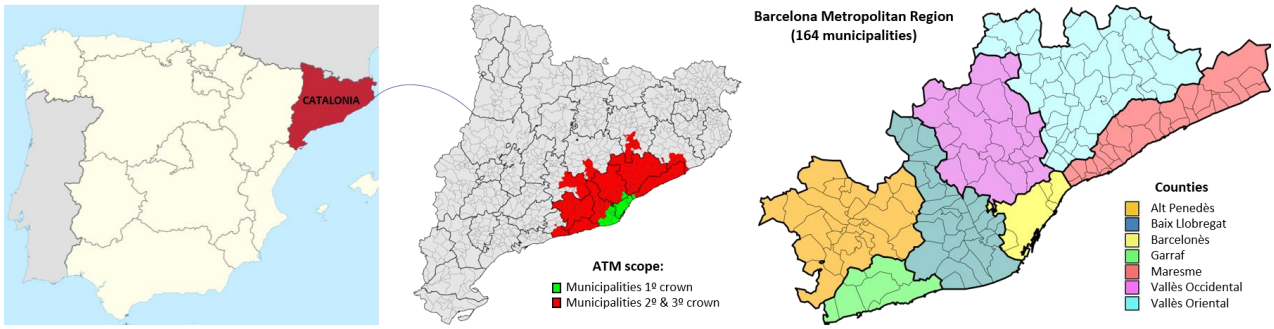

Figure 2 – Barcelona Metropolitan Region – 164 municipalities

The DS covers 164 municipalities, extending beyond the administrative boundaries of the Barcelona Metropolitan Area (AMB). Mobility governance in the region is shared mainly between the AMB (36 municipalities forming the first metropolitan ring) and the Autoritat del Transport Metropolità (ATM), which organises the wider mobility region into concentric rings:

- **First ring (AMB):** the continuous urban area including Barcelona, L'Hospitalet de Llobregat, Badalona, Sant Adrià de Besòs, and Santa Coloma de Gramenet.
- **Second ring:** adjacent metropolitan cities such as Terrassa, Sabadell, Granollers, and Mataró.
- **Third ring:** consolidated expansion areas connected through major transport corridors, including Manresa, Igualada, Vic, Blanes, and El Vendrell.

This structure reflects significant socio-spatial diversity, combining one of Europe's densest urban cores with medium- and low-density municipalities across Central Catalonia. Barcelona city alone hosts 1.59 million inhabitants and generates around 3.1 million daily trips, 59% of which are made by PT (dades obertes catalunya, 2025), illustrating its central role in mobility. The region benefits from a highly developed multimodal transport system integrating bus, metro, tram, suburban and regional rail networks. ATM oversees mobility planning, fare integration, and system coordination. In 2022, the integrated system enabled 924 million trips and operated 807 bus lines, 2,652 buses, and approximately 145-165 metro trains in service, depending on the hour.

Despite its consolidated transport network, a series of initiatives and projects conducted in the regions concluded that the CCAM maturity is low to medium. Existing CCAM-related initiatives include the LogiSmile (2021-2023) autonomous last-mile freight robot, the autonomous bus pilots ERIKA and WeRide (2025), and research on integrating CCAM into PT and freight planning. These remain small-scale but provide a relevant foundation for CulturalRoad's participatory and equity-centred approach.

The Barcelona region is also a major industrial, technological and innovation hub in the Western Mediterranean. Its demographic diversity, multimodal transport network, and coexistence of dense and low-density areas offer a highly suitable context for assessing CCAM preparedness, cultural attitudes, and equity impacts. ATM's role as regional mobility coordinator facilitates strong stakeholder engagement and the integration of CulturalRoad results into strategic instruments such as the Mobility Master Plan (PDMM) and municipal SUMPs.

The region's Mediterranean climate, with warm, dry summers and mild winters, shapes seasonal travel patterns and outdoor mobility. Cultural and culinary traditions, such as *arròs negre*, *esqueixada*, *tapes*, *crema catalana* and *pa amb tomàquet*, influence social norms and public perceptions, including attitudes toward technological innovation. These contextual elements are relevant for CulturalRoad's analysis of trust, behavioural responses, and societal acceptance.

3.2 Objective of the Demonstration Site

3.2.1 Existing or planned CCAM solutions

The Barcelona region has implemented several initiatives to enhance public transport performance, sustainability and accessibility, including the integration of the two tram networks, the establishment of the Low Emission Zone (ZBE), and modernised fare and payment systems. Strategic planning instruments, such as the Infrastructure Master Plan 2021-2030, the Mobility Master Plan 2025-2030, and the Urban Goods Distribution (DUM) strategy, further support the transition toward safer and more efficient mobility.

In parallel, the region participates in key European CCAM and 5G innovation projects, including:

- **5GMED - 5G for Future Mobility in the Mediterranean Corridor (2020-2024):**

5GMED develops a sustainable 5G architecture enabling advanced CCAM and railway services along the cross-border section between Catalonia (Figueres/La Jonquera) and Perpignan. The project deploys a multi-stakeholder 5G and edge-computing infrastructure operated by mobile network providers, neutral hosts and transport authorities, and validates use cases including ADS support, tele-operation, predictive QoS and mission-critical communications. Testing combines real cross-border trials with controlled experiments in small-scale facilities such as Castelloli's ParcMotor circuit, equipped with 5G, C-V2X, RSUs, HD cameras and MEC nodes.

5GMED addresses key challenges, roaming optimisation, latency reduction and service continuity, and provides guidelines for scalable business models and infrastructure models. Its results offer valuable insights for CCAM deployment strategies and digital infrastructure planning in the Barcelona region.

- **5GCroCo - 5G Cross-Border Operations for Connected and Automated Mobility (2018-2022)**

5GCroCo designed and tested 5G solutions enabling seamless CCAM operations across national borders, addressing a significant barrier to automated mobility. Large-scale trials in the France-Germany and Luxembourg-Germany corridors demonstrated network continuity with interruption times of around 120 ms, vastly outperforming conventional roaming mechanisms. The project validated three CCAM use cases: Tele-Operated Driving, high-definition map generation and distribution, and Anticipated Cooperative Collision Avoidance.

Small-scale tests in UTAC-CERAM (France), the A9 Digital Test Field (Germany) and AstaZero (Sweden) provided further evidence. Although not centred in Catalonia, 5GCroCo's findings directly inform the Barcelona region's readiness for scalable CCAM deployment and cross-border interoperability, providing technical benchmarks for future pilots and regulation.

3.2.2 Objective of the Demonstration site (DS)

Within CulturalRoad, the Barcelona DS aims to develop an updated CCAM deployment map for the region, covering both passenger and freight transport. The focus is on applying participatory methods from the CulturalRoad two-step co-creation framework to refine and update the initial top-down CCAM roadmap developed by ATM and CARNET in 2022. The objective is to integrate user needs, stakeholder perspectives, and societal values into future CCAM deployment scenarios.

3.3 Demonstration site specific co-creation methodology

3.3.1 Cocreation framework

The Barcelona DS examines the feasibility of integrating CCAM technologies in ways that benefit both residents and visitors. The co-creation process aims to generate insights that inform the design and testing of public-facing interfaces and services, ensuring that CCAM adoption is inclusive, transparent and effective. The CulturalRoad two-step co-creation framework includes:

Step 1 Stakeholder Workshop: A workshop involving representatives from the mobility industry, public authorities and research institutions. It aims to identify problems, barriers and opportunities for CCAM deployment. Insights from this session feed directly into the forthcoming focus groups with end-users.

Step 2 – Focus Groups with end-users: These focus groups will explore perceptions, expectations, and acceptance across societal segments identified during Step 1: young people, older adults, people with reduced mobility (PRM), and recently arrived expatriates were identified by participants. Outputs will support user-oriented planning, regulatory considerations and communication strategies, informing the update of the CCAM deployment roadmap.

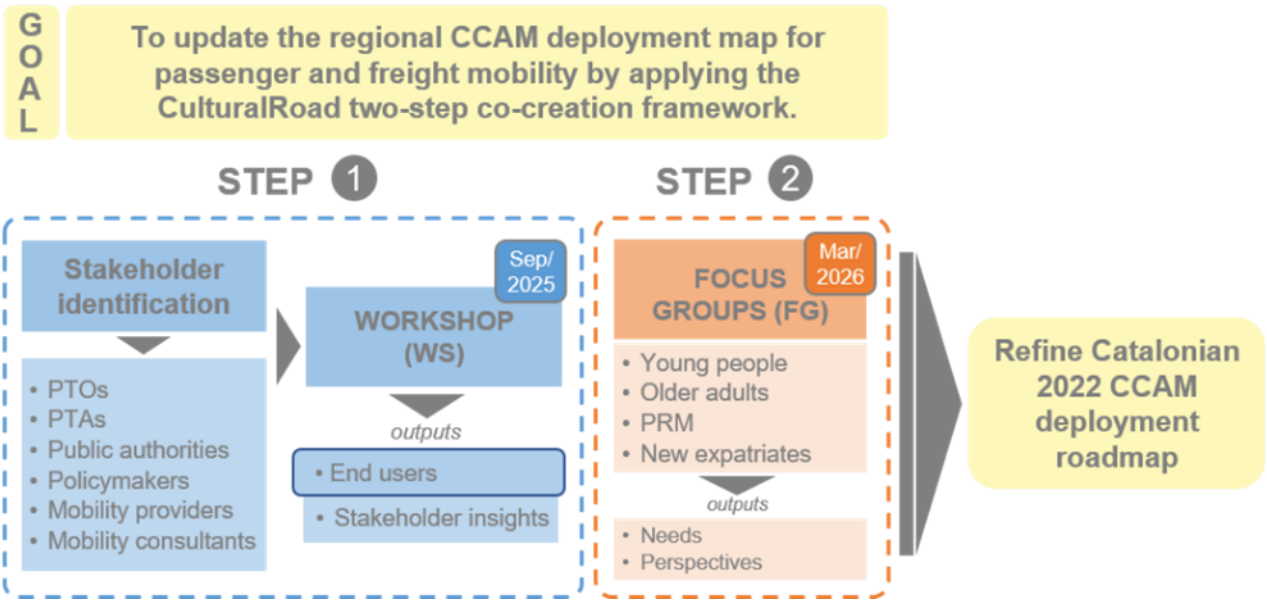

Figure 3 – Barcelona region Two-Step Co-creation framework application process

3.3.2 Data collection and methodology

The first stakeholder workshop took place on **23 September 2025** at the headquarters of ATM. Representatives from key public authorities, technology centres and public/private operators participated. The workshop aimed to collect institutional visions, identify opportunities and challenges for equitable CCAM integration, discuss priority actions and strengthen collaboration among stakeholders. The session was organised by the ATM and UPC.

Participants acknowledged the growing potential of CCAM technologies to enhance safety, efficiency and sustainability. References to international robotaxi pilots and European initiatives illustrated rapid technological progress and highlighted the need for Catalonia to address regulatory, institutional and infrastructural gaps. The workshop concluded with consensus on the importance of inter-institutional coordination and knowledge exchange. Priority actions identified include:

- **Regulatory alignment:** streamline pilot authorisation and clarify liability frameworks.
- **Data governance:** develop common standards for data sharing compliant with legal and ethical requirements.
- **Interoperability and governance:** enhance coordination between administrations to support integrated CCAM ecosystems.
- **Equity and inclusivity:** incorporate social and accessibility criteria into CCAM planning.
- **Pilot implementation:** begin with controlled or interurban use cases (e.g., night-time freight) before scaling to complex urban contexts.

Workshop 1 (stakeholders)

Name Stakeholder: Àrea Metropolitana de Barcelona
Stakeholder type: Public administration
Contact person: Environmental Services Professional – Environmental department

Name Stakeholder: Railgrup
Stakeholder type: Public transport consultancy

Contact person: Director of Market Intelligence, Innovation and Sustainability (Capgemini consultancy)

Name Stakeholder: Railgrup
Stakeholder type: Public transport consultancy
Contact person: Project technical officer (In-move by Railgrup)

Name Stakeholder: Generalitat de Catalunya
Stakeholder type: Public administration
Contact person: Deputy Director General of the Decarbonisation and Smart Roads Department

Name Stakeholder: Eurecat
Stakeholder type: Technological center
Contact person: Technological Promoter of Applied Artificial Intelligence

Name Stakeholder: Diputació de Barcelona
Stakeholder type: Regional authority
Contact person: Technician at the Mobility and Road Safety Department

Name Stakeholder: Servei Català de Trànsit
Stakeholder type: Transport authority
Contact person: Technical office

Name Stakeholder: Generalitat de Catalunya
Stakeholder type: Regional authority
Contact person: Directorate-General for Transport and Mobility

Name	Type	Contact person
Àrea Metropolitana de Barcelona	Public administration	Environmental Services Professional (Environmental department)
Railgrup	Transport consultancy	Director of Market Intelligence, Innovation and Sustainability (Capgemini)
Railgrup	Transport consultancy	Project technical officer (In-move by Railgrup)
Generalitat de Catalunya	Public administration	Deputy Director of the Decarbonisation and Smart Roads Department
Eurecat	Technological Centre	Technological Promoter of Applied Artificial Intelligence
Diputació de Barcelona	Regional authority	Technician at the Mobility and Road Safety Department
Servei Català de Trànsit	Transport authority	Technical office
Generalitat de Catalunya	Regional authority	Directorate-General for Transport and Mobility

3.3.3 Analysis and contextualized findings

The Spanish workshop was defined by a high percentage of negative comments (Sentiment: negative), coupled with focus on non-specific or cross-cutting obstacles (Barriers (other)) but also a notable presence of positive remarks (Sentiment: positive), together reflecting a balanced yet consistently critical stance. These codes were defined in the codebook, and are discussed and explained in the next sub-sections. A pragmatic approach towards demonstrated effectiveness and practical feasibility was highlighted by the participants' thorough discussion of context-specific application scenarios (Use Case) and the necessity of evidence from real-world deployments (Pilot/Testing).

3.3.3.1 Sentiment: negative

The negative opinions among participants resulted less from scepticism toward the technology itself and more from perceived organisational, institutional, and ecosystem-level barriers.

> PB.3: "*[answering the moderators' question regarding challenges and barriers of CCAM adoption] the challenge we are facing is not an economic challenge, in part, but it is a challenge of acceptance, and it is a challenge of the value chain, for exampleI* ***it is not a matter of vehicles, it is a matter of the whole world's ecosystem*** *[…]"*

Importantly, sentiment itself was never stated in isolation. Substantial thematic categories including safety, perceived impact, infrastructure needs, and governance & policy barriers frequently co-occurred with prevailing codes. One participant summarized this by noting that:

> PB.4: "I ***think one of the most important handicaps is that all the agents*** *[stakeholders]* ***agree*** *and that they use the same data, that they agree so that there is interoperability.* ***It is more a matter of governance than technological*** *[..]"*

Similarly, the positive sentiment emerging as the third most discussed theme, typically appearing in connection with very specific use cases or conditional benefits. This pattern shows that negative sentiment served as a contextual influence of other concerns, rather than an autonomous evaluation attitude. Concerns were grounded in real-world constraints rather than mistrust in automation. Additionally, one participant noted:

> PB.5: "*[talking about the involvement of stakeholders' organisation in CCAM adoption] but* ***as an organization****, let's say we do mobility plans,* ***right now we are not taking anything into account about autonomous mobility in the mobility plans****, although it is in the field of mobility, it [CCAMs adoption] belongs to the management of local roads".*

This illustrates the more general view where CCAM is not currently seen as essential or included into regular mobility planning, but it is also not actively rejected.

3.3.3.2 Barriers (other)

Barcelona displayed a relatively high count of barriers (other), indicating that stakeholders often stated concerns in broad, unspecific terms that did not fall clearly into established categories such as technological, financial, regulatory, or operational impediments. These scattered barriers generally represented uncertainty, fragmentation, coordination issues, or overall tension within the overall system. This form of barrier was closely connected to negative attitude, suggesting a generalised sense that "many things stand in the way," even if participants could not always describe a distinct type of barrier. Throughout the workshop, social acceptance and stakeholder coordination were viewed as the main obstacles rather than technology itself.

> PB.3: *"[talking about experiences and pilots and how it created this negative sentiment] And does this attitude come from a theme that is not technological, but from someone who deals with this project?* ***It is a combination of factors*** *[..]* ***And it is very complex*** *[…] Starting with the* ***support of public agents, very low, nobody wanted it [a test pilot]****, nobody wanted it, then we kept pivoting it […]"*

> PB.4: *" [talking about the resistance to change as a barrier of CCAM adoption] it is very linked to the model you talked about, later we will put the technology,* ***but the first thing we must be clear about is the model*** *because, if we are not clear about it, technology, in the end, is not an end in itself, it is a tool that must be able to help us make mobility much better within cities, in rural areas and wherever it is."*

3.3.3.3 Use Case

Participants in Barcelona regularly approached CCAM through a use-case lens, what specific problems the technology would solve, where it would work, and for whom. Focus was less on the broad idea of CCAM and more on local situations such as ports, interaction with heavy logistics, or "social CCAM" helping vulnerable groups.

> PB.8: *"There are two challenges, for me there are three, of autonomous driving. One is **public transport**, the other **is long-distance trucks**, let's see, electric, and the other is **taxis**. I believe that, in this sense, the **autonomous driving** part, if it makes sense for us to **promote it** from the directorate, well for these three factors […]"*

This use-case orientation appeared to serve as a type of pragmatic filtering as participants were unwilling to assume benefit without demonstrated context-specific value. This included strong attention to inclusiveness, reflected in the remark:

> PB.Z: *"One of the surnames we give to **mobility is inclusivity** as necessary, that is, what you said, we cannot leave any group behind, and also accessibility, that is, guaranteed. That is, accessibility in all senses. **Accessibility is the fact that everyone has the right and only the decision to be able to use it or not**."*

3.3.3.4 Pilot/ Testing

Pilot / Testing emerged as the fifth most discussed code in the Barcelona group, suggesting a strong preference for empirical validation over theoretical claims. Participants frequently argued that data from real deployments, not theoretical models, should serve as the foundation for CCAM adoption, planning, and policy decisions. Discussions identified pilots as essential to evaluating feasibility, operational issues, user behaviour, and integration into the existing mobility ecosystem.

> PB.3: *"[talking about the transition from automation at ports into the urban mobility and how it can be made socially acceptable by doing projects and pilots] how do we introduce this into a world where not everything is automated or digitized yet and that we share... Of course, these are the projects that started a few years ago and **now we are reaching the key phase**"*

4 EILAT

4.1 Introduction to the demonstration site

Table 4 – Demonstration Site Card

Population	52000
GDP per capita	€55,000 (Israel)
Geographical Context	Seaside resort, located in a hyper-arid desert which is distant from other cities and communities, at a strategic crossroads between three continents and four countries.
Transport Context	Limited network – some buses, taxi services
CCAM Maturity	Low: no trials to date
Related research aspects	Tourism, adoption of CCAM to link the airport to ferry services

Located in the southernmost part of Israel, Eilat represents the most unique Israeli landscape between desert and sea. The region experiences an arid desert climate with temperatures often surpassing 40°C in summer and 21°C in the winter. The Red Sea's mild year-round temperatures (20–28°C) sustain one of the world's northernmost coral reefs, home to very diverse marine life. With an average of 360 sunny days a year, Eilat is a hotspot for outbound and domestic tourism. In addition to the tourism industry, desert agriculture is also being developed in the arid regions, with a primary focus on date crops1.

The city possesses critical strategic assets, including a seaport that functions as a maritime gateway to the Far East and an international airport. Furthermore, it hosts academic institutions and specialized Research and Development centres. These resources, when combined with its substantial tourism assets, collectively position the city as a significant engine for generating economic and business opportunities, with a projected potential capacity to accommodate up to 20 million tourists annually 1.

4.2 Objective of the Demonstration Site

4.2.1 Existing or planned CCAM solutions

Eilat's transport network includes road systems for private vehicles, buses, and taxis. As public transport (buses) is regulated by Israeli law, operations are prohibited during Shabbat from Friday evening until Saturday evening. Cooperative apps such as Waze are also widespread in Isreal and newer vehicles are equipped with smart systems connected to the environment and infrastructure, including active prevention system\ and warning systems for enhanced safety.

Transportation infrastructure planning in Eilat currently relies solely on transportation data, such as the volume of vehicles using the proposed roadways, without the involvement of the public. This leads to challenges in addressing the needs of local communities. The overarching objective is to tailor the infrastructure to better serve the population's needs. Two demonstrations are therefore currently planned around Eilat: one connected to land transportation and the other to marine transportation. They aim to reduce traffic congestion and provide efficient and safer alternatives that incorporate up-to-date technology and are affordable for all cultures and people.

The land demonstration site is centred on Road 90, one of the main roads leading to Eilat and also the most dangerous road in Israel. With the airport transitioning to an international hub, tourist numbers are expected to rise in the near future, significantly increasing traffic on this already busy road. While the current regulatory framework does not permit the operation of autonomous vehicles on existing transportation lines, a new and dedicated line specifically designated for autonomous vehicles will be prepared. The area designated for this new line spans across regions with varying jurisdictions, requiring collaboration between our partner Eilat Municipality and regional authorities to align on the requirements and ensure the successful establishment of the dedicated line.

The marine demonstration site provides a novel solution in the area by introducing a marine shuttle. Developed as part of the Eilat municipality's master transportation plan, the marine shuttle will bridge the gap between the city's needs and the lack of land infrastructure, operating between several points along the shore of the Gulf of Eilat. A marine survey has already been conducted to analyse the shuttle route and assess marine traffic. The Eilat Municipality has also collaborated with experts to evaluate the infrastructure of the piers at the locations where the shuttle will stop.

4.2.2 Objective of the Demonstration site

The main goal of the demonstration site in Eilat is the assessment of the feasibility of deploying CCAM from Ramon Airport to major city destinations, including last-mile air travel connections, with particular attention to the challenges experienced by elderly people, individuals with disabilities, and tourists.

The objective of the project is to conduct a comprehensive feasibility assessment for the deployment of Cooperative, Connected, and Automated Mobility (CCAM) services from Ramon Airport to key city locations. This encompasses the evaluation of last-mile air travel mobility solutions, the exploration of potential CCAM-enabled sea shuttle services, the development of a city-wide mobility heatmap for trend analysis, and a thorough analysis of existing transportation modes, with a specific focus on identifying and mapping accessibility barriers encountered by the elderly, people with disabilities, and tourists.

4.3 Demonstration site specific co-creation methodology

4.3.1 Cocreation framework

In Eilat, the co-creation framework follows a two-stage participatory approach designed to engage key stakeholders and citizens in the planning and validation of CCAM solutions.

The overall objective for Eilat is to assess the feasibility of integrating CCAM technologies to benefit both residents and tourists. The insights gained from this process will inform the design and testing of public-facing infrastructure interfaces and services, ensuring that CCAM adoption is inclusive, transparent, and effective.

Step 1 - Data Collection via Direct Engagement of stakeholders: This phase involved a series of structured, individual interviews with key professionals and influential stakeholders within Eilat's transportation and urban development ecosystem. During these interviews participants were introduced to preliminary operational concepts for the CCAM-enabled sea and land shuttle projects. The engagement served two main purposes: first, narrative mapping, which focused on identifying the main drivers and incentives for establishing such a transportation system in the city, as well as the key concerns expressed by managing and regulatory bodies; and second, an administrative feasibility assessment, aimed at evaluating the potential for effective collaboration among public, commercial, and governmental entities to advance the projects efficiently within Eilat.

Step 2 - End-User Engagement: At a more advanced stage, two focus group sessions involving a diverse range of end users are planned. One group will focus on elderly residents, while the other will engage tourists. The purpose of these sessions is to deepen the understanding of user expectations and to identify potential social barriers to the adoption of CCAM services. The outcomes of the process will provide insights into end-user expectations and barriers, as well as recommendations for more user-oriented planning, regulatory, and communication measures to ensure the successful adoption of CCAM technologies in Eilat.

Final Stage: Stakeholder Echoing of Focus Group Results: The final stage involves presenting the focus group outcomes to key stakeholders. This process aims to reflect the needs, barriers, and preferences of end users back to the decision-makers, ensuring that these insights are translated into practical solutions and integrated into the feasibility assessment of CCAM implementation in Eilat.

The co-creation procedure is summarized in the figure below.

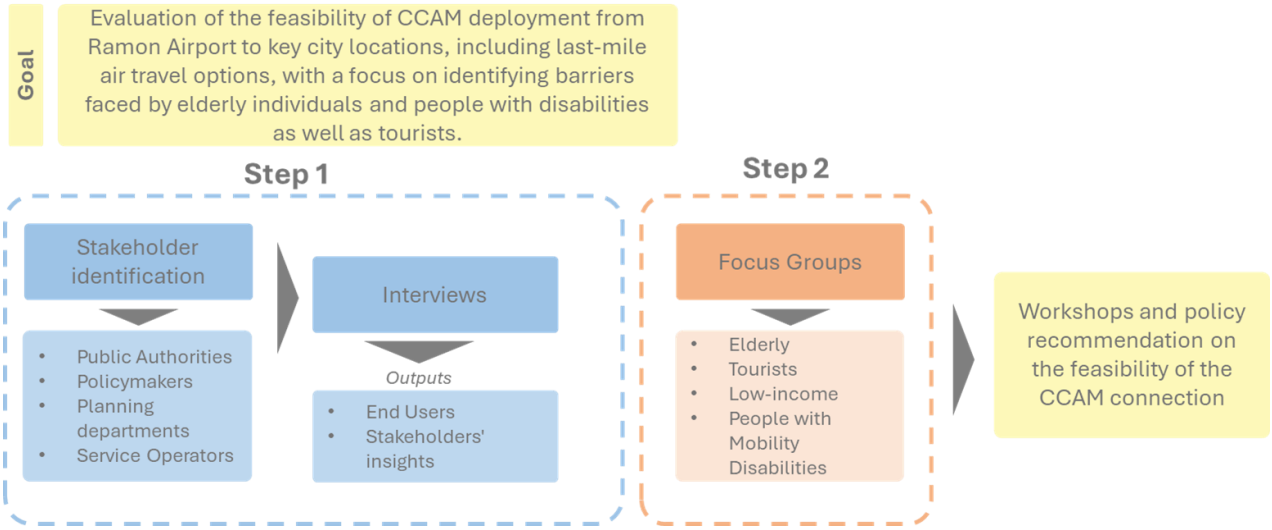

Figure 4 – Eilat region Two-Step Co-creation framework application process

4.3.2 Data collection and methodology

The Eilat Stakeholder Workshop was conducted through individual interviews during September and October. The interviewees were selected based on their roles as key personnel responsible for infrastructure and projects in Eilat, as well as professionals and government officials who collaborate with the Eilat Municipality to promote more effective urban transportation.

Interviews- List of Interviewed Stakeholders

Name Stakeholder: Eilat Transportation Department Manager (PE.1)

Stakeholder Type: Regional Council

Name Stakeholder: Innovation division (PE.2)

Stakeholder Type: Ministry of transportation

Name Stakeholder: Director of the Construction and Infrastructure Division (PE.5)

Stakeholder Type: Planning Department, Eilat municipality

Name Stakeholder: Director of the Infrastructure and Renovated Buildings Department (PE.6)

Stakeholder Type: Planning Department, Eilat municipality

Name Stakeholder: Marina Manger (PE.7)

Stakeholder Type: Eilat Municipal Operations Company

Name Stakeholder: Innovation and Business Development Manager (PE.3)

Stakeholder Type: Location-Based Transportation Services Company

Name Stakeholder: Head of data (PE.8)

Stakeholder Type: Location-Based Transportation Services Company

Name Stakeholder: Chief Scientist (PE.4)

Stakeholder Type: National Highway Safety Authority, and Academic

Stakeholder	Service Area
Eilat Transportation Department Manager	Regional Council
Innovation Division	Ministry of transportation
Director of Innovation Development Business Development	Location-Based Transportation Services Company
Chief Scientist	Transportation safety at the National Highway Safety Authority & academic
Director of the Construction and Infrastructure Division	Planning Department, Eilat municipality
Director of the Infrastructure and Renovated Buildings Department	Planning Department, Eilat municipality
Marine Manager	Eilat Municipal Operations Company
Head of data	Location-Based Transportation Services Company

4.3.3 Analysis and contextualized findings

The Israeli interviews were characterised by a predominantly positive and innovation-driven sentiment (Sentiment: positive), with stakeholders expressing optimism and even urgency regarding the implementation of autonomous mobility. At the same time, safety concerns (Safety) and infrastructural requirements (Infrastructure Needs) were frequently emphasised as critical necessities for deployment. Despite the general excitement, the data also showed significant critical perspectives (Sentiment: negative), particularly with regard to ethical ambiguity and uneven judgements of infrastructure readiness. Public acceptance (acceptance) discussions focused on the necessity of tailoring technology to user demands, highlighting the fact that effective adoption depends not only on the advancement of technology but also on contextual fit and societal importance.

4.3.3.1 Sentiment: positive

The Israelian interviews revealed a clear pro-innovation and safety-focused vision for CCAM, with stakeholders primarily seeing autonomous mobility as an opportunity to modernise mobility services, improve public transport, and position the country at the forefront of technological innovation. The idea of AM was consistently discussed in relation to public transport and shared mobility services rather than single or private car usage, reflecting a collective, system-oriented understanding of its potential.

> *PE.1: "[Talking about the stakeholders' opinion about AM in public transport] Yes to public transportation - **it is more efficient and there is no waste of time**."*

A tone of enthusiasm, almost a sense of need, about implementing AM was shown by the narratives, which were more detailed and easier to interpret because the data came from individual interviews. Several interviewees emphasised that AM might significantly enhance current mobility services, demonstrating that this enthusiasm was not abstract but rather linked to specific expectations of increased service quality, efficiency, and safety.

> *PE.2: "[When asked about external opportunities of AM:] Traffic congestion costs the state a great deal; if congestion is reduced, it saves money, decreases accidents, and lowers air pollution. **All of this can be promoted through autonomous transportation**, but it requires broad adoption, especially in the public transport sector."*

According to the stakeholders, Israel should actively engage with autonomous mobility, reflecting a broader confidence in the advantages that well-executed AM may bring to society. Overall, the optimism surfaced as a forward-thinking perspective based on the belief that AM can significantly further national mobility goals.

> *PE.2: "Improving routes and services, enhancing passenger experience, reducing noise, and **introducing innovative transport can make it an attraction that shifts people from private cars to autonomous public transport**."*

4.3.3.2 Safety

Throughout the Israeli interviews, one of the most frequently mentioned themes was safety. Participants regularly linked autonomous mobility to the potential for safety improvements, often treating improved safety as an essential reason for implementation.

> *PE.1: "[Talking about perceived impacts of AM] From a safety perspective, in the early stages there will be concerns, but **over time there will be an understanding that it is safer**, more efficient, and more economical."*

> *PE.3: "[Talking about peoples fear of using AM, the stakeholder expressed a strong view about human driver safety]* As long as there is a ***human factor on the road, there will be accidents***"

> *PE.5: "[Talking about benefits of CCAM, after stating that the stakeholder initially does not trust the technology but will get used to it due to facts like this:] In fact, **the connection between the vehicles is what constitutes the safety advantage**."*

Simultaneously, the participants expressed a call for the involvement of professional supervision to guarantee reliable systems.

*PE.4: "In this industry there are **not enough safety professionals, human factors experts** are not sufficiently present in the industry. It is **necessary to do this gradually** and with very intensive monitoring."*

4.3.3.3 Sentiment: negative

Even though the tone was mostly optimistic, there was also some negative thoughts, which mostly focused on perceived readiness issues and uncertainty. Ethical considerations was a topic of conflict, highlighted by contrasting remarks such as

*PE.7: "There are no laws, and therefore it is **not ethical**."*

*PE.6: "There are **no ethical concerns** regarding implementation."*

This ambiguity emphasised concern regarding regulatory and ethical frameworks that are perceived as incomplete or insufficiently defined.

4.3.3.4 Acceptance

Acceptance talks in the Israeli interviews centred on the idea that successful adoption of autonomous mobility depends on aligning the technology with user needs and their expectations.

*PE.6: "[When asked about challenges of AM implementation] The adaptation of the technology to the **needs of the population**."*

Participants frequently discussed how to use autonomous mobility, where it should be deployed, and how it could be expanded, emphasising a perceived need to engage with the technology to avoid falling behind. A few interviewees also stated that organisations could increase acceptability if they provided further services to enhance the overall customer experience, such content platforms integrated into the ride. Taken together, these viewpoints emphasise user-centred design and service quality as core determinants of acceptance in the Israeli context.

*PE.3: "[Talking about impact of AM adoption and adjustments the organisation has to make for the customers] Generally, my **organization strives to react as quickly as possible to technological changes so as not to fall behind**. And as soon as this technology enters, I, as an organization, will **need to provide additional services**, for example, to improve the ride experience by adding a content platform."*

4.3.3.5 Infrastructure Needs

The topic around the infrastructural needs lead to a more divided conversation. Some participants argued that the present infrastructure was insufficient and therefore made the implementation of AM on a large scale difficult.

*PE.7: "**Regarding infrastructure - everything is lacking**, and even what exists is not properly organised."*

Others expressed different evaluations:

*PE.1: "In terms of **infrastructure, everything exists**"*

The opposing viewpoints highlight the necessity of methodical evaluation and open communication regarding actual infrastructure needs for CCAM deployment.

5 KARLSRUHE

5.1 Introduction to the demonstration site

Table 5 – Demonstration Site Card

Population	309,000
GDP per capita	€72,000
Geographical Context	Total area of about 173 km2. Bordered by the Rhine and Kraichgau hilly region. Internet capital of Germany, home to high tech
Transport Context	Bus, Tram, established cycling city
CCAM Maturity	Medium: Ongoing pilots
Related research aspects	CCAM integration with cycling and public transport

Karlsruhe is located in southwestern Germany's Baden-Württemberg state, near the French border alongside the Rhine River and close to the Black Forest. As part of the trinational Upper Rhine region, it plays a central role in cross-border mobility, economic cooperation and European transport connectivity. Karlsruhe is directly linked to major north–south and east–west corridors, including the Rhine–Alpine TEN-T axis, which connects Rotterdam with Genoa. High-speed rail services, regional train lines and the extensive tram-train system of the Karlsruhe model provide efficient connections across the city and into the wider region.

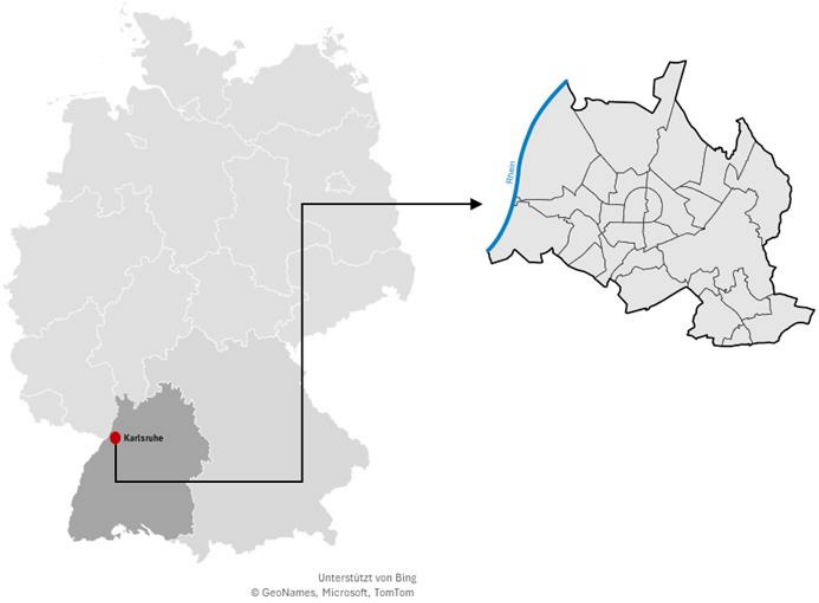

Figure 5 – Location of Karlsruhe in Baden-Württemberg and its 27 districts

Its summers are notably hot, and the city experiences more sunshine than many other regions, benefiting from its location in the Rhine Valley. With this setting, Karlsruhe enjoys a distinctive blend of geographical and cultural influences.

The city is home to about 300,000 residents, including a substantial student population due to its well-regarded universities and research institutions as it is home to one of Germany's oldest technical universities and Europe's largest IT cluster. This youthful, international community brings a dynamic energy to Karlsruhe and positions it as a centre for innovation in science, technology, and sustainability, particularly in mobility, drawing from both its natural setting and openness to innovation. This strong research, technology and administrative sector attract a large daily inflow of commuters from the surrounding districts and also has an impact on the population structure, which, with an average age of 42,8 years, is younger than the German average (Presse-Agentur, 2025; Stadt Karlsruhe, 2025).

The interplay of its geographical location, vibrant community, and emphasis on technological and environmental progress shapes Karlsruhe's urban landscape, daily life and overall atmosphere, making it a prime setting for sustainable mobility innovations and CCAM developments.

Taking a closer look at mobility in Karlsruhe, Karlsruhe is characterized by comparatively low car dependency and a strong orientation toward sustainable transport. Although the average household owns 0,88 cars, only 17,9 percent of residents use a car daily or almost daily based on the mobility survey from 2023. Cycling has become the most frequently used mode of transport, with 37,1 percent riding daily or nearly daily – with a bicycle availability of 2,18 bikes per household – while 43,9 percent of residents walk daily, reflecting the city's compact structure and good accessibility.

Public transport remains widely accessible – nearly 58 percent of households can reach a tram stop within five minutes on foot – but daily usage has slightly decreased to 12,5 percent compared to 2018, partly due to increased home-office work. Car sharing has grown steadily, with about one quarter of residents using such services at least once a year, especially in the central districts. E-scooter and shared bicycle use are mainly concentrated among younger populations, further reflecting ongoing shifts toward flexible, multimodal travel options.

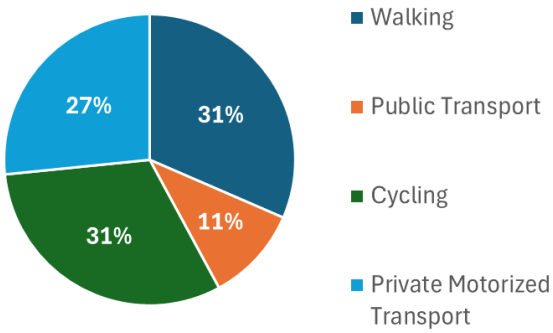

Figure 6 – Modal Split in Karlsruhe in 2023 (from the survey SrV-Erhebung 2023, own figure).

5.2 Objective of the Demonstration Site

5.2.1 Existing or planned CCAM solutions

The city's transportation network is well-developed, offering a mix of public transportation, cycling infrastructure, and car-sharing options. This positions Karlsruhe as a forward-thinking hub for mobility. In recent years, parts of the tram system have been moved underground to make room for pedestrians and usable space in the city centre. However, when it comes to CCAM services, the city is still in early stages. Several foundational technologies and trials are already in place, but they have limited citizen-facing applications showcasing CCAM's full potential. The city of Karlsruhe is part of the Testfeld Autonomes Fahren

Baden-Württemberg (TAF-BW) for testing CCAM solutions in predefined areas (BADEN-WÜRTTEMBERG, 2025).

5.2.2 Objective of the Demonstration site

Karlsruhe's demonstration site under CulturalRoad aims to bridge the gap between citizen expectations and the practical capabilities of new CCAM applications. By engaging the community directly, the demonstration aims to gather insights into public preferences and concerns, ensuring that future mobility solutions are developed with citizens' needs in mind.

This alignment is central to achieving the CulturalRoad vision, which prioritises citizen-centred innovation. Through real-world demonstrations, Karlsruhe showcases CCAM technologies in relatable, accessible ways, accelerating their development by integrating public feedback early in the process. This approach not only enhances trust in automated mobility but also fosters a collaborative framework where technology development and public adoption grow in tandem.

More concretely, a prototype showing next-generation CCAM applications will be built and presented to citizens at local public events to achieve this ambitious objective. The feedback generated will be integrated into the intended CCAM application and tested again to validate its usefulness for the citizens, ensuring the practical and specific needs of citizens are taken into consideration.

5.3 Demonstration site specific co-creation methodology

5.3.1 Cocreation framework

In the CulturalRoad project, the co-creation framework follows a two-step participatory approach designed to engage key stakeholders and citizens in the planning and validation of CCAM solutions. The overarching objective for the case region of Karlsruhe is to enhance public acceptance of CCAM technologies by using Virtual Reality (VR) tools to explore users' expectations, needs, and information requirements. The insights gained through this process will inform the design and testing of public-facing interfaces and service infrastructures that ensure inclusive, transparent, and effective CCAM adoption.

Step 1 - Data Collection via Direct Engagement of Stakeholders: The first step consists of a general workshop involving stakeholders from the mobility industry, policymakers, and research institutions. The workshop aims to identify key problems, barriers, and opportunities related to the deployment of CCAM technologies in general. Participants were recruited from institutions including organisations such as KVV, VDV, FZI (vehicle), TU Ilmenau and HKA (UX), LVB, Fraunhofer IVI and IOSB, the Ministry of Transport, NVBW, and technology providers [see final participants in 6.3.2.2].

The workshop focused on:

- Identification of the main technical and social barriers to CCAM adoption;
- A shared understanding of stakeholder needs and opportunities for collaboration;
- Preliminary guidelines for communicating CCAM to citizens, including user experience (UX), interface design, and information provision;
- Definition of relevant target groups for further exploration in step 2.

In addition to the structured discussion, the workshop included a showcase of an early Virtual Reality (VR) interface prototype, illustrating how passenger information and user interaction with CCAM systems could be experienced in immersive environments. This demonstration was used to initiate feedback and to explore potential design directions for later focus group testing.

Step 2 - End-User Engagement: The second step will involve two focus groups with end-users representing different societal segments to explore user perspectives and acceptance in depth.

- Focus Group 1: International students with limited mobility living in suburban or urban contexts ("Limited Mobility Race, Sub/Urban").
- Focus Group 2: Suburban and rural residents, recruited to reflect diversity in income levels, age groups, and mobility conditions (including participants with limited mobility).

Each focus group will use Virtual Reality (VR) and interactive visualization tools to present potential CCAM scenarios. Participants will experience these simulated environments and engage in structured discussions. This immersive approach supports a deeper understanding of user expectations, perceived benefits, and concerns about CCAM technologies.

The outputs of this step will include:

- Detailed qualitative insights into user needs, expectations, and barriers regarding CCAM;
- Validation of communication and interface concepts developed in Step 1;
- Recommendations for inclusive, user-centred design of CCAM services and information systems.

Visualization of the co-creation framework

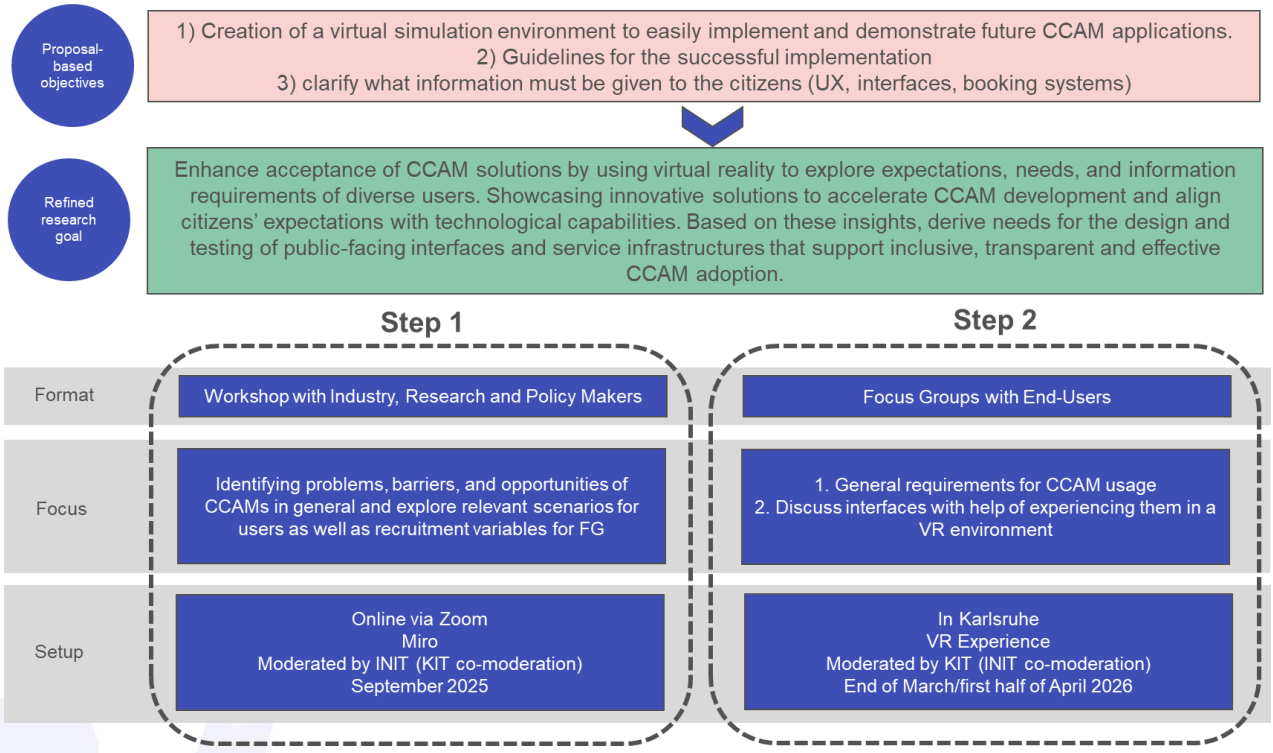

Figure 7 – Karlsruhe Co-Creation Framework

5.3.2 Data collection and methodology

The workshop took place online on September 30, 2025. The participants were selected among German public transport operators and research institutes that work with CCAM solutions. The participants were recruited from all of Germany and not only from the pilot city of Karlsruhe. Of the ten invited partners, only

five could make it to the workshop. A list of the actual participating stakeholders is provided in the following. One participant was present for each of the institutions that agreed to take part in the workshop. Their names have been redacted for privacy purposes.

Workshop 1

Name Stakeholder: *Association of German Transport Companies (VDV)*

Stakeholder Type: *Association*

Name Stakeholder: *Public Transport Operator Frankfurt Rhein-Main Region*

Stakeholder Type: *Public Transport Operator – regional level*

Name Stakeholder: *Public Transport Operator Leipzig*

Stakeholder Type: *Public Transport Operator – regional level*

Name Stakeholder: *Public Transport Operator Monheim*

Stakeholder Type: *Public Transport Operator – regional level*

Name Stakeholder: *Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung*

Stakeholder Type: *Research Institution*

5.3.3 Analysis and contextualized findings

The German workshop was defined by a generally optimistic mindset (Sentiment: positive), a focus on particular use cases (Use Case), inclusivity in deployment (Accessibility & Inclusion), and a keen understanding of procedural and regulatory obstacles (Governance & Policy Barriers). In order to promote wider societal trust and acceptance, discussions showed both optimism and pragmatism, emphasising the necessity of public engagement and long-term supportive frameworks (Acceptance).

5.3.3.1 Sentiment: positive

The conversation had a generally positive and forward-thinking tone. Participants expressed optimism regarding overcoming barriers and recognised the importance of ongoing research and engagement from the community. Despite their frustration with regulatory procedures, their comments showed a belief in the progress via collaboration, development, and inclusive approaches. The code for sentiments never occurred alone but alongside other codes showing that in the case of Germany it was often accompanied by comments regarding the expected positive impact of CCAM for example an increase in safety, user experience and traffic flow.

> *PK.3: "Connected automated driving also has the potential to improve safety**: fewer human errors, optimised traffic flows, shorter waiting times at traffic lights, less congestion**."*

5.3.3.2 Use Case

Finding suitable use cases for autonomous mobility seemed to have been an important objective for the participants. They have been discussing areas and locations where a CCAM service could be facilitated while keeping in mind areas where traditional or already existing services are sufficient and won't require a change in their eyes.

*PK.3: "For routes with regular traffic, traditional scheduled services make sense. In **rural areas**, however, **on-demand transport** is more worthwhile because demand is spread out over time."*

*PK.2: "[Answering to the comment above] Exactly, in cities such as Karlsruhe, the public transport network is heavily utilised – trams are more efficient there than robot taxis. However, on **university campuses or in outlying areas, shuttles can be useful for providing fine-grained access**."*

One participant noted that for the sake of a possible standardisation instead from focussing on specific cases one should rather concentrate one different user groups and their needs.

*PK.4: "We **mustn't try to accommodate every special case** – otherwise we won't achieve any standards. But we do have to **take different user groups into account**."*

5.3.3.3 Accessibility & Inclusion

Accessibility and inclusivity were seen as crucial but frequently overlooked components of CCAM development. The participants emphasised that accessibility issues are often ignored in the early stages of design, pointing out that this could result in solutions that don't meet the demands of actual users.

*PK.4: "**Accessibility** is **often put on the back burner during development**. But it is essential in public transport. We **need to raise awareness of sensitive issues at an early stage**. Otherwise, we **risk developing solutions that do not meet actual needs**."*

Participants emphasised issues such as interface usability for wheelchair and visually impaired users and the significance of multilingual support to serve varied passenger groups, calling for active understanding and early inclusion of inclusive design principles. In general, their viewpoint highlighted the need for accessibility to be a fundamental component of automated mobility rather than an afterthought.

*PK.1: "What about accessibility for **visually impaired people or wheelchair users**? Are the controls at an accessible height and available in simple language?"*

*PK.5: "An example: **multilingualism**. There may be people in a vehicle who prefer Arabic or Spanish. The interface should be individually adjustable via smartphone."*

5.3.3.4 Governance & Policy Barriers

Stakeholders claim that inconsistent governance and overly complicated regulations hold back the adoption of automated mobility in Germany. They criticised the scattered approval system, resulting in to a "patchwork" of regulations because federal states and municipalities have different standards and interpretations, creating uncertainty for developers and operators.

*PK.1: "[Talking about the impact of different regulations] that **leads to inconsistencies** again: the same vehicle could be registered in one federal state and not in another because the state authorities make different decisions. More objective criteria are needed here."*

*PK.4: "There is also a danger that the KBA [German Federal Motor Transport Authority] will approve something that causes problems for local road traffic authorities. This **would result in a patchwork quilt: vehicles would be allowed to drive in one city but not in another**."*

Participants argued that these differences restrict scalability and innovation because vehicles may be accepted in an area but rejected in another. In addition to more efficient measures like real-world testing environments and streamlined commissioning procedures, they called for more uniform, independent, and transparent approval standards to improve Germany's competitiveness internationally.

*PK.3: "I would **like to see the barriers to commissioning lowered**. Currently, vehicles must demonstrate that they can travel an extremely high number of accident-free kilometres before they can be used without a driver. This makes us unattractive internationally. Real-world laboratories and more pragmatic approvals would be useful."*

*PK.3: "[When asked to prioritise one measure for politicians or providers] the **standardisation of requirements**: safety, security, infrastructure development, data protection. Today, this is a patchwork quilt between federal states and even cities. That slows down development."*

5.3.3.5 Acceptance

Acceptance, according to stakeholders, is a complex and socially rooted challenge in the deployment of automated mobility. One participant in the discussion pointed out that practical experience with demonstration rides had demonstrated generally high acceptance with children usually responding enthusiastically, and no one left feeling less safe than before.

*PK.2: "Our experience has shown that **acceptance in practice was high**. Some children are **enthusiastic about technology**, while others are sceptical. However, no one got out after a ride and said they were now more afraid than before."*

In response, one other participant emphasised that acceptance involves social norms and communication habits, such as losing eye contact with a human driver, in addition to adjusting to the technology. Drawing comparisons with how public acceptance of trains changed over time, they stressed the need for new interaction tools, such as displays, and ongoing citizen participation to build trust.

*PK.4 [responding to the comment of PK.2] "The theory is one thing, but in practice it is a social problem. We have cultural rules such as eye contact with the driver. If the driver is no longer there, new forms of communication are needed, such as displays. **If we don't take this into account, there is a risk of losing acceptance**."*

*PK.2 [responding to the comment PK.4] "Exactly, that's why **citizen participation is important**. We have done a lot of dissemination and let a wide variety of people ride along. There are reservations, but they can be overcome – as was the case with the railway in the past."*

Simultaneously, another participant noted that developing purely for acceptance may present competing user demands. For example, wheelchair users and older passengers have different preferences. The stakeholder argued that in order to maintain acceptance and balance conflicting needs, open communication regarding design choices is crucial.

*PK.1: "I would like to take a step back and look at the bigger picture: in the past, vehicles were often designed with user input. This can lead to conflicting requirements – for example, older people want lots of handrails, whereas wheelchair users want as few as possible. It is **important to explain transparently why certain requests cannot be implemented. This creates acceptance."***

Overall, the discussion showed both optimism for improving public acceptance and an awareness of the complex and dynamic nature of societal trust in automated systems.

6 LJUBLJANA

6.1 Introduction to the demonstration site

Table 6 – Demonstration Site Card

Population	549,171 (Ljubljana urban region)
GDP per capita	EUR 32,620
Geographical Context	The region is located in the centre of Slovenia: between the Alps, Dinaric Alps and the Pannonian plain. Strategically located on two trans-European transport corridors: the Baltic-Adriatic corridor and the Mediterranean corridor. Ljubljana urban region is cultural, scientific, economic, political and the administrative centre of Slovenia with a third of GDP of the country.
Transport Context	Extensive bus network, nearly 142,500 people commuting to work daily, mainly using car as their mode of transport.
CCAM Maturity	Low: no trials to date
Related research aspects	Commuting, stakeholder needs, SUMPs

The Ljubljana Urban Region, coordinated by the Regional Development Agency of the Ljubljana Urban Region, brings together 25 municipalities, including Slovenia's capital, Ljubljana. Positioned at the heart of the country, it lies where the Alps, the Dinaric Alps and the Pannonian Plain meet, giving it both geographical diversity and an important strategic role in national and international connectivity. As part of the Western Slovenia cohesion region, it covers 2,334 square kilometres—around eleven percent of the national territory.

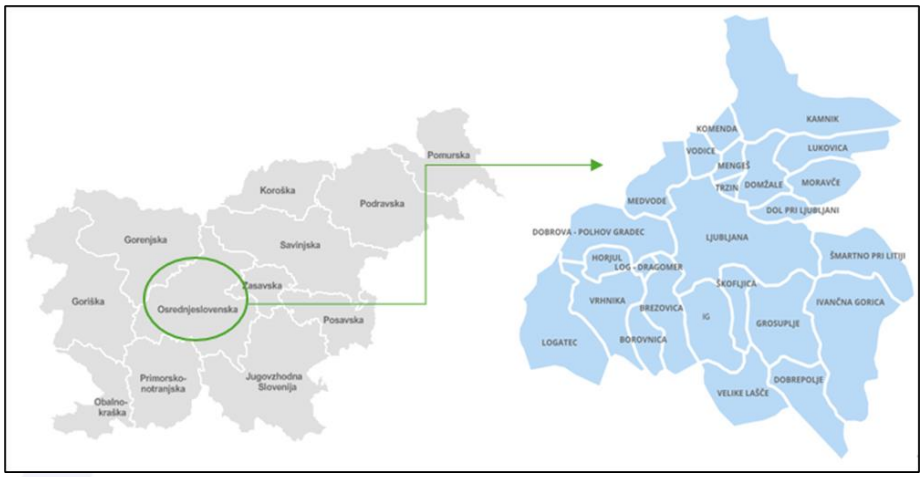

Figure 8 – Ljubljana Urban Region – 25 municipalities

The region has a richly developed polycentric structure that includes 921 settlements and has been strongly shaped in recent years by suburban growth, driven by urban expansion and migration. It is well embedded in European transport flows, lying on two key TEN-T corridors: the Baltic–Adriatic and the Mediterranean. Its road network offers fast links to major neighbouring centres such as Zagreb, Trieste, Budapest and Vienna, while Ljubljana Airport connects the region with global destinations.

With 549,171 inhabitants, the Ljubljana Urban Region is one of Slovenia's most urbanised and densely populated areas. It is home to over a quarter of the country's population, and the City of Ljubljana alone recorded 293,845 residents in 2022. Population density averages 235.3 inhabitants per square kilometre, though it varies widely—from more than a thousand in the most urbanised districts to just over thirty in the most rural parts.

The region serves as Slovenia's leading centre of knowledge, research, education and culture, generating more than a third of the national GDP. Its economic and institutional strength draws large numbers of commuters each day, most of whom rely on cars. In 2023, around 142,500 people travelled to Ljubljana daily for work, joined weekly by approximately 28,000 students.

Mobility patterns across Slovenia show that 84 percent of residents aged 15 to 84 travel every day, making an average of 2.7 trips totalling around 34.5 kilometres and lasting just over an hour. Personal cars dominate work-related travel, accounting for around 80 percent of all commuting trips. The average distance travelled to work is thirty-two kilometres, with most journeys falling between ten and twenty kilometres. Educational trips, although representing only a small share of daily mobility, tend to be longer and more frequently rely on public transport.

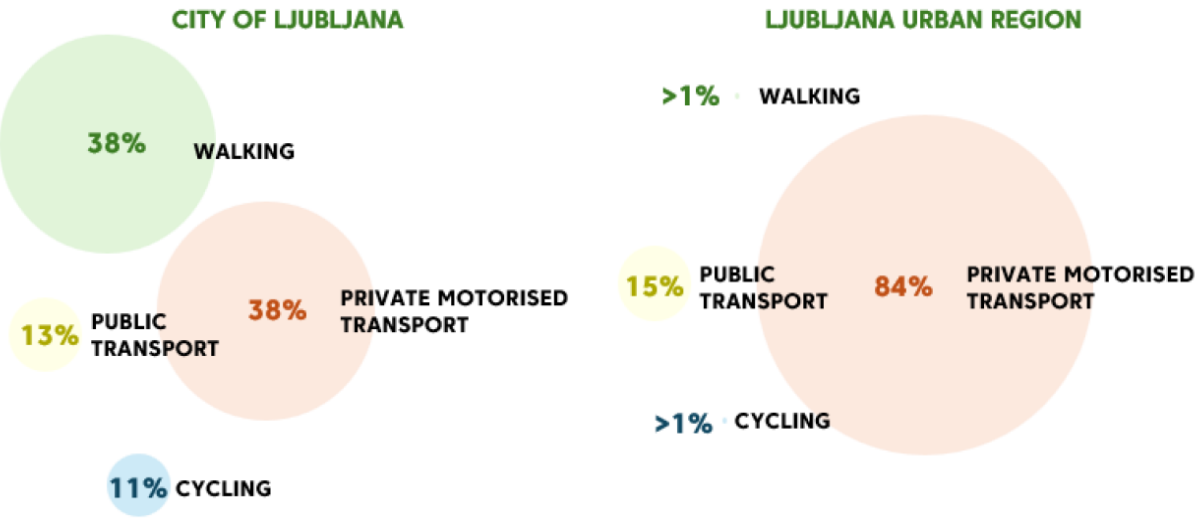

Figure 9 – Modal Split in Ljubljana Urban Region

In the Ljubljana Urban Region, daily mobility remains overwhelmingly car-dependent. About 85 percent of all trips into the region from other parts of Slovenia are made by car—a share that has remained unchanged since the COVID-19 pandemic. Within the region, public transport represents only about eight percent of trips to work, school or errands, indicating a slow shift toward more sustainable alternatives.

Although twelve municipalities have adopted local Sustainable Urban Mobility Plans and the region approved its own SUMP in 2018, the uptake of Connected, Cooperative and Automated Mobility technologies remains limited. At the same time, the region is actively implementing a broad range of measures to strengthen sustainable mobility and reduce reliance on private cars. Ljubljana's participation in the EU's "100 climate-neutral cities" initiative underscores its commitment to environmental responsibility and long-term climate goals. Continued development of accessible, low-emission transport solutions will be essential for improving mobility, reducing congestion and enhancing air quality across the region (Celostna PRometna strategija Ljubljanske URbane regije, 2025; Slovenia, 2025; LUR, 2022; Mestne obcina Ljubljana, 2025; Region, 2022).

6.2 Objective of the Demonstration Site

6.2.1 Objective of the Demonstration site

The primary objective of the Ljubljana Urban Region's involvement in the CulturalRoad project is to increase the acceptance and implementation of CCAM systems. The demonstration will focus on engaging regional stakeholders, including municipalities, businesses, and citizens, to co-create solutions that address current mobility challenges. The goal is to integrate CCAM technologies into the regional SUMP, which will serve as the foundation for long-term policy development and regional mobility planning. By involving the public and policymakers in the process, the demonstration aims to create a sustainable transport model that aligns with CulturalRoad's broader vision.

Key actions in the Ljubljana Urban Region include:

- Engaging a wide range of stakeholders and policymakers to discuss and support the deployment of CCAM systems.
- Organising workshops with local communities and stakeholders to ensure the fair deployment of CCAM technologies.
- Updating the region's Sustainable Urban Mobility Plan (SUMP) to incorporate CCAM services and long-term policy improvements.
- Preparing a White Paper on CCAM within the region, which will guide future policy development and serve as a resource for other regions across Europe.

6.3 Demonstration site specific co-creation methodology

6.3.1 Cocreation framework

The two-step co-creation process in the Ljubljana Urban Region will be organised as a structured sequence of activities that moves from gathering insights to translating them into concrete strategic outputs.

Step 1 - Data Collection via Direct Engagement of stakeholders: In the first step, a broad group of stakeholders has been brought together—policymakers, mobility experts, transport providers, local communities and everyday users. They participated in thematic workshops and interviews designed to explore expectations, concerns and opportunities linked to CCAM deployment. These sessions will allow to identify shared priorities, understand barriers to acceptance and map out the conditions needed for fair and effective implementation across the region.

Step 2: End-User Engagement: In the second step, the insights gathered during co-creation will be consolidated and transformed into practical guidance. The findings will be used to update the Regional Sustainable Urban Mobility Plan, ensuring that CCAM services are anchored in long-term mobility objectives. At the same time, a White Paper on CCAM in the region will be prepared, offering policy recommendations. Through this process, what begins as collaborative dialogue will be formalised into policies, strategies and knowledge that support the region's transition toward more sustainable, inclusive and future-oriented mobility.

Figure 10 – Visualization of the co-creation framework

6.3.2 Data collection and methodology

The workshop was held online on 21 October 2025 and brought together a carefully selected group of Slovenian public transport operators and research institutions engaged in the development and implementation of CCAM-related solutions. Out of eight invited organisations, five were ultimately able to attend, each represented by a single designated participant. The names of these individuals have been removed to safeguard their privacy, yet the institutions they represent are listed in the subsequent section. Despite the reduced number of attendees, the workshop ensured balanced representation and enabled focused, constructive discussion among the key stakeholders involved.

Workshop 1

Name Stakeholder: The Institute of Civilization and Culture (ICK)

Stakeholder Type: Independent Institute

Name Stakeholder: PNZ - Transport Ecology Laboratory

Stakeholder Type: Consultant

Name Stakeholder: Municipality of Ljubljana

Stakeholder Type: Public Authority

Name Stakeholder: SRIP – Circular Economy

Stakeholder Type: Independent Partnership

Name Stakeholder: IJS – Institute “Jozef Stefan”

6.3.3 Analysis and contextualized findings

In the Slovenian stakeholder workshop participants viewed CCAM with caution and awareness of social issues, concerns about safety, justice, and larger societal consequences dominated discussions. As one participant pointed out, stakeholders strongly link trust with safety and societal readiness, warning that technology frequently advances more quickly than society:

> PL.2: "*Technologically, we are often ahead of ourselves, **technology progresses faster than society**.*".

6.3.3.1 Safety

Participants believed that automation would increase road safety because they state that most traffic accidents are caused by humans.

> *PL.2: "**Humans cause most accidents**, and once machines take over, accident rates decrease."*

Another made a reply, highlighting the fact that even a small number of accidents brought on by automated systems could still be viewed very negatively and raising the question of what level of safety society would find acceptable.

> *PL.3 "[responding to PL.2] […] The question remains: **what level of safety is socially acceptable**? Probably only a minimal number of accidents, yet even those would be perceived very negatively."*

There was also discussion about how public acceptance and safety perception could be improved through alternative approaches that include human supervision. One participant proposed using remote operators to meet security standards:

> *PL.4: "Safety perception could be further improved by **introducing remote operators** – for instance, one operator could supervise ten vehicles and intervene if one experiences an issue."*

6.3.3.2 Perceived Impact with Sentiment: negative and Sentiment: positive

Negative perceived impacts

Many participants expressed concerns about increasing inequality and competitive trends that could make automated mobility exclusive or inaccessible for certain groups. As one speaker pointed out:

> *PL.3: "There are also risks related to personal freedom – the car represents independence, and if AM vehicles belong to a higher price range (100K+ Euro), they will be **accessible only to the wealthy, while others will rely on subscriptions.** For example, Uber raises its prices during major events because it can, forcing other users to pay higher rates even if they are not attending the event. If left entirely to the market, this could lead to inequality."*

Another respondent emphasised the risk of increasing mobility segregation by asking whether "*will we still travel freely, as we do today*" if vehicle ownership and access varies greatly between income levels.

> *PL.2: "[…] there are broader questions – will we still travel freely, as we do today? **Will mobility segregation deepen?** Today, two people can drive on the same road in cars worth €10K and €100K respectively; in the AM world, that may no longer be the case."*

Concerns about equity also related to the connection of AM and public transport. The majority of people who use public transportation nowadays do not have driver's licenses, according to stakeholders. The only obstacle left will be financial if that one disappears. In this sense, if economic accessibility is not given priority, automation could accidentally cause passengers to switch from shared to individual automated transport modes.

> *PL.3: "Most **public transport users** today are people **without driving licenses**. If that barrier disappears, the only remaining one will be financial."*

Additionally, participants voiced doubts regarding public acceptance and readiness, highlighting the influence of misinformation on public perception.

> *PL.4: "Public awareness is crucial – **people often confuse electric and autonomous vehicles**, assuming that if an electric car catches fire, it must be autonomous".*

Participants also remarked that:

> *PL.5: "AM mainly appeals to **technology enthusiasts**"*

Indicating a limited appeal outside of early adopters which may hinder wider acceptability if equity is not addressed.

The implementation period of autonomous mobility was perceived as a difficult phase due to irrational expectations and unexpected outcomes. Although there is a lot of public enthusiasm for automation, they warned that the practical adoption will probably be gradual because of strict safety regulations and regulated testing facilities and procedures.

> *PL.5: "[While asked about barriers of AM adoption] **expectations about autonomous mobility** may be **too high**. The transitional phase of AM will be slow, mostly because we prefer to stay on the safe side. Over time, people might even find autonomous vehicles frustrating because of their lower speeds. Speed analyses are poor."*

Participants also warned about operational issues, such as the possibility of increasing traffic if people utilise personal autonomous vehicles inefficiently and possible frustration for users at slower travel speeds.

> *PL.4: "A potential downside of AM is that if everyone owns their own autonomous car and sends it across town for errands, this will only **increase traffic**."*

Others voiced economic concerns, pointing out that rather than decreasing overall dependency on cars, automation would change vehicle ownership models through leasing and maintenance dynamics.

> *PL.2: "Toyota's financial branch has studied how the introduction of **AM could actually increase car sales** – not because of new ownership, but due to leasing models, battery prices, and maintenance factors."*

Positive perceived impacts

Stakeholders expressed optimism over autonomous mobility's long-term advantages, highlighting the fact that public opinions frequently change for the better as consumers become more used to new technologies. They pointed out that once the benefits of advances in terms of ease and safety are shown, they are often accepted.

> *PL.4: "Over time, users usually realize that new technologies once seen as unnecessary actually improve safety and convenience."*

Participants also emphasised how autonomous mobility might fill in transportation coverage gaps, especially in rural and suburban areas with few public transportation options and driver shortage. Autonomous shuttles could run frequently in these situations, reducing operating costs and enhancing accessibility for those with limited mobility, thus contributing to the reduction of transport poverty.

> *PL.4: "AM could bring great **advantages to suburban and rural transport**, where public transport coverage is weak and there is a shortage of drivers – a trend across Europe. **Autonomous shuttles could operate 24/7**, cutting driver costs and improving accessibility for non-mobile residents, thus reducing transport poverty."*

6.3.3.3 Use Case

Stakeholders outlined where and how the technology might be used while addressing a range of potential use cases for autonomous mobility. They suggested that ride-sharing models and flexible autonomous vehicles, like minibuses that can transport both passengers and packages, might provide effective and sustainable ways to lower the number of private automobile owners

> *PL.4: "**Ride-sharing** could be a solution: not everyone needs their own car – for example, **autonomous minibuses could carry both passengers and parcels**."*

Participants expected that controlled environments, such as highways and railroads, where conditions are more predictable and regulatory barriers are lower, will likely see the start of large-scale implementation.

> *PL.3: "The first large-scale implementation of AM will likely happen on **highways and railways**."*

Others predicted that cities will serve as the first testing grounds, especially on fixed routes and inside constrained operational regions. School transport was mentioned as a potential early use case because of its frequent schedules.

> *PL.2: "The **rollout will start in cities, on fixed routes and limited areas**, then expand to highways. **School transport** could be an **early opportunity**."*

Overall, stakeholders stressed that the transition toward automated mobility must be guided intentionally, noting that:

> *PL.2: "We must pay close attention to potential inequalities. The future may bring subscription-based vehicle access rather than ownership. Our goal should be to guide this transitional phase toward fair, safe, and sustainable mobility."*

7 UNITED KINGDOM

7.1 Introduction to the demonstration site

Table 7 – Demonstration Site Card

Population	3.5million (combined West Midlands and Oxfordshire)
GDP per capita	€30,000 to 50,000
Geographical Context	West Midlands: Diverse city region (20% non white population) and areas of high deprivation Oxfordshire: Medieval City accommodating significant student / research population bordered by rural area
Transport Context	Mostly bus, heavy rail (private operated), limited mass transit.
CCAM Maturity	Low / Medium: some demonstrators
Related research aspects	Rural needs, inclusivity and accessibility. Traffic management needs

The United Kingdom (UK) demonstration site is the largest in the CulturalRoad project, with the ambition to achieve regional and national impacts. It combines two main areas, Oxfordshire and the West Midlands. The demonstration side has therefore two main objectives, one more regional/local and another more regional/national. The activities required strong coordination and collaboration between the two key partners involved, the Oxfordshire County Council (OCC) and Transport for West Midlands (TfWM). The two partners took the lead in collecting the data in each of the two regions and supported the joint data analysis process. The co-creation approach is, in fact, combining the results from both, to deliver guidelines and suggestions that can be upheld at a national level but still reflect regional and local needs. Given this premise, this chapter discusses the Oxfordshire and West Midland region separately, to better highlight keys differences and requitements. However, the result section present combined results, with local and nationwide insights.

7.1.1 Oxfordshire

Oxfordshire is a picturesque county located in the South East region of England. It is known for its rolling hills, verdant meadows, and the serene River Thames that meanders through its landscape. The county is home to the city of Oxford and market towns such as Abingdon, Banbury, Didcot, Henley and Witney. The city of Oxford hosts the University of Oxford and Oxford Brookes University. The population of Oxfordshire is diverse and dynamic, with a mix of urban and rural communities. The county has a population of approximately 750,230 residents. It is culturally diverse with 23.2% of the population identifying as non-white British, rising to 46.5% within the city of Oxford.

Oxfordshire boasts a rich culinary heritage, with local produce playing a central role in its gastronomy. The region is known for its traditional dishes, such as Oxford sausage, a lightly spiced pork sausage, and Oxford Blue cheese, a creamy, blue-veined cheese with a distinctive flavour.

The region experiences moderate rainfall throughout the year, with the wettest months usually October and November. Spring and summer bring beautiful, sunny days, making it an ideal time for outdoor activities and exploring the countryside.

Oxfordshire has a long history of motor vehicle manufacturing with Morris Motors Ltd starting in 1919 and part of the Morris complex is still used by BMW today to make the MINI. The county sits within Motor Sport

Valley and is home to several single-seater racing teams, such as Renault, Haas and Williams, and their supporting industries, driving innovation in the vehicle industry. That innovative vision from academia and the motor vehicle industry has led to Oxfordshire being home to several self-driving companies, specialist sensor manufacturers and Connected Autonomous Mobility Testbeds. For example, Didcot was the location of the first-ever passenger-carrying trials of a fully electric autonomous bus in the United Kingdom.

Oxfordshire's transport context is shaped by a variety of factors, including its geographical location, population distribution, economic activities, and environmental considerations. Oxfordshire faces several transport-related challenges, including congestion, environmental impact, and the need for better connectivity. The existing public transport network in Oxfordshire follows a radial, 'hub and spoke' pattern centred on Oxford, particularly the city centre. However, connectivity is more limited outside these radial corridors, both within Oxford and especially in the more rural areas of Oxfordshire.

Oxfordshire's transport network is transforming with an ambitious plan to deliver a zero-carbon transport network by 2040. This plan aims to enable the county to thrive while protecting the environment and making Oxfordshire a better place for all residents. The Local Transport and Connectivity Plan (LTCP), adopted in July 2022, aims to reduce the need for travel and discourage unnecessary individual private vehicle use by making walking, cycling, public, and shared transport the natural first choice.

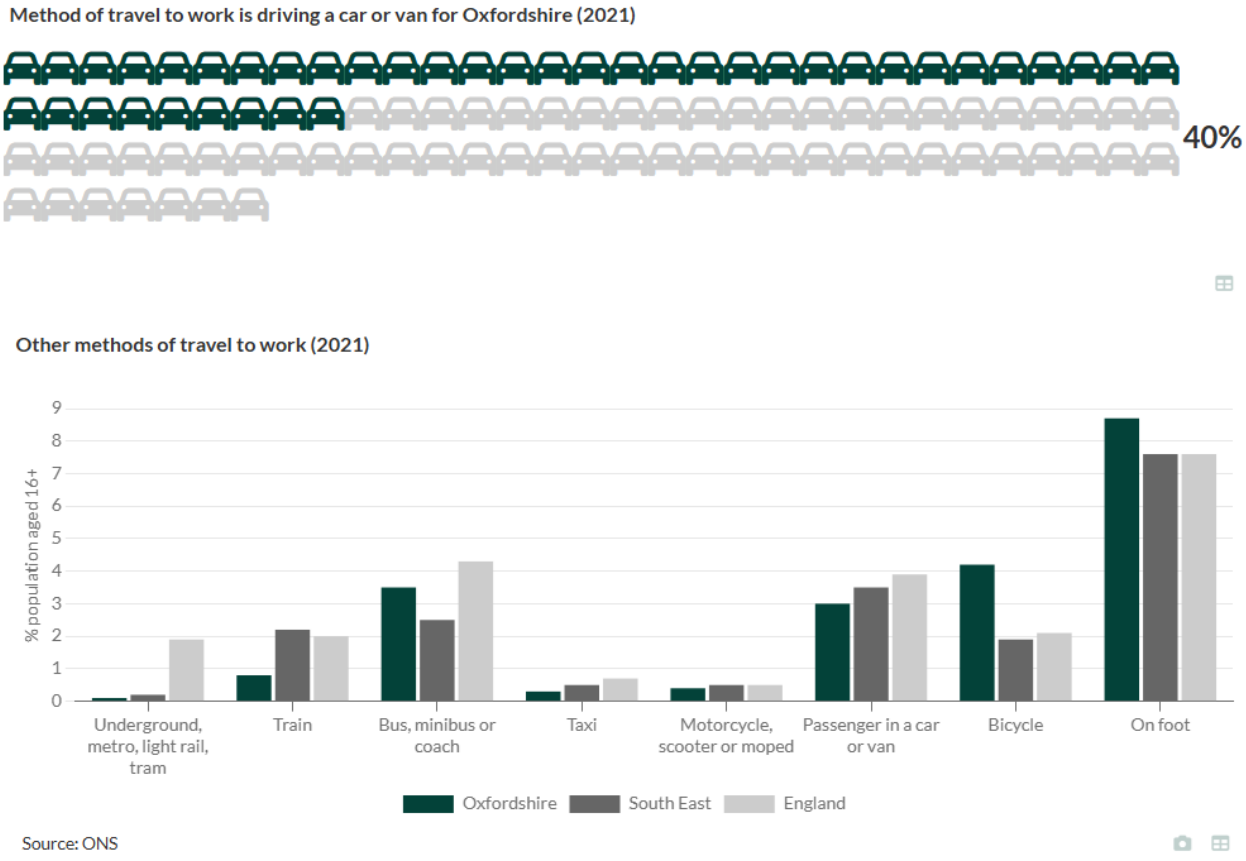

Figure 11 – Commuting patterns in Oxfordshire (Council, 2025)

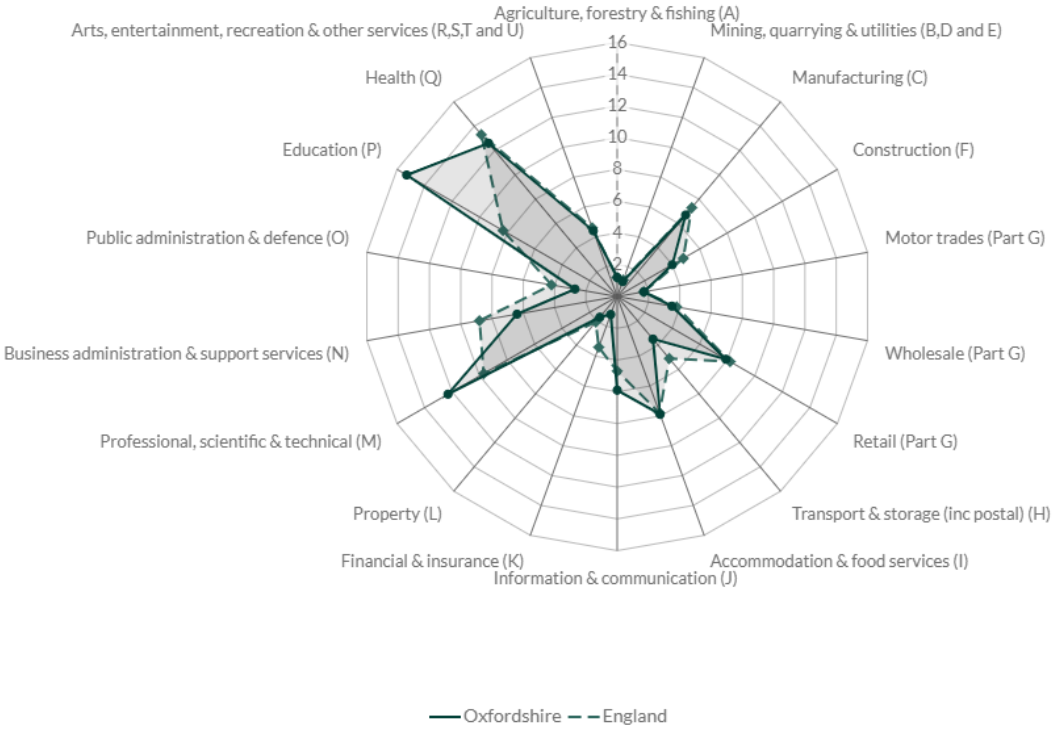

Figure 12– Employment structure in Oxfordshire (Council, 2025)

The two figures above provide further insight into Oxfordshire's socio-economic and transport context. Figure 11 highlights commuting patterns, showing that driving remains the dominant mode of travel to work, while walking and cycling are relatively common compared to regional and national averages. This reflects the county's mix of urban and rural areas and the challenges of connectivity beyond Oxford's radial transport corridors. Figure 12 illustrates Oxfordshire's employment structure, with a strong presence in education, health, professional, scientific, and technical sectors, underlining its knowledge-based economy and innovation-driven industries. Together, these trends reinforce the importance of Oxfordshire's Local Transport and Connectivity Plan (LTCP) in reducing car dependency and supporting sustainable travel options to meet its zero-carbon transport ambition by 2040.

7.1.2 The West Midlands

The West Midlands is a multicultural region, influenced by British, Indian, Pakistani, Caribbean, and Chinese cultures, which is reflected in its vibrant food (e.g., Balti curries), music, and arts scene. Traditional dishes also include fish and chips and Staffordshire oatcakes. The climate is temperate, with mild winters and warm summers, although the weather can be unpredictable with frequent rain showers.

The Automotive Heritage and its Legacy: the West Midlands is traditionally known as the birthplace of the UK's automotive industry, profoundly shaping its identity, economy, and physical infrastructure.

- Industrial Heart: Historically, the region, particularly cities like Birmingham and Coventry, was the "workshop of the world", building on the legacy of the First and Second Industrial Revolutions. This industrial expertise laid the foundation for vehicle manufacturing.

- Iconic Brands: The West Midlands became the home for iconic British car manufacturers such as Jaguar, Land Rover, Austin, Rootes, and MG Rover. By the early 1970s, the region accounted for approximately 60% of total car production in the UK.

- Economic Transition: The concentration of the automotive sector, while a source of prosperity for much of the 20th century, made the region highly vulnerable to de-industrialisation and globalisation starting in the mid-1960s, leading to significant factory closures and economic challenges, such as the collapse of MG Rover in 2005.

- Modern Relevance (CCAM Context)**:** Despite the historical decline in volume manufacturing, the region retains a significant presence in high-value automotive engineering, research, and design. Companies like Jaguar Land Rover remain a crucial economic anchor. This legacy of engineering skill and established supply chains is now being leveraged by Transport for West Midlands (TfWM) to transition the region into a global hub for Connected and Automated Mobility (CCAM) and low-carbon vehicle technology, including the National Automotive Innovation Centre and the UK Battery Industrialisation Centre in Coventry. The region's history with the internal combustion engine is now directly informing its approach to the future of transportation.

Current Public Transport Usage and Challenges: Usage and Modal Share - The West Midlands Combined Authority (WMCA) area faces a significant challenge in its modal split, where car use heavily dominates overall travel.

- Overall Modal Split - Historically, around 70% of all trips in the region were made by car, compared to just 10% by public transport (PT).
- City Centre Focus - Public transport use is highly concentrated on journeys into key urban centres during the morning peak (AM peak). For example, in Birmingham City Centre, PT accounts for approximately 59.0% of AM peak trips (2023 data), split between bus, rail, and metro. In contrast, Coventry City Centre sees PT usage at around 19.6% in the AM peak, highlighting the reliance on private cars outside of the primary conurbation.
- Bus Network Importance: The bus network remains the backbone of public transport, accounting for roughly 4 out of every 5 public transport journeys and is crucial for the 25% of households in the region that do not own a car.

Key Issues: The primary challenges for the existing public transport network are:

- Unreliability due to Congestion - The most cited issue by bus riders (reported by 72% in a TfWM survey) is that services are unreliable or didn't turn up on time. This unreliability is directly caused by rising traffic congestion across the metropolitan area, which has led to longer journey times and reduced network accessibility.
- Affordability - The West Midlands ranks in the bottom quartile globally for public transport affordability among major global cities, acting as a major barrier to increased ridership.
- Post-Pandemic Car Recovery - Following the COVID-19 pandemic, private car usage has rebounded quickly, often exceeding pre-pandemic levels, while PT patronage has been slower to recover. This trend risks a 'car-led recovery' that exacerbates congestion and undermines sustainable mobility goals.

Outlook and Future Trajectory: the outlook for the next decade is defined by the West Midlands' strategic goals to increase sustainable travel modes, set against the systemic risks posed by a rapid, uncoordinated deployment of Connected and Automated Mobility (CAM).

Strategic Goals (Transport for West Midlands - WMLTP): the West Midlands Local Transport Plan (WMLTP) aims to fundamentally shift the region's travel culture with key targets:

- Sustainable Travel Target - To achieve 50% of all trips made by sustainable modes (PT, walking, cycling) by 2035.
- The "45-Minute Region" - The ambition is to ensure residents can access essential services, work, and education within 45 minutes of travel *without needing a car*.
- Infrastructure Investment -The strategy focuses on building high-capacity, reliable PT services, including extensions to the West Midlands Metro and the development of SPRINT Bus Rapid Transit corridors to circumvent congestion.

The Role and Risk of CAM (West Midlands Local Authority Perspective): The core tension for the next 10 years, as highlighted by Local Authorities (LAs), is managing the integration of automated vehicles (AVs):

- Risk of Increased Congestion - Without public sector control, the expected large-scale introduction of taxi-like automated services risks a sub-optimal deployment that increases the number of single-occupancy automated vehicle trips. This could dramatically increase urban congestion, making the city more car-centric and threatening the viability of bus-based public transport.
- Upholding Public Service - The LA's expectation is to ensure that future bus-like CAM services can be successfully integrated to meet (and not degrade) the core public transport outcomes of safety, reliability, affordability, and accessibility.
- Preventing PT Decline - The strategic priority is to prevent new mobility services from undermining existing public transport by drawing away riders and investment, thereby worsening the transport options for the most vulnerable and car-less communities.

7.2 Objective of the Demonstration Site

7.2.1 Existing or planned CCAM solutions

The CulturalRoad demonstration in the West Midlands builds upon previous CCAM pilots in the region. These pilots, alongside the CulturalRoad project, are intended to inform the use of CCAM as another transport mode in transport planning and future policies. Transport for West Midlands (TfWM) aims to ensure that CCAM is accessible, equitable, and safe. A critical first step in achieving this is to build trust with the user base.

A key current deployment trial is running in parallel with the CulturalRoad demonstration:

- Location: National Exhibition Centre in Solihull.
- Duration: The trial will last until March 2026.
- Operation: Three shuttles provided by Ohmio are operating around the National Exhibition Centre campus.
- Future Plans: This deployment complements plans for a fully automated and commercial service running in time for main events at the National Exhibition Centre in 2027, such as the Invictus Games and the ITS World Congress

7.2.2 Objective of the Demonstration site

The UK demonstration pilot has two natures. The first contact is regional and local, which is implemented in Oxfordshire. The second context is regional and national, and this is implemented at the level of the West Midlands area. While the two activities are connected, their aim differs.

Oxfordshire: The CulturalRoad demonstration in Oxfordshire aims to develop a better understanding of the population, how they travel and how Cooperative, Connected and Automated Mobility (CCAM) solutions could help them switch from private vehicle usage to other modes of transport particularly public transit. It also seeks to understand people's barriers to change, whether related to a lack of options in rural areas, age, disability, neurodiversity, or cultural factors. This will be done through a series of targeted surveys and focus groups where the various CCAM solutions can be discussed, and the collected views can be incorporated into new design solutions for CCAM services along with the associated digital and physical infrastructure needs.

West Midlands: The demonstration in the West Midlands, primarily carried on by Transport for West Midlands (TfWM) as a key member of the Automated Mobility Network (AMN), is focused on ensuring the integration of Connected and Automated Mobility (CAM) services aligns with public sector duties and community benefit.

The primary objective is to move from subsidised CAM trials toward a clear path for achieving safer, more reliable, affordable, and accessible transport for users.

This is broken down into the following key objectives, based on the Local Authority (LA) perspective:

Public Service & Equity Objectives

- **Align CAM with Societal Goals:** Ensure the development of CAM products and services that are safe, sustainable, equitable, and appropriate and that they benefit the communities they serve. This is a necessity to prevent deployment that is solely aimed at meeting private sector objectives, which risks degrading public trust.
- **Uphold Public Transport Priorities:** Assess and ensure that future bus-like CAM services can meet, and certainly not erode, the foundational public transport (PT) outcomes, which include: increased safety, reliability, affordability, and accessibility.
- **Manage Social Impact:** Define a path to mitigate major social risks, such as job displacement for existing PT drivers and the potential for taxi-like CAM to increase congestion and reinforce car-centric urban patterns.

Strategic and Capability Objectives

- **Develop LA Capacity and Expertise:** Increase the capability and capacity of LAs to consider the direct and indirect consequences of CAM. This involves creating an easy-to-do engagement path with a strong shared evidence base to support future investment decisions by senior leaders.
- **Support National Strategy:** Use local insights and lessons learned to contribute to the development of a holistic national strategy that fully addresses the effects of automation on both public and private transport and clarifies the crucial role of LAs in managing these effects.

- **Promote Sector Co-ordination:** Engage in the AMN's activities to Collaborate to Accelerate (share learning) and Unify to Simplify (develop consistency) to reduce barriers for deployment across the UK

7.3 Demonstration site specific co-creation methodology

7.3.1 Cocreation framework

As discussed at the beginning of this chapter, the co-creation has ambitions at a national and regional level. The overall co-creation framework for the UK demonstration site can therefore be summarized as in Figure 13. The framework is composed in two steps, as described in Section 2, and supports national and regional goals. To reflect this difference, two different data collections were executed by OCC and TfWM, and are discussed in the following sub-sections.

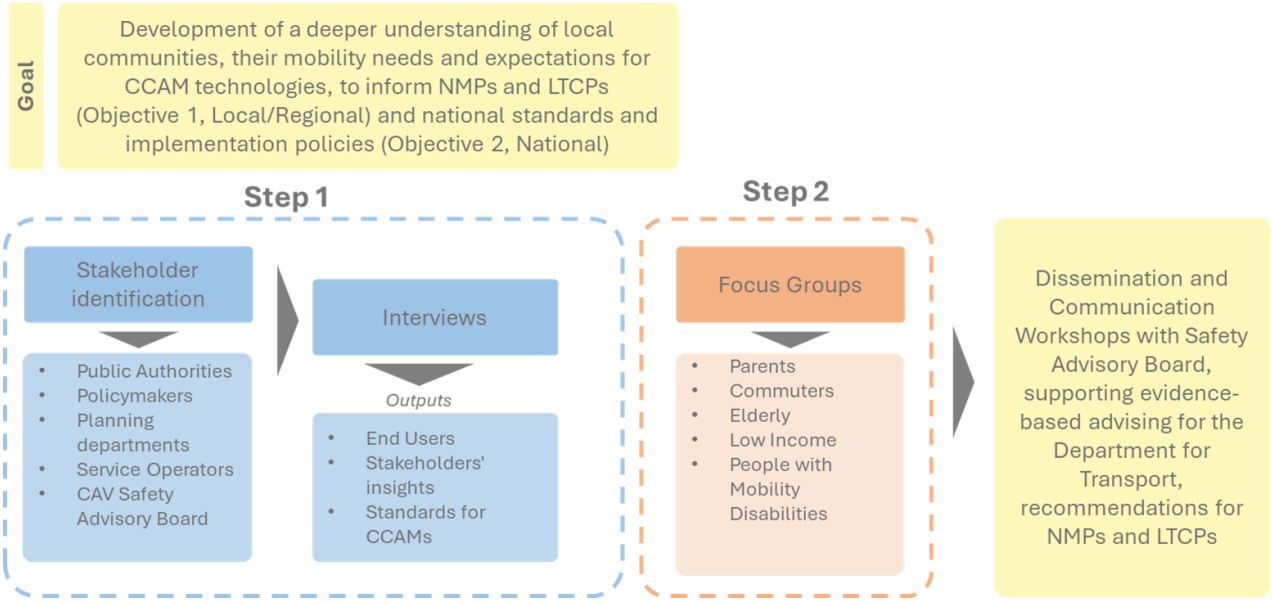

Figure 13– Cocreation Framework in the United Kingdom Demonstration Site

7.3.1.1 Implementation in Oxfordshire

Goal: To understand the barriers and opportunities for Oxfordshire's rural population—focusing on age, disability, and neurodiversity—to support the adoption of CCAM solutions and reduce reliance on private vehicles (car and taxi).

Outcome: Insights will feed into delivery planning, infrastructure design, and policy development related to the adoption and integration of CCAM solutions (both at regional and national levels). This includes Network Management Plan (NMP) and future Local Transport & Connectivity Plans (LTCP).

Step 1 - Data Collection via Direct Engagement of stakeholders: OCC organized Stakeholder Workshops after identifying and engaging with individuals and services areas within the County Council who are involved in transport delivery/planning, service delivery, strategic planning, and policy development. During the workshops, the various viewpoints regarding needs, priorities, considerations, types of infrastructure requirements, and policy factors.

Step 2 - End-User Engagement: Focus Groups will be organized with end users. The insights from Step 1 – Stakeholder workshops (WS) -- will inform the development of questions for the Focus Groups (FGs). The FGs are expected to include rural residents, older adults, people with disabilities, and neurodiverse individuals—subject to confirmation after transcript analysis and review of organizational-level assumptions. The purpose of the FGs is to identify previously unrecognized needs and influencing factors, and to validate existing organizational assumptions.

7.3.1.2 Implementation in the West Midlands

Goal: To understand the barriers and opportunities for West Midlands Metropolitan Urban Area — focusing on all citizens in the region and supporting the adoption of CCAM solutions and reducing reliance on private vehicles (car and taxi).

Outcome: Insights will feed into delivery planning, infrastructure design, and policy development related to the adoption and integration of CCAM solutions (both at regional and national levels). BSI CAV Safety Advisory Board and supporting the Department for Transport in the development of future CCAM guidance for the UK

Step 1 - Data Collection via Direct Engagement of stakeholders: TfWM organized Stakeholder Workshops after identifying and engaging with individuals and services areas within the region who are involved in transport delivery/planning, service delivery, strategic planning, and policy development. During the workshops, the various viewpoints regarding needs, priorities, considerations, types of infrastructure requirements, and policy factors.

Step 2: End-User Engagement: Focus Groups will be organized with end users. The insights from Step 1 – WS with the stakeholders – will be used to develop the questions for the Focus Groups (FGs). FGs will include specific interest groups, likely to include but not limited to: residents, older adults, people with disabilities, and neurodiverse individuals. The outcomes will be used to validate organisational-level assumptions.

Step 3. Feedback Loop

- Findings from the focus groups will be fed back to organizational stakeholders as part of follow-up and dissemination of findings activities.
- Refine CCAM service design and delivery recommendations as well as policy frameworks.
- Ensure solutions are inclusive, practical, and culturally/geographically appropriate for any cohorts identified.

7.3.2 Data collection and methodology

In Oxfordshire, two online workshops were delivered via Microsoft Teams to engage a diverse group of internal stakeholders. Participants were drawn from a range of senior roles spanning transport and service delivery, strategic planning, and policy functions across the County Council, ensuring representation from multiple perspectives within the organisation. To accommodate varying availability, the workshops were scheduled one week apart (**Workshop 1** 13/10/2023; **Workshop 2** 20/10/2023). Recognising the challenges of securing attendance for a one-hour session, an additional online survey—based on the question script outlined above—was introduced as an alternative engagement method, enabling broader participation and inclusion in the data collection process. Transcripts from both workshops were processed and shared in word

format for ease of coding and in ATLAS.ti. During processing, any reference to an identifiable individual was replaced with a code (as shown in the participant tables below), and any business-sensitive information was redacted. Additional text was also inserted and clearly marked using [] to clarify meaning where the automated transcript was unclear, and where local colloquialisms were used by participants to assist project partners in the next phase of coding and labelling responses.

In the West Midlands, one online workshop was delivered via Microsoft Teams, with the support and moderation of our research partner Mustard Research to engage a diverse group of Senior internal & external stakeholders. Participants were drawn from a range of roles from the CAM eco-system in the West Midlands, ensuring representation from multiple perspectives. The two-hour workshop took place on 30th September 2025. Transcripts from the workshop were processed and shared in word format for ease of coding and in ATLAS.ti. During processing, any reference to an identifiable individual was replaced with a code (as shown in the participant tables below), and any business-sensitive information was redacted. Additional text was also inserted and clearly marked using [] to clarify meaning where the automated transcript was unclear, and where local colloquialisms were used by participants to assist project partners in the next phase of coding and labelling responses. As for the agreement with the stakeholders that join these workshops, the name of the stakeholders are not reported in for the UK workshops.

Workshop 1 (organized by OCC - 13/10/2025)

Stakeholder Type: Place Shaping Public Transport

Stakeholder Type: Fleet Service

Stakeholder Type: Place Planning (Transport)

Workshop 2 (organized by OCC - 20/10/2025)

Stakeholder Type: Area Travel Plans -Place Shaping

Stakeholder Type: Place Planning and Coordinator Place Shaping

Workshop 3 (organized by OCC - 20/10/2025)

Stakeholder Type: Place Planning and Coordinating

Stakeholder Type: Strategic Transport Manager

Stakeholder Type: Place Planning (Central)

Stakeholder Type: Public Transport - Place Shaping

Stakeholder Type: Innovation Service

Workshop 4 (organized by TfWM - 30/09/2025)

Stakeholder Type: Public body

Stakeholder Type: Local Government Authority

Stakeholder Type: Motability Operations

Stakeholder Type: Global Consultancy

Stakeholder Type: Engineering/Systems Organisation

The aforementioned workshops were held separately for both Oxfordshire and TFWM. It is also envisaged (to be confirmed) that a joint national workshop will be organized, aiming to recruit participants at a national level and include the following: public transport regulatory bodies, CCAM regulators in the UK, CCAM technology providers for public transport, public and private mobility service companies, and logistics and delivery companies leveraging CCAM.

7.3.3 Analysis and contextualized findings

Stakeholders in the UK workshops articulated nearly polarised views, ranging from strong optimism about opportunities to deep concern about risks and consequences of automated mobility. Their perspectives clustered around sentiment (positive/negative), perceived barriers, accessibility and inclusion, safety, and concrete use cases, reflecting an ongoing tension between technological promise and societal readiness for CCAM

7.3.3.1 Negative and positive sentiment

Stakeholders' opinions were highly polarised, with both strong optimism and substantial concern overlapping. Sentiment never appeared on its own but always co-occurred with other themes such as safety, accessibility, use cases or broader barriers, underscoring that reactions were closely related to concrete deployment questions rather than abstract attitudes. This polarisation underlies the content and will reoccur in the paragraphs that follow, as concerns about traffic, social effects, and early rollouts coexist with optimistic hopes about potential for users and the economy.

For example in general, concrete deployment questions were always associated with sentiment. Participants were concerned about unexpected consequences like congestion or the decline of public transport if private automated vehicles become too appealing, but they also saw potential in increasing mobility options.

> PUK.3: *"The way I'm thinking about it, it's **not necessarily a replacement to public transport. It could be an extension.** It could be an extension, but we have to get it right. If it becomes a replacement to public transport, sure, accessibility has to be thought through even more."*
>
> PUK.4: *"At the moment, it still feels like **we are taking a technology and trying to decide what problem it's solving**, as opposed to saying this is why we're doing this collectively, and this is how we're going to approach the whole thing."*
>
> PUK.4: *"**Direction and focus** is the only thing that's going to get us to the next step in **moving this from a technology to a transport solution**."*

7.3.3.2 Barriers (other)

Stakeholders pointed out several kinds of non-technical barriers that slow down the transition from pilots to real-world deployment. They noted that political dynamics and institutional hesitation increase the risk for projects to stay in a "research space," funded as feasibility studies that never proceed to implementation.

> PUK.4.: *"[When asked about challenges and barriers] it still feels very much that this is sitting in the research space, not in the **reality we need to tackle this and figure out what we're actually practically doing.** From a consultancy perspective, it means a lot of the feasibility studies and projects, first of all, you have to subsidise them, so we're investing in this as research, too, which we were very keen to do, and we did three out of four out of one competition. But then they stop. **The continuum of taking a transport solution project from creation to implementation doesn't actually happen.** It doesn't follow through. It **just gets looked at as a research**, as a feasibility, but then it is halted."*

They therefore pointed out that technology is not the main barrier, but that politics, economic constraints and adoption context shape whether automated mobility will bring benefits or create new problems.

> PUK.6: *"it's not the technology is the issue there is there's other things which kind of prevented it going forward?"*
> PUK.7: *"Yeah, politics. I think that was."*

Participants also pointed to financial and commercial uncertainties as key obstacles. They expected that parts of the system will initially be more expensive, with costs only coming down over time, and argued that it is unrealistic to assume that CCAM will be cheaper than existing solutions from day one.

> PUK.4: *"[When asked about challenges and barriers] It's one of these things that **initially parts of it will be more expensive**, but the expectation is that these costs, both for the technology as well as for the human contributions, will go down, and hopefully will then **make the whole system affordable**. But I think that if we are wanting to expect that connected autonomous mobility is just going to be implemented and on day one be more affordable than what we already have, I think this is also an **unreasonable expectation** to have. This is where conversations with government and so forth to be able to discuss what would be a reasonable expectation?"*

Additional obstacles emerged by risk aversion and long planning periods in transportation. Stakeholders observed that many actors would rather be "second" rather than "first" players, delaying large-scale deployment until they had learnt from others.

> PUK.4: *"[When asked about challenges and barriers] You do transport for the next ten, twenty, thirty years. At which point does it start making sense? But that also means that a lot of **people want to be the second people to implement something**, **not the first people** to implement something because you want to wait for it to happen, see all the issues, have the lessons learned and so forth."*

Participants brought up technical-systems barriers in addition to these systemic issues. They highlighted how challenging it is to demonstrate that automated systems can at least match human drivers before deployment and noted the rigorous standards related to cyber security, testing, and safety of CCAM.

> *PUK.5: "[When talking about safety opportunities of AM reflecting that it needs proof] it comes back to the piece of proving how these systems - prior to physical deployment, how do you say this vehicle is going to at least match a human driver in terms of it doesn't make mistakes, or it makes fewer mistakes. **How do you prove that before you deploy**? […] Technically, I think there's **some challenges to overcome from the testing point of view**, from the cyber security point of view, and*

protecting these systems, these highly complex and typically highly connected systems. That's an incredibly difficult challenge to overcome."

Lastly, stakeholders proposed that some of these barriers may be overcome through sharing international experience. They argued that better strategies for commercialisation and deployment at home could be influenced by lessons learnt from places where early commercial services are already being tested.

> *PUK.3: "[Talking about how barriers can be overcome while collaborating more and combine forces]* ***Learning internationally****, a lot is happening in the international arena around commercialisation of these projects. Nowhere near commercial projects, but they're doing commercial service where we are slightly behind the curve in terms of commercial operations.* ***Maybe learning from them as to what is their sweet spot, what is causing that commercialisation to take some shape****. Maybe not 100 per cent there yet, but that could help take us forward in our thinking around all the barriers we've got currently. Maybe that's a* ***different approach to join hands and understand use cases****, what's the case study looking like in other places?"*

7.3.3.3 Accessibility & Inclusion

Stakeholders noted that not everyone can benefit from the current transport design, particularly those with accessibility needs who face first- and last-mile difficulties. They did view this as a fundamental issue that every automated mobility implementation must address.

> PUK.3: *"Unfortunately,* ***public transport doesn't work for everybody****. Just the way it's designed, how do you do that first mile, last mile for people with accessibility needs? We can walk ten minutes, but they struggle with that. That's where the challenges are for us, really."*

Additionally, they saw potential in technology for improving mobility for individuals who are unable to drive, especially those with disabilities. However, they emphasised that this potential can only be achieved if vehicles and services are properly designed and connected with larger networks.

> PUK.3 *"I want to focus on the private mode of transport. I know we talked mostly public mode of transport here. I think if and when it happens, it's going to open up a huge area for people who don't drive, and that number is progressively - obviously a lot more dependent on public transport - but progressively that number is increasing. People with disabilities, there's a huge proportion who don't drive. I know there's lots of issues around accessibility in public spaces, but if it comes into the private space, this is a huge opportunity for people to commute. Remember, there's a whole social aspect to that commute, other than just work, and that could have huge impact for our customers."*

> PUK.1 *"we did focus groups with people with mobility impairments, if you could get the design right of the shuttle so that people can actually use them, it could be really useful and it could have a use, especially in the short journeys. Maybe people can go to a park and ride, and then get a journey in somewhere. But it's got to be designed right."*

Lastly, one participant portrayed automated services as possible extensions to public transport rather than its replacement. They stressed that accessibility issues become much more pressing if automation replaces public transport rather than enhances it.

> PUK.3 *"The way I'm thinking about it, it's* ***not necessarily a replacement to public transport****. It* ***could be an extension****. It could be an extension, but we have to get it right. If it becomes a replacement to public transport, sure,* ***accessibility has to be thought through even more****."*

7.3.3.4 Safety

It was made clear that safety was both the main promise and an essential condition for acceptance. Stakeholders believed that many individuals would be open to using automated systems if they felt safe and that, in theory, complete automation may lower human error-related incidents.

> PUK.6: *"people would want to use the system if they felt safe"*

> PUK.7*: "if everything was autonomous, you could probably suggest that it would be safer,* ***but you can't take into account the human factor in the whole thing****, yeah."*

Additionally, they highlighted safety as the most often mentioned advantage in discussions on industry and policy, connecting it to the possible decrease in crashes brought on by human mistake. They did, however, note that this advantage is dependent upon solid evidence and thorough evaluation.

> PUK.5: *"[When asked about opportunities of AM] I think the safety aspect is probably the one that gets the drum banged on this quite frequently, and I think there is merit. There is merit within that in terms of the number of road accidents caused by human error. I think these could be significantly reduced […] it comes back to the piece of* ***proving how these systems - prior to physical deployment, how do you say this vehicle is going to at least match a human driver in terms of it doesn't make mistakes****, or it makes fewer mistakes.* ***How do you prove that before you deploy?"***

8 CROSS COUNTRY CONSIDERATIONS

This chapter examines cross-country variations and shared patterns in stakeholder perceptions of CCAM adoption and deployment, revealing how national contexts shape discussions of benefits, barriers, and the broader societal role of autonomous mobility. It discusses the cross-country insights and incorporates our analysis derived from combining data from the different demonstration sites, identifying opportunities for Europe to excel in CCAM development whether in deployment, industry, or test cases.

Table 8 in the Annex presents the Code Group–Document, a Table derived from the software package for qualitative data analysis ATLAS.ti, Version 8.4.5 (1136) (https://atlasti.com/), showing how frequently each analytical dimension (code group) appears across countries after normalising it. Each code group, which is made up of several separate codes, represents a higher-level analytical category inside the Framework Method (see definitions below the table). Overall, the cross-country comparison indicates a conversation that is simultaneously opportunity-oriented and barrier-conscious, with variances across national contexts.

8.1.1 Challenges & Barriers and Benefits of CCAM

Overall, the workshop transcripts showed a balanced focus on the concepts of ‘Challenges & Barriers’ and ‘Benefits of CCAM’. It appears that stakeholders in each country are aware of the many potential advantages, particularly increased accessibility, new use cases in public transport, safety gains, and the possibility to modernise mobility systems.

However, codes and quotes (such as accessibility, adoption, pilot/testing, regulation, safety, and perceived impact) associated with the ‘Challenges & Barriers’ category were also articulated in terms of risks, uncertainties, and practical limitations. This mirroring shows that stakeholders are not merely "for" or "against" autonomous mobility. Instead, they hold ambivalent, often conditional positions, where the very aspects they anticipate (e.g. flexibility, on-demand services, safety, financial gains) are simultaneously seen as sources of new challenges and inequalities.

As a consequence, the discussion around ‘Challenges & Barriers’ shed light on a broad range of issues, including infrastructural set up, operational constraints, economic feasibility, legal restrictions, regulatory and governance issues, and user-related challenges such perceived uncertainty, safety, and trust. Benefits of CCAM, on the other hand, were also mentioned. These benefits can be obtained primarily by combining perceived benefits such as increased accessibility, economic and environmental advantages, mobility improvements, workforce possibilities, pilot testing opportunities, safety gains, and improved user experiences.

Stakeholders across nations unite on the view that CCAMs can substantially increase safety on our roads (by removing the human component), accessibility and inclusivity (by providing door to door services for vulnerable users or outside the crowded urban core), and promote more efficient and less congested public transport. The compounding effects of these benefits can bring unprecedented welfare gains, thanks to the reduction of accidents, gentrification of sub-urban areas, more inclusive public transport for vulnerable and low-income households. However, CCAMs are also likely to trigger the opposite effects without proper regulatory support. In the absence of a proper deployment plan, CCAMs can boost social inequality by making it more expensive and therefore inaccessible for certain user groups. This threat is especially critical during the initial deployment phase, where CCAM costs are expected to be higher. Similarly, the increased safety aspects seem obvious in the case of CCAM-only interactions, but in the case of hybrid traffic (CCAM interacting with conventionally human driven vehicles) these benefits are feared to be strongly reduced if not completely cancelled. If CCAMs are designed without accounting for users who speak different languages or, more importantly, users with limited physical or perceptual abilities, including children, the expected

benefits may also not be fully realized. Another important element that was mentioned in some demonstration sites is the data standardization and sharing among different stakeholders. It is important to stress that CCAMs are not just autonomous vehicles. By definition, CCAM stands for Connected, Cooperative and Automated Mobility. While less obvious to the end-user, the connectivity part is what makes this technology able to potentially deliver on these benefits. There is hence a need for standardization of formats and data sharing across stakeholders. The overall picture is therefore that policy makers should work to provide a clear and well-defined regulatory framework that allows all involved stakeholders to cooperate, and more importantly to benefit from this cooperation. In this sense, there was also some criticism towards the tendency in Europe to make very strict regulations, which may reward users with a more safe and inclusive system, but effectively make the European Union a 'follower' country compared to other 'leader' countries, such as the United States and China, both when it comes to technological development and deployment.

8.1.2 System and Participatory Factors and Mobility

The strong presence of the 'Mobility and System' & 'Participatory Factors' categories indicates that rather than framing CCAM as a purely technological breakthrough, stakeholders tend to define it as an aspect of mobility models and governance. Discussions centred around the shift from private vehicle use towards public transport and shared services and how AM could function as on demand bus services, connecting to existing public transport lines, or flexible shuttles. Much of the discussion also focused on more general mobility-system changes rather than the automation technology itself, where accessibility, issues of pricing, integration, planning and infrastructure are key factors.

From the stakeholder's perspective CCAM was viewed less merely as "autonomous cars" and more as modernised public transport and service models, with debates over who designs and regulates these systems. This relates to an ongoing issue in the European context as several stakeholders made clear distinctions between Europe and the US and China, expressing concern that strict regulations and slow governmental decision-making could cause Europe to "fall behind" and even force businesses to test and implement their innovative strategies overseas. However, these same factors also highlight where Europe can excel in the CCAM landscape. It is widely acknowledged that replacing personal vehicles with privately owned CCAMs is unlikely to deliver substantial benefits - particularly in terms of equity, environmental impact (e.g. congestion), and inclusivity. The true end goal, according to the stakeholders, is the deployment of fully autonomous, collective public transport services. This marks a significant contrast with the United States, where the focus tends to be more on individual mobility (like Waymo's robotaxis). European cities are also typically dense and built around historic urban structures, which presents very different opportunities and challenges compared to Chinese cities, many of which have been developed with new mobility technologies in mind. Adding to the views of the stakeholders, this requires the development of vehicles able to navigate within these more complex urban environments, while also guaranteeing higher safety protocols, making Europe an ideal place to test more advance CCAM technology. If this opportunity gives an edge to European companies manufacturing small or medium sizes CCAMs, it is also true that these stakeholders must be put in the conditions to test and deploy in real - and ideally large scale - use cases. These tests and pilots hopefully can determine commonalities and differences in design requirements not only in different countries but also within a country.

8.1.3 Accessibility and Equity

A central overlapping theme from the workshops is the fear of an emerging equity-accessibility dilemma. In several sites, AM is viewed as beneficial for people with disabilities, older adults and others with mobility restrictions; on-demand services and vehicle variety are seen as opening new forms of participation in everyday life. However, stakeholders remain concerned that these advantages might only be available to those who can afford them. Concerns about "the future may bring subscription-based vehicle access rather than ownership" and that without strong regulation "autonomous vehicles… will be accessible only to the

wealthy, while others will rely on subscriptions" are raised by the belief that subscription-based models, surge pricing, and premium fleets are possible models. Most stakeholder expressed that rather than having the market determine mobility solutions, the shift must be directed towards equitable, safe, and sustainable mobility. This brings a crucial dilemma for policymakers. As several respondents noted, CCAMs are unlikely to be cheaper than conventional vehicles at deployment. While prices may decline over time, authorities must ensure a goal-driven rather than profit-driven rollout. This requires not only clear regulations but also the selection of appropriate areas and use cases aligned with the long-term goal of a more accessible and equitable public transport system. Authorities should also consider subsidising autonomous mobility services in the beginning to counterbalance the increased ticket costs.

An opportunity arises from the current maturity level of CCAM technology. Pilot projects and early deployments can - and should - focus on connecting areas that are poorly served today or that require additional vehicles for vulnerable users. As already mentioned, complex infrastructure, dense urban cores, and intense vehicle interaction greatly increase testing and deployment costs. When it comes to use CCAM in combination with public transport in dense European cities, multiple small vehicles are needed to replace a single large bus, and efficiency can suffer due to congestion and interactions with conventional vehicles. By contrast, areas outside the urban core are often linked to cities by larger, simpler roads, making them more suitable for current CCAM capabilities. Moreover, one of the main costs of improving accessibility in these areas is the human driver - an expense removed in CCAM operations. This may also reduce concerns about CCAMs displacing jobs, since deployment would focus on areas that the current system cannot adequately serve. In conclusion, prioritizing testing outside dense urban cores offers a dual opportunity: operators gain concrete, manageable use cases to advance their technologies, and regulators can promote deployment strategies that support long-term acceptance and a public-transport-oriented CCAM model. These observations are based on the combination of quotes and observations from different workshops. To validate them, it is therefore recommended to engage again the stakeholders – either with one-to-one interviews or with a Delphi study – to present them with these findings and either confirming them or updating them.

8.1.4 Social-Cultural and Psychological Factors

The 'Social-Cultural Factors' and 'Trust & Acceptance' groups underline that acceptance has a strong connection to place attachment, public perception, fairness, and local mobility cultures. Concerns regarding the loss of "normal" travel freedoms and new forms of mobility segregation coexist with supportive views of AM for people with disabilities. Safety, transparency, and perceived adaptability to local needs are frequently cited as fundamentals of trust across nations, but the discussion also shows that these factors are not always developed methodically as trust and acceptance are often mentioned, but more as pre-requirements or obstacles rather than fully explored subjects.

The 'Psychological Factors' and 'Ethics' code groups, on the other hand, are comparatively less prominent, even though their underlying codes are mentioned in the discussions. This indicates a gap in explicit reflection on psychological and ethical dimensions as such. Stakeholders discuss the advantages and disadvantages of automation in great detail, but less about how different user groups may feel about automation, how cultural values may shape risk perception, or what normative principles should guide decisions beyond the fulfilment of existing regulation, In the same direction, although cultural norms and environmental factors are present in other groupings, they hardly become independent subjects of discussion. This points to a chance for the psychological factors pillar of the project: instead of allowing these dimensions to stay implicit, they should be made more visible and identifiable.

This suggests the need to actively engage and inform the public about CCAMs - both the technology itself and the broader deployment vision including use cases and services. Fears of losing mobility freedom, for example, do not stem from the technology but from cross-country legislation (particularly regarding private

car use) and user costs. Some users may simply be unable to afford a CCAM, meaning that building a dedicated infrastructure could inherently create inequities and restrict mobility. These issues depend on deployment strategies rather than the technology. There is also growing scepticism about whether CCAMs can adapt to different contexts, especially across countries. At the same time, despite extensive stakeholder discussions on these points, the limited attention to ethical considerations and psychological factors - particularly for disadvantaged user groups - shows that a holistic deployment strategy cannot be achieved without directly involving end-users. These aspects must be explicit and visible when developing European standards for CCAM rollout. Therefore, it is essential not only to establish a clear regulatory framework but also to include citizens in decisions about how CCAMs will shape Europe's mobility landscape. Procedures such as those developed in CulturalRoad provide one example, though not the only one, of how this participation can be effectively integrated.

9 CONCLUSIONS

This deliverable has presented the first step of the CulturalRoad participatory co-creation framework and documented its implementation across the five demonstration sites. Through a series of structured workshops with local authorities, public transport operators, industry representatives, and research organisations, the project has gathered a rich set of insights on expectations, concerns, and perceived opportunities related to Connected, Cooperative, and Automated Mobility (CCAM). The outcomes highlight both common themes across Europe and context-specific nuances shaped by local mobility systems, governance structures, and cultural factors.

Across countries, stakeholders consistently emphasised equity, accessibility, and inclusion as essential principles for future CCAM deployments. This reflects a shared understanding that automated services should complement and enhance public transport rather than replace it, and that deployment strategies must consider diverse user groups, particularly those with mobility impairments or limited access to existing transport options. Workshops also revealed a strong focus on governance and policy barriers, with stakeholders frequently pointing to regulatory uncertainty, risk aversion, and long planning horizons as key obstacles to moving from pilots to real-world operations. In contrast, technological barriers were discussed less prominently, suggesting confidence—sometimes misplaced—in the maturity of CCAM technologies.

At the same time, the discussions showed significant optimism regarding the potential benefits of CCAM, including increased safety, improved user experience, and new mobility opportunities in underserved areas. Participants highlighted the importance of clear use cases, international knowledge exchange, and transparent communication with citizens to support trust and acceptance. The workshops also underscored the need for coherent, long-term deployment strategies that integrate CCAM into existing mobility ecosystems in a way that aligns with local objectives and constraints.

Taken altogether, the workshop analysis indicates that across all countries CCAM can be seen through multiple perspectives: as an appealing option for more flexible, accessible and modern mobility systems, and simultaneously as a site of new barriers, uncertainties and potential inequalities. The main findings are as follows: (1) equity and accessibility must be viewed as primary design criteria rather than side effects. (2) governance, pricing models, and regulatory frameworks will largely determine whether benefits are widely shared or separated. (3) stakeholders think in terms of mobility systems and use cases rather than isolated vehicles and (4) there is still a need to strengthen the explicit discussion of psychological and ethical issues to fully understand how different populations may experience and thereby support or reject the shift to automated mobility. These findings together help define clear opportunities for CCAM deployment across Europe. First, existing CCAM solutions are not designed to support public-transport-oriented deployments capable of operating effectively in European cities, which are often characterised by narrow and crowded streets. This creates an opportunity for Europe to become a pioneer in both developing and testing technology tailored to this context. Second, early pilots and tests can be leveraged to steer CCAM deployment toward greater accessibility and equity. Third, the population must be actively engaged in order to achieve widespread acceptance. There is a necessity for true human-centred approach on CCAM designs from the technology, the vehicle up to the service. Finally, a key threat lies in overly restrictive regulations and data-sharing standards, which pose a serious risk of turning Europe into a follower rather than a leader.

By presenting these findings, the deliverable establishes a solid foundation for the second step of the co-creation framework, in which end users will be engaged through focus groups. Their perspectives will be essential to validate the insights collected in this first phase, refine emerging deployment scenarios, and ensure that CCAM solutions address concrete needs across different socio-demographic and cultural contexts. The combined results of these two steps will feed into the broader methodological and policy

outputs of CulturalRoad, including guidance for equitable deployment and recommendations for the Five-Pointed Star Rating System.

Overall, this deliverable provides a reproducible, transparent account of how co-creation can be organised across diverse European settings, while offering a clear picture of the expectations, tensions, and priorities that shape the early stages of CCAM planning.

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1 ANNEX

1.1 Analysis and contextualized findings table

	Germany		Israel		Slovenia		Spain		UK	
	Absolute	*Table-relative*	*Absolute*	*Table-relative*	*Absolute*	*Table-relative*	*Absolute*	*Table-relative*	*Absolute*	*Table-relative*
Benefits of CCAM	180,0	2,9%	203,8	3,2%	239,2	3,8%	212,5	3,4%	216,0	3,4%
Challenges & Barriers	208,8	3,3%	233,9	3,7%	239,2	3,8%	249,1	4,0%	259,0	4,1%
Ethics	0,00	0,0%	14,1	0,2%	5,7	0,1%	3,67	0,1%	12,00	0,2%
Mobility	151,2	2,4%	143,5	2,3%	142,3	2,2%	157,5	2,5%	140,0	2,2%
Psychological Factor	36,01	0,6%	69,1	1,1%	91,1	1,4%	40,3	0,6%	59,00	0,9%
Role & Positioning	72,01	1,1%	69,1	1,1%	68,3	1,1%	131,9	2,1%	66,00	1,0%
Social-Cultural Factor	129,6	2,1%	108,1	1,7%	131,0	2,1%	80,6	1,3%	118,0	1,9%
System & Participatory Factor	216,0	3,4%	187,9	3,0%	119,6	1,9%	190,5	3,0%	187,0	3,0%
Technology	158,4	2,5%	106,3	1,7%	91,1	1,4%	128,2	2,0%	98,00	1,5%
Trust & Acceptance	100,8	1,6%	117,0	1,8%	125,3	2,0%	58,6	0,9%	98,00	1,5%

Table 8 Code Group Occurrence Document table from Atlas.ti.

The code group **Benefits of CCAM** consists of Accessibility & Inclusion, Adoption, AM in Public Transport, Congestion, Connectivity, Cultural Values & Norms, Economic / Financial Feasibility, Environmental / Sustainability, Opportunities, Perceived Ease of Use, Perceived Impact, Perceived Usefulness, Pilot / Testing, Regulation, Safety, Shared Mobility, Use Case, User group, and Workforce Impact.
The code group **Challenges & Barriers** consists of Accessibility & Inclusion, Adoption, AM in Public Transport, Barriers (other), Congestion, Connectivity, Cultural Values & Norms, Economic / Financial Feasibility, Equity & Fairness, Governance & Policy Barriers, HM-Interaction, Infrastructure Needs, Legal Issues, Operational Barriers, Perceived Ease of Use, Perceived Impact, Perceived Risk & Uncertainty, Perceived Usefulness, Pilot / Testing, Public Transport Integration, Regulation, Safety, System Reliability & Maintenance, Technological Challenges, Trust in Automation, User group, and Workforce Impact.
The code group **Ethics** consist of Cultural Values & Norms, Environmental / Sustainability and Ethics.
The code group **Mobility** consists of Accessibility & Inclusion, AM in Public Transport, AV / Fleet Composition, Congestion, Infrastructure Needs, Mobility Model, Place Attachment / Local Context, Privacy, Private Mobility, Public Transport (General), Public Transport Integration, Shared Mobility, Technology Affinity / Openness / Readiness, Trust in Automation, Use Case, and User group.
The code group **Psychological Factors** consists of Perceived Ease of Use, Perceived Risk & Uncertainty, Perceived Usefulness, Privacy, Safety, Technology Affinity / Openness / Readiness, and Trust in Automation.

The code group **Role & Positioning** consists of Adoption, Co-Creation / Participation, Experience / Familiarity, Mobility Model, Pilot / Testing, Privacy, Public Perception, Public Transport Integration, Technology Affinity / Openness / Readiness, and User group.

The code group **Social-Cultural Factors** consists of Acceptance, Accessibility & Inclusion, Cultural Values & Norms, Environmental / Sustainability, Equity & Fairness, Ethics, Experience / Familiarity, Place Attachment / Local Context, Private Mobility, Public Perception, Shared Mobility, and User group.
The code group **System & Participatory Factors** consists of Adoption, AM in Public Transport, AV / Fleet Composition, Co-Creation / Participation, Communication & Transparency, Congestion, Connectivity, Cybersecurity, Economic / Financial Feasibility, Governance & Policy Barriers, HM-Interaction, Infrastructure Needs, Legal Issues, Mobility Model, Operational Barriers, Pilot / Testing, Public Transport (General), Public Transport Integration, Regulation, Remote Control, System Reliability & Maintenance, Technological Challenges, and Workforce Impact.
The code group **Technology** consists of Adoption, AM in Public Transport, AV / Fleet Composition, Communication & Transparency, Connectivity, Cybersecurity, HM-Interaction, Perceived Ease of Use, Perceived Usefulness, Privacy, Remote Control, System Reliability & Maintenance, Technological Challenges, Technology Affinity / Openness / Readiness, and Use Case.
The code group **Trust & Acceptance** consists of Acceptance, Adoption, Communication & Transparency, Cultural Values & Norms, Cybersecurity, Perceived Risk & Uncertainty, Privacy, Public Perception, Remote Control, Safety, and Trust in Automation.