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Participatory planning for common European standards for connected and autonomous vehicles

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Abstract

This research presents a framework for participatory planning and co-creation designed to support the development of equitable and widely adopted Connected, Cooperative, and Automated Mobility (CCAM) solutions in Europe, while accounting for cultural and geographical diversity. Specifically, it reports the results of the first step of a two-step Participatory Co-Creation Framework developed within the EU-funded CulturalRoad project. The framework brings together policymakers, city associations, technology providers, and service operators from five countries: Germany, Israel, Slovenia, Spain, and the United Kingdom.
The methodology is applied at multiple governance levels, including the national level and the municipal level. The findings provide insights into how Europe can position itself within the global CCAM ecosystem, particularly in comparison with China and the United States, and how common European standards can be developed while respecting diverse geographical and cultural contexts. A key finding is that CCAM development should prioritize minority groups and vulnerable users to ensure both efficiency and inclusivity. At the same time, the results highlight that the European ecosystem requires tailored solutions that cannot be directly transferred from the Chinese or US models.

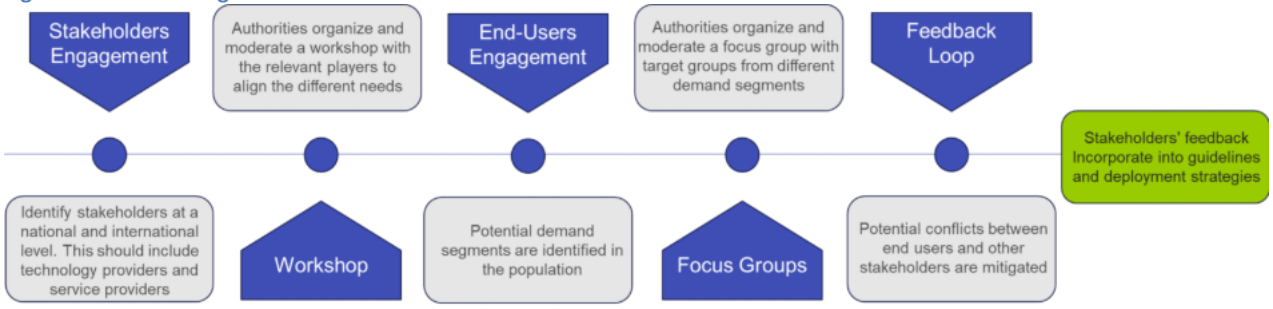
Introduction

Connected, Cooperative, and Autonomous Mobility (CCAM) is regarded as one of the main technological solutions to increase efficiency and reduce emissions, without the need to build more infrastructure [1], [2]. The idea of CCAM is to combine Autonomous Mobility functionalities with Connectivity functions to enhance safety (e.g., anticipatory behaviour)[3] and cooperative aspects for network management (e.g., platooning) [4]. While the technological benefits of CCAM technologies are clear, critical deployment challenges remain in the fields of acceptance . Because the acceptance of new and unfamiliar technologies is difficult to model, designing effective deployment policies remains in fact challenging [5], [6]. Additionally, there is the practical problem of aligning the needs of different stakeholders, from service providers, to policy makers, and technological developers, who often have different goals and different business plans. In a European context, it is also relevant to develop common standards for CCAMs that, on one hand, allow interoperability between different countries and their transport networks, and on the other hand allow to develop solutions that are tailored to the needs of each country.
In this context, this paper introduces a Two Step Participatory Co-Creation Framework that is designed to promote and engage all relevant stakeholders into the process of designing standards for CCAM solutions. The rest of this summary is structured as follows. The next section introduces the framework. Then, we introduce the five case studies to which the framework is applied, their specific goals, and details about the data collection. Finally, we present the results from the first step and the conclusions.

Methodology

The proposed Two-Step Co-Creation Framework aims to engage all relevant stakeholders in the decision-making process, including industry, civil society, governmental authorities, and research institutions. The first step focuses on identifying these stakeholders and their needs. Policy makers are engaged first to explore how, and to what extent, they envision integrating CCAM solutions into the mobility ecosystem. Then, all other relevant stakeholders - including end users - are involved. The process is summarized in Figure 1. In the first step, stakeholders participate in a series of dedicated workshops (WSs) to provide input for developing effective and equitable CCAM deployment strategies and to identify the population segments most likely to be affected. The second step involves organizing Focus Groups (FGs) with representatives from each target group of end users, ensuring that their needs are included in the deployment plans.

Figure 1 – Methodological framework



Crucially, the framework actively engages both users and stakeholders throughout the policy development process via a "Feedback Loop" phase. In this phase, feedback from users is relayed to stakeholders, and individual users are interviewed to confirm that their input has been adequately considered. Here, the distinction between co-creation and participatory planning becomes clear and depends on the willingness of policy makers to actively engage citizens. In co-creation, citizens and stakeholders collaboratively develop solutions alongside policy makers. In participatory planning, citizens' inputs are used to inform decisions, but the final decision-making authority remains with policy makers. From a methodological point of view, both WS and FG are in principle organized as Focus Groups, using the Framework Method and Thematic Analysis as data analysis methods [7], [8]. However, there were some context-based deviations for example, one-to-one interviews are executed with individuals with visual or audio impairments, who otherwise would not be able to be fully represented in a group discussion.

Case studies and data collection

The methodology presented in the previous section is general by design, as it is designed to be applicable to different contexts as well as different levels of governance. This sub-section discusses the application to five Demonstration Sites (DS) within the context of the CulturalRoad project. Each sub-section below introduces the goal of each demonstration site, the number of workshops that were organized, and general statistics.

Barcelona (Spain)

The Spanish demonstration site focuses on the development of a CCAM deployment roadmap for the region of Catalunya. The proposed framework is deployed and tested directly from the regional transport authority, Autoritat del Transport Metropolità (ATM). A single workshop was organized with 8 stakeholders, including representatives from public administrations, transport authorities, industry, and regional authorities.

Eilat (Israel)

The demonstration site in Israel investigates the feasibility of CCAM deployment from the airport to key city locations, with a focus on older individuals, vulnerable users, and tourists.
In addition, the demonstration site is investigating integration with marine solutions (autonomous ferries) to alleviate congestion in the city center. Stakeholders, including service operators, transport authorities,

members of the transport ministry, service providers, and local policy makers were engaged in 8 one-to-one interviews. The interviews were conducted by the municipality of Eilat.

Karlsruhe (Germany)

The demonstration site in Karlsruhe focuses on technology development and enhanced ease of use and accessibility. The city already tested CCAM technology through pilots in the past. In this demonstration site, organized by the company INIT, which is specialized in information systems and dashboards for public transport, and the Karlsruhe Institute of Technology (KIT), focuses on using virtual reality to co-design solutions that can facilitate the use the interactions of the user with an autonomous vehicle. The demonstration site organized one workshop with several associations of users, public transport providers, and technological developers, to understand their prospective on the features needed in a CCAM solution.

Ljubljana (Slovenia)

The activities in this demonstration site are managed by the Development of the Regional Development Agency of the Ljubljana Urban Region. Given the limited presence of initiatives around CCAM, the goal is to develop a white paper for CCAM guidelines focusing on mobility needs of vulnerable groups such as older individuals, people with disabilities, and students/commuters from suburban and rural areas. A workshop was organized with 5 stakeholders, including public authorities, research institutes, associations, and consultancy companies.

Oxfordshire and West Midlands (United Kingdom)

The demonstration site in the United Kingdom is the largest for deployment level, as it has ambitions to promote CCAM uptake at the national level. The demonstration site has three objectives. First, to integrate CCAM deployment guidelines with Network Management Plans and future Local Transport & Connectivity Plans. Second, to feed the information from the participatory exercise directly into national standards through the BSI CAV Safety Advisory Board and supporting the Department for Transport in the development of future CCAM guidance for the United Kingdom. Third, to identify the sets of policies that can promote safe, efficient, and economic transport to, from, and within the West Midlands Metropolitan.
The activities are coordinated by Transport for West Midlands, the regional transport authority, and the Oxford Shire County Council. Four workshops were organized with 15 stakeholders in total, ranging from policy makers, service operators, service providers, planners, public bodies, to Engineering companies.

Table 1 – Dimension and deployment level in each demonstration site

Spain	
DS Population	5.07 million
Deployment Level	Regional demonstration site covering 164 municipalities under ATM's mobility governance.
Israel	
DS Population	52,000
Deployment Level	Local deployment with focus on specific urban corridors
Germany	
DS Population	309,000
Deployment Level	Local deployment at a city level
Slovenia	
DS Population	549,171
Deployment Level	Regional demonstration 25 municipalities in the Ljubljana Urban Region
United Kingdom	
DS Population	3.5 million
Deployment Level	National Level

Results and discussion

This last section presents a summary of the results across all countries. It should be stressed that these results only reflect the first step of the proposed methodology, hence we are still missing the input from the end users. These outcomes highlight both common themes across Europe and context-specific nuances shaped by local mobility systems, governance structures, and cultural factors.

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

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

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

These early results establish a solid foundation for the second step of the co-creation framework, in which end users will be engaged through focus groups. Their perspectives will be essential to validate the insights collected in this first phase, refine emerging deployment scenarios, and ensure that CCAM solutions address concrete needs across different socio-demographic and cultural contexts. The combined results of these two steps will feed into broader methodological and policy outputs, including guidance for equitable deployment for CCAMs. Future research aims also at investigating maturity of the CCAM ecosystem in Denmark.

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