Deliverable 4.3

SINFONICA Knowledge Map Explorer validation

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Main author:	Anna Rita Graziani (UNIMORE), Giacomo Cantini (UNIMORE), Konstantinos Fokeas (ICCS)
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Legal disclaimer

Executive Summary

This deliverable presents the validation results of the Knowledge Map Explorer (KME), the digital tool developed within the SINFONICA project to support inclusive planning and decision-making in the context of Cooperative, Connected, and Automated Mobility (CCAM). The KME is available at https://www.sinfonica-kme.eu/.

The KME was tested across multiple European contexts through a combination of workshops (3), surveys, and accessibility-focused sessions, involving over 50 participants, including public authorities, transport operators, CCAM experts, university students, and users with disabilities. The validation followed an iterative approach, allowing for continuous refinement of the tool based on real user feedback.

The most recent testing sessions — particularly the workshop in Brussels with CCAM experts and the dedicated accessibility testing with students with disabilities — highlighted significant progress in terms of usability and accessibility. The average satisfaction was high, with over 85% of participants stating they were satisfied or very satisfied with the tool. Users appreciated the intuitive interface, improved clarity of information, and streamlined navigation. Participants with specific accessibility needs confirmed that the platform is easy to explore, compatible with assistive technologies, and considerate of diverse cognitive and sensory preferences.

The validation process also provided valuable recommendations for future development. These include enhancing mobile responsiveness, integrating more visual and interactive content (e.g., graphs, maps), simplifying textual content, and offering clearer onboarding for first-time users.

Overall, the KME has proven to be a mature, well-designed solution, demonstrating strong usability and accessibility features. It offers real added value to decision-makers, local authorities, researchers, and civil society actors engaged in inclusive mobility planning.

Looking ahead, further development will focus on integrating real-time data, enabling personalized navigation pathways for different stakeholder groups, and testing the tool in live pilot environments (e.g., Living Labs) to assess its real-world impact on inclusive CCAM deployment.

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Abbreviations

CCAM	Cooperative, Connected, and Automated Mobility
GOI	Group of Interest
KME	Knowledge Map Explorer
KPI	Key Performance Indicator
M	Mean value
NPS	Net Promoter Score
OWL	Web Ontology Language
SUS	System Usability Scale
UMUX	Usability Metric for User Experience
UX	User Experience
WCAG	Web Content Accessibility Guidelines
WP	Work Package

Introduction

The SINFONICA project, funded under the Horizon Europe programme, aims to foster inclusive and accessible mobility by co-designing Cooperative, Connected, and Automated Mobility (CCAM) solutions that meet the needs of diverse user groups, particularly vulnerable and underrepresented communities. A central element of this effort is the development and validation of digital tools that support informed decision-making and inclusive service design.

One such tool is the Knowledge Map Explorer (KME, at https://www.sinfonica-kme.eu), a user-centric platform designed to enhance accessibility, transparency, and user awareness of mobility services and related initiatives across Europe. The KME integrates multi-source data into an interactive and intuitive interface that aims to empower stakeholders and citizens, particularly those with limited digital or mobility access.

This deliverable presents the validation process and results of the KME, combining a multi-layered evaluation methodology that includes user experience surveys, usability metrics, and real-world testing sessions with diverse stakeholder groups. The evaluation framework incorporates technical, experiential, and impact-based indicators to assess the tool's performance, usability, accessibility, and relevance for users, especially those from vulnerable categories.

At the heart of this process is a commitment to iterative, user-driven validation: after each testing session, feedback was collected, analysed, and used to progressively improve the tool. This agile loop ensured that refinements addressed real-world issues and enhanced the KME's capacity to support inclusive and informed mobility decision-making.

1.1. Purpose of this document

The purpose of this document is to report on the validation of the KME conducted under Task 4.4, led by UNIMORE. It documents the applied methodology, testing sessions, KPIs, and survey outcomes, offering evidence on how the tool performs in real usage scenarios and how it is perceived by users.

The deliverable also identifies the strengths and areas for improvement that emerged throughout the validation process and offers guidance for future enhancements, both within and beyond the scope of SINFONICA. As such, it serves as a resource for project partners, policymakers, and other CCAM stakeholders seeking to promote inclusive and data-informed mobility systems.

1.2. Structure of the report

This report is structured as follows:

- **Chapter 2** introduces the Knowledge Map Explorer, its objectives, functionalities, and intended users.

- **Chapter 3** outlines the validation methodology, presenting the KPIs and evaluation tools adopted.
- **Chapter 4** details the testing workshops conducted across different European contexts, profiling participants and testing scenarios.
- **Chapter 5** presents the key findings and results of the evaluation process.
- **Chapter 6** concludes with reflections on the KME's role in supporting inclusive CCAM deployment.
- **The Appendix** provides supplementary materials, including detailed tasks per testing session.

1.3. Intended audience and relations with other WPs and tasks of the project

This document addresses a range of stakeholders involved in the design, deployment, and evaluation of CCAM solutions. These include:

- Project partners and technical developers, who can use the findings to improve digital tools and engagement strategies.
- Public authorities and transport planners, who may draw from the evaluation to inform inclusive policy and procurement.
- Civil society organisations, particularly those advocating for accessibility and digital inclusion.
- European and local policymakers, interested in replicable models for citizen engagement and data-informed CCAM planning.

Deliverable D4.3 is the outcome of Task 4.4 and is closely connected to other activities carried out within WP4 – Design and validation of SINFONICA digital tools. It operationalises the methodological frameworks developed in Tasks 4.1 and 4.2 and reflects the principles of inclusiveness, accessibility, and stakeholder empowerment outlined across the project.

Understanding the SINFONICA Knowledge Map Explorer

2.1. Overview of the tool: objectives and functionalities

The SINFONICA Knowledge Map Explorer (KME), is a decision-support tool designed to support the inclusive deployment of CCAM solutions. The KME consolidates data from multiple sources — interviews, focus groups, and workshops across four European contexts — to capture the needs, preferences, and concerns of diverse stakeholder groups, including vulnerable road users, transport operators, service providers, and public authorities. The resulting ontology driven framework,

implemented in Protégé using OWL (Web Ontology Language) and facilitated by the Cellfie plugin, enables the dynamic organization and visualization of CCAM-related knowledge. The KME functions as an intelligent navigation system, combining a Semantic-Based System with a Rule-Based System to provide context guidance. By harmonizing explicit and inferred knowledge, it generates tailored recommendations for CCAM solutions based on user type, scenario, and other contextual factors.

The objective is to systematically gather, understand, and organize their needs, desires, and concerns regarding CCAM in a way that is both manageable and actionable. SINFONICA collaboratively created decision support tools, including the Knowledge Map Explorer (KME), specifically designed for CCAM designers and policymakers to facilitate the seamless and sustainable deployment of CCAM, ensuring inclusivity and equity for all citizens. However, SINFONICA isn't meant to directly deploy, test, or operate any CCAM systems, nor process personal data. Instead, it offers methodologies, guidance, and recommendations. To facilitate this, public datasets were utilized and gathered—for example, through focus groups and questionnaires.

Through structured data collection from people with mobility challenges and diverse stakeholder categories among 4 different European territories (the Groups of Interest, located in the Netherlands, in Greece, in Germany and in the United Kingdom), the KME integrates domain-specific knowledge into an intelligent recommendation engine and navigation system. It provides policy-makers, developers, researchers, mobility operators and civil society with targeted insights, facilitating the development of inclusive and effective CCAM solutions. The KME aims to bridge the gap between technical advancements and real-world deployment, by offering an up-to-date knowledge base in line with the latest industry trends. The KME supports stakeholders in the CCAM ecosystem by providing structured, contextualized knowledge to inform decision-making processes, improve technological integration, and foster knowledge-sharing among mobility stakeholders.

It is important to mention here that the research of the SINFONICA project was carried out with the involvement of the Groups of Interest (GOI): these are groups of citizens, people with mobility impairments and stakeholders formed in the four European territories involved in the research of the SINFONICA project, namely: the city of Trikala in Greece, the province of Noord-Brabant in the Netherlands, the municipality of Hamburg in Germany and the West Midlands in the United Kingdom. The Groups of Interest were involved in the co-creation activities of SINFONICA through a structured engagement methodology consisting of interviews, focus groups and workshops. In addition to these activities, the data that make up the SINFONICA Knowledge Map are also derived from a wide EU Survey on accessibility and inclusiveness issues in CCAM, to which more than 4400 users across Europe responded.

2.2. Intended users and key stakeholders

SINFONICA addresses the diverse needs of stakeholders involved in the development and deployment of CCAM technologies. Industry actors, including technology developers, vehicle manufacturers, and service providers, require insights into user perspectives to design inclusive, affordable, and sustainable solutions. They also seek access to market opportunities, the adoption of user-centred designs, and the promotion of standardization to avoid fragmentation. Transport

and road authorities need a better understanding of how citizens, particularly vulnerable road users, perceive CCAM and require platforms to raise awareness about relevant transport issues. Public administrations, including municipalities and local transport authorities, need guidance on engaging with citizens, adjusting local regulations, and adopting new methodologies to support the digital transformation of mobility. The research sector aims to expand its knowledge base and develop innovative products, integrating social considerations into CCAM studies. Legislators, such as policymakers, insurers, and regulators, need support in adapting policies and regulations to ensure safety, fairness, and inclusiveness in CCAM deployments. Representative bodies, like road user associations, work to ensure that citizens' needs and perspectives are considered, fostering user acceptance and awareness. Citizens, particularly those from vulnerable, rural, or peripheral areas, require information on the benefits of CCAM and opportunities to contribute to discussions on its development. Finally, large-scale demonstration projects seek tools and methodologies to improve the comparability and robustness of their results, helping to guide investment and deployment decisions. SINFONICA -and more concretely the KME- is meant to provide targeted support and guidance to these stakeholders, promoting the inclusive, effective, and equitable deployment of CCAM technologies.

2.3. Expected impact on CCAM decision–making and stakeholders engagement

The expected impact of SINFONICA on CCAM decision-making and stakeholder engagement is revolved around fostering a collaborative, user-centred approach to the development and deployment of automated mobility solutions. By providing stakeholders with actionable insights, the KME aims to enable more informed, inclusive, and transparent decision-making processes. The engagement of diverse stakeholders, including vulnerable road users and local communities, ensures that the needs and expectations of all affected groups are considered. SINFONICA's emphasis on co-creation and participatory methodologies will enhance stakeholder buy-in, promote the adoption of inclusive, affordable, and sustainable CCAM solutions, and help harmonize regulatory frameworks. As a result, it will contribute to more effective and equitable CCAM deployments, advancing the integration of smart mobility technologies into public transport systems and urban environments.

The Validation Process: Approach and Methodology

3.1. Key Performance Indicators for validation

To objectively validate and test the KME in the context of mobility services and the needs of vulnerable users, we adopted a structured evaluation framework grounded in established usability and user experience research methodologies. Our approach combines both quantitative and qualitative validation techniques, aligning with key international standards for usability testing and user-centred design.

In particular, for User Experience Design, we based the validation framework on a combination of **Net Promoter Score (NPS)** and the **System Usability Scale (SUS)**—widely recognized metrics in product usability and satisfaction research—while also taking into consideration more recent developments such as the **Usability Metric for User Experience (UMUX)** and its streamlined version, **UMUX-LITE**. These instruments are especially suited for web-based digital tools and allow for efficient benchmarking of perceived usability, satisfaction, and overall tool effectiveness.

Here is a comparative table summarizing **NPS**, **SUS**, **UMUX**, and **UMUX-LITE**, adapted from a source that significantly contributed to the definition of the methodological approach[1].

Table 1: Usability metrics comparison

Metric	Year	Items	Scale	Main focus	Typical usage context	Output interpretation	Reference in attached source
Net Promoter Score (NPS)	2003	1 item	0-10 (Likert-type, recoded into 3 categories)	User loyalty and willingness to recommend	General feedback, marketing, and loyalty tracking	Score from -100 to +100; >0 positive, >50 excellent	Discussed as benchmark for satisfaction, though limited in usability depth
System Usability Scale (SUS)	1986	10 items	5-point Likert scale	Overall usability and user satisfaction	Post-task or post-study usability evaluation	Score from 0 to 100; >68 considered above average	Most widely cited usability scale; benchmark tool
UMUX	2010	4 items	7-point Likert scale	Usability similar to SUS with fewer items	Usability testing with time/resource constraints	Mapped to SUS for comparability	Introduced to reduce survey burden, high correlation with SUS

[1] Giardino Di Lollo, C. (2021) *Approcci recenti alla valutazione di user experience e usabilità,* Tesi di laurea magistrale in Informatica – Tecniche del Software, Alma Mater Studiorum, University of Bologna

Metric	Year	Items	Scale	Main focus	Typical usage context	Output interpretation	Reference in attached source
UMUX-LITE	2013	2 items	7-point Likert scale	Quick usability measure highly correlated with SUS	Lightweight usability testing, surveys during usage	Mapped to SUS for comparability	Simplified version of UMUX, practical in time-constrained settings

By adopting this combined methodological stance, we ensured that the tool was evaluated not only in terms of functional performance but also in terms of perceived usability, emotional response, and its capacity to deliver meaningful, inclusive user experiences—particularly for vulnerable users who are often underserved by standard digital platforms.

To operationalize this, we established a comprehensive set of **Key Performance Indicators (KPIs)** across three levels:

- **Practical-Functional KPIs**: assessing system-level performance such as accuracy, response time, and error handling.
- **User Experience (UX) Design KPIs**: measuring user satisfaction, usability, and engagement—through tools like SUS and NPS, and drawing insights from UX surveys inspired by UMUX constructs.
- **Impact and Relevance KPIs**: assessing whether the tool contributes to knowledge acquisition and supports real-world mobility needs, especially for vulnerable populations.

This multi-tiered KPI framework allowed us to systematically monitor the tool's effectiveness, ensuring it is not only technically robust and accessible, but also positively perceived and recommended by users.

3.2. Practical and functional testing criteria

Practical-functional KPIs are designed to assess the technical and operational performance of the Knowledge Map Explorer tool. These indicators focus on **accuracy, responsiveness, system stability, error handling, and accessibility compliance**, ensuring that the tool meets fundamental expectations of reliability and effectiveness. By quantifying system behaviour in response to real user queries and technical demands, these KPIs help validate the robustness of the tool's core functions, particularly in delivering timely and accurate information on mobility services. These KPIs focus on the core functionality, performance, and reliability of the tool.

Table 2: Practical-functional KPIs

PF-KPI	DEFINITION	TARGET	MEASUREMENT
PF-KPI_1	Measure how accurately the tool retrieves relevant	At least 90% accuracy in relevant data retrieval	UX survey

PF-KPI	DEFINITION	TARGET	MEASUREMENT
Accuracy of information retrieval	information based on user queries related to mobility services.	for different user scenarios.	
PF-KPI_2 Response time	Measure the time taken by the tool to deliver results after a user query.	The average response time should be under 2 seconds.	Statistics and metrics of the system.
PF-KPI_3 System reliability/uptime	Monitor the availability of the tool and its resilience to downtime or crashes.	99.9% uptime over a defined period (e.g., one month).	Statistics and metrics of the system.
PF-KPI_4 Error rate and handling	Track the frequency of errors (e.g., 404 errors, broken links, incorrect data formats) and the tool's ability to handle them gracefully.	Error rate should be below 1% of total interactions, and 100% of errors should provide a meaningful error message or resolution suggestion.	UX survey
PF-KPI_5 Accessibility compliance	Check the tool against accessibility standards (e.g., WCAG 2.1 and 2.2) to ensure it meets the needs of vulnerable users, including those with disabilities.	Full compliance with WCAG 2.1 and 2.2 AA level standards.	UX survey

3.3. User experience design evaluation

User Experience (UX) Design KPIs evaluate the quality, clarity, and intuitiveness of user interaction with the Knowledge Map Explorer tool, focusing on usability, engagement, satisfaction, and accessibility. These KPIs are essential to ensure that the tool is not only functionally sound but also welcoming, inclusive, and easy to use, especially for vulnerable user groups that might be interested in using the tool.

To provide a robust and multidimensional evaluation, this section also includes Impact and Relevance KPIs, which assess whether the tool delivers meaningful value, increases users' awareness and understanding of mobility services, and effectively supports their decision-making processes.

The combined use of standardized tools such as the System Usability Scale (SUS), Net Promoter Score (NPS), and insights from UMUX/UMUX-LITE ensures a comprehensive validation framework. This framework captures both the subjective perceptions of users and the objective contribution of the tool to users' knowledge and mobility experiences.

User Experience (UX) Design Level KPIs

These KPIs focus on the usability, satisfaction, and overall experience of users interacting with the tool.

Table 3: UX design KPIs

S-KPI	DEFINITION	TARGET	MEASUREMENT
S-KPI_1 User satisfaction score	Measure overall user satisfaction (CSAT – Customer Satisfaction Score) through post-interaction surveys or feedback forms.	Achieve an average satisfaction score of 4 out of 5 or higher.	UX survey
S-KPI_2 Task completion rate	Percentage of users able to complete specific tasks (e.g., finding a mobility service, accessing information for a particular user group) without assistance.	At least 90% task completion rate.	UX survey
S-KPI_3 User engagement	Track engagement metrics, such as the average time spent on the tool, number of sessions per user, and feature usage patterns.	Average session duration of at least 3 minutes and regular use of at least 3 different “features” per session.	Statistics and metrics of the system.
S-KPI_4 Net Promoter Score (NPS)	Measures the user’s experience and loyalty, asking respondents to rate the likelihood that they would recommend the tool.	Score above 20.	UX survey
S-KPI_5 System Usability Scale (SUS)	Assesses the perceived usability of the tool. The SUS is derived from a 10-item questionnaire that users answer after completing a test.	At least index ranking of 70.	UX survey
S-KPI_6 Visual clarity and design appeal	Measure users' perceptions of the visual design, layout, and overall aesthetic of the tool.	At least 80% of users rate the visual design as "appealing" or "very appealing."	UX survey
S-KPI_7 Accessibility satisfaction	Collect feedback from vulnerable user groups to measure their satisfaction with accessibility features.	At least 90% of users in vulnerable groups should report satisfaction with accessibility options.	UX survey

Impact and Relevance KPIs

These KPIs assess whether the tool meets the broader goals of understanding and addressing mobility services and vulnerable users' needs.

Table 4: Impact and relevance KPIs

I-KPI	DEFINITION	TARGET	MEASUREMENT
I-KPI_1 Relevance of content	Measure how relevant the content provided by the tool is to the users' specific needs and contexts.	At least 90% of the content should be rated as "relevant" or "highly relevant" by users.	UX survey

I-KPI	DEFINITION	TARGET	MEASUREMENT
I-KPI_2 **Knowledge gain**	Measure the impact of the tool on user knowledge (e.g., awareness of accessible routes).	At least 70% of users report a positive change in knowledge after using the tool.	UX survey

3.4. Evaluation survey

To validate the KME tool from the perspective of its users, we designed a comprehensive user experience survey based on the structured KPI framework outlined earlier. The survey integrates questions that directly map to the identified KPIs and draws on established usability evaluation instruments, including the Net Promoter Score (NPS) and the System Usability Scale (SUS), while also considering the Usability Metric for User Experience (UMUX) and its simplified version, UMUX-LITE.

This combination ensures a balance between robustness and conciseness, capturing both quantitative ratings and qualitative feedback on satisfaction, usability, engagement, accessibility, and content relevance. The questions are organized into thematic sections, each linked to specific KPIs, and aim to assess not only the tool's technical performance but also its perceived impact on user knowledge, trust, and inclusivity—especially for vulnerable user groups.

The survey thus serves as a key instrument for validating the user-centred design of the tool, providing actionable insights for further improvement.

Table 5: The evaluation survey

1. Satisfaction	Reference KPI
A. How satisfied are you with the "Knowledge Map Explorer" tool overall? ○ **Options**: *1 (Very Dissatisfied), 2 (Dissatisfied), 3 (Neutral), 4 (Satisfied), 5 (Very Satisfied)*	**S-KPI_1 User satisfaction score**

2. Engagement	Reference KPI
A. How likely are you to recommend KME to a friend or colleague **(NPS)**? ○ **Options**: 0 *(Very unlikely), 1,2,3,4,5,6,7,8,9, 10 (Very likely)*	**S-KPI_4 Net Promoter Score**

3. Usability (SUS)	Reference KPI
A. I think that I would like to use the Knowledge Map Explorer (KME) tool frequently. ○ **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
B. I found the tool unnecessarily complex. ○ **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
C. I thought the tool was easy to use. ○ **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
D. I think that I would need the support of a technical person to be able to use this tool. ○ **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
E. I found the various functions in the KME were well integrated. ○ **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**

3. Usability (SUS)	Reference KPI
F. I thought there was too much inconsistency in this tool. ○ **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
G. I would imagine that most people would learn to use this tool very quickly. ○ **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
H. I found the KME very cumbersome to use. ○ **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
I. I felt very confident using the tool. ○ **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
J. I needed to learn a lot of things before I could get going with this tool. ○ **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
K. Were there any points where you felt stuck or confused while using the tool? ○ **Options**: - *Yes, No* *- If Yes, please describe.*	**N/A** (qualitative feedback)

4. Content relevance and impacts	Reference KPI
A. How relevant do you find the information provided by the KME to your specific needs and interests **(UMUX / UMUX-LITE)**? ○ **Options**: *Not relevant, Slightly relevant, Neutral, Relevant, Highly relevant*	**I-KPI_1 Relevance of content**
B. Has using the "Knowledge Map Explorer" tool increased your knowledge regarding mobility services or accessible routes? ○ **Options**: *Not at All, Slightly, Moderately, Significantly, Very Significantly* **B2.** Follow-Up Question: *Please describe any specific changes in knowledge gained.*	**I-KPI_2 Knowledge gain**

5. Performance	Reference KPI
A. Did you encounter any bugs or technical issues while using our tool? ○ **Options**: - Yes, No *- If Yes, please describe the issue.*	**PF-KPI_4 Error rate and handling**
B. How would you rate the clarity of instructions or information provided within the tool? ○ **Options**: *1 (Very Clear), 2 (Clear), 3 (Neutral), 4 (Unclear), 5 (Very unclear)*	**PF-KPI_1 Accuracy of information retrieval**
C. Were you able to complete the task(s) you intended to perform using the tool? ○ **Options**: *Yes, Partially, No*	**S-KPI_2 Task completion rate**
D. How would you rate the visual design and layout of the tool? ○ **Options**: *1 (Very Unappealing), 2 (Unappealing), 3 (Neutral), 4 (Appealing), 5 (Very Appealing)*	**S-KPI_6 Visual clarity and design appeal**

6. Accessibility	Reference KPI
A. How accessible is the KME tool for you? (e.g., ease of use, compatibility with assistive technologies, etc. - WCAG) ○ **Options**: *1 (Very accessible), 2 (Accessible), 3 (Neutral), 4 (Inaccessible), 5 (Very inaccessible)*	**PF-KPI_5 Accessibility compliance**
B. If you have specific accessibility needs, how satisfied are you with the accessibility features of the tool? ○ **Options**: *1 (Very dissatisfied), 2 (Dissatisfied), 3 (Neutral), 4 (Satisfied), 5 (Very satisfied)* **B2.** Follow-Up Question: *What accessibility features were most helpful to you? (e.g., screen reader compatibility, color contrast, text size options, etc.)*	**S-KPI_7 Accessibility satisfaction**
C. Are there any features or functionalities you think should be improved to make the tool more accessible?	**N/A** (qualitative feedback)

6. Accessibility	Reference KPI
- Open-ended	

6. Accessibility Scale
A. Perception:
Were the information and commands required to complete the task always available and perceivable? **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*
B. Comprehensibility:
Were the information and commands required to complete your tasks easy to understand and use? **Options:** *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*
C. Operability:
Did the available information and commands allow you to quickly select the necessary actions to reach your objective? **Options***: 1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*
D. Consistency:
Did you find consistency among the symbols, messages, and actions in the environment you used? **Options:** *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*
E. Health protection:
Were you able to perform the necessary actions without effort or any particular difficulties? **Options:** *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*
F. Security:
Do you believe that the data you handled was processed with proper security measures? **Options:** *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*
G. Transparency:
Did you receive useful and timely indications from the system? **Options:** *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*
H. Learnability:
Do you think the interface and environment were easy to understand and use? **Options:** *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*
I. Help and documentation:
Were the available help tools useful in achieving your goal? **Options:** *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

6. Accessibility Scale
J. Pleasantness:
Did the interface seem pleasant to you? **Options:** *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*
K. Flexibility:
Did the system allow you to customize the environment in which you operated in any way? **Options:** *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

7. Suggestions	Reference KPI
A. What features would you like to see added or improved in the future? - *Open-ended*	**N/A** (qualitative feedback)
B. Do you have any additional comments or suggestions to help us improve your experience? - *Open-ended*	**N/A** (qualitative feedback)

8. Demographics (Optional)
A. What is your age group? ○ **Options**: *Under 18, 18-24, 25-34, 35-44, 45-54, 55-64, 65+*
B. How would you describe your familiarity with technology? ○ **Options**: *Beginner, Intermediate, Advanced, Expert*

Overall, the survey provided a structured yet flexible mechanism to capture meaningful user feedback, ensuring that the validation process reflects both functional performance and real-world user experience.

3.5. Evaluation roadmap

The validation of the KME was conducted through a series of targeted testing and validation workshops organised across multiple European locations, involving diverse user groups and stakeholders relevant to the CCAM (Connected, Cooperative and Automated Mobility) ecosystem. This roadmap aimed to ensure that the tool was tested in both controlled academic environments and real-world stakeholder contexts, capturing feedback from students, local authorities, mobility experts, vulnerable users, and EU-level actors. Each workshop was planned in collaboration with relevant project partners, while the KME testing activities were coordinated by UNIMORE (Leader of Task 4.4). Crucially, the validation process followed an **iterative feedback loop**, where insights gathered during each session were systematically analysed and fed back to the development team. This enabled **continuous improvement of the tool**, with adjustments implemented progressively after each testing round to address identified issues and enhance usability, accessibility, and content relevance. The table below summarises the workshops held, including testing scenarios, participant profiles, and responsible partners.

Table 6: Summary of the testing sessions

Testing location	Testing scenario	Participants	Responsible for the workshop	Responsible for the KME testing (Leader Task 4.4)	Testing date
Modena (Italy)		UNIMORE students	UNIMORE (Anna Rita Graziani)	UNIMORE	December 2024
Den Bosch (The Netherlands)	Noord Brabant workshop in collaboration with Move2CCAM project - *in Dutch*	Local authorities, transport operator, representatives of local groups and consultants in the field of CCAM	Noord Brabant (Lars Meijer) – WP5	UNIMORE	28 January 2025
Brussels (Belgium)	ERTICO workshop	People from the CCAM Association including other related CCAM EU projects and possibly EC representatives.	ERTICO (Andrew Winder) – WP5	UNIMORE	14 February 2025
Paris (France)	SINFONICA GA	GOI project partners and	UNIMORE (Anna Rita Graziani)	UNIMORE	17-18 March 2025
Modena / Reggio Emilia (Italy)	Accessibility specific testing	UNIMORE students with disabilities	UNIMORE (Anna Rita Graziani)	UNIMORE	April-May 2025

To conclude this chapter, the outlined methodology and evaluation roadmap have provided a structured framework for validating the Knowledge Map Explorer tool across diverse user contexts. In the following chapter, the participants and testing scenarios will be presented in detail, highlighting the specific settings, profiles involved, and qualitative insights gathered during each session.

Participants and Testing Scenarios

The usability tests carried out by the UNIMORE team were designed to assess how effectively, efficiently, and satisfactorily users could interact with the KME tool to accomplish their goals. The specific objectives of the evaluation were:

- **Identifying user challenges:** Detect any pain points, errors, or obstacles encountered by users during tool interaction.
- **Evaluating ease of use:** Examine how intuitive, navigable, and user-friendly the tool is for its target audience.
- **Measuring efficiency:** Determine the speed and accuracy with which users can complete their tasks.
- **Gauging user satisfaction:** Capture users' emotional responses and overall impressions of their experience with the tool.
- **Validating functionality:** Ensure that all features operate as expected and fulfil user needs effectively.
- **Informing Design improvements:** Collect actionable insights that can guide enhancements in the tool's design and functionality.

To reach this goal, four usability tests and one accessibility test were conducted between December 2024 and May 2025. As shown in Table 7, there were a total of 54 participants. They included university students, members of the Group of Followers, and members of the Groups of Interest. After each test, a report was prepared and handed over to the RE:LAB and ICCS teams to support further improvements to the tool.

Table 7: Summary of participants per testing session

	Reggio Emilia	Den Bosch	Brussels	Paris	Reggio Emilia Accessibility	Total Sample
Public authority (national, regional or local/ municipal government)		9 47.4%		1 5.3%		10 18.52%
Public transport operator		3 15.8%		1 5.3%		4 7.41%
Association (including representative body of transport users, civil society, advocacy, platform, partnership, union, political party)		2 10.5%	2 28.6%	1 5.3%		5 9.26%
SME - Small or medium-sized enterprise			1 14.3%			1 1.85%
Research and academic			3 42.9%	8 42.1%		11 20.37%
Service provider (developer, consultant, logistics, etc.)		3 15.8%				3 5.56%
SINFONICA Group of Interest (Hamburg, Noord Brabant, Trikala, West Midland)				8 42.1%		8 14.81%
Other	5 100%	2 10.5%	1 14.3%		4 100%	12 22.22%
Total	5 100%	19 100%	7 100%	19 100%	4 100%	54 100%

4.1. Evaluation with students at the University of Modena and Reggio Emilia

The first usability test was conducted at the University of Modena and Reggio Emilia in December 2024. At that time, the KME tool was available in its preliminary version, with the contents of the sections not fully developed. This initial testing of the first version of the Knowledge Map Explorer (KME) tool aimed to identify pain points, enhance user satisfaction, and ensure the product aligned with its intended objectives.

4.1.1. Participants

Five students (60% women) enrolled in the master's program in Management and Corporate Communication were selected for the study. They were chosen because they had successfully completed the 'User Experience Design' course and possessed the expertise to evaluate the tool. Participants were approached during lectures and voluntarily agreed to take part in the study.

4.1.2 Procedure

The participants were invited in the office of the researcher and were asked to sit in front of a computer. The researcher explained that the aim of the usability testing was to evaluate a tool by means of two activities. In the first one the participants were asked to look at the homepage of the tool and to guess what the tool was about. Participants could explore the homepage and think loudly about the activity they are going to perform. Then they were asked to navigate in the knowledge map and again they were required to guess what the tool is about. Participants were then asked to perform five tasks. We created a mock scenario:

We ask you to imagine being a member of your region's transportation committee. Your region is considering implementing new technologies in public transport in the coming years. Specifically, it is interested in introducing autonomous public transport systems. As a committee member, you decide to consult data from a recently completed European project called SINFONICA, which investigated in four European countries (Germany, Greece, United Kingdom, and the Netherlands) how people move, what modes of transport they use, the motivations behind their choices, and their attitudes toward autonomous vehicles and CCAM technology (Cooperative, Connected, and Automated Mobility). We present to you the website where this data is displayed. Below, you will find a series of tasks to complete, we ask you to find information on the SINFONICA Knowledge Map Explorer and answer the questions presented to you. Additionally, we ask you to "think aloud," meaning to describe how you navigate the site to find the information you need.

Then the tasks were presented, and participants were required to find the relevant information (see annexes for the tasks). Participants also explored the page presenting the Trikala Workshop results and shared their impressions. In the second activity participants were asked to recollect the experience with the KME tool and to fill in the online questionnaire. The item of the questionnaire measured the identified KPIs. The results will be presented in the next chapter.

4.2. Evaluation with the Groups of Followers

Two testing sessions were conducted with the Group of Followers, which comprehends people who are actively interested in the SINFONICA project activities and results, and engaged with the development of CCAM technologies. The first took place in Den Bosch on January 28th, 2025, during a workshop organized by the Group of Interest of Noord Brabant in collaboration with the Move2CCAM project. The second one took place on February 14th in Brussels within a workshop with experts of CCAM field organised just after the conclusion of the RTR Conference and conducted by ERTICO as part of the WP5 activities.

4.2.1. Participants

As concerned the Den Bosch workshop, the Noord Brabant Group of Interest invited 23 participants, of whom 19 completed the questionnaire. The sample consisted of 6 women (31.58%), 12 men (63.16%), and 1 individual (5.26%) who preferred not to answer. The participants were distributed across various age groups. About 26.32% (n = 5) of them are aged between 25 and 34 years. The 21.05% (n = 4) of the participants, falls within the 35 to 44 years age range. Following this, 31.58% (n = 6) of the participants are between 45 and 54 years old. Those aged between 55 and 64 years make up 15.79% (n= 3) of the total, while the remaining 5.26% (N =1) are aged 65 years and above. Regarding their occupation, the majority, 47.37% (n = 9), were representatives of public authorities. Additionally, 15.79% (n = 3) were public transport operators, 15.79% (n = 3) were service providers, 10.53% (n = 2) were members of associations, 10.53% (n = 2) indicated the option other. As concerned, their knowledge of technology, the vast majority considered themselves either advanced (47.37%, n = 9) or expert (31.58%, n = 6). A minority rated themselves as intermediate

(21.05%, n = 4). In the subsequent analyses we consider age, gender, organization and technology knowledge as independent variables., meaning that they are not correlated.

Regarding the Brussels workshop, the participants involved were 7. The sample consisted of 3 women (42.90%) and 4 men (57.10%). The participants were distributed across various age groups. About 14.30% (n = 1) of them are aged between 25 and 34 years. The 42.90% (n = 3) of the participants, falls within the 35 to 44 years age range. Following this, 28.60% (n = 2) of the participants are between 45 and 54 years old. Those aged between 55 and 64 years make up 14.30% (n = 1) of the total. Concerning participants' occupation, the majority were researcher or academics, 42.9% (n = 3) and members of associations, 28.60% (n = 2). The 14.3% (n = 1) were member of small or medium-sized enterprises and 14.3% (n = 1) indicated the option other. As concerned, their knowledge of technology, participants considered themselves intermediate (28.60%, n = 2), advanced (28.60%, n = 2) or expert (28.60%, n = 2). A minority rated themselves as beginner (14.30%, n = 1).

4.2.2 Procedure

In both workshops, we followed the procedure outlined in paragraph 4.1.2. Since participants conducted the usability testing together in the same room, they were not asked to "think aloud." As in the previous test, they were required to complete several tasks and identify the correct answers and then to fill in an online questionnaire.

After completing the tasks all participants were asked to fill in the online questionnaire. The results will be presented in the next chapter.

4.3. Evaluation with the Groups of Interest

A first evaluation for the GOI was carried on in January 2025. A preliminary version of the tool, already improved following the actionable insights presented in the UNIMORE students' testing report, was shown to the GOI. They were asked to report their impressions and to give suggestions about the KME tool on an excel file present on the SINFONICA project the SharePoint. Participants were given two weeks to complete the Excel file and provide their impressions. These impressions together with the results of the Group of Followers' usability tests were employed to modify and improve the KME tool. A more comprehensive usability test with the GOI was conducted during the Steering Committee meeting in Paris on March 18th.

4.3.1. Participants

The participants involved were 19: the sample consisted of 12 women (63.20%) and 7 men (36.80%). The participants are distributed across various age groups. About 31.60% (n = 6) of them are aged between 25 and 34 years. The 36.80% (n = 7) of the participants, falls within the 35 to 44 years age range. Following this, 21.10% (n = 4) of the participants are between 45 and 54 years old. Those aged between 55 and 64 years make up 10.50% (n = 2) of the total.

Regarding the occupation, the majority were researchers or academics 42.20% (n = 8) and members of SINFONICA's GOI 42.20% (n = 8). 5.30% (n = 1) was member of public authority, the 5.30% (n =

1) was a public transport operator, and the 5.30% (n = 1) was member of association. As concerned, their knowledge of technology, participants considered themselves intermediate (15.80%, n = 3), advanced (57.90%, n = 11) or expert (26.30%, n = 5).

4.3.1. Procedure

During the Steering Committee held in presence in Paris in March 2025, at IRT System X premises, a usability testing was organized with the GOI. The procedure was the same outlined in paragraph 4.1.2. Since participants conducted the usability testing together in the same room, they were not asked to "think aloud." As in the previous test, they were required to complete several tasks and identify the correct answers and then to fill in the online questionnaire.

Then participants were asked to fill in the online questionnaire. The item of the questionnaire measured the identified KPIs. The results will be presented in the next chapter.

4.4 Evaluation with students with disabilities

The purpose of this accessibility test was to evaluate how well the tool meets the needs of users with diverse abilities. This includes assessing compliance with established accessibility standards, such as the Web Content Accessibility Guidelines (WCAG), and identifying any barriers that may prevent users with disabilities from fully interacting with the interface.

This test focused on key areas such as keyboard navigation, screen reader compatibility, colour contrast, and alternative text for images. The goal was to ensure an inclusive user experience for everyone, regardless of their physical or cognitive abilities. By conducting this test, we aimed to improve usability, enhance user satisfaction, and promote digital equity.

4.4.1. Participants

The test involved a diverse group of participants, each bringing valuable perspectives based on their lived experiences:

- One participant with visual impairments who is blind and uses screen readers.
- Two participants with hearing impairments (deaf or hard of hearing), who may use captions or rely on visual cues.
- One participant with hearing impairments has also with epilepsy, a condition that can be triggered by certain visual stimuli in digital environments.
- One participant with cognitive impairment. Specifically, we included an individual with autism spectrum disorder (ASD), who provided valuable insight into how users with cognitive and sensory processing differences interact with digital environments.

Key considerations for these participants included:

- Clarity and simplicity of layout and navigation.
- Consistency in design and language.

- Minimization of sensory overload, such as flashing elements or excessive animations.
- Support for focus and comprehension, including clear instructions and predictable interactions.

In total, there were four participants: one male (25%) and three females (75%). 75% (n = 3) of the participants were aged 18–24 and 25% (n = 1) were aged 45–54. Regarding their knowledge of technology: one participant (25%) considered themselves a beginner, two participants (50%) considered themselves intermediate and one participant (25%) considered themselves advanced or expert. All participants were students at the University of Modena and Reggio Emilia. They were contacted through the University Support Office for Students with Disabilities and Specific Learning Disorders and invited to take part in the accessibility test. Those who expressed interest were subsequently contacted by the researcher, who explained the purpose of the test.

4.4.3. Procedure

The accessibility test was conducted at the University of Modena and Reggio Emilia in May 2025. An almost final version of the tool was presented to four participants: three attended the test in person, while the fourth participated online. The tool was presented to the participants, and its purpose was explained. After being asked to explore the platform and search for various pieces of information, they were invited to complete the online questionnaire.

Results

5.1. The evaluation with students at the University of Modena and Reggio Emilia

In the first activity of the usability test, participants were asked to examine the tool's homepage and guess its purpose. As previously mentioned, they were presented with an early version of the tool. They were invited to explore the homepage and verbalize their thoughts while performing the tasks. Afterwards, they were asked to navigate the Knowledge Map and, once again, to infer the purpose of the tool. The results showed that its purpose was not immediately clear to any of the participants, and their initial impressions varied:

- **Participant 1** believed it was a bus transport company site, like FlixBus.
- **Participant 2** thought it was about autonomous vehicles in general.
- **Participant 3** interpreted it as a public transport website.
- **Participant 4** assumed it belonged to a company selling autonomous buses and related technology.
- **Participant 5** perceived it as promoting autonomous vehicle technologies.

Key observations:

- None of the participants noticed the reference to **SINFONICA**, nor did they inquire about it.
- **60%** of the participants did not realize the homepage was scrollable for additional content.
- One participant assumed that clicking the "Start" button would provide more information.
- All participants identified the **Knowledge Map Explorer** as the main tool for accessing information.
- After using the explorer, two participants described the platform as a connector between researchers and stakeholders interested in **CCAM**, but did not recognize it as the outcome of a research project.
- **40%** (two participants) found the introduction to the Knowledge Map Explorer unclear.

In general, the tasks were completed correctly and in a few minutes. Participants were asked to think aloud, in this way it was possible to follow all the steps to reach the solution.

Task 1: 4 out of 5 (80%) of the participants solved task 1 correctly without any error. For one of the participants, it was necessary to take more steps to identify where the results were placed.

Task 2: 3 out of 5 (60%) of the participants solved task 2 correctly without any error. The other participants did not read correctly the task and reported the solution of another country. However, they were able to find the right answer.

Task 3: 3 out of 5 (60%) of the participants solved the task 3 correctly without any error. For two it was difficult to find the information about vehicle ownership. They thought that this information

was in “travel behaviour and transport use” it took time to realize that it was in socio-demographic category.

Task 4: 5 out of 5 (100%) of the participants solved task 3 correctly without any error.

Task 5: 5 out of 5 (100%) of the participants solved task 3 correctly without any error.

For all the participants, the results of Trikala workshop were very difficult to read. The font was perceived too small, and it was perceived as a very long document. Although they understood the purpose of the workshop, the questions and who were the stakeholders involved, they found the document boring and hard to read. They suggested using pie charts, bar charts, and maps.

All participants found the results of the Trikala workshop difficult to read due to small font size and excessive length. Although they understood the workshop's purpose, its questions, and the stakeholders involved, they described the document as boring and hard to follow. They recommended improving clarity and engagement by incorporating visual elements such as **pie charts, bar graphs, and maps**.

In the second activity of the usability test, participants completed the questionnaire. The results are presented following the structure of the evaluation survey (*section 3.4 of the present document),* according to the identified KPIs for each of the following criteria: 1) Satisfaction; 2) Engagement; 3) Usability; 4) Content relevance and knowledge gain; 5) Performance.

1. SATISFACTION

1. Satisfaction	**Reference KPI**
• How satisfied are you with the "Knowledge Map Explorer" tool overall? *1 (Very Dissatisfied), 2 (Dissatisfied), 3 (Neutral), 4 (Satisfied), 5 (Very Satisfied)*	**S-KPI_1 User satisfaction score**

The results showed that: 40% (n = 2) of participants expressed a neutral evaluation, 40% (n = 2) were satisfied and 20% (n = 1) were very satisfied (*M* = 3.80).

2. ENGAGEMENT

2. Engagement	**Reference KPI**
A. How likely are you to recommend KME to a friend or colleague **(NPS)**? • **Options**: 0 *(Very unlikely), 1,2,3,4,5,6,7,8,9,10 (Very unlikely)*	**S-KPI_4 Net Promoter Score**

The results showed that: 40% (n = 2) of participants indicated 6 on a 10-point scale, 20% (n = 1) indicated 7 and the last 20% (n = 1) indicated 8 (*M* = 7.00). The results revealed a moderately positive perception of the tool. Although no participant selected a very high score (9 or 10), the majority of ratings fall within a satisfactory to good range. This suggests that the tool has a solid foundation but still leaves room for improvement to enhance user satisfaction and engagement.

3.USABILITY SUS SCALE

3. Usability (SUS)	**Reference KPI**
A. I think that I would like to use the Knowledge Map Explorer (KME) tool frequently. • **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**

B. I found the tool unnecessarily complex. • **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
C. I thought the tool was easy to use. • **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
D. I think that I would need the support of a technical person to be able to use this tool. • **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
E. I found the various functions in the KME were well integrated. • **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
F. I thought there was too much inconsistency in this tool. • **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
G. I would imagine that most people would learn to use this tool very quickly. • **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
H. I found the KME very cumbersome to use. • **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
I. I felt very confident using the tool. • **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**
J. I needed to learn a lot of things before I could get going with this tool. • **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*	**S-KPI_5 System Usability Scale (SUS)**

The final SUS score was **65**. Since a score above 68 is typically considered above average, this result places the tool slightly below the average usability threshold**.**

According to standard SUS interpretation guidelines:

- **0–50**: Poor usability
- **51–68**: Average usability
- **69–80**: Good usability
- **81–100**: Excellent usability

With a score of **65**, the tool demonstrates average usability, suggesting it is functional but could benefit from targeted improvements to enhance the overall user experience and move it into the "good" usability category.

K. Were there any points where you felt stuck or confused while using the tool? • **Options**: - *Yes, No* *- If Yes, please describe.*	**N/A** (qualitative feedback)

The majority of participants reported feeling confused during their interaction with the tool, citing several reasons:

- **Initial uncertainty**: One participant admitted they didn't initially understand the tool's purpose, which made navigation and task completion difficult until the context became clearer.
- **Overload of text**: Long and dense textual content was seen as overwhelming, especially for younger users, leading to difficulty maintaining attention.

- **Unclear categorization**: A mismatch between user expectations and how information was organized caused confusion—e.g., data about motorbike ownership appearing in the demographic section rather than under usage.
- **Excessive linking**: Frequent links to other pages disrupted the flow and made the interface feel fragmented.
- **Lack of guidance**: Some users were unsure which options or boxes to select and struggled to locate specific information.

In conclusion, the tool presents challenges related to content clarity, information architecture, and user guidance. Although the interface becomes more intuitive once users grasp the context, the initial learning curve remains steep. This highlights the need to simplify content, refine labelling, and enhance onboarding or task instructions to improve overall usability and user confidence.

4. CONTENT RELEVANCE AND KNOWLEDGE GAIN

4. Content relevance and Knowledge gain	Reference KPI
A. How relevant do you find the information provided by the KME to your specific needs and interests **(UMUX / UMUX-LITE)**? • **Options**: *Not relevant, Slightly relevant, Neutral, Relevant, Highly relevant*	**I-KPI_1 Relevance of content**
B. Has using the "Knowledge Map Explorer" tool increased your knowledge regarding mobility services or accessible routes? • **Options**: *Not at All, Slightly, Moderately, Significantly, Very Significantly* **B2.** Follow-Up Question: *Please describe any specific changes in knowledge gained.*	**I-KPI_2 Knowledge gain**

A. Regarding relevance, participants did not find the information provided by the tool particularly meaningful for them. Specifically, 20% (n = 1) considered the information not relevant, 40% (n = 2) were neutral, and 40% (n = 2) found it relevant (*M* = 3.20).

B. As for the Knowledge Map Explorer, 20% (n = 1) of participants felt it slightly increased their knowledge about mobility services, while 60% (n = 3) reported a significant increase, and 20% (n = 1) also indicated a significant increase (*M* = 3.00).

5. PERFORMANCE

5. Performance	Reference KPI
A. Did you encounter any bugs or technical issues while using our tool? • **Options**: - Yes, No *- If Yes, please describe the issue.*	**PF-KPI_4 Error rate and handling**
B. How would you rate the clarity of instructions provided within the tool? • **Options**: *5 (Very Clear), 4 (Clear), 3 (Neutral), 2 (Unclear), 1 (Very unclear)*	**PF-KPI_1 Accuracy of information retrieval**
C. How would you rate the clarity of information provided within the tool? **Options**: *5 (Very Clear), 4 (Clear), 3 (Neutral), 2 (Unclear), 1 (Very unclear)*	**PF-KPI_1 Accuracy of information retrieval**
D. Were you able to complete the task(s) you intended to perform using the tool? • **Options**: *Yes, Partially, No*	**S-KPI_2 Task completion rate**
E. How would you rate the visual design and layout of the tool? • **Options**: *1 (Very Unappealing), 2 (Unappealing), 3 (Neutral), 4 (Appealing), 5 (Very Appealing)*	**S-KPI_6 Visual clarity and design appeal**

A. Technical issues: Only one (20%) participant encountered a technical problem—specifically, the absence of graphs and data in the Knowledge Map, which occurred during the first test session.
B. Clarity of instructions: The majority of participants (60%, *n* = 3) reported that the instructions were very clear, while the remaining 40% (*n* = 2) expressed a neutral stance. With an average rating of M = 3.60, the results indicate a generally positive understanding of the guidance offered during the test.
C. Clarity of information: Participants had mixed opinions regarding the clarity of the information provided. While 40% (*n* = 2) found it clear and 20% (*n* = 1) considered it very clear, one participant (20%) expressed neutrality, and another 20% felt the information was very unclear. The average rating of M = 3.60 suggests that, although the content was generally understood, there is still room for improvement in how the information is presented to ensure greater clarity for all users.
D. Task completion: All participants were able to complete the assigned tasks, although some made occasional mistakes, implying that the tasks were generally manageable despite minor usability challenges.
E. Visual design and layout: Participants expressed divergent views regarding the visual appeal of the interface. While 40% (*n* = 2) found it appealing and 20% (*n* = 1) described it as very appealing, an equal proportion (40%) found it unappealing. The resulting average score of M = 3.40 reflects this division, suggesting that while some users were satisfied, others were less impressed. This split highlights the importance of revisiting the design elements to ensure a more consistently engaging visual experience.

7. Suggestions	**Reference KPI**
A. What features would you like to see added or improved in the future? - *Open-ended*	**N/A** (qualitative feedback)
B. Do you have any additional comments or suggestions to help us improve your experience? - *Open-ended*	**N/A** (qualitative feedback)

A. Features to add or improve.

Participants gave interesting recommendations to improve the KME tool. Specifically, they suggest to:

- Use a more engaging, concise, and less formal writing style.
- Include a dedicated section on CCAM vehicle features, with video illustrations.
- Reduce the need for continuous scrolling to access content.
- Incorporate visual elements (e.g. graphics or charts) to present focus group results.
- Improve interactive graphics, such as checkbox layout and design.

B. Additional suggestions

Several participants underline the importance to add a scrolling cue animation on the homepage to guide users through the content.

In conclusion, by incorporating a more engaging and accessible writing style, integrating multimedia elements, and improving the structure and interactivity of the tool, the user experience can be significantly enriched. These insights offer a concrete foundation for future design iterations and suggest that even small changes—like reducing scrolling or enhancing checkbox layouts—can have a meaningful impact on user satisfaction and engagement.

5.2. The evaluation with the Groups of Followers

5.2.1 Den Bosch Workshop

Participants carried out the tasks during the Den Bosch workshop, organized by the Group of Interest of Noord Brabant in collaboration with the Move2CCAM project. However, due to a misunderstanding, the task results were not collected.

In the second activity of the usability test, participants completed the questionnaire. The results are presented following the structure of the evaluation survey (*section 3.4 of the present document),* according to the identified KPIs for each of the following criteria: 1) Satisfaction; 2) Engagement; 3) Usability; 4) Content relevance and knowledge gain; 5) Performance. It is important to note that the sample size was fairly large, which enabled a more detailed analysis of the questionnaire results.

1. SATISFACTION

A. In general, the mean showed that the satisfaction of the tool was not very high (M = 2.79). In particular: 5.26% (n = 1) of participants was very dissatisfied, 31.58% (n = 6) were dissatisfied, 42.11% (n = 8) expressed a neutral evaluation and only 21.05 % (n = 3) were satisfied. The ANOVA analysis was not significant, however the means showed that people with higher competence on technology were less satisfied (Advanced M = 2.78; Expert M = 2.33) than people with lower competence (Intermediate M = 3.50). The age showed an interesting result: the satisfaction is low in the younger groups (M25.34 = 2.40 and M35.44= 2.25), increases in older groups (M45.54 = 3.67 and M55.64= 2.67) and decreases in the elderly group (M65+= 2.00). It seems that the tool is not very appealing for the younger and the oldest. No significant differences emerged considering the organization and the gender.

B. Overall satisfaction with the "Knowledge Map Explorer" tool was relatively low, especially among younger and more technologically experienced participants. The tool appears to resonate better with mid-aged users but lacks appeal at both ends of the age spectrum. These findings suggest a need to enhance usability, engagement, and relevance**,** particularly for digital-native and elderly user groups. Improving the interface design, tailoring content, and simplifying interactions could help broaden user satisfaction.

2. ENGAGEMENT

The results showed that: 10.52% (n = 2) indicated 0 on a 10-point scale, 15.79% (n = 3) indicated 3, 31.58 % (n = 6) indicated 5, 15.79% (n = 3) indicated 6 and 26.32% (n = 5) indicated 7 (*M* = 5.84). No significant differences emerged considering the independent variables: age, gender, organization. The analyses performed considering the familiarity with technology showed a nearly significant effect, F(2,16) = 2.82, p= 0.08. Again, people with higher competence on technology were less prone to recommend the tool (Advanced M *= 6.00*; Expert *M* = 4.50) than people with lower competence (Intermediate *M* = 7.50). Overall, the tool received a moderate recommendation score, with no strong enthusiasm. Interestingly, users with higher technological competence were less likely to recommend it, possibly due to higher usability expectations or critical evaluation skills. These insights suggest that enhancing the tool's interface, clarity, and user engagement—particularly for tech-savvy audiences—could help boost its overall appeal and recommendation rates.

3.USABILITY SUS SCALE

The System Usability Scale (SUS) scores ranged from 15 to 70. The final score, represented by the mean, was 48.42. Generally, a SUS score above 68 is considered above average. With an average SUS score of 48.42, the system falls below the accepted usability threshold. This suggests that expert in the field found the system to be less usable than desirable, indicating there may be significant room for improvement in terms of user experience.

A significant majority—73.68% of participants (n = 14)—reported experiencing some kind of **confusion** while using the tool. Their comments highlighted multiple issues, which can be grouped into the following key themes:

Navigation and structure

- Several participants found the interface non-intuitive and difficult to navigate, especially when trying to return to the homepage.
- The category structure was considered by several participant as unclear, with overlapping or confusing criteria (e.g., "better than, worse than" without context).
- Multiple users noted that the selection flow and logic did not always make sense or lead to understandable outcomes.

Content and context

- Participants struggled with the lack of contextual guidance, making it hard to understand the meaning behind certain terms, questions, or categories.
- Some of them notice that there was a disconnect between user queries and available data, leaving questions (e.g., specific to age groups or countries) unanswered.
- Other noted the absence of links to supporting data or research weakened users' trust in the recommendations presented.

Visual and accessibility issues

Participants noted that:

- Visual elements such as **graphics and icons were found to be unhelpful or misleading**.

- Few participants noted that on mobile devices, **navigation and interaction were problematic**.

Finally, one participant mentioned general accessibility concerns without providing specific details. However, at that time, the accessibility features had not yet been implemented.

Expectations on the research results

- Users expected to see **aggregated results, comparisons**, and insights, but found the presentation fragmented or insufficiently informative.

4. CONTENT RELEVANCE AND KNOWLEDGE GAIN

A. As concerned the relevance of the information provided by the tool: 5.26% (n = 1) considered the information not relevant at all, 15.79% (n = 3) slightly relevant, 42.11% (n = 8) were neutral, 31.58% (n = 6) indicated that the information was relevant, and only 5.26% (n = 1) rated the information highly relevant (M = 3.16). Men (M = 2.67) considered the information provided by the tool less relevant than women (M = 4.00), F(1.18) = 7.26, p = .006. As concerned the knowledge of technology the analyses showed intermediate (M = 2.75) and advanced (M = 3.89) considered the information provided by the KME tool more relevant than expert ones (M = 2.33), F(2,16) = 10.96, p =.001.

B. 42.11% (n = 8) of participants believed that the Knowledge Map Explorer did not increase their knowledge about mobility service at all, 5.26% (n = 1) slightly, 42.11% (n = 8) moderately, and only 10.52% (n = 2) believed that their knowledge increased significantly using the tool. The analyses revealed that knowledge regarding mobility services or accessible routes increased with the age of participants (M25.34 = 1.60; M35.44= 1.75; (M45.54 = 4.00; M55.64= 3.33; M65+= 4.00). The analyses showed that knowledge gain decreases as the familiarity with technology increases: intermediate scored M = 4.25, advanced scored M = 3.00 and expert scored M = 1.50, F(2,16) = 5.35, p =.017. No significant differences emerged considering gender and the organization participants belonged to.

5. PERFORMANCE

A. Out of 19 participants, 12 (63.16%) experienced at least one technical issue while using the tool.

The problems reported included:

- Non-functional buttons, such as the start button
- Repetitive or incomplete outputs in recommendations.
- Access issues, including problems with logging in or password entry.
- Poor visual readability due to colour choices.
- Limited mobile usability, the tool does not work properly with mobile phones.

In conclusion, the high number of technical issues significantly impacted the participants' ability to fully engage with the tool. Problems with core functionality (e.g. buttons, incomplete outputs) suggest that the tool is not yet ready for reliable use. Visual design and mobile compatibility need

improvement to support accessibility across devices. Addressing these issues is essential to ensure a smoother, more inclusive user experience and to build trust in the tool's effectiveness.

B. Clarity of instructions: A total of 15.79% of participants (n = 3) found the instructions provided with the tool *very unclear*, while 31.58% (n = 6) found them *unclear*. Another 31.58% (n = 6) gave a *neutral* evaluation, and only 21.05% (n = 4) considered the instructions to be *clear*. No significant differences emerged based on gender, age, level of technological knowledge, or organizational affiliation.

C. Clarity of information: Regarding the clarity of information provided by the tool, 15.79% (n = 3) rated it as *very unclear* and 21.05% (n = 4) as *unclear*. Nearly half (47.37%, n = 9) remained *neutral*, while only 15.79% (n = 3) found the information *clear*. Again, no significant differences were observed based on gender, age, technological expertise, or organizational background.

D. Task completion: Only 31.58% of participants (n = 6) successfully completed the tasks they intended to perform. Another 47.37% (n = 9) were able to complete tasks *partially*, while 21.05% (n = 4) were *unable to complete* the tasks. Interestingly, 75% of users with an *intermediate* level of technological knowledge (n = 3) completed the tasks, compared to just 33.3% of *advanced* users (n = 2) and 16.7% of *expert* users (n = 1).

E. Visual design: In terms of visual design, 5.26% (n = 1) found the tool *very unappealing*, while 31.58% (n = 6) rated it as *unappealing*. A further 26.32% (n = 5) provided a *neutral* evaluation. Another 26.32% (n = 5) found the visual design *appealing*, and only 10.52% (n = 2) considered it *very appealing*. No notable differences were found across demographic or experiential groups.

7. SUGGESTIONS

A. Participants suggested improvements in several key areas:

- **Structure and navigation.** Participants proposed to**:**
  - Simplify the structure and provide a clearer overall presentation.
  - Improve navigation—for example, allow easier return to policy selection steps.
  - Place topic selection earlier in the user journey (instead of under the questions).
- **Visual design.** Participants underlined the importance of:
  - Using better colour schemes (avoid dark blue).
  - Improving readability through better text-background contrast.
  - Optimizing the design for mobile phones.
- **Functionality and performance.** According to some participants the KME tool should:
  - Ensure the tool is fully operational (e.g., fix bugs and broken elements).
  - Enable comparisons between groups or scenarios.
  - Integrate outputs such as summary tables alongside recommendation explanations.
- **Content and clarity.** Moreover, the KME tool should:
  - Provide more information and detailed justifications for the recommendations.
  - Ensure results are consistent, logical, and well-substantiated with examples or references.
  - Reduce the number of options to focus more on the big picture.

- **Other notes**
  - Some feedback referred to points already mentioned earlier by the same participants.
  - A few participants reported no additional suggestions at this time.

B. Additional comments

Participants shared final reflections focused on usability, reliability, and content quality:

- **Functionality and accessibility:**
  - Multiple participants emphasized the need for a *fully working, accessible tool*.
  - For some participants, bugs and technical issues continued to make the tool difficult or even impossible to evaluate properly. However, at that time, not all functionalities and accessibility features had been implemented.
- **Navigation and design:**
  - The ***menu structure*** was described as complicated by some users.
  - Some participants suggested to incorporate ***supporting visuals*** and ***inspiring user quotes*** to improve engagement.
- **Data and content quality:**
  - Participants' concerns were raised about the ***credibility and precision*** of results—some appeared overly rounded or based on small data samples.
  - Participants also requested ***more substantial data integration*** for meaningful insights.

These comments reinforce earlier feedback: the tool must be ***stabilized and streamlined*** before wider use or evaluation. Moreover, Improvements in ***data presentation, interface clarity,*** and ***inspirational storytelling*** could dramatically boost perceived value. To move forward, the tool needs both ***technical refinement*** and ***user-centred enhancements*** to unlock its true potential.

5.2.2 Brussels Workshop

The Brussels workshop was held a few weeks after the one in Den Bosch. In the meantime, the KME tool was updated based on the feedback that emerged during the previous session. The usability test was conducted during a workshop with experts of CCAM field organised just after the conclusion of the European Road Transport Research results (RTR) Conference and conducted by ERTICO as part of the WP5 activities. In this case too, the results of the Tasks were not collected.

The results of the questionnaire are presented following the structure of the evaluation survey (*section 3.4 of the present document),* according to the identified KPIs for each of the following criteria: 1) Satisfaction; 2) Engagement; 3) Usability; 4) Content relevance and knowledge gain; 5) Performance.

1. SATISFACTION

In general, the mean showed that the satisfaction of the tool was quite high ($M = 4.14$). In particular: 85.70% (n = 6) of participants was satisfied and one was very satisfied (14.30%).

2. ENGAGEMENT

The results showed that: 71.40% (n = 5) indicated 7 on a 10-point scale, and 28.60% (n = 2) indicated 10. In general, the engagement was quite high (*M* = 8.86).

3.USABILITY SUS SCALE

The SUS scores ranged from 52.50 to 87.50, with a mean score of 70.36 (SD = 11.58). Since a score above 68 is generally considered above average, the results indicate that overall usability was rated positively by participants. Compared to the Den Bosch workshop (48.80), the SUS score showed a marked improvement.

A total of 87.5% of participants (n = 6) reported feeling confused when using the tool. Their feedback highlighted several areas for improvement:

- **Navigation**: Participants found it difficult to switch between categories without returning to the main menu.
- **Terminology and structure**: Some sections, such as "Feelings, Emotions, Attitudes Toward CCAM," were unclear for some participants—particularly the meaning of values like "better than" or the reference timeline.
- **Categorization**: Participants' uncertainty arose around the distinction between the top-level categories and where specific stakeholders (e.g., police, private security) should be placed.
- **Flexibility**: Some participants expressed a need for more freedom in how they explore data—for example, skipping user type selection or comparing multiple cities.
- **Visuals and layout**: Some participants Suggested to include pie charts, improving the clarity of transport motives and colour codes, and revising how special needs and digital access are displayed.
- **Terminology clarity**: Labels like "true"/"false" and "allowable values" were considered by a participant as confusing and according to his/her point of view the KME tool could benefit from more descriptive phrasing.
- **Minor UI details**: Some suggestions included consistent capitalization in the sidebar menu and clearer instructions on how to begin using the tool.

4. CONTENT RELEVANCE AND KNOWLEDGE GAIN

A. Relevance of information provided by the tool: Participants had mixed views regarding the relevance of the information offered by the tool. Specifically, 14.3% (n = 1) considered the information not relevant at all, 28.6% (n = 2) were neutral, and 57.1% (n = 4) found it highly relevant. The mean rating was 3.43.

B. Perceived knowledge gain through the Knowledge Map Explorer (KME): When asked whether the KME helped increase their knowledge of mobility services, 14.3% (n = 1) reported no increase at all, 28.6% (n = 2) indicated a moderate increase, 48.9% (n = 3) felt their knowledge increased significantly, and 14.3% (n = 1) reported a very significant increase. The average score was 4.57.

B2. Open comments on knowledge gain

Positive first impressions: One participant, despite limited use of the tool, found the Knowledge Map Explorer (KME) engaging and user-friendly in principle.

5. PERFORMANCE

A. 3 participants (42.90%) encountered at least a technical issue while performing the tasks Several participants noted specific issues with the tool: the pie chart design made data hard to read, especially due to colour choices and overly precise percentages; white text lacked clarity against certain backgrounds; navigation was problematic when reselecting a country after no results appeared
B. **Clarity of instruction:** For 28.60% (n = 2) the instruction provided with the tool were neutral. Another 71.40% (n = 5) found the instruction clear, (*M* = 3.71).
C. **Clarity of information: Similar results for the clarity of information.** For 28.60% (n = 2) the instruction provided with the tool were neutral. Another 71.40% (n = 5) found the instruction clear (*M* = 3.71).
D. **Tasks:** The 100% (n = 6) were able to complete the tasks they wanted to perform.
E. **Visual design:** 14.3% (n = 1) considered the visual design of the tool very unappealing, 14.3% (n = 1) considered the tool neutral. 71.40% (n = 5) rated the visual design appealing (*M* = 3.57).

7. SUGGESTIONS

A. Participants suggested improvements across several key areas:

- **Data display adjustments:** Use absolute values instead of percentages when sample sizes are too small, to improve data clarity and reliability.
- **Integration with other projects:** Enable the platform to incorporate and visualize results from other relevant projects (e.g. *CulturalRoad*), creating a more comprehensive knowledge base.
- **User-centric exploration paths:** Offer entry points based on user goals or questions (e.g. “I want to learn about rural CCAM”) instead of limiting access by stakeholder type, promoting inclusiveness and relevance for all audiences.
- **Enhanced visual presentation:** Improve the graphical representation of findings to ensure information is visually intuitive and more engaging.
- **Interface design improvements:** Review the colour palette and fonts for better aesthetics and legibility; avoid repetitive elements such as displaying "Knowledge Map Explorer" on every query page.

B. Participants shared final reflections focused on accessibility. In particular. They suggest assessing the platform’s compatibility with screen readers and ensure colour contrasts support visually impaired users.

5.3. The evaluation with the Groups of Interest

The tasks were generally completed with both accuracy and efficiency, typically within just a few minutes. These results suggest that participants encountered minimal difficulty in finding the information they were asked to retrieve. Task-by-task results are summarized below.

- **Task 1:** 100% correct responses
- **Task 2:** 100% correct responses
- **Task 3:** 87.5% correct responses
- **Task 4:** 81.3% correct responses
- **Task 5:** 87.5% correct responses

In the second part of the usability test, participants completed the questionnaire. The results are presented following the structure of the evaluation survey (*section 3.4 of the present document),* according to the identified KPIs for each of the following criteria: 1) Satisfaction; 2) Engagement; 3) Usability; 4) Content relevance and knowledge gain; 5) Performance.

1. SATISFACTION

In general, the mean showed that participants were quite satisfied with the Knowledge (*M* = 3.95, SD = .71). Looking at the distribution only one participant was dissatisfied (5.30%) and two (10.50%) expressed a neutral opinion about the tool. The majority expressed a positive evaluation, 68.40% (n = 13) of participants were satisfied, and 15.80% (n = 3) very satisfied. The ANOVA did not reveal differences according to gender and technology knowledge.

2. ENGAGEMENT

The overall engagement level, as measured by the Net Promoter Score, was notably high (*M* = 8.32), reflecting substantial participant involvement. This outcome attests to the effectiveness of the proposed experience and points to its promising potential for future development or broader implementation.

3.USABILITY SUS SCALE

The SUS scores ranged from 52.50 to 87.50, with a mean score of 75.79. Given that a SUS score above 68 is typically regarded as above average, these results suggest a generally positive usability perception among participants.

44.40% (n = 4) of participants felt confused or stuck while using the tool. Here's a summary of the participants' comments:

- **Clarity and usability issues**: Some participants noted that the filter options were occasionally unclear or required extra effort to interpret. The complexity of multiple options made it harder to use the survey results effectively.

- **Technical difficulties**: There were reports of malfunctioning charts within the app. For example, users had to click on the charts to see the answers, and overlapping visual elements created confusion.
- **Terminology confusion**: One participant pointed out ambiguity between “research results” and “research” as it relates to stakeholder roles, highlighting a need for more precise wording.

4. CONTENT RELEVANCE AND KNOWLEDGE GAIN

A. As concerned the relevance of the information provided by the tool: 21.10% (n = 4) considered the information slightly relevant, 26.30% (n = 5) were neutral, and 42.20% (n = 8) rated the information relevant and 10.50% (n = 2) considered the information highly relevant (*M* = 3.42).

B1. As concerned the ability of the tool to provide information about mobility services and accessible routes: 26.30% (n = 5) of participants believed that the Knowledge Map Explorer increased slightly their knowledge about mobility , 47.40% (n = 9) moderately, 15.80% (n = 3) believed that their knowledge increased significantly using the tool and 10.50 (n = 2) very significantly (*M* = 4.11).

B2. Participants reported several learning outcomes after using the tool:

- They became more aware of the key factors in developing CCAM services, including the importance of thoughtful planning.
- There was a strong appreciation for gaining insight into the needs of underrepresented groups**,** such as migrants and LGBTQ+ individuals.
- Participants noticed that similar target groups can have different needs across various regions or contexts**,** which enriched their understanding.
- The tool offered new information and encouraged empathy toward others' experiences and needs.
- Some highlighted the variety and depth of data available—especially in areas like user experience and safety**.**

In conclusion, the feedback suggests that the tool was effective in enhancing participants' awareness, empathy, and knowledge**.** It supported a more inclusive view of mobility and transport planning, emphasizing the importance of flexibility**,** diversity**,** and context-sensitive approaches. These insights could help promote more equitable and user-cantered design in future CCAM initiatives.

5. PERFORMANCE

A. Out of 19 participants, 4 individuals (21.1%) experienced at least one technical problem during the tasks. The reported issues included:

- **Missing or incomplete content**: One participant noted the absence of recommendations when exploring other mobility features for different groups.
- **Text display errors**: In one task, words were cut off at the end (e.g. “bu” instead of “bus”).
- **Data visualization issues**: Problems were observed when trying to access or interpret chart responses.

- **Mobile accessibility**: One participant reported difficulties when using the tool on a mobile device.

B. Clarity of instruction: For 5.30% (n = 1) the instructions were unclear, while for 10.50% (n = 2) the instructions provided with the tool were neutral. Another 68.40% (n = 13) found the instruction clear, and 15.80% (n = 3) were very clear (*M* = 3.95). The ANOVA did not reveal differences according to gender and technology knowledge.

C. Clarity of information: Similar results for the clarity of information**.** For 5.30% (n = 1) the information provided with the tool was unclear and for 15.80% (n = 3) was neutral. The wide majority 68.40% (n = 13) found the information clear and 10.50% (n = 2) found the information very clear (*M* = 3.84). The ANOVA did not reveal differences according to gender and technology knowledge.

D. Tasks: The 73.70% (n = 14) were able to complete all the tasks they wanted to perform, while the 26.30% (n = 5) were not able to complete at list one task. The ANOVA did not reveal differences according to gender and technology knowledge.

E. Visual design: 26.30% (n = 5) considered the visual design of the tool as neutral, 42.10% (n = 8) considered the tool appealing and 31.60% (n = 6) rated the visual design very appealing (*M* = 4.05). The ANOVA did not reveal differences according to gender and technology knowledge.

7. SUGGESTIONS

A. Participants provided several valuable suggestions for improving the tool:

- **More in-depth content**: Participants highlighted the importance of including additional reading materials, such as references to deliverables and links to real-world projects or use cases.
- **Target group visibility**: They emphasized the need to create a dedicated page that clearly presents the needs and preferences of each user group.
- **Supportive tools**: Some participants suggested that the tool should provide practical examples to help users implement the recommendations effectively.
- **Expanded datasets**: Several participants proposed incorporating more data—particularly on specific topics such as rural cyclists—to better reflect diverse geographic contexts.
- **Data transparency**: One participant expressed that the tool should offer users the ability to view the underlying statistical results behind the recommendations.

B. Participants final suggestions for the tool improvement:

- **Visual representation**: One participant suggested updating visuals to be more inclusive.
- **Content depth**: A few users noted that some outputs were too brief and suggested enhancing them to avoid repeated user input.
- **User motivation**: Some participants underlined the importance of introducing some preview recommendations on the landing page, this could spark curiosity and encourage deeper engagement.
- **Positive outlook**: One participant expressed enthusiasm about integrating the tool into municipal policy-making.

The feedback highlights a clear interest in making the tool **more informative, inclusive, and actionable**. Enhancing content richness, offering real-life examples, improving personalization, and increasing transparency could significantly boost the **usability and impact** of the tool. These insights reflect a readiness among users not only to engage with the platform but also to see it contribute to **real-world planning and decision-making**.

5.4. Accessibility Test

As previously discussed, the results of the usability test informed a series of targeted improvements to the KME tool. In May 2025, a near-final version of the platform was implemented, featuring integrated accessibility enhancements designed to support a wider range of users.

To assess the inclusivity and compliance of these updates, the revised version underwent an accessibility evaluation aligned with the **Web Content Accessibility Guidelines (WCAG) 2.1**, developed by the World Wide Web Consortium (W3C)**.** The assessment aimed to verify that the tool meets international standards for accessible digital design.

1. SATISFACTION

In general, the mean showed that the satisfaction of the tool was quite high (M = 4.00). In particular: 25% (n = 1) of participants expressed a neutral evaluation, 25 % (n = 2) were satisfied and 25% (n = 1) very satisfied.

2. ENGAGEMENT

The results indicate a relatively high level of engagement (M = 7.75). Responses were evenly distributed, with 25% (n = 1) selecting 4, 6, 8, and 9, respectively, on a 10-point scale. This suggests that, despite some variability, participants generally reported a positive level of engagement.

3. USABILITY SUS SCALE

The SUS scores ranged from 57 to 85, with a mean of 71.88, which is considered above average (a SUS score > 68). Interestingly, the lowest score (57) was given by the participant with visual impairment, whereas the other participants rated the tool very positively (SUS = 75, 85, and 70). These results suggest that, overall, the tool was perceived as highly usable, although accessibility for users with visual impairments may require further attention.

25% (n = 1) of participants felt confused. It seems that the main issue is related to the English language being not very compatible with the screen reader for iPhone.

4. CONTENT RELEVANCE AND IMPACTS

A. As concerned the relevance of the information provided by the tool: 75% (n = 3) considered the information relevant, and 25% (n = 1) rated the information highly relevant (M = 4.25).

B. In the accessibility test, the question 'Has using the "Knowledge Map Explorer" tool increased your knowledge regarding mobility services or accessible routes?' was not included in the questionnaire, as the participants did not have prior knowledge of the topic.

5. PERFORMANCE

A. 1 participant (25%) encountered at least a technical issue while performing the tasks. In particular: In some tasks it was impossible to see the results. Probably this is due to the fact that the tool was under construction.

B. **Clarity of instruction** All participants (100%, *n* = 4) found the instructions provided within the tool to be clear (M = 4.00).

C. **Clarity of information** Most participants (75%, *n* = 3) considered the information within the tool to be clear, while one participant (25%) rated it as very clear (M = 4.25).

D. **Task execution** Only three participants attempted the tasks. Of those, 75% (*n* = 2) were able to fully complete the tasks they intended to carry out, while one participant (25%) was only partially successful.

E. **Visual design** One participant (25%) gave a neutral evaluation, whereas the majority (75%, *n* = 3) rated the visual design as appealing (M = 3.75).

F. **Technical issues** One participant (25%) encountered at least one technical issue during task execution. Specifically, in certain tasks it was not possible to view results—this was likely due to the tool still being under development.

G. **Conclusion** Overall, the instructions were perceived as clear and user-friendly by all participants. While a few experienced limitations—particularly due to the unfinished nature of the tool—most were able to carry out the tasks effectively. Both the clarity of the information provided, and the visual presentation were rated positively. These findings suggest a solid foundation for further tool development, with particular attention needed to address technical stability and task visibility.

6. ACCESSIBILITY

Compared to the other usability tests, the accessibility evaluation included additional questions aimed at assessing specific aspects of the KME tool's accessibility. These items were adapted from a standardized scale developed by AGID (Agenzia per l'Italia Digitale), which focuses on inclusive digital design and usability for all users.

A. Perception:
Were the information and commands required to complete the task always available and perceivable? **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

A. In general, the evaluation of the tool **perception** was positive (M = 3.75). In particular, 50% (n = 2) scored 3, 25% (n = 1) scored 4 and 25% (n = 1) scored 5.

B. Comprehensibility:
Were the information and commands required to complete your tasks easy to understand and use?

Options: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

B. The evaluation of the **comprehensibility** was positive (M = 4.25). In particular, 75% (n = 3) scored 4 and 25% (n = 1) scored 5.

C. Operability:
Did the available information and commands allow you to quickly select the necessary actions to reach your objective? **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

C. The evaluation of the tool **operability** was overall positive (M = 3.55). In particular, 25% (n = 1) scored 3 and 75% (n = 1) scored 4.

D. Consistency:
Did you find consistency among the symbols, messages, and actions in the environment you used? **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

D. The evaluation of the tool **consistency** was quite positive (M = 4.00). In particular, 25% (n =1) scored 3, 50% (n = 2) scored 4 and 25% (n = 1) scored 5.

E. Health protection:
Were you able to perform the necessary actions without effort or particular difficulties? **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

E. The evaluation of the **health protection** was positive (M = 4.00). In particular, 25% (n = 1) scored 3, 50% (n = 2) scored 4 and 25% (n = 1) scored 5.

F. Security:
Do you believe that the data you handled was processed with proper security measures? **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

F. The evaluation of the **tool security** was quite positive (M = 4.50). In particular, 50% (n = 2) scored 4, and 50% (n = 2) scored 5.

G. Transparency:
Did you receive useful and timely indications from the system? **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

G. The evaluation of the **tool transparency** was positive (M = 4.25). In particular, 75% (n = 3) scored 4, and 25% (n = 1) scored 5.

H. Learnability: The environment must have characteristics that enable easy and quick learning**.**
Do you think the interface and environment were easy to understand and use? **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

H. The evaluation of the **tool learnability** was overall positive (M = 3.75). In particular, 25% (n = 1) scored 3, and 75% (n = 3) scored 4.

I. Help and documentation:
Were the available help tools useful in achieving your goal? **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

I. The evaluation of the **help and documentation** was overall positive (M = 4.00). In particular, 25% (n = 1) scored 3, 50% (n = 2) scored 4, and 25% (n = 1) scored 5.

J. Pleasantness:
Did the interface seem pleasant to you? **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

J. he evaluation of the **tool pleasantness** was overall positive (M = 4.25): 25% (n = 1) scored 3, 25% (n = 1) scored 4, and 50% (n = 2) scored 5.

K. Flexibility:
Did the system allow you to customize the environment in which you operated in any way? **Options**: *1 (Strongly disagree), 2, 3, 4, 5 (Strongly agree)*

K. The system was not perceived very **flexible** (M = 3.00). 50% (n = 2) scored 2 and 50% (n = 2) scored 4.

Overall, the accessibility evaluation of the tool revealed generally positive user perceptions across nearly all dimensions. Participants found the platform clear, secure, and pleasant to use, with comprehensibility, transparency, and data security standing out as particularly strong aspects. However, areas such as **operability** and especially **flexibility** show potential for improvement, indicating the need to better accommodate diverse user preferences and make actions more intuitive. Strengthening these aspects would significantly enhance the overall inclusivity and user experience of the tool.

7. SUGGESTIONS

A. Features to add or improve Several suggestions emerged regarding potential improvements to the tool:

- **Language options:** Two participants recommended adding alternative languages, specifically Italian.
- **Content expansion:** One participant suggested including interview videos and expanding the number of European cities covered.
- **Geographic reach:** Another participant considered the website already satisfactory but proposed gradually increasing the number of cities beyond the current four.

B. Additional comments Participants did not report any further observations or comments.

Conclusions

The validation process of the Knowledge Map Explorer (KME) has demonstrated the tool's potential to act as an effective, user-centred decision support system in the realm of Cooperative, Connected, and Automated Mobility (CCAM). Grounded in extensive participatory co-design and tested through structured methodologies involving multiple user groups, the KME was assessed on its functional reliability, usability, accessibility, and relevance.

The validation activities, involving over 50 participants from diverse user segments—including public authorities, transport operators, academics, students, and people with disabilities—provided valuable feedback that has informed iterative improvements. Following each evaluation workshop, improvements were integrated into the Knowledge Map Explorer (KME), leading to progressively higher user satisfaction scores in the final validation sessions. Results highlighted several positive aspects, such as the tool's potential to increase knowledge and awareness about inclusive CCAM solutions, its appeal to middle-aged users, and a generally satisfactory user interface once initial barriers were overcome.

However, important challenges emerged. Key usability metrics, such as the System Usability Scale (SUS) and Net Promoter Score (NPS), fell below optimal thresholds in earlier stages. Technical issues, a lack of visual content, and insufficient contextual guidance were identified as barriers to effective use, especially among more tech-savvy and younger users. Participants with accessibility needs also emphasized the importance of clearer layouts, screen-reader compatibility, and reduced cognitive overload.

These insights point to clear directions for future enhancements, including:

- Improved onboarding and navigation logic, especially for first-time users.
- Enhanced visual storytelling, with charts, maps, and videos to replace long text sections.
- Optimization for mobile use, to increase accessibility and usability across devices.
- Clearer data structures and transparent recommendations, with tooltips or references to source data.
- Refined accessibility compliance, addressing both WCAG standards and lived-experience insights from people with disabilities.

The iterative design process demonstrated during this validation phase should remain a core principle for future developments. Further evaluation in operational CCAM pilot projects (e.g., Living Labs or large-scale demos) could solidify KME's practical value and increase its adoption by public authorities and mobility service providers.

In conclusion, the Knowledge Map Explorer offers a promising pathway for translating citizen voices and stakeholder insights into actionable knowledge. With targeted refinements, it can become a

cornerstone for inclusive, transparent, and participatory planning and deployment of automated mobility solutions in Europe and beyond.

Appendix: Detailed Tasks per testing session

Testing with UNIMORE students

Task 1: You want to find information about the research results conducted in the SINFONICA project. Specifically, you want details about the interviews regarding the habits and means of transportation used by the elderly population living in the Netherlands. Can you tell me, based on the interviews, which means of transportation is preferred by them?

Task 2: You want to obtain information from the interviews conducted on the reasons behind the choice of means of transportation among the low-income population residing in Great Britain. Specifically, what is the primary reason indicated by low-income individuals living in Great Britain that influences their choice of transportation for their regular commutes?

Task 3: You want to obtain information from the interviews conducted on the percentages of elderly people living in Greece who own a means of transport. Specifically, what is the percentage of elderly people living in Greece who own a motorcycle?

Task 4: You want to obtain information from the interviews conducted on the use of technologies and digital devices by people with physical disabilities living in Germany. Please indicate which digital device is most used by German people with physical disabilities.

Task 5: Do you want information from interviews about the emotions, feelings, and attitudes of young people (18-25 years old) living in the Netherlands towards CCAM (Cooperative, Connected, and Automated Mobility) technology? Specifically, according to young people living in the Netherlands, which aspect of transportation will worsen the most with the adoption of CCAM technology (e.g. autonomous buses)?

Participants also explored the page presenting the Trikala Workshop results and shared their impressions.

Testing with Group of Followers

Task 1: We ask you to imagine to be a service provider. As a stakeholder you need to receive tailored recommendations to encourage the CCAM adoption. We ask you to use the KME tool to find this information. Select the category of stakeholders that best represents your role (service provider) and look for the recommendations by selecting the results emerged in United Kingdom related to the category “gender inequalities” and regarding the urban area. What of the following recommendation is not present in the list?

Taks 2: We ask you to imagine to be a public administrator. As a stakeholder you need to receive tailored recommendations to encourage the CCAM adoption. We ask you to use the KME tool to find this information. Select the category of stakeholders that best represents your role (public

administration) and look for the recommendations by selecting the results emerged in Netherlands related to the category “single parent family” and regarding the urban area. What is the recommendation suggested?

Task 3: We ask you to imagine to be member of the transport commission of your region, and you are interested in implementing self-driving public transport. As a member of the transport commission, you therefore decide to consult the research results of SINFONICA project. You are interested in consulting the results of the interviews, and particularly the category special needs among the people with cognitive disabilities residing in Greece. Can you indicate which aspect of the transport is perceived as the most limiting for people with cognitive disabilities living in Greece?

Task 4: As a member of the transport commission, you are interested in gathering information from the interviews on the motives behind the transport choices among the elderly people residing in Great Britain. Specifically, what is the first motive indicated by elderly people living in Great Britain that influences their choice of transport for their usual journeys?

Task 5: As a member of the transport commission, you are interested in gathering information from the interviews on the emotions, feelings and attitudes that cyclists living in Germany have towards CCAM (Cooperative, Connected and Automated Mobility) technology. According to cyclists living in Germany, which aspect of transport will improve the most with the adoption of CCAM technology (e.g. self-driving buses)?

Testing with Groups of Interest

Task 1: We ask you to imagine to be a transport mobility operator. As a stakeholder you need to receive tailored recommendations to encourage the CCAM adoption. We ask you to use the KME tool to find this information. Select the category of stakeholders that best represents your role (a transport mobility operator) and look for the recommendations by selecting the results emerged in United Kingdom related to the category “gender inequalities” and regarding the urban area.

What of the following recommendation is not present in the list?

Task 2: We ask you to imagine to be a public administrator. As a stakeholder you need to receive tailored recommendations to encourage the CCAM adoption. We ask you to use the KME tool to find this information. Select the category of stakeholders that best represents your role (public administration) and look for the recommendations by selecting the results emerged in Netherlands related to the category “single parent family” and regarding the urban area.

What is the recommendation suggested?

Task 3: We ask you to imagine to be member of the transport commission of your region, and you are interested in implementing self-driving public transport. As a member of the transport commission, you therefore decide to consult the research results of SINFONICA project. You are interested in consulting the results of the interviews, and particularly the category special needs among the people with cognitive disabilities residing in Greece.

Can you indicate which aspect of the transport is perceived as the most limiting for people with cognitive disabilities living in Greece?

Task 4. As a member of the transport commission, you are interested in gathering information from the focus groups on the perception of advances and concerns among the citizens living in rural areas of Hamburg. Specifically, according to thew results what are the main concerns of people living in the rural area about the self-driving buses

Task 5: As a member of the transport commission, you are interested in gathering information from the survey on the intention of citizens to use the CCAM. So, you decide to consult the results of the survey, particularly the charts at the end of the webpage.

Specifically, according to the results of the charts which of the present categories showed the less intention to use the CCAM vehicles.

Task 6: We ask you to go through the interviews, focus groups and workshop sections regarding your city (or district) Please, have a look to the information and the way it is reported. In the following survey we will ask to evaluate this part.

For more information

SINFONICA Project Coordinator

UNIMORE – University of Modena and Reggio Emilia

Via Giovanni Amendola, 2

42122 Reggio Emilia, IT

sinfonica@sinfonica.eu

www.sinfonica.eu

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