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CALL TOPIC DT-ART-02-2018: SUPPORT FOR NETWORKING ACTIVITIES AND IMPACT ASSESSMENT FOR ROAD AUTOMATION

Third European Conference on Connected and Automated Driving (EUCAD 2021) – Proceedings report

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Abbreviations & definitions

Term	Description
ARCADE	EU H2020-DT-ART-2018-2019/H2020 CSA project Aligning Research & Innovation for Connected and Automated Driving in Europe, GA number 824251
CAD	Connected Automated Driving
CCAM	Cooperative, connected automated mobility
CSA	Coordination and Support Action
R&I	Research & Innovation
SRIA	Strategic Research and Innovation Agenda
Horizon Europe	EU's R&I funding programme until 2027 (follower of H2020)

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Abstract

The third European Conference on Connected and Automated Driving (EUCAD 2021) was held virtually from 20 to 22 April 2021. EUCAD 2021 moto was "*Yes, we CCAM! A Partnership for Europe*" and kicked-off the new European Partnership on Connected, Cooperative and Automated Mobility (CCAM).

The Conference was organised by the European Commission, with the support of the EU-funded Coordination and Support Action ARCADE, and in collaboration with the European Partnership on CCAM.

All the sessions were recorded and the videos, as well as the presentation files (where applicable), are available for replay/ download at https://www.connectedautomateddriving.eu/eucad2021/programme/#pres.

The EUCAD 2021 Proceedings report is a written summary of the key takeaways from the Conference Plenary and thematic break-out sessions, and provides an overview of the other activities, such as the virtual exhibition of Research & Innovation initiatives.

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1. Introduction

ARCADE is a Coordination and Support Action funded by the European Commission's Horizon 2020 programme, aimed at building consensus across stakeholders from all sectors for a sound and harmonised deployment of Connected, Cooperative and Automated Driving (CAD) in Europe and beyond.

One of the tasks of ARCADE CSA is to support the European Commission with the organisation of the bi-annual European CAD conferences, taking place in Brussels, Belgium. The 2021 edition of the EUCAD conference was organised as a fully virtual event due to the Covid-19 pandemic.

ARCADE is responsible for the practical set up of the Conference and the organisation of the exhibition and thematic breakout sessions, while the Organisation Committee is responsible for the conference programme and the plenary sessions organisation. This Committee consists of representatives from EC (DG RTD, DG MOVE, CINEA), ARCADE (ERTICO, APTIV, AustriaTech, CLEPA, IDIADA, FKA, UITP, University of Leeds, VOLVO, VTT) and the European Partnership on CCAM (ERTRAC, EUCAR).

1.1.Purpose of the document

The EUCAD 2021 Proceedings report is a summary overview of the main outcomes of the Conference Plenary and break-out sessions, as well as the virtual exhibition of Research & Innovation initiatives.

1.1.Intended audience

This document is intended for event participants as well as for any interested stakeholder who could not attend the conference.

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2. Overview

The third European Conference on Connected and Automated Driving (EUCAD 2021) was held virtually from 20 to 22 April 2021. EUCAD 2021 moto was "*Yes, we CCAM! A Partnership for Europe*" and kicked-off the new European Partnership on Connected, Cooperative and Automated Mobility (CCAM).

Figure 1: EUCAD 2021 Conference promotional banner

The Conference was organised by the European Commission, with the support of the EU-funded Coordination and Support Action ARCADE, and in collaboration with the European Partnership on CCAM.

All the sessions were recorded and the videos, as well as the presentation files (where applicable), are available for replay/ download at https://www.connectedautomateddriving.eu/eucad2021/programme/#pres.

2.1. Motivation

It is the ambition of the European Commission to make Europe a world leader in the deployment of cooperative, connected and automated mobility (CCAM) and to deliver -in cooperation with public and private stakeholders- smart, innovative and sustainable mobility solutions. Yet before we can safely deploy automated mobility systems and services on European roads, that are reliable and that reflect the needs and expectations of future users in ever-changing mobility landscapes, a multitude of complex challenges taking place at societal, human, technical, regulatory, economic and operational level need to be addressed.

To tackle these challenges, Europe is teaming up with the entire CCAM stakeholder community to align R&I efforts, ensure effective collaboration between public and private bodies and support the full cross-sectoral value-chain to make CCAM a reality. Horizon Europe will kick-off a Co-Programmed European Partnership on CCAM, which will agree on a common and long-term Strategic Research and Innovation Agenda (SRIA) to solve technological and societal barriers on the way to accelerate the implementation and deployment of CCAM solutions.

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EUCAD conferences are the only ones in Europe that bring together political leaders from the European Commission and Member States with European and international high-level representatives of industry, academia and road authorities to discuss the way forward towards implementation and deployment of CCAM solutions in Europe and beyond.

2.2. Objectives

The objectives of EUCAD 2021 were to:

- **kick-off the European Partnership CCAM**: present the concept, vision, objectives of the Partnership and demonstrate European collaboration to advance CCAM;
- **take stock of R&I on CCAM**: indicate how R&I can answer to specific policy and societal issues, thereby illustrating the need for European political and technological leadership in developing automated mobility solutions;
- **allow** major **road transport stakeholders** to participate in active debates in order **to network and exchange knowledge** on the most recent technological developments and policies in the area of connected and automated mobility;
- provide a forum for stakeholders to join forces in **exploring the way forward towards CCAM implementation** by identifying next challenges and topics to tackle across thematic areas and through multisector cooperation.

2.3. Targeted Audience

The EUCAD conferences are targeting participants from both private and public sectors, representatives from the European Institutions, cities, automotive and telecom industries, users, road operators, public transport operators, regulators, insurance companies, research centres and universities. Stakeholders from non-European countries are also invited as Speakers in both plenary and breakout sessions.

The last EUCAD Conference in 2019 attracted nearly 700 participants from the EU (24 Member States present) and other parts of the World (13 countries) as well as more than 7000 viewers via web stream.

2.4. Format

The Conference consisted of a series of plenary sessions complemented by several thematic breakout discussions. The first two days were primarily policy-oriented while the third day was fully dedicated to breakout sessions exploring specific R&I challenges.

The six Plenary Sessions revolved around the European Commission's political priorities in relation to CCAM and were moderated by Cathy Smith.

The twelve Breakout Sessions were focused on specific R&I research questions, were moderated by the session organisers and featured interactive panel discussions combined with active audience participation

A virtual exhibition provided the opportunity to invited European and national projects to present their objectives & results through downloadable materials and/ or demonstration videos. The virtual exhibition was accessible continuously across the three days.

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2.5.Programme at a glance

EVENT AGENDA

The meetings and sessions schedule is displayed in the Europe/Brussels time zone (the current time is 18:00)

Tuesday, April 20, 2021

10:30 - 11:00	Opening session Plenary 20/04
11:00 - 12:00	Plenary 1: A CCAM Partnership for Europe Plenary 20/04
12:00 - 13:00	Break
13:00 - 14:00	Plenary 2: Automated Road Transport: From Horizon 2020 to Horizon Europe Plenary 20/04
14:00 - 14:30	Break
14:30 - 15:30	Plenary 3: Building trustworthy CCAM together Plenary 20/04

Wednesday, April 21, 2021 ✖ All locations

EVENT AGENDA

The meetings and sessions schedule is displayed in the Europe/Brussels time zone (the current time is 18:00)

Wednesday, April 21, 2021

11:00 - 11:15	Keynote speech DG MOVE Director-General Henrik Hololei Plenary 21/04
11:15 - 12:15	Plenary 4: How to make CCAM work? Plenary 21/04

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EVENT AGENDA

The meetings and sessions schedule is displayed in the Europe/Brussels time zone (the current time is 18:00).

Wednesday, April 21, 2021

11:00 - 11:15	Keynote speech DG MOVE Director-General Henrik Hololei Plenary 21/04

EVENT AGENDA

The meetings and sessions schedule is displayed in the Europe/Brussels time zone (the current time is 19:10).

Thursday, April 22, 2021

09:00 - 10:30	BO1: Large-scale demonstrations: What is the next level? BO1
	BO2: Managing traffic in a CCAM ecosystem: how to do it efficiently and safely? BO2
	BO3: After the Corona pandemic: new perspectives for CCAM and Quality of Life? BO3
10:30 - 11:00	Break
11:00 - 12:30	BO4: Key Vehicle Technologies for CCAM: Is the level of maturity sufficient for high-level automation? BO4
	BO5: Infrastructure support: How can it extend the Operational Design Domain? BO5
	BO6: Ethics for CCAM: how can Responsible Research and Innovation answer to ethical challenges?

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12:30 - 13:30	Break
13:30 - 15:00	BO7: Human Factors of remote control operation: what are the lessons learned and future challenges? BO7
	BO8: Standardisation and roadworthiness in CCAM: what are the achievements and next steps? BO8
	BO9: Accessible & Meaningful: what does it take to make CCAM the citizen's given choice? BO9
15:00 - 15:20	Break
15:20 - 16:50	BO10: Boosting CCAM with AI: how to ensure effectiveness and acceptability? BO10
	BO11: Scenarios for validation: what data sources do we need? BO11
	BO12: Green Deal: How will CCAM contribute to reducing environmental impact? BO12
17:05 - 17:50	Closing session Plenary 22/24

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3. Plenary Sessions

3.1. Opening session

With the European Green Deal and the Sustainable and Smart Mobility Strategy, the European Commission is looking to deliver smart, innovative, sustainable and affordable mobility solutions for the near future. Deployment of Cooperative, Connected and Automated Mobility (CCAM) is a key element of this strategy and it is the ambition of the European Commission to make Europe a world leader in this field.

This session's objectives were to kick-start the conference and share the European Commission's political priorities in relation to CCAM, but also to present the vision and goal of the upcoming Partnership on Cooperative, Connected and Automated Mobility.

Mariya Gabriel, European Commissioner for Innovation, Research, Culture, Education and Youth, and Adina Vălean, European Commissioner for Transport, explained how the new Partnership and its activities will contribute to achieve the EU's political priorities and address Europe's most pressing challenges through coordinated research and innovation actions.

Figure 2: Commissioners Mariya Gabriel (left) and Adina Vălean (right)

3.1.1. Key points of interest raised

Mariya Gabriel, European Commissioner for Innovation, Research, Culture, Education and Youth:

- Connected, Cooperative and Automated Mobility (CCAM) is a game changer of our mobility system. It can contribute to the green and digital transition, support Europe's recovery and increase the international competitiveness of our industry.
- The Commission has invested more than 350 Million Euros from 2014-2020 in research projects for CCAM addressing technological development, large-scale

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demonstration and testbeds for human-centric automation, safety and traffic management, but we still have much more work ahead of us.

- Horizon Europe, the next EU's research and innovation framework programme will be our main tool to accelerate the transition to a green and digital economy by fostering innovation. More than 35% of the actions of Horizon Europe will be related to the European Green Deal.
- Horizon Europe will push smart and climate neutral solutions into the market in the short to medium term, making them affordable and accessible. This includes the support of zero-emission vehicles, user-oriented, safe and smart mobility services as well as automated mobility solutions.
- One novelty of Horizon Europe are the European Partnerships. They bring the European Commission and private and/or public partners together to address some of Europe's most pressing challenges through concerted research and innovation initiatives.
- One of these partnerships will be created for the area of CCAM: the CCAM Partnership will help making Europe's automotive industry more competitive globally by pooling resources and exploiting synergies.
- Close cooperation between the industrial sectors, researchers, Member States and at international level is vital for deploying CCAM. Therefore, the new European Partnership on CCAM is a major step forward.
- It is important, that the partnership also works in synergy with other key programmes, such as the Connecting Europe Facility Programmes and the Digital Europe Programme.
- The concept of citizen engagement is essential for wider acceptance of automated driving technologies. By involving local and regional actors, we can make society be part of the solution.

Adina Vălean, European Commissioner for Transport:

- In order to meet make our mobility systems safer, cleaner and more efficient we have to deploy at greatest speed all technologies and invest in further mobility targeted research.
- Connected and automated systems can fundamentally improve the functioning of the whole transport system and contribute to sustainability and safety goals.
- CCAM can help to develop new mobility concepts, moving from a driver-centred to a mobility-user approach.
- Data is key to make our digital dreams come true. Availability and quality are both improving, but we still have a long way to go.
- The EC is currently updating the regulatory framework, so that we can make the most of data.
- The EC is drafting proposals for revising the Intelligent Transport Systems Directive, as well as the Delegated Regulations on real-time traffic information, and on multi-modal travel information services.
- The EC is also working on a stronger coordination mechanism for national access points established under the ITS Directive, which will help build a Common European Mobility Data Space. This data space will gather all existing transport and mobility data, organised in such a way that they can easily be re-used.

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- We need infrastructure that allows sharing data in real-time, and that can enable collaboration with vehicles. I am thinking of traffic management centres and intelligent transport systems.
- Our Connecting Europe Facility has been supporting the deployment of ITS corridors for many years, and is currently funding 49 ITS Actions.
- In 2016, the C-ROADS platform was created. Today, 18 Member States are coordinating 29 actions, which are together receiving funding of €192 million. These actions are ensuring the full harmonisation of C-ITS services.
- 2019 saw the first European vehicles equipped with C-ITS as standard. This marks a move away from passive and active safety, to cooperative safety. This is a huge milestone.
- CEF 2, together with the revised TEN-T Regulation, will set the bar ever higher for innovative and smart infrastructure.
- To be smarter, we need to share more. Share visions, share ambition, share data and share services.

3.2.Plenary 1 - CCAM Partnership for Europe

The European Commission proposes a new European partnership for Connected, Cooperative and Automated Mobility (CCAM) in Horizon Europe. The objectives of this session are to present the vision and objectives of the new European Partnership on CCAM and to discuss the relevance and expectations towards the new Partnership from public authority, industry or European Commission perspectives.

Figure 3: Plenary 1 - (from top left to bottom right) Cathy Smith (moderator), Helene Niklasson (EUCAR), Sabine Kuehschelm (CEDR), Anjes Tjarks (City of Hamburg), Sigrid de Vries (CLEPA), Rosalinde van der Vlies (European Commission)

The introduction to Plenary 1 was done by Rosalinde van der Vlies, EC DG RTD, Director Clean Planet. She set the scene with the smart and sustainable mobility strategy and the timeline for developing the CCAM Partnership. Panel speakers were Helene Niklasson (EUCAR Chair 2021, Vice President Innovation Ecosystems and Partnerships, Volvo Group);

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Sabine Kuehschelm (Representative for Austria in the Conference of European Directors of Roads - CEDR, Head of Road Infrastructure and Traffic Safety, Federal Ministry for Transport Innovation and Technology - Bmvit); Anjes Tjarks (Senator for Transport and Mobility of the Free and Hanseatic City of Hamburg); Sigrid de Vries (Secretary General, CLEPA the Automotive Supply Industry Association).

The speakers talked about their concrete expectations on how CCAM will increase safety in road transport; reduce the negative impacts of mobility on the environment; strengthen the competitiveness of European industries; and ensure inclusive mobility and goods access for all.

3.2.1. Key points of interest raised

Ms van der Vlies explained that the CCAM Partnership will accelerate the deployment of CCAM, enabling a user-centric all-inclusive mobility and contributing as well to safety and sustainability. For this, public and private cooperation and the number and variety of participants are key.

Helene Niklasson explained that EUCAR joint vision, as the research association of the automotive manufacturers in Europe, is to achieve sustainable, safe, clean and efficient road transport solutions, providing freedom of mobility to all, with benefits to users and society. EUCAR has supported the European Commission in creating a partnership specifically for CCAM to speed up implementation of higher levels of automated mobility. Indeed, a strong collaborative mindset will help integrate pre-competitive automated solutions into society, making European Industry competitive on the global market.

Sabine Kuehschelm introduced the CEDR perspective explaining that climate change is creating enormous pressure on politics to reduce CO_2 emissions and road authorities are looking for solutions to address these issues. The CCAM Partnership activities on R&I and deployment are very important in that respect, and active participation from all Member States is key towards a common EU approach.

Anjes Tjarks explained the framework of CCAM activities for cities, and their important role in the CCAM Partnership. The impact of automation to fight climate change could be much higher if it were well integrated with existing public transport. Many ongoing pilots in the area of CCAM including different vehicle types should be integrated into the whole transport system.

Sigrid de Vries commented how the automotive sector is driven by innovation and is a key pillar for EU employment and economic growth. Climate change and efficiency in transport are highly relevant. Society needs green, affordable, accessible and economically strong transport. The CCAM Partnership will help aligning stakeholders' actions and support quick deployment of technologies.

Why is CCAM not yet ready for deployment? What is still missing?

Sigrid de Vries responded that the main reason is the users' mindset, explaining: there should be more confidence in technologies, so that society is ready for automation. The capabilities of automation should be communicated in a secure, reliable and robust way to the public. From a technology perspective, it is necessary to advance technologies for sensors, actuators, in-vehicle decision making and robustness.

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What can the CCAM Partnership do to accelerate the innovation process?

Helene Niklasson explained that innovation is only successful when it is implemented in real life. The CCAM Partnership is fostering a way of working, identifying the activities needed and addressing them. “This cannot be achieved by a company or stakeholder group alone”, said Niklasson. “We have to collaborate, work and understand the users to make it happen”. Furthermore, she emphasised working with a global perspective, ensuring harmonisation of standards and technology.

W*here alignment between public and private planning will help to accelerate innovation?*

Sabine Kuehschelm explained that CCAM technology is a means to an end and will help us to achieve the societal expectations for safe, smart and sustainable mobility. Infrastructure is essential to support this transition and public investments in infrastructure have to be carefully considered. Getting involved in R&I activities at this early stage will help the decision-making process for planning and aligning towards deployment.

How can CCAM change our day-to-day lives (specifically in cities)? What are the prospects, benefits and risks?

Anjes Tjarks explained that there is a large potential to change people lives, enhancing the quality of transport and inclusiveness, and decreasing air pollution. Collaboration between public and private sectors will facilitate deployment. At this point it is important to set the scene, and work on standards and regulations.

How important are large-scale demonstration actions in pilots, field operational trials and living labs? How will the CCAM Partnership include users and raise awareness and adoption of CCAM by society?

Helene Niklasson responded that innovation in this area will happen by working together and including end-users and society. *“Validating the safe system functioning in large scale pilots and working with end-users in field operational trials will help us to advance the technical maturity and robustness overall*”, said Niklasson. Furthermore, working with society in living labs all over Europe will raise awareness and facilitate adoption of CCAM. The knowledge and information gathered from these large-scale demonstrations should be shared and eventually facilitate the impact assessment on all aspects of CCAM-enabled mobility.

Why should EU Member States and road authorities join the CCAM Partnership?

Sabine Kuehschelm responded that for CCAM to be a success all over Europe, a co-ordinated deployment is essential and it will only be successful if we manage to harmonise activities across EU member states. Learning, creating knowledge and sharing experiences with other member states will accelerate innovation and deployment, avoiding isolated solutions without critical mass.

CCAM is described as R&I partnerships, what are the society sectors expected to participate?

Rosalinde van der Vlies explained that the CCAM Partnership is open to all partners, there are a lot of surrounding activities beyond R&I in the Partnership, and society sectors such as end users should also be included.

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Why is a public-private partnership so important to not only advance technology but transform mobility?

Sigrid de Vries replied that synergies and collaborations are key to achieve success in the CCAM Partnership. The definition of a Strategic Research and Innovation Agenda has already facilitated this sharing and collaborating process, identifying which are the areas to be tackled.

Rosalinde van der Vlies concluded that the coordinated approach will foster public acceptance, support market uptake, make the EU more competitive and a world leader in CCAM.

The participants in the session were asked if their organisations intend to join the CCAM Partnership, and 56% of the respondents indicated their intention to join.

3.3. Plenary 2 - Automated Road Transport: from Horizon 2020 to Horizon Europe

One of the main goals of the EU Research and Innovation programme Horizon 2020 is to transform and digitise European industry and services in such way that the transport system will become more resilient, environmentally friendly, safe and seamless for the benefit of all citizens, the economy and society. The Horizon 2020 Automated Road Transport and Mobility for Growth calls were the main contributors towards this goal. Horizon 2020 funded projects have resulted in significant research actions aiming to advance key technologies for innovative connected and automated driving functions and applications, particularly through demonstrations and pilot tests that explore the performance, safety and user acceptance of these systems.

This session aims to provide an overview of the achievements of CCAM-related Horizon 2020 calls and projects and explore how to best integrate their results and lessons learned into the R&I priorities of Horizon Europe first calls, but also how synergies can be further exploited in the new framework programme.

Dirk Beckers, Director of European Climate, Infrastructure and Environment Executive Agency (CINEA) gave a keynote speech in which he presented an overview of automated road transport topics in Horizon 2020 framework programme as well as an overview of EU-funded projects managed by the Agency. In addition, statistical figures were presented along with the high-level barriers and challenges to be discussed in the new framework programme Horizon Europe. Moreover, the role of CINEA, the new Agency established by the European Commission, in the implementation of the new automated road transport calls has been presented. In Horizon Europe, feedback to policy and synergies are two important aspects which can be used to a) complement different actions that focus on fighting climate change and b) identify future research needs.

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Figure 4: Plenary 2 – Moderator Cathy Smith and Dirk Beckers (CINEA)

The other session panellists included Karen Vancluysen, Secretary General of POLIS, Angelos Amditis, ERTICO Chairman and Research Director of ICCS, Aria Etemad, Senior Project Manager Automated driving functions at Volkswagen Research Innovation and Emilia Silvas, Cluster Program Manager at TNO's Integrated Vehicle Safety Department.

3.3.1. Key points of interest raised

The main achievements in Horizon 2020 research projects highlighted by the panellists are summarised below:

- Better understanding of the human role in CCAM systems;
- How the system architecture looks like for an automated vehicle that can offer different level of automation, development of safe and connected automated solutions;
- Enhanced infrastructure information;
- Collaboration and integration technologies that an automated vehicle needs in order to hit the road;
- Implementation of large scale pilots of several automated vehicles not only in controlled environment but also in real traffic conditions;
- Progress on validation frameworks for CCAM systems improving also key enabling technologies such as connectivity, positioning, artificial intelligence and cybersecurity;
- Code of practice on how to develop and design automated functions;
- Embed the new technology into cities and how to integrate automation into Sustainable Urban Mobility Plan (SUMP);
- AV readiness framework for cities;
- Regulatory steps for preparing the cities into the new era;
- Developed modelling tools that assess the impact of AV technology in an urban setting.

The panellists also highlighted the following main lessons learned and challenges to be addressed in Horizon Europe:

- Integration and bringing applications to reality seems more complicated. Several components are developed and a more harmonised approach is required;

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- A more coherent approach is necessary at country level and synergies are of paramount importance between EU Member States in terms of regulation and infrastructure readiness;
- Limitation of sensors;
- In terms of data storage and collection different approach should be followed depending on the purpose that is required;
- Not easy to get approval for testing on EU roads;
- Consult public/cities authorities on the actual needs and relevant use cases for automation, and be involved from the beginning of a project lifecycle and shaping together with other stakeholders;
- Stronger partnerships at different levels between industry, research and cities;
- Need to be realistic and follow a pragmatic approach in the real deployment and introduction of AVs into existing road network;
- Include reference and user groups into projects in order to raise awareness and increase acceptance and to ensure that the needs of different stakeholders are taken into consideration;
- Handling of data storage, collection, what kind of data is needed for which purpose for instance impact assessment or development of new functions. Data sharing with others due to GDPR, IPR, data format or other issues;
- Develop safe and secure components and systems by design;
- Connectivity aspects as a key enabler for large-scale deployment in real time traffic conditions and in a safe way;
- Design more embedded CCAM systems that have not only good performance but CCAM systems that can perform well at city level;
- The greening of transport system, digitalization, safe and efficient mobility are principles to be attained by stakeholders;
- Harmonised approval process for testing at National and European level.

The panellists also expressed their expectations on the CCAM Partnership:

- Keep sustainability at the core of mobility policy;
- Technological developments should go hand in hand with human aspects;
- New call topics should also focus on the new emerging technologies;
- Strong collaboration among stakeholders and learn from each other;
- Better collaboration among Member States;
- Bringing innovation activities closer to large-scale implementation, testing and deployment;
- EC to monitor closely the implementation of the CCAM partnership activities and provide appropriate clarifications;
- Making the implementation of research projects easier and faster.

How to encourage entities from countries that are currently less involved in this area of research to increase their participation?

A wide range of different type of entities from all EU Member States and associated countries are eligible to participate in the relevant Calls. This includes industry, academics, research organisations and consultancy. There is no specific restriction in terms of participation from specific Member States and associated countries unless it is specifically requested in the Call

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text. Government representatives and National Contact Points of all Member States are encouraged to explore the future funding opportunities in this area of research. It is an important domain for technological innovation where significant financial resources will be made available by CINEA, both for research and for deployment. In addition, it is important that interested entities and stakeholders should participate at the Info-Days organised at National or European level regarding the new funding opportunities as well as to check CINEA's and Commission's websites on a regular basis.

How can automated driving contribute to the sustainability goals of cities, and what will be the most impacting changes in cities that are needed for (or enabled by) automated vehicles?

More information is needed to better understand the actual impact of such systems in complicated environments as cities and regions are. Sustainability should be kept at the core of the discussions and see how CCAM helps those goals and make sure that modal shift is still at the core of sustainable urban mobility policy. It should be clarified and decided which part of automation is needed for a city and which are the important rules and conditions that should be set in order to reach the sustainability goal.

How to harmonize the European approval process among different countries?

A major finding in the frame of L3Pilot testing activities is that there are approval or admission procedures in place in most of European countries but they are not harmonised. One of the main objectives of the newly EU-funded project called Hi-Drive is the harmonisation of admission procedures and the goal is to create a code of practice for road testing that will be implemented in Europe with the help of experienced authorities.

Why are some EU countries reluctant to embrace the new technology?

EU countries are not reluctant to embrace this technology. Because this topic is new and the technology is not well established, countries try to find a way to safeguard themselves and traffic participants. Also it depends on different needs and priorities that each region or country has set in order to implement the automation on the road. In some countries, the process is straightforward but in other countries a number of pre-testing activities should be conducted until the stakeholders get the final approval. The optimal goal is that if an approval for road testing is issued in Germany then the same approval can be used also in France or other European country, which is not the case now.

Are the Horizon EU funds open to UK applicants/ entities/ projects/ stakeholders?

UK is expected to soon become an associated country to the EU's R&I Framework programme Horizon Europe[1].

3.4.Plenary 3 – Building trustworthy CCAM together

CCAM solutions will have to reflect the needs and expectations of future users in ever-changing mobility landscapes. Only then will society be able to trust, accept and embrace

[1] More information: https://ec.europa.eu/info/sites/info/files/research_and_innovation/strategy_on_research_and_innovation/documents/ec_rtd_uk-participation-in-horizon-europe.pdf

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these innovative services. Addressing user needs, expectations, and concerns throughout the technological development and deployment cycles, whether regarding safety, liability, sustainability, or ethical issues, will be crucial to build trust while raising public awareness on CCAM. An in-depth understanding of different mobility cultures, needs, and imaginaries will ensure that CCAM technologies are safe, trusted and accepted by users, and that overall CCAM solutions are reflective of current societal needs and challenges. As such, fostering a co-creative approach in the planning, development, and evaluation of CCAM systems and services will allow society to not only trust, but also co-design the automated and connected mobility world of tomorrow.

The aim of this session is to discuss:

- how trust in CCAM must be nurtured from inception to use by involving citizens, cities and future users in a co-creation process with researchers and manufacturers;
- how such a participatory approach can support the development and deployment of inclusive, shared, and human-centric mobility solutions that are reflective of current and future needs, both at an individual and collective level.

Panellists included Jean-François Sencerin, Deputy Alliance Global Director, Automated Driving Strategy at Renault, and Director of the France Vehicule Autonome programme; Kristina Lindfors, Director General of the Urban Transport Administration, city of Gothenburg; Dimitris Milakis, Head of the research group 'Automated driving and new mobility concepts' at the Institute of Transport Research, German Aerospace Center (DLR), and Hilary Sutcliffe, co-founder and director, TigTech, and director of SocietyInside.

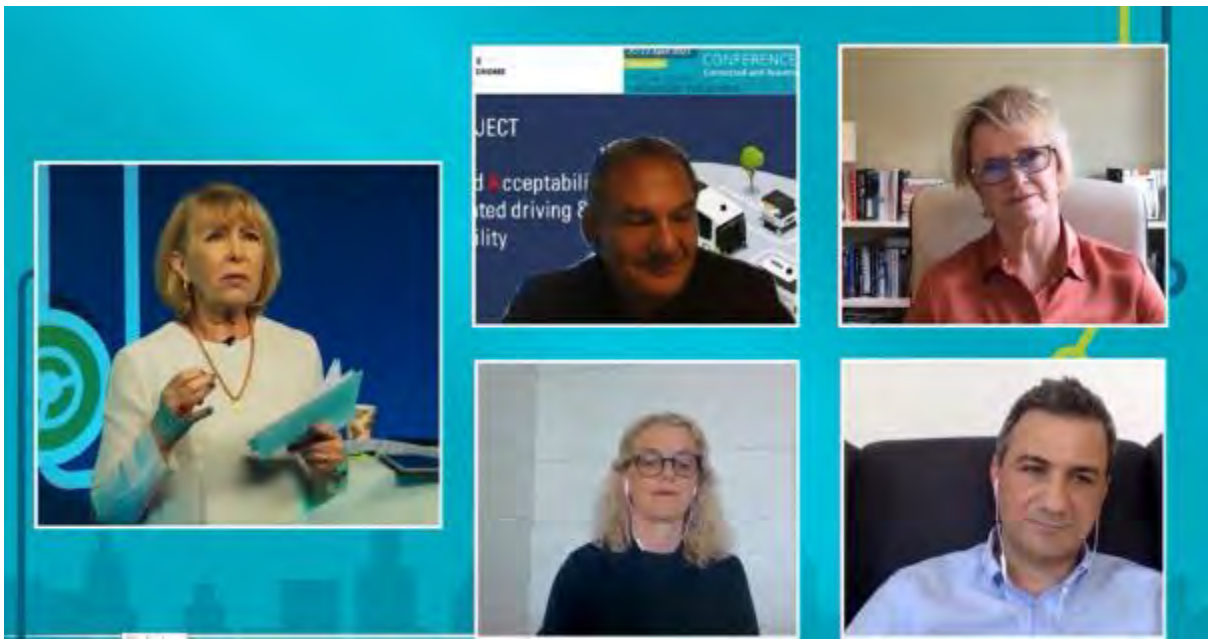

Figure 5: Plenary 3 - (from top left to bottom right) Cathy Smith (moderator), Jean-François Sencerin (Renault), Hilary Sutcliffe (SocietyInside), Kristina Lindfors (city of Gothenburg), Dimitris Milakis (DLR)

3.4.1. Key points of interest raised

- CCAM solutions will have to reflect the needs and expectations of future users for society to trust, accept and embrace these innovative services;

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- Addressing user needs, expectations, and concerns throughout the technological development and deployment cycles, whether regarding safety, sustainability, or urban planning, will be crucial to build trust while raising public awareness on CCAM;
- An in-depth understanding of different mobility cultures, needs, and imaginaries will ensure that CCAM technologies are safe, trusted and accepted by users;
- Fostering a co-creative approach in the planning, development, and evaluation of CCAM systems and services will allow society to not only trust, but also co-design the automated and connected mobility world of tomorrow;
- Trust has to be fostered not only around the technology, but also in the overarching governing structures that will be steering the development of CCAM.

Main challenges

- Lack of inclusion of social science and humanities in current CCAM research, and of research focusing on the societal, non-technological dimensions of CCAM;
- Terminology gap to efficiently communicate about CCAM to both experts and non-experts;
- User needs and expectations towards CCAM have been narrowly framed; the broader societal impact of CCAM (both positive and negative) must be better understood.

Next steps

- More robust, shared methodologies are needed to communicate about CCAM and to regulate CCAM at local, national and EU level: alignment is needed to share a common objective between stakeholders;
- Future research should not only cover CCAM in terms of individualistic needs, but also in terms of collective, societal needs; more SSH research on CCAM is also crucial;
- More pilots and demonstrations should be organised at local level (urban, peri-urban and rural areas) to test the potential of CCAM to address mobility needs and challenges;
- Regular dialogues and engagement with citizens, non-users, and people from different social groups are key to understand their mobility needs and expectations;
- A more in-depth exploration of the positive and negative impacts of CCAM on the long-term and along the entire value chain is necessary (related methodologies and impact assessments should be developed).

Hilary Sutcliffe explained that the development of CCAM has to adhere to a mobility landscape where community and sustainability are key pillars. However, the interests of car and tech companies remain front and centre in the development of CCAM technologies. Ms Sutcliffe emphasised the need to align the development and deployment of CCAM with actual, collective needs in order to offer simple and accessible solutions. CCAM should be deployed for social good: it should be less individualistic and more integrated into community-based transport systems.

Jean-Francois Sencerin highlighted the need for relevant scenarios and global methodologies to ensure and assess acceptability by society. There is a need for an integration of collective solutions between the right stakeholders at the right levels (local, regional, national, international), together with competitive partners, in order to understand the

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multidimensional challenge of deploying CCAM for the common good. This necessitates clarity on the benefits, risks and expectations of CCAM by all, especially users and citizens.

Kristina Lindfors highlighted the importance of raising public awareness on the possibilities and opportunities presented by CCAM and the role of public authorities to support and facilitate pilot tests and demonstrations. She emphasised the value of research and innovation to understand collective and individual needs, to assess the limits of accessible transportation at local level and to integrate mobility solutions into urban planning.

Dimitris Milakis explained that there are still many under-researched aspects concerning CCAM: business cases, health, and equity, among others. Safe, reliable, secure and easy to use CCAM systems should answer to various opportunities (in business, in health, in jobs, in accessibility) with minimum costs for health and for the environment, while being affordable. The right regulatory framework will be key to facilitate technological innovation on the one hand, and to ensure the inclusive distribution of benefits on the other, while mitigating any possible adverse effects.

What is trust in governance?

According to Hilary Sutcliffe, trust in governance is crucial and trust in CCAM needs to be reflected in the governance of CCAM, as trust in the rules and regulation governing technology is the biggest predictor in determining the societal role that technology can play. Policymakers must get to regulation early and make sure the intent is not just about smoothing the path to innovation and adoption. In addition, policy and regulatory processes have to be inclusive and open in order to demonstrate the choices that have been made leading to CCAM on our roads. In comparison to recent events in the United States, Europe must make sure that it is no regulatory wild west when it comes to CCAM. Citizens must have the knowledge about the governance in order to trust the governance. This will trickle down into trust in the technology.

Kristina Lindfors highlighted that trust in governance is high in Sweden. Citizens know that public authorities can be trusted (whether this is academia, policy, research), which makes them naturally curious and open to innovative technologies. Safety, however, remains important, regardless of the trust in overarching governance models.

What is the right recipe to build up trust in CCAM?

According to Jean-François Sencerin, to achieve trustworthy CCAM, we need to develop a safe, driving operator on board that takes into account design and accessibility, but also the acceptability and economic profitability of these systems. Efforts should focus on CCAM as a service that answers to actual socio-economic, environmental needs and make sure CCAM is deployed as a common good. For this, we need first to agree on what we collectively expect from CCAM and the use-cases we want to explore: do we need CCAM to reduce congestion, or to offer efficient services? We need to clarify the final objective together with all relevant stakeholders, and look at some of the negative impacts as well. For that, common methodologies and impact assessments are necessary.

For Dimitris Milakis, a regulatory framework that deals with these *negative* impacts will be key.

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How can we practically understand co-creation in relation to CCAM? How can all voices be heard on a large scale?

The deployment process of CCAM should be an open process, according to Dimitris Milakis. Public acceptance cannot be *ensured*, because it implies that we know how this technology will behave in the future, or that we impose a certain technology for the future. This is why we need co-creation. Various and relevant social groups must be included, which is not the case today. We should focus on users, but also on non-users, teens, children, pedestrians, cyclists, people with disabilities, people from low-income backgrounds. A recent Australian study explored to what extent parents would agree to let their children use AVs: most parents were reluctant; yet, with the inclusion of reassuring features (micro cameras and such), they were more positive. It is very important to listen to what people in society have to say for the design and operation of a new technology like CCAM.

Trust in governance is also key: how can we ensure co-creation in that aspect as well?

Hilary Sutcliffe talked about the signals of trustworthiness, such as Intent: the biggest cause of distrust in governance and companies is the belief that business models come before people and planet. The public good cannot come second, and in that respect, community and sustainability are key. The questions we should ask are: what kind of cities do we want? Do we want more traffic? What type of communities do we want? What is the role of cars, buses, mobility in general? And not, do we want self-driving cars?

Are we having frank and honest conversations with people on these subjects?

Kristina Lindfors said that we need to involve and talk to citizens, in a continuous process, to address different issues. The inclusion aspect in urban transportation is key to develop and implement strategies and policies in public transport that work for everybody. Setting up dialogues with citizens in cities and beyond is crucial to earn the trust of people, in parallel to the setup of pilots and demonstrations of new mobility solutions. You also have to share this knowledge and input, in Europe and beyond.

What about the role of the media to build up trust?

The media is key to foster trust, said Jean-François Sencerin. Yet the communication strategy changes depending on who is doing what. There is a timeline for experimenting, a timeline for deployment, for policymaking, for designing and a timeline to present a service to users. These are all different, and we have to build a common narrative and align our positions in order to avoid deception. The more people are experiencing, the more people are convinced by the service. Communication and media are key but they are difficult to align at project level. When discussing with citizens about autonomous mobility, we do not have the right wording to describe what CCAM is about. We need better and more targeted communication to discuss with citizens. Methodologies that are adapted to mobility services exist. We have reached in France an important milestone with the mobility orientation law, which allows experimentation and deployment of automated mobility. This regulatory effort will also reassure citizens. We need to focus on large-scale demonstrations with limited ODDs on specific areas on public roads, not just experiments but demonstrations of real services. We are also preparing safety standards in order to build regulatory frameworks that are harmonised and consistent in the setting-up of large-scale deployments.

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How do we ensure that people in peri and semi urban areas are not excluded from the process as well?

Dimitris Milakis stressed that multi-stakeholder efforts and co-creation are needed to explore and address these peri and semi-urban needs. People from different geographies must be included and allowed to express their future mobility needs, with or without CCAM.

Kristina Lindfors mentioned the organisation of tests currently outside of Gothenburg, in more rural areas. It is certainly interesting to see what people in those areas need and how to make it is easier for them in terms of mobility.

Innovative mobility solutions are cool, but what about the acceptance of these future mobility services in terms of affordability?

Jean-François Sencerin answered that this depends on the use-case. If we are discussing about shared mobility, then the aim is to make them affordable and accessible. CCAM is not only about deploying high-end vehicles.

Hilary Sutcliffe added that when discussing mobility strategies, the self-driving aspect is almost a distraction. A lot of the discussion is about equality and about the cancellation of buses in rural areas because councils cannot afford them anymore. How can we actually rethink mobility as a service, and to manufacture them in relevant geographical areas? There are many exciting developments for the future of mobility and there are other options to explore beyond CCAM, which should be at the centre of the conversation with citizens and cities.

Which area should we focus more on in order to increase trust for users: infrastructure, vehicle technology or legislation?

For Dimitris Milakis, all three are needed. We need the technology to demonstrate its promised benefits; unfortunately, we are not there yet. This is the responsibility of R&D communities and manufacturers. We need to let the people experience the technology to show them that it can serve them. We need to organise pilots for testing. Moreover, we need regulatory frameworks to make sure these expected benefits are achieved. This is the responsibility of public authorities, from national to local level, to align their regulatory targets.

What are your hopes for the CCAM Partnership and how can it foster trust in CCAM?

For Jean-François Sencerin, the Partnership will be useful to elevate member states' efforts at EU level.

For Dimitris Milakis, the Partnership can bring a much-needed systemic perspective. We need to look at the long-term aspects of CCAM: public health and equity, for example, which are under researched, and a deeper understanding of the needs and expectations of people, for which we crucially need more SSH researchers, at the very least methodologically speaking.

Interactive polls results

Session participations were asked to name one positive impact which they expect from CCAM and the most important one was "Safety", followed by inclusivity/ accessibility, collaboration and comfort.

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Figure 6: Results from interactive poll in Plenary 3

A second question to the audience was to give one negative impact which they expect from CCAM. Increased traffic and resulting congestion came in first, followed by inequality, exclusion, security and privacy issues.

3.5.Day 2 Opening Keynote Speech

Henrik Hololei, Director-General DG MOVE, European Commission, framed cooperative, connected and automated mobility in the larger digitalisation and decarbonisation agenda. How transport will evolve in this context and what the European Commission will do is the subject of the Sustainable and Smart Mobility Strategy (SSMS). The latter shows that increasingly larger stakeholder groups need to collaborate to reach maximum potential and Vision Zero. This is also true within the European Commission and you will therefore find initiatives in the hands of multiple DGs in the SSMS.

3.6.Plenary 4 – How to make CCAM work

To make CCAM work everywhere and under all conditions, the maturity and deployment readiness needs to be increased while finding ways to safeguard safety, including legal aspects and societal benefits. This is a multidisciplinary and multi-stakeholder challenge

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where various partners can contribute in complimentary ways. In this session, the challenges of how to cope with increased complexity, higher operational speeds, larger fleets and how to sufficiently prepare CCAM for market take-up will be addressed. Panellists will discuss what they can do from their stakeholders' perspective to help overcome challenges that are related to expanding or optimizing the Operational Design Domain (ODD). This discussion also includes what the current expectations or needs from the other stakeholders are, e.g., OEMs can improve sensor capabilities or enhance sensor fusion for better decision making, road operators can improve their infrastructure or provide digital traffic (safety) information, which also contributes to easier recognition of certain scenarios. Both parties, together with others, can discuss and describe what kind of vehicle behaviour is intended (when inside the ODD). There is of course also a legal component in this debate and the question is how can such intended safe behaviour of CAVs be safeguarded and tested beforehand.

The aim of this session is to discuss:

- what needs to be done to make CCAM work in general and from panellists' stakeholder perspective in particular;
- panellists' expectations or needs from other stakeholders to jointly succeed;
- the multidisciplinary and multi-stakeholder challenge of optimizing the ODD and safeguarding the safety of CCAM solutions and how to pave the way for a large-scale deployment and market take-up of these solutions.

The panellists included Serge van Dam, Special Advisor at Rijkswaterstaat and Chair of CEDR CAD Group; Sofie Vennersten, Director of Drive Sweden; Joost Vantomme, Smart Mobility Director at ACEA; Jessica Uguccioni, Lead Lawyer at the Automated Vehicles Review Law Commission Of England and Wales, and Mohammed Mezghani, Secretary General of UITP.

Figure 7: Plenary 4 - (from top left to bottom right) Cathy Smith (moderator), Joost Vantomme (ACEA), Serge van Dam (Rijkswaterstaat), Sofie Vennersten (DriveSweden), Jessica Uguccioni (Law Commission England/Wales), Mohammed Mezghani (UITP)

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The audience was asked to indicate their agreement/ disagreement with the following statement:

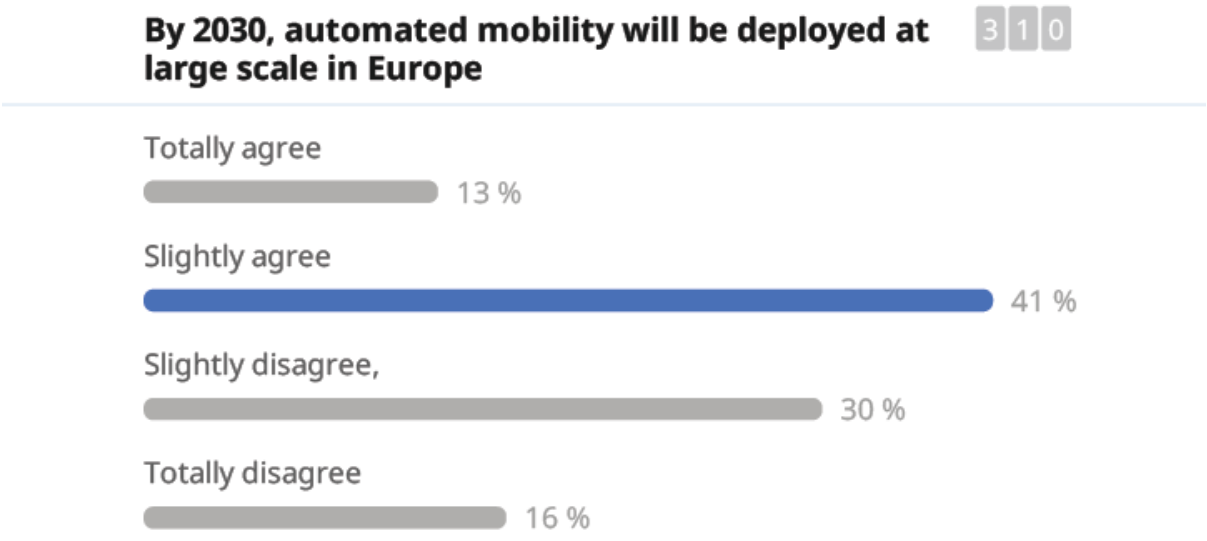

Figure 8: Results to interactive poll in Plenary 4

3.7.Plenary 5 – Invested in CCAM

Coordinated and long-term public and private investments are paramount to maintain and extend European leadership in the deployment and integration of CCAM solutions in a transport ecosystem that puts societal benefits front and centre. Public and private stakeholders involved in developing CCAM systems and services need to share and foster a common vision in order to roll out innovative and resilient mobility services, based on CCAM, that are tailored to the needs of future users. Collectively, they need to define a coherent deployment plan at the appropriate geographical level, analyse and agree on necessary investments in infrastructure, equipment, and required human resources, and define the relevant business models that can attract the right actors for the long-term. This cooperation depends on a shared belief in the potential of CCAM solutions and requires targeted investments and allocation of resources by public and private stakeholders from local, regional, national and international arenas.

This session aims to explore opportunities for public and private stakeholders to aligned and transparently plan, work and invest in facilitating and accelerating CCAM deployment.

Panellists included Christel FIORINA, Deputy Director public road network and traffic management at the French Ministry of Transport; Eckard STEIGER, Director Industrial Cooperations Automated Driving for BOSCH; Jacqueline ERHART, Team Leader CCAD and Digital Infrastructure at ASFINAG and Chairwoman of ASECAP's Permanent Committee on ITS and Connected & Autonomous Vehicles; Herald RUIJTERS, Director of Unit "Investment, Innovative and Sustainable Transport" at DG MOVE, European Commission; Carlo van de Weijer, General Manager of the Eindhoven AI Systems Institute at the Eindhoven University of Technology.

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Figure 9: Plenary 5 - (from top left to bottom right) Cathy Smith (moderator), Christel FIORINA (French Ministry of Transport) Eckard STEIGER (BOSCH), Jacqueline ERHART (ASFINAG), Herald RUIJTERS (EC), Carlo van de Weijer (Eindhoven University of Technology)

Christel FIORINA started by saying that the Transport sector is strategic for the economy and society not only for France but also for Europe. Transport infrastructure is the backbone of the EU economy and guaranties the freedom of movement. One big challenge is the digital transformation. France believes that it must have its own strategy of green and digital mobility, but an EU one is also necessary. The dynamic is to bring together all the stakeholders: States, cities, OEMS, suppliers, researchers.

Eckard STEIGER stated that Bosch Automated Driving business area targets to deploy technology asap, to realize a broad access to the benefit of all. Development of mature technology is key. The industry needs cooperation for a safe deployment based on common rules and to identify which additional investments are required for the future.

Jacqueline ERHART concurred that stakeholders need partnerships to make the different roadmaps converge. In the beginning of Automated Driving, the role of road operators was a bit neglected, but with growing digitalisation, it is changing and becoming a decisive part of a global transport and mobility system. First generation of safety use cases in open channels are going in operations now. Road operators also work on the next generation of uses cases/services, especially the support of digital infrastructure to include all vehicles in a mixed environment.

Herald RUIJTERS declared that EC's Sustainable and Smart Mobility Strategy goal is to make connected and automated multimodal mobility a reality and to deploy automated mobility at large scale by 2030. Digitalization is a lever to realize this objective. CCAM requires a common vision, a common agenda but also coordinated investments, not only in R&I, but also for deployment. We need to consider infrastructure, develop new technologies, harmonize standards and specifications, test and validate pilots, update and develop our skills and revise regulation when needed.

Through the Connecting Europe Facility (CEF), EC has invested a lot over the last years and is now in the final preparation phase of CEF2. They will also revise the TEN-T regulation and integrate the necessary evolutions triggered by digitalization. To help make connected and automated multimodal mobility a reality, the Strategy includes also a revision of the ITS Directive and of the related Delegated Regulations on Real Time traffic Information and on

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Multimodal Traffic Information. This revision considers enlarging geographical coverage and datasets, as well as making the link between data and services.

Carlo VAN DE WEIJER added that we need not just financial but also political investment. We are annually losing 3-4% GDP because of negative effects of mobility (traffic jams, injuries, etc.). 2/3 are due to limited safety. That alone is a political reason to motivate transformation. Additionally, traffic jams have an environmental impact. Every euro spent to reduce these negative effects will come back 4-5 times. If you look at the industry, people will spend money for more comfort delivered by these kind of CCAM services. We need to start with investment in research of course, but then focus on deployment. And we need to create volumes, starting with rich people, to lower costs through. The real business case at the very beginning is comfort and consequently more safety.

What does define a good opportunity to deploy CCAM? Does it start with the ambition to make transport more sustainable and inclusive (political dimension), solving an issue at local level (operational dimension), or will it depend on a solid business case (economic dimension), or rather a mix and why?

According to Christel FIORINA, there are different incentives and criteria to deploy CCAM and justify investments. CCAM is fundamental, because it is strongly linked to the freedom of movement, inclusion and ecological transition. In the global competition, the EU and MS have led a third way on digital, respectful of Human Rights, privacy and we need to convince the world of this vision. Smart mobility and CCAM are part of this vision. In the sector of transport, we do not address the issue of sovereignty so well. DG Connect tries to address this challenge, but for smart mobility, the market is still led by non-European companies.

Jacqueline ERHART added that from a business case dimension, CCAM is a big opportunity to exchange data through the development of the ISAD and sensors.

For Eckard STEIGER, we need user acceptance of the technology to be deployed. It is linked to the business case. For sure, we are in some kind of competition with other global players, who have advantages in data technology. Using data from the fleet, make it available, is key.

Why is investment in innovation key to foster innovation, competitiveness and to create European champions?

For Carlo VAN DE WEIJER, we need to create EU champions around data. We need European rules and a fair deal and use of data to improve the business case of mobility and safety. Companies will have to invest a lot of money but we need fair rules and a fair competition.

Why is from your perspective a coordinated long-term funding agenda mandatory for an efficient development and deployment of CCAM?

According to Herald RUIJTERS, if we want to realize a common vision on CCAM, we need also to develop a long-term common funding agenda. Our EU Partnerships and funding instruments such as CEF or Horizon Europe are multi annual planning instruments, which encourage additional investments at national, regional or local levels. Complementarity of funding enhances efficiency and that is why we need a coordinated long-term funding agenda. A long-term funding agenda is a powerful lever because it gives visibility and stability to the actors involved. It is important for public actors, but also and especially for industrial actors, who need to be able to calculate their business cases and return on investment before making decision on resources. If for example we decide at EU level to support a certain kind of

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technology or infrastructure, the message and the resources need to be clear and to remain stable over the long run. It is the only way to foster innovation and deployment.

What are the most promising initiatives or success stories you have witnessed so far and the lessons learned from it?

For Christel FIORINA, the C-road platform is a good example of an efficient cooperation between many MS and EC. We need to continue on that interconnection of road networks. The other will be the European Common Mobility Data space. It is key to develop and train the algorithms in cases where European companies get access to and deliver data.

Carlo VAN DE WEIJER added the example of traffic information and connected navigation 15 years ago: nice lessons learned and a good cooperation between companies and regulators.

What are the biggest lacks and hurdles for deployment, which you identified so far and how can we tackle or avoid them?

According to Jacqueline ERHART, it would be interesting to look at the future infrastructure requirements over the long run. Investments in infrastructure take time. We see a huge potential in digital infrastructure. One of the biggest hurdle is to define the services we need and the appropriate technology.

Is the focus not too much on motorways?

Jacqueline ERHART answered that C-Roads has started on motorways. C-Roads 2 projects are now extended to the rural and urban environments. Herald RUIJTERS added that we started with motorways, but are now eager to enlarge to many others topics.

Europe is a continent with a large variety of (national) stakeholders, cultures and environments. Is that a threat or an opportunity?

For Carlo VAN DE WEIJER, diversity means complexity but also opportunity. If we can make something happen in Europe, considering this complexity, we can rule it out in the entire world.

Since road transport accounts for 70% of CO_2 emissions, of all 30% that all transport represents in the EU, do we need more roads or more flexible railways connecting Europe?

According to Christel FIORINA, we should end the war between train and road and encourage multimodality. Carlo VAN DE WEIJER added that compared to the huge amounts of money required to develop train infrastructure compared to CCAM, the business case for train is not good.

When we are looking at the USA, a small start-up raises tens of millions of dollars to work on a small part of the whole system. In CCAM Partnership we are speaking about funding up to 400M€. Is this amount at the level of our ambitions?

Herald RUIJTERS answered that EC funding should be a trigger for additional funding coming from other sources at national, industrial or local level. The lessons learned for the past with EC PPPs is that this instrument is a good lever to initiate further funding.

Could CCAM be used to implement some form of efficient congestion pricing that can respond flexibly to traffic conditions and maybe even time preferences of passengers, e.g. prioritising those with less patience at a higher price?

Jacqueline ERHART answered that ASECAP lives on a user-based principle and is considering a pricing system for CCAM, where CCAM will first be used by the luxury industry and then become public transport.

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In conclusion, support from EU, cooperation between all stakeholders and EU champions are needed to develop smart infrastructure and services. We also need to go faster in the digital transformation of the sector and invest more in smart clients and services.

3.8.Plenary 6 – CCAM around the world

International cooperation is key to getting CCAM on roads around the world. Global standards, joint approaches, exchanging knowledge, experience and best practices can contribute to this. The objective of this session is to learn about new policies and research activities of different regions of the world to support the development and deployment of CCAM and to discuss main benefits and future priorities for International Cooperation.

The aim of this session was to discuss:

- the importance of international cooperation in order to facilitate or even accelerate global deployment and adoption of CCAM solutions.
- how lessons learned from their region can contribute to tackling global challenges, while taking into account the balance between tailor-made solutions that work best in certain conditions and the desire for harmonization.

The panellists included Jane Lappin, Chair of Standing Committee on Vehicle-Highway Automation at US Transportation Research Board; Seigo Kuzumaki, Japan's SIP-adus Program Director and Fellow Advanced R&D and Engineering at Toyota Motor Corporation; Lam Wee Shan, Chief Innovation & Transport Technology Officer at Singapore Land Transport Authority; Rita Excell, Executive Director of the Australia and New Zealand Driverless Vehicle Initiative (ADVI); Young-Jun Moon, Chief Director of the National Transport Technology department at the (South-)Korea Transport Institute (KOTI).

Figure 10: Plenary 6 - (from top left to bottom right) Cathy Smith (moderator), Jane Lappin (TRB) Seigo Kuzumaki (SIP-adus), Lam Wee Shan (LTA), Rita Excell (ADVI), Young-Jun Moon (KOTI)

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Each panellist provided a short presentation reflecting on:

- key policies and actions in their country to facilitate or even accelerate the development and deployment of connected and automated driving;
- areas where International Cooperation can be beneficial to support their country's objectives on CCAM.

The panellists provided examples of where international cooperation helped their organization to tackle some challenges. They also shared their view on the best way to find a balance between competition and cooperation in relation to CCAM research and deployment. Finally, they explained how the Covid-19 Pandemic affected the CCAM activities in their region.

3.9.Closing session

The EUCAD2021 Closing Session reflected on the discussions that took place across all plenary and breakout sessions and draw conclusions from different stakeholder viewpoints. Panellists identified the next challenges and topics to be tackled across thematic areas towards a large-scale deployment of CCAM by 2030.

The panellists in the closing session were Laurianne Krid, Director General of FIA Region I; Ingrid Skogsmo, Senior Research Leader Future Transportation at the Swedish National Road and Transport Research Institute (VTI); Steve Phillips, Secretary-General of CEDR (Conference of European Directors of Roads), and Armin Gräter, Technical Product Manager Regulation Automated Driving at BMW Group.

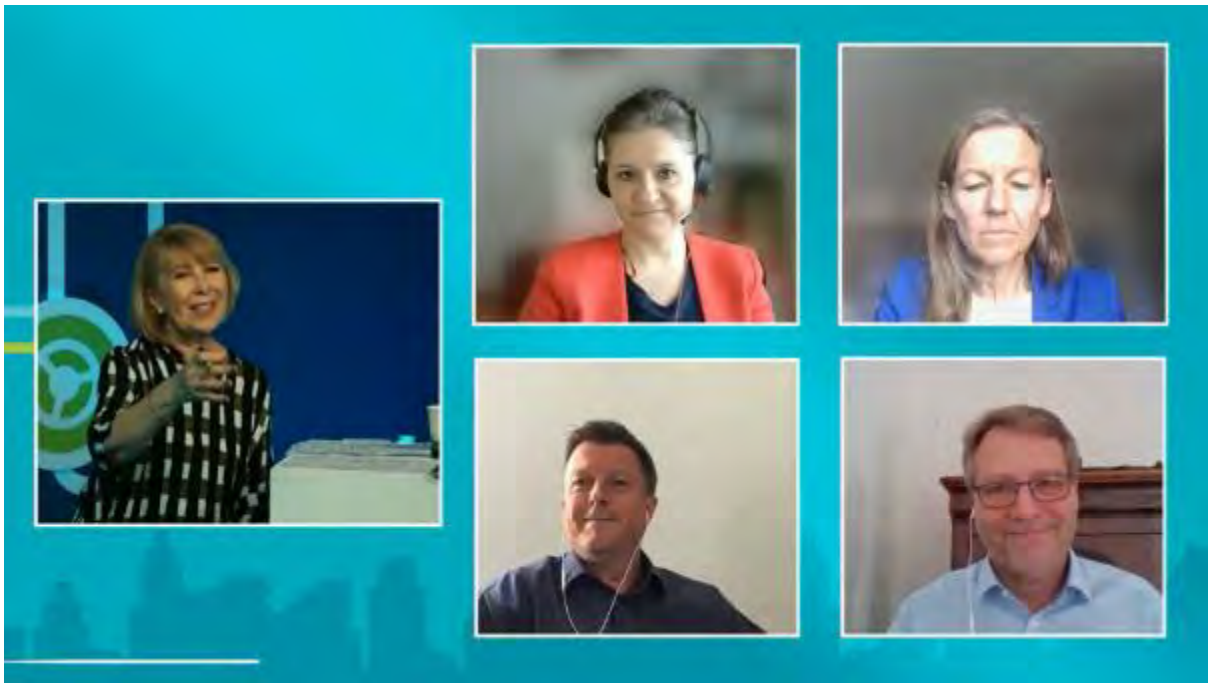

Figure 11: Closing - (from top left to bottom right) Cathy Smith (moderator), Laurianne Krid (FIA) Ingrid Skogsmo (VTI), Steve Phillips (CEDR), Rita Excell (ADVI), Armin Gräter (BMW)

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The panel discussion was followed by a Closing Speech by Jean-Eric Paquet, Director General, DG Research & Innovation, European Commission.

Figure 12: Closing - Jean-Eric Paquet (European Commission)

3.9.1. Key points of interest raised

- Co-creation of CCAM technologies and solutions and involvement of users in the design process are essential for the acceptance of CCAM and for meeting societal goals.
- Decision makers, cities and planners should explain the functions and added value and potential problems/risks of CCAM in a transparent way.
- Further research is needed to make a comprehensive assessment of impacts of CCAM on mobility and society and to develop support tools to plan and implement CCAM solutions on the ground.
- Close dialogue and cooperation with road operators is needed to develop infrastructure support solutions, which result in win-win situations for both the CCAM developers and the road operators.
- The question how to improve connectivity along the whole road network to support higher levels of automation remains a major challenge.
- Stronger cooperation between all CCAM stakeholders is essential to advance CCAM. The new European Partnership on CCAM will help to make cooperation between the different actors of the value chain (including industry, researchers, road operators, cities and public transport operators) and between public and private stakeholders a reality.
- The Partnership should help to structure the investments of industry and Member States and align National Programmes. It should make sure that the roll out does not only take place in some frontrunner places, but in all Member States.
- The Research Agenda of the Partnership must be defined in such a way, that a seamless transition between the outcomes of the research and demonstration projects to large roll out can be ensured.

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- The new Partnership should actively seek coordination, synergies and alignment with other European Partnerships and other Funding Programmes (e.g. Connecting Europe Facility, InvestEU).
- CCAM systems should be developed in a way that they can contribute to achieving our sustainability goals - mainly by supporting new mobility concepts and making transport flows more efficient. This is key to get the broad support from policy makers and society.

Laurianne Krid said that we have to increase trust between governments and users in order to achieve acceptance of the new technologies. Public authorities must explain the functions and added value and potential problems/risks of CCAM in a transparent way. Co-creation of technologies and solutions and involvement of users in the design process are essential for the acceptance of CCAM and for meeting societal goals. The development of solutions for people and their mobility needs must be the focus and not just technologies. Automated vehicles and new technologies can be part of the solutions, but they should not be at the centre of the discussion. The US PAVE initiative, which tries to involve systematically users in the design process of CCAM and explain the benefits of CCAM, is a good initiative, which should be developed also in Europe - maybe with the support of the European Partnership.

Ingrid Skogsmo added that user involvement should have its focus on addressing the needs of the citizens. It is important to involve the “end users” already in the research and design phase. User acceptance, which is not the right term, because it means that you just tolerate what is being offered, should be replaced by “Community embracement”, which means that all innovative technologies and services should be fully embraced or supported by the users and the community. A comprehensive assessment of potential impacts and the development of tools to this end are needed, which will support local authorities, politicians and planners to plan and implement CCAM solutions on the ground.

Steve Phillips said that all types of road infrastructure (not only motorways) must be prepared to support highly automated vehicles in the future. Thus it is also important to look at the needs of the road operators in terms of providing infrastructure support for CCAM. Solutions must be developed in cooperation with the road operators, which should result in win-win situations for both the CCAM developers and the road operators. Preparing the road infrastructure for CCAM requires heavy investments, which will have long lasting impacts. Road operators are heavily investing in the digital twins of road infrastructure, which will be used not only for CCAM, but for the whole operation, planning and maintenance of infrastructure. Connectivity along the whole road network to support higher levels of automation, better engagement of Member States and alignment of national research programmes remain major challenges.

Armin Gräter said that the key to increase acceptance and accelerate deployment of CCAM systems is testing with real people. People will quickly accept new technologies, when they have the possibility to test them in reality. These tests are also essential to get useful data on the safety of CCAM, which will be needed for the safety validation and regulation of CCAM systems. By 2030, the Partnership will demonstrate user-oriented and well-integrated mobility concepts, enabled by CCAM in many living labs in Europe, with increased safety and a reduced carbon footprint. To make these large-scale demos in living labs happen, it is crucial to get a strong involvement of local authorities as well as public transport operators.

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Cooperation is a prerequisite to advance CCAM. The new European Partnership on CCAM will help to make cooperation between the different actors of the value chain and between public and private stakeholders a reality.

In his closing speech, **Jean Eric Paquet** said that the new European Partnership on CCAM will help to better coordinate and streamline all research and testing activities of the public and the private sector to accelerate the roll-out by 2030. Horizon Europe and the new Partnership should work together to help structure the investments of industry and Member States, align National Programmes, and make sure that roll out does not only take place in some frontrunner, but all Member States.

The CCAM partnership should make sure that there is close cooperation with the Cities and support the Mission on 'Climate-neutral and Smart Cities' by implementing several large-scale demonstrations of shared automated mobility systems and services in cities. The Research Agenda must be defined in such a way, that a seamless transition between the outcomes of the research and demonstration projects to large roll out can be ensured.

At the same time, the new Partnership should actively seek coordination, synergies and alignment with other European Partnerships and other Funding Programmes (e.g. Connecting Europe Facility, InvestEU). We should develop automated mobility solutions as a major tool to deliver on the green and digital transition. New CCAM solutions must show that in the medium to long term they can largely contribute to achieving our sustainability goals - mainly by supporting new mobility concepts and making transport flows more efficient. This is key to get the broad support from policy makers and society.

Citizens engagement is crucial for acceptance of the new CCAM solutions. Therefore, the European Partnership should look out for new ways of getting the real users involved, when developing the new technologies and services. This should go beyond involving the users in the different living labs towards the end of the partnership. Citizens should be involved at an early stage of the development process in co-designing the features of the CCAM solutions and in discussions on main concerns, ethical issues and values.

At the end of the session, the audience was asked to name the biggest challenge in their view, to deploy CCAM by 2030. Safety, acceptance and regulation were the three challenges that came on top, followed by interoperability, infrastructure, cooperation and human being.

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Figure 13: Closing session poll results

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4. Breakout sessions

4.1.BO1-CCAM Large-scale demonstrations: What is the next level

At European, national, or local levels, numerous CCAM demonstrations (mainly pilots, some FOT and living labs) are taking place in the past years with the goal to test and validate technical developments but also to raise user awareness towards automated mobility. This session has reviewed the benefits, limitations and lessons learned of current demonstrations and discussed the needs for the next level.

The session was moderated Stephane Dreher, Senior Manager at ERTICO – ITS Europe, who also set the scene, together with the other first two speakers, Henriette Cornet, Senior Manager Knowledge & Innovation at UITP and Armin Graeter, Technical Product Manager Regulation Automated Driving at BMW Group, about the next level of large-scale demonstrations, with a focus on:

- Building the CCAM ecosystem based on discussions happening in ARCADE, emphasizing the need for harmonization;
- The need to involve citizens in large-scale demos and how this can be done;
- The need for technological development and validation.

The remaining three speakers were from Dimitri Konstantas, Professor and Director of the Information Science Institute at the University of Geneva; Nadege Faul, Project Manager Urban mobility projects and experimentations at VEDECOM, and Daniel Avdagic, Co-Founder and Managing Director of AV Living Lab BTC in the City of Ljubljana. They illustrated what is needed for the next level with their respective projects and initiative(s).

Figure 14: BO1 - (from top left to bottom right) Stephane Dreher (ERTICO), Armin Gräter (BMW), Nadège Faul (VEDECOM), Henriette Cornet (UITP), Dimitri Konstantas (UNIGE), Daniel Avdagic (AVLivinglab Ljubljana)

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4.1.1. Key points of interest raised

- System level thinking is of key importance to provide service also after the large-scale demonstrations.
- Technology regulation needs to evolve;
- City authorities need to be involved in Urban design and city development;
- We need to test real service pilot with larger fleets.
- It is important to look into the details of the range of use-cases.
- Increase the speed is also important to justify the AV service.
- It is important to comply with public transport service. It is important to develop a new model for shared mobility services. This is not a normal bus service or a taxi service. This is something new and it is complicated to develop a new shared service.
- The case is not to discuss what is private and what is public, we need to mix and focus on the shared services. The technology and user needs will lead us to the best solutions.
- The living labs is an important model to really test and involve different sectors and various systems to test and combine various services for different users. Building and evolving the eco-system for shared mobility.

4.1.2. Results from the interactive polls

The audience was asked to give their opinions at several points during the session. Here are the questions which they were asked to answer to and the results to these polls:

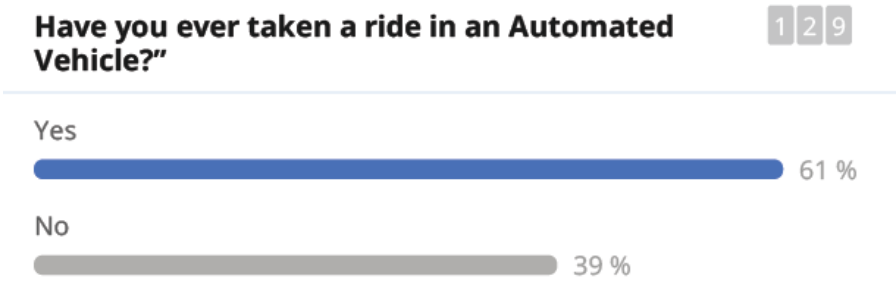

Figure 15: BO1 – results from poll question 1

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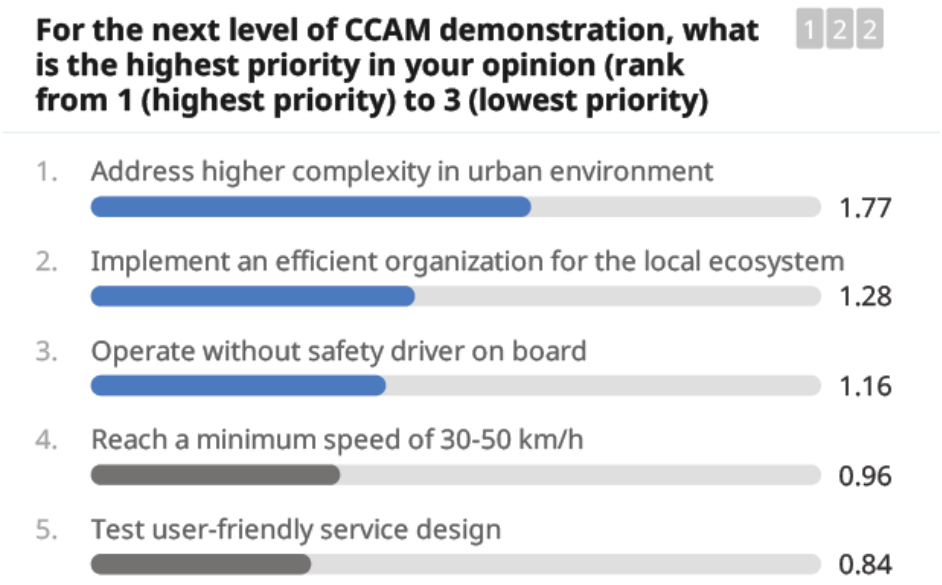

Figure 16: BO1 – results from poll question 2

4.1.3. Questions and answers

Question:	*Answer:*
If we want to address the challenges and make the cities more sustainable, healthy, we need to have strong the public private cooperation, for testing, experiment, and exchange of best practices and scale it up. Involvement of Citizen is key.	Agreed. Who are the main actors to be involved in the future: from UITP it is important to have a system thinking with all stakeholders involved to reach the benefit for all. It is also important to ensure that the service will continue after the demonstration is completed. The service should really continue in full operation.
Mapping CCAM landscapes with testing centres and living labs is highly supported. By looking the map it´s easy to find out gaps and needs, because some of the gaps are related simply to geographical location.	There are some centres where a lot is tested. Avoid redundancies and promote complementarity.
Large scale demos are a great demo of the technology maturity and use cases. Still how EU can support the gap between R&I demos and the real commercialisation / deployment with financial support to cities to put AV shuttles in place ?	Financial support is obviously needed, but it is also important to have the engagement from users and providers, regulation in place and business models. What shall we do to motivate the transport operators to really be engaged in the CCAM partnership? It is crucial to involve the public transport operators.
@Dimitri. What is AVENUE shuttle buses´ capability to operate in minus degrees with snowy conditions? To market entry need to have weather proof solutions. Next step for EU pilot project is to land all kind of infra and weather conditions.	We have operated also in Snow and cold condition, Denmark and Sweden. It can be an issue in heayy rain/snow

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4.2.BO2 - Managing traffic in a CCAM ecosystem: how to do it efficiently and safely?

Several European projects have shown that mixed traffic situations with automated and conventional vehicles on the road can have negative effects on safety and efficiency and have successfully developed mitigation solutions for specific scenarios. The challenge is to obtain a common view on the most important scenarios to be addressed, on available solutions and on potential interrelations. In this session an overview on key scenarios and solutions, as well as the relevance for the traffic system and important next steps have been highlighted.

Moderator: Dr. Wolfgang Ponweiser, Senior Research Engineer, AIT Austrian Institute of Technology GmbH

Speakers:

- Susanne Schulz, Head of Department Kooperative, vernetzte und automatisierte Mobilität from Die Autobahn GmbH des Bundes, the biggest road operator in Europe
- Prof. Markos Papageorgiou, Professor and Director of the Dynamic Systems & Simulation Laboratory from Technical University of Crete
- Tiffany Vlemmings, Project Manager Strategy, Innovation and International affairs from NDW - Dutch National Data Warehouse
- Julian Schindler, Group Leader System Automation & Integration from German Aerospace Center (DLR)
- Dr Risto Kulmala, Principal Advisor, Traficon

Figure 17: BO2 - (from top left to bottom right) Markos Papageorgiou (TUC), Wolfgang Ponweiser (AIT), Risto Kulmala (Traficon), Julian Schindler (DLR), Tiffany Vlemmings (NDW), Susanne Schulz (Autobahn)

4.2.1. Key points of interest raised

- Traffic management will be necessary and important in future.
- Cooperation between the involved stakeholders is vital, particularly between road operators, the automotive industry and service providers. It is essential to realise win – win situations for the involved stakeholders, otherwise there will be no cooperation.

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Main challenges

- The key step is to start exchanging data, but there are several challenges such as lack of standardisation and digitization.
- What is not clear is if automated vehicles should be able to break the law in order to behave as other road users. This question was asked to the audience via a poll and 76% of the poll participants stated that automated vehicles should be able to do this but regulated by context, while 16% stated that automated vehicles should under no circumstances be able to break to law (see chapter 4.2.3).

Next steps

- Concerning the responsibilities for traffic management in key situations, it is expected that, as today, also in future the government will set the frame of what is allowed and what can be done. Local authorities will decide what will be applied and how to apply it. The responsibilities of the OEMs and the amount of decisions made by the driver will change over time as functionality and level of automation will change.
- A key element is to understand Operational Design Domains (ODDs) and to set up an ODD-ISAD (infrastructure classification scheme for automated driving) framework. The starting point would be the exchange of ODD and ISAD attributes, and the next step would be a common shared view on a situation and what sort of ODD is available there. This would be a basic building block for ODD management. A close interaction of fleet, traffic and ODD management will be of high importance in future.
- Vehicles being connected are highly important also in future, so that support from infrastructure side is possible. Particularly, quality, availability, coverage and security have to be addressed. It is important to have a test network for regular function tests when new services and system components are put in operation.

Prof. Markos Papageorgiou highlighted the dramatic changes in the control loop for future traffic management systems, such as vehicles acting as mobile sensors, new (wireless) communication channels, massively distributed computing and vehicles as actuators. New opportunities to realise more efficient traffic control include real time AAC time gap control. Intelligent vehicles may lead to dumb traffic flow, if not managed appropriately. The connected automated vehicles and traffic management communities should connect for maximum synergy. Regarding responsibilities for traffic management in key situations, the government will set the frame of what is allowed and what is not. Local authorities will decide what to apply and how to apply it. What will be the responsibility of OEMs and what will be the decisions taken by the driver will change over time as functionalities and levels of automation evolve.

Tiffany Vlemmings pointed out that there is currently no cooperation between traffic management and navigation providers, resulting in two different control loops. Today the road user combines information from these different areas. In the Socrates 2.0 project, aiming to merge these two control loops, three levels of cooperation have been defined: from exchanging data and the agreement on the use of protocols, to a shared view with a common operational picture, to a coordinated approach where services towards the users are aligned. According to some first lessons learned from the Socrates 2.0 project, the hardest point is to have a clear win for all parts to enable cooperation. What if we could translate what human drivers are currently doing automatically by interpreting information from different sources, in

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a way that it is useful for machines? The key step is to start exchanging data, but there are several challenges such as lack of standardisation and digitisation.

Julian Schindler provided insights into areas where automated driving is not an easy task. A key question is does the vehicle understand that it cannot solve a situation. If yes, the vehicle starts a transition of control and, if that fails, a minimum risk manoeuvre is initiated. The TransAID project has developed several solutions, where infrastructure helps to prevent, manages or supports and distributes Transition of Control or Minimum Risk Manoeuvres so that efficiency and safety are increased.

Susanne Schulz started from the situation today, where e.g. road works warning via ITS-G5 is in operation, and presented the new service architecture of Autobahn traffic management centre, set up in a modular design, including a central geo service, special applications like analysis of the traffic situation and central monitoring of services and components. Essential for future applications is that the road operator understands the ODDs of the vehicles and that the vehicle side understands how traffic management is carried out. Having a test network for regular function tests when new services and system components are put in operation will be a key element as well in the future. Most important for a successful system introduction is the effective cooperation between road operators, the automotive industry and service providers to connect vehicles with the infrastructure.

Dr. Risto Kulmala focused on how fleet and ODD management will have to be integrated in traffic management, since it is an essential part of the business case for many use cases such as robo taxis, shuttles or road haulage. He stressed the importance of ODD management as an infrastructure support measure and the clear need for an ODD-ISAD framework. The first step towards ODD, fleet and traffic management would be the exchange of ODD attributes on the one side and ISAD attributes on the other side, the next step would be a common shared view on what is the situation there and what sort of ODD is available, which is a basic building block for ODD management. The final step would then be the ODD, fleet and traffic management. Digital infrastructure and data exchange with the vehicles are important, there has to be quality, availability, coverage and security. The physical infrastructure has to be prepared for Minimum Risk Manoeuvres. Another important element is consistency, since humans can live with inconsistencies but it is difficult for machines.

4.2.2. Questions and answers

Dilemma that AVs, which should improve road safety, should hand over control exactly in difficult situations where human drivers might cause accidents.

Julian Schindler answered that the infrastructure can help and that it would be a good step forwards to have infrastructure in several parts of the road helping to avoid transition of control and extending the ODDs.

Liability shift from the driver to the vehicle provider and eventually to infrastructure.

Susanne Schulz answered that a key element for providing data with the required quality from infrastructure is to have information on the ODDs.

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4.2.3. Results from the interactive polls

The audience was asked to give their opinions at several points during the session. Here are the questions which they were asked to answer to and the results to these polls.

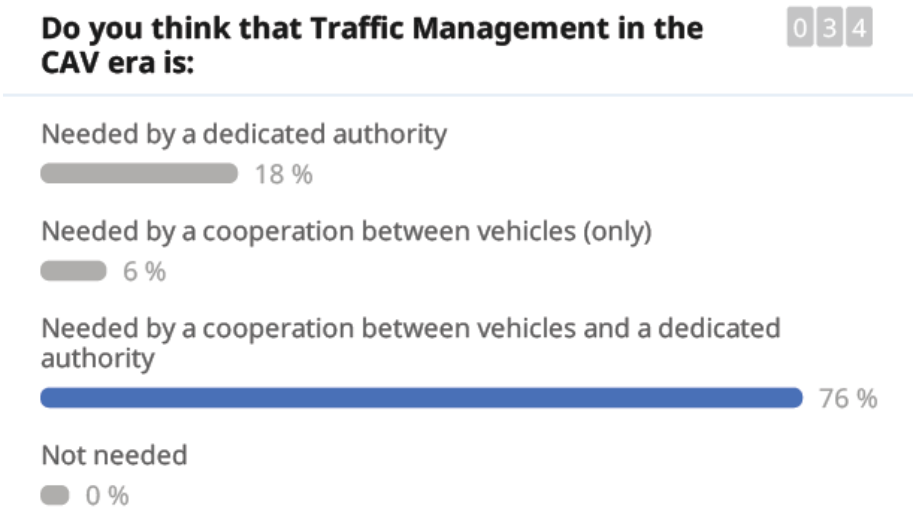

Figure 18: BO2 – results from poll question 1

The audience has been asked, if automated vehicles should be able to break the law in order to behave as other road users: 76% of the participants stated that automated vehicles should be able to do this but regulated by context, while 16% stated that automated vehicles should under no circumstances be able to break to law. The remaining 8% think that AVs should be able to break the law based on their own judgement.

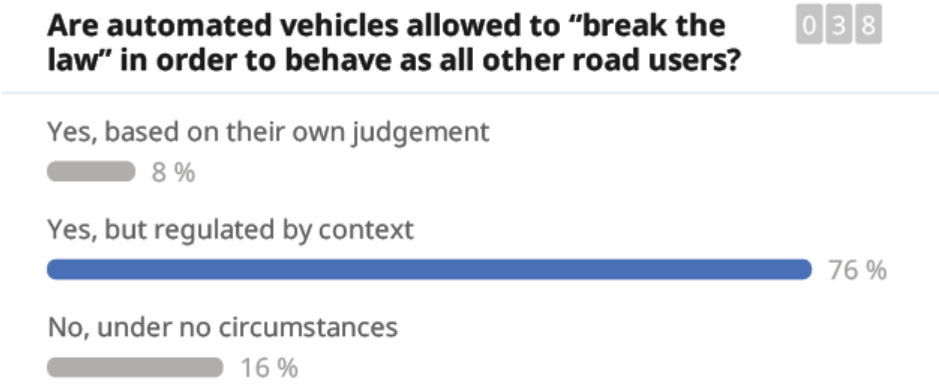

Figure 19: BO2 – results from poll question 2

Answering another poll question, 71% stated that ODD definitions of automated vehicles should be openly accessible for everybody, 27% stated that they should be confidential but accessible by specific entities, while only 2% stated that ODDs should be confidential and only accessible for OEM/Tier1.

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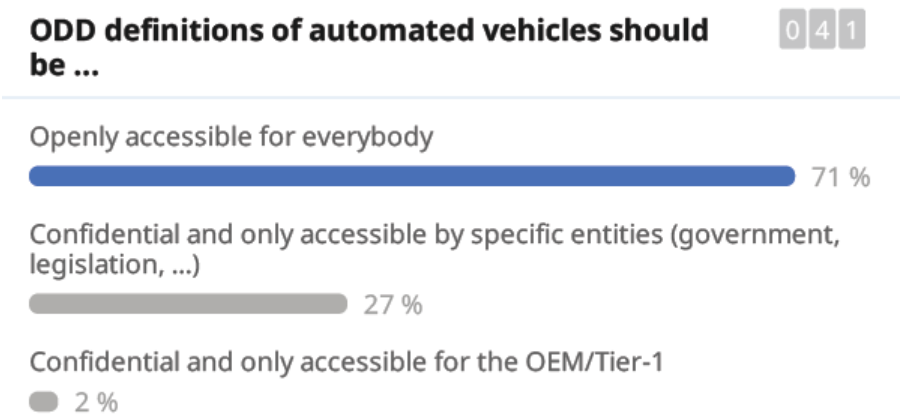

Figure 20: BO2 – results from poll question 3

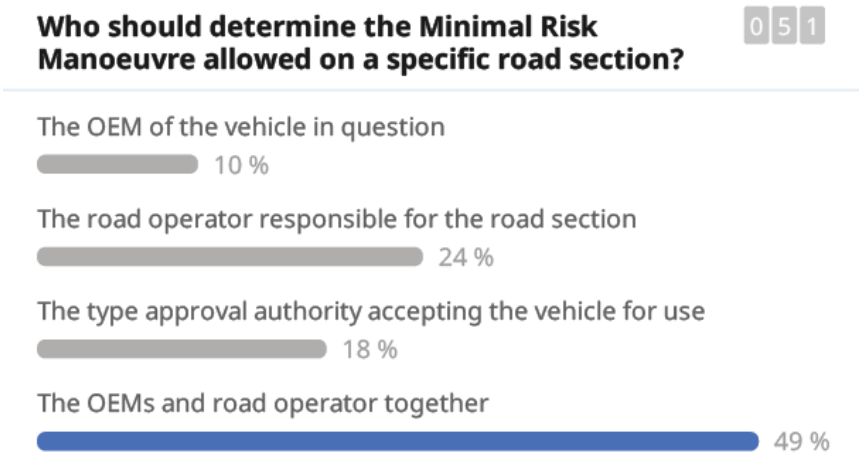

Figure 21: BO2 – results from poll question 4

The audience was asked who should take the lead for such a framework. 45% stated, that road operators together with AV industry should be the champion of such a framework, 21% see the European Commission together with the member states as champion. The importance of cooperation was visible as well in the answers to an additional poll question, where 49% stated that the OEMs and the road operator together should determine the Minimum Risk Manoeuvre allowed on a specific section, while 24% think this is the responsibility of the road operator.

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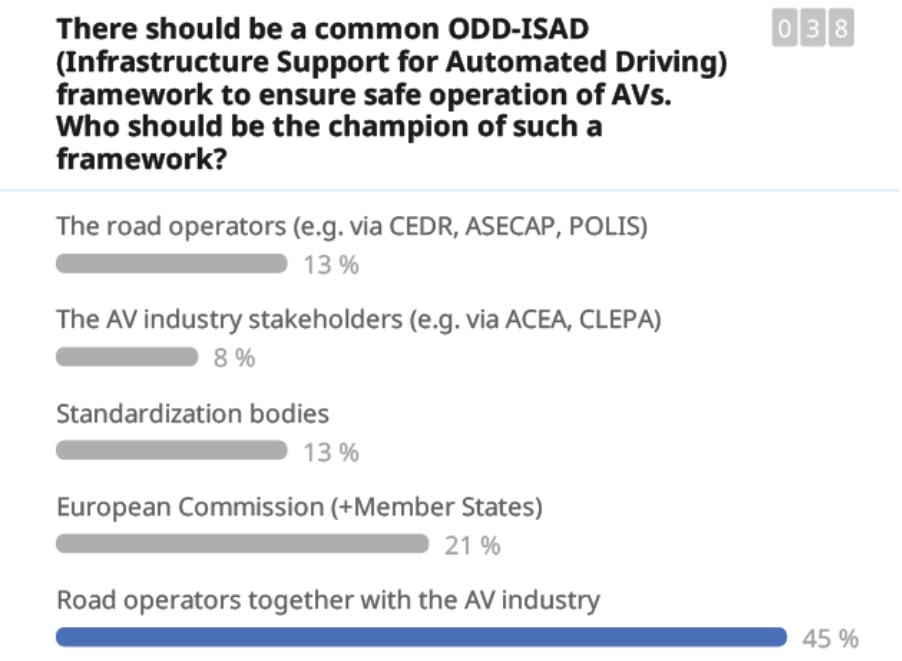

Figure 22: BO2 – results from poll question 5

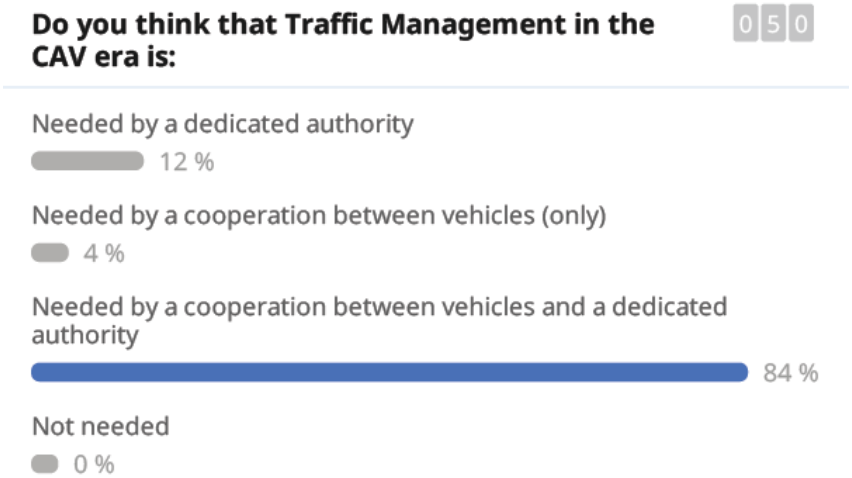

Figure 23: BO2 – results from poll question 6

4.3.BO3 - After the Corona pandemic: New perspectives for CCAM and Quality of Life?

During the pandemic, many of us re-evaluated ideas about mobility and how it influences the Quality of Life (QoL). CCAM could play a role in making mobility more sustainable and equitable, combining automated forms of transport with active forms (walking and cycling), public transport and micro mobility. This session addressed how QoL can be defined for different cities and regions; how the measures of QoL are linked to a sustainable transport system; and whether CCAM solutions can support the goal of improving the QoL and under which conditions.

The objective of the breakout was to stimulate thinking on how mobility is affected by pandemic and the role of CCAM on enhancing our QoL in the post-pandemic world, and to share the thoughts on these topics.

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Moderators:

Isabel Wilmink, Senior Scientist, TNO | Satu Innamaa, Principal Scientist, VTT (download presentation)

Speakers:

- Patricia La Torre, Head of Strategic Partnerships, Humanising Autonomy
- Yvonne Barnard, Senior Research Fellow, Institute for Transport Studies, University of Leeds
- Hannah Rakoff, Social Scientist, Volpe National Transportation Systems Center, U.S. DOT
- Endre Angelvik, Chair of UITP Combined Mobility Committee, Vice President Mobility Services, Ruter

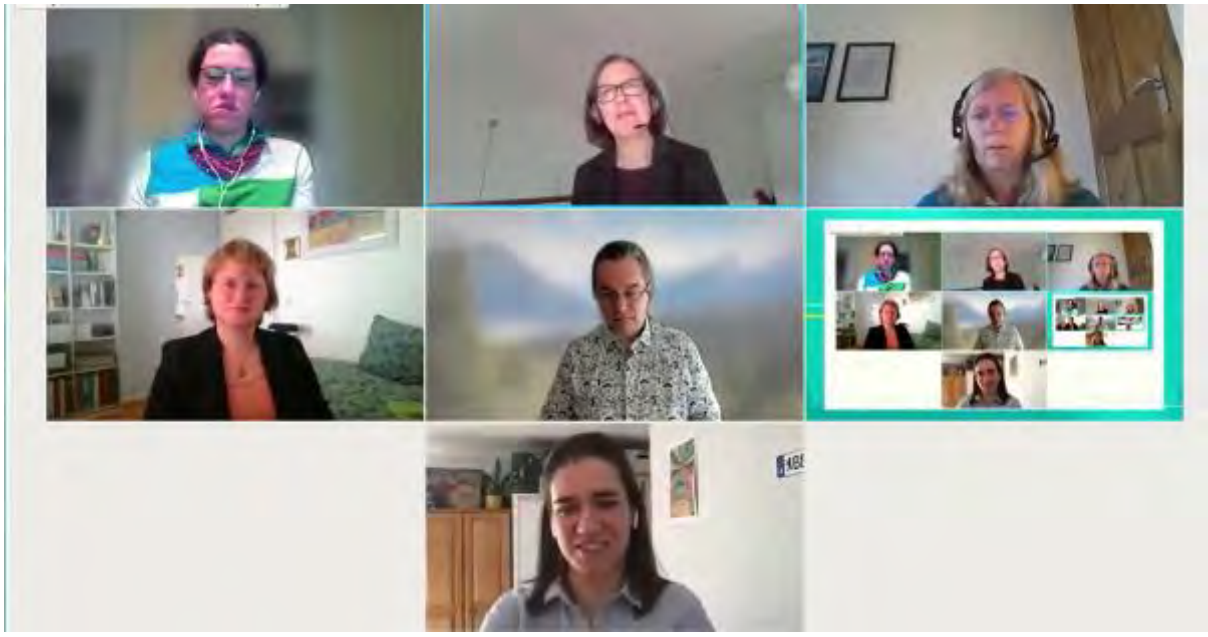

Figure 24: BO3 - (from top left to bottom right) Hannah Rakoff (USDoT), Satu Innamaa (VTT), Yvonne Barnard (LEEDS), Isabel Wilmink (TNO), Endre Angelvik (Ruter), Patricia La Torre (HA)

4.3.1. Key points of interest raised

During the session, we discussed how the pandemic has not just brought negative but also positive effects on our mobility and we do not want to go back to old normal. But to ensure that, we should not just wait for it to happen but actively make the future we want to aim for.

- New forms of mobility should be looked for, and we should not be so dependent on private car use.
- System or society viewpoint is important. Therefore, wider societal impacts should be in focus, not just travel time and comfort.
- CCAM will affect our QoL in many ways. Citizen-centric approaches are needed for evaluation instead of limiting it to the user view. Better grip of citizen needs is also needed.
- CCAM is part of the mobility system, and should not be considered as an isolated technology. When addressing the impacts of CCAM, a systematic way of breaking

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down the impact areas into elements to address them is needed as the impacts of CCAM are so complex and far-reaching.

- Sustainability of mobility is the key for the future, and CCAM needs to contribute to that. Sustainability and equity goals are often not targeted at the moment. Focus is now too much on consumer view. We should get from user optimum towards system optimum.

Patricia La Torre highlighted that the urban mobility systems do not understand people, or how they interact with the world. The costs of vulnerable road user collisions in US and Europe alone has been estimated to be $156bn and 7430 pedestrians and cyclists are killed each year in EU. This is why it is important to bring in the human view. The pandemic has changed radically our mobility. This can be an opportunity to grow back green, to put greater emphasis on accessibility and to provide more alternative types of mobility respecting the requirements e.g. for social distancing. New normal requires new solutions being able to analyse human behaviour in the transport system and understand its impact on everyday life and people. We should rebuild better: put human perspective first and emphasise adaptable approaches.

Yvonne Barnard looked into how QoL could be influenced by CCAM, looking at areas such as health, well-being, and equity. CCAM will have a large impact on areas such as personal mobility, traffic safety, traffic efficiency, and the environment. One of the main questions is whether we should take an individual perspective (e.g. does CCAM increase our comfort?) or a societal one (e.g. will it make our cities more liveable?). As the impact of CCAM is such a complex topic, it is important to break down the impact areas into more detail, and to use methods to discuss and investigate them in a systematic and structured manner. Examples of such approaches were given from Roadmaps (from ERTRAC), Scenarios (from the CARTRE and ARCADE projects) and Impact Pathways (from the Trilateral Impact Assessment Framework for Automation in Road Transportation). More can be found on this work at www.connectedautomateddriving.eu. After the pandemic, there is an urgent need to re-assess roadmaps, scenarios and impacts, looking at both positive and negative changes, and rethinking the individual versus the societal quality of life.

Hannah Rakoff talked about “How can quality of life be affected by vehicle automation?” Quality of life in cities builds on many aspects which include both basic necessities but also provision of choices on top of these. Quality of life goals are similar to sustainability goals. There are two types of constraints for the cities to lead the development of the mobility system: physical constraints, such as limited space and land, and policy constraints, such as funding for different modes. Cities saw that quality of life may benefit from vehicle automation - or not. The hopes towards the impact of automation include improved accessibility, safety, efficiency and environmental impact. The fears include that automation may lead to more motorized vehicle mileage, less active travel and use of public transport, decreased safety for non-car users, and decrease in equity.

Endre Angelvik presented “The Oslo study - Fleets of autonomous vehicles” that looked at the Norwegian capital region and a transition to shared mobility, raising the question “How can large cities deliver inclusive transport services?”. Focus was on how autonomous cars may change (public) transport in cities. The study found that, when rides are shared, the number of cars in the city can be reduced by 84-93%, thus showing a large reduction in all scenarios explored. The number of vehicle kilometres travelled also decreased in some scenarios, by 14-31%, but in another scenario the traffic volume doubled resulting in a complete traffic

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breakdown. These results are comparable to what was found in other studies, so a future with shared CCAM could have both positive and negative outcomes. Three long-term drivers are (1) new and more flexible service opportunities, (2) new competitors in the mobility providers' industry, and (3) the possibility to reduce the costs of public transport options with autonomous vehicles in the fleet. Several trials are on-going, and the next steps are to start the first regular operations, then scale up so that autonomous vehicles will become part of regular public transport contracts.

4.3.2. Results from the interactive polls

The audience was asked to give their opinions at several points during the session. Here are the questions which they were asked to answer to and the results to these polls:

Audience insights on pandemic during the pandemic

How did the corona pandemic change your mobility habits?

1. Dramatic limitation to personal mobility
2. Travelled only locally
3. Public transport operation was stopped / People tried to avoid public transport
4. More traveling by private car (to replace PT use) / Less travelling by car (due to less traveling overall)
5. No flights
6. Working from home, no commuting
7. More biking and walking
8. Moved further on the country side

What did you find POSITIVE about the changes in your mobility?

1. Time savings due to no need to commute
2. No need to bike to work in rain, snow, hailstorms
3. No rush to work during the peak hour
4. More time to walk (walking meetings etc.) / More walking
5. Enjoying biking much more than before / More biking
6. No need to live close to work location
7. Plenty of space in public transport for comfortable ride
8. Much less fuel consumption / More carbon neutral mobility
9. No business trips, especially by plane
10. Easier every day logistics
11. Getting to know your environment better when walking

What did you find NEGATIVE about the changes in your mobility?

1. Not possible to meet people / Lack of personal interaction
2. Lot of constraints
3. Less use of public transport for health safety reasons
4. People are not comfortable any more to use every seat in public transport
5. Concern to use public transport in long distance travel
6. No leisure travelling / Not possible to travel further away or abroad
7. Road traffic fatalities per VMT rose greatly
8. Lack of commute by bike has reduced exercise and one's "own" time
9. All days are similar

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10. Quick chaotic changes to infrastructure by expanding sidewalks or bike lanes overnight or making road closures
11. Use of non-renewable electricity at home
12. More use of home delivery using diesel and fossil fuel powered vehicles

Audience insights on CCAM

What automated mobility solutions you foresee to enhance our quality of life?

1. Robotaxi, air taxi
2. Autonomous mobility to complete mass transit where it is not deployed or relevant
3. First and last mile solutions for missing connections
4. Automated shuttled or taxis to help uptake of MaaS and reduce dependence on the private car
5. Autonomous mobility for long distance travel (e.g. for vacations)
6. Optimal and reliable calculation of itineraries on real time, avoiding traffic congestion

If we prioritise the societal perspective in design of automated mobility, how can we get solutions that are attractive to people?

1. We should not forget the service vehicles (plumbers, electricians, etc.) which are often forgotten in these discussions
2. Education for children (kindergarten, schools, driving schools) to promote sustainable transport and to use public transport
3. Create safe space/infrastructure for active mobility, cycling and walking
4. Broaden the public transport vehicle types (e.g. shuttles)
5. Create modular vehicle solutions to allow shared use but in separate space
6. We should involve different user groups
7. Study user needs of different groups and behaviour using user-centric testing in pilots
8. Easy booking with different payment models
9. Easy access solutions at low cost

What is the biggest hope and fear for our quality of life in the automated mobility of future?

Hopes:

1. Road fatalities to reduce significantly
2. To enhance mobility services in rural areas
3. More travel flexibility
4. Reduced pollution

Fears:

1. Concerns about disinfection lead to reduced options for travel
2. Targeting of limited funds to cleaning rather than to road safety
3. Women's needs are not enough represented
4. Social gaps will grow if only few will afford a personally owned car or is allowed to operate an automated vehicle
5. Not everyone able to use the automated services due to high end user costs
6. AVs' growth leads to renaissance of individual mobility at cost of public transport
7. CCAM solutions do not arrive to public transport
8. To get stuck in a traffic jam without an opportunity to leave the vehicle

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With a lot less cars you need a lot less parking space for them, what should we do with that space to maximize the quality of life?

1. Delivery hubs for pick-up instead of parking spaces for the delivery vehicles
2. Mobility hubs
3. Space for outdoor sports
4. Green space
5. Space for social interaction
6. Space for small businesses (pop-up stores, cafes, etc.)
7. Waiting space for the automated vehicles

4.4.BO4 - Key Vehicle Technologies for CCAM: Is the level of maturity sufficient for high-level automation?

Robust and accurate environment perception is absolutely essential for highly automated vehicles to enable the safe and unambiguous extraction of reliable information for real-time driving decision-making. Vehicle technologies need to reliably identify, track and discriminate between benign and hazardous objects in the path of the vehicle, under the full range of environmental conditions in which the vehicle is intended to operate. This session addresses the different challenges which must be overcome through advances in vehicle technologies in order to enable CCAM with higher levels of automation to become reality in the near future.

Moderator:

Gereon Meyer, Head of the European & International Business Development VDI/VDE Innovation + Technik GmbH, Germany

Speakers:

- Luisa Andreone, Programme Manager Collaborative Projects Automation & Connectivity at CRF Stellantis Italy
- Sven Beiker, Founder and Managing Director of Silicon Valley Mobility US
- Samia Ahiad, System & Validation Metier Manager at Valeo France
- Andree Hohm, Head of Self Driving Car Project at Continental Germany
- Anna Rossi, Technology Partnerships Director at Faurecia France

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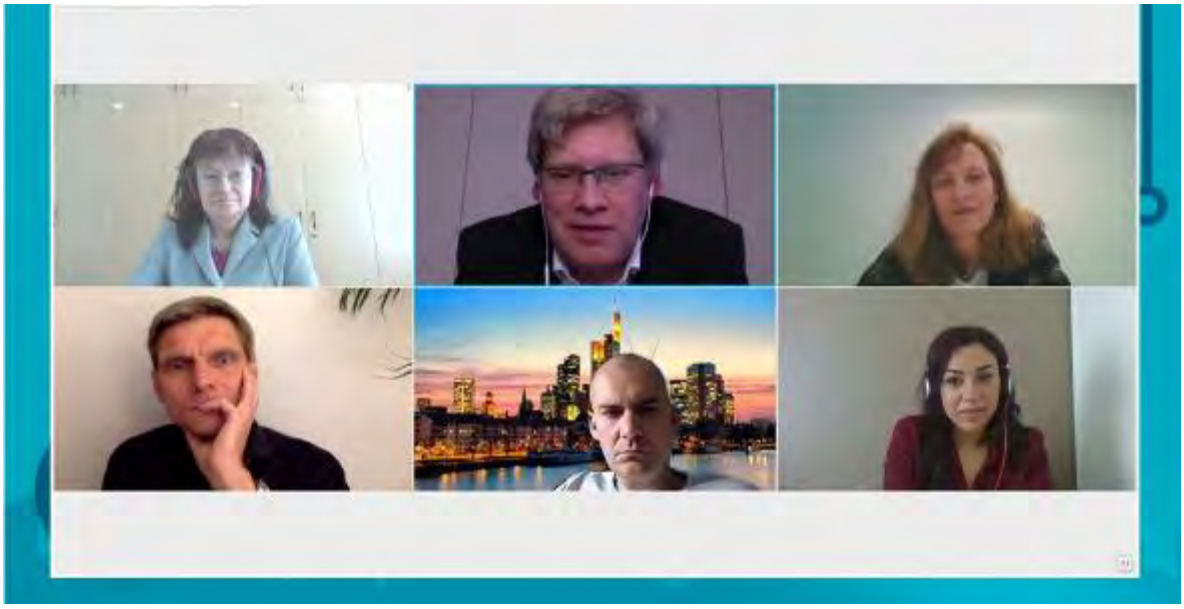

Figure 25: BO4 - (from top left to bottom right) Luisa Andreone (CRF), Gereon Meyer (VDI/VDE-IT), Anna Rossi (Faurecia), Sven Beiker (Silicon Valley Mobility), Andree Hohm (Continental), Samia Ahiad (Valeo)

4.4.1. Key points of interest raised

- SAE Level 4 automation will be probably feasible soon in restricted Operational Design Domains (ODDs), while more complex scenarios are expected to be addressed in a safe way by the end of the decade.
- Prediction of intention of vulnerable road users (VRUs) is a key functionality to achieve safe high levels of automation
- Connectivity with infrastructure can support automation providing also important information on environment perception
- Infrastructure will play a key role in achieving high level of automation (e.g. by providing clear lane markings or environment perception information through connectivity for data fusion)
- A large set dataset of traffic scenarios is needed to train machine-learning algorithms to support prediction and trajectory planning
- Data Fusion will be fundamental to achieve environment perception and will support the handling of potential failure of sensors.
- A robust fall-back strategy in case of malfunction is paramount to ensure safety and acceptability of highly automated vehicles
- To achieve safe automation, environment perception specifications must be derived from end user requirements and expectations, including at least 3 different sensing technologies.
- To ensure user acceptance, responsible, step-by-step introduction of automated vehicles with further established human-machine interfaces is needed. To be successful, driverless vehicles should eliminate ‘usage concern’.
- Moving towards high levels of automation, the driver will increasingly become a passenger. This will increase the activities to be performed within a vehicle and will impact the design of car interiors. Furthermore, new seating positions need to be addressed and evaluated in terms of safety, also in combination with new in-vehicle furniture (e.g. tables, displays or tablets).

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- Driver and passenger monitoring and appropriate hand-over procedures are important for higher level of automation
- In the case of driverless shared automated vehicles, it is still important to ensure the inclusiveness and passengers' privacy and security.

Main challenges

- Prediction of intention (Vulnerable Road Users)
- In an urban scenario, the presence of many obstacles makes environment perception very difficult
- Extending the ODD to construction zones, toll gates, mixed traffic and other complex scenarios also in urban roads
- Severe weather conditions
- All scenarios that can lead to an incorrect environment perception (e.g. object or traffic signs obstructed, faded or unclear, misleading sensor returns or multiple objects combined, small but serious objects or large but benign objects).
- Costs and production readiness of data fusion
- Hand-over procedures

Next steps

- Further expansion the ODD of automated vehicles
- Further research on data fusion
- Appropriate training of machine learning algorithms to handle complex traffic scenarios

Future research needs

- How to integrate the automated vehicles in the existing traffic
- Driver monitoring, couple this information with the context. Societal aspects
- Sensing capabilities and their KPIs. Supervision of the AD system regarding the ODD and its capabilities in real time
- Environment Perception

Gereon Meyer stated that SAE Level 4 automation will be probably feasible soon in relatively straightforward application environments such as motorways. This could occur even in the coming 5 years by advancing with the current driver assistance systems. On the other hand, automation in more complex environments, like city traffic (with cyclists and pedestrians), will require more fundamental shifts in the concepts of environment perception and on-board decision-making system control. This might not happen for at least 10 years of more due to the need of high-quality representation of the environment based on sensor data fusion, artificial intelligence (AI) assisted decision making or high-definition localisation systems with dynamic maps. The key question is how mature are technologies for high level of automation? The answer to this question has a tremendous importance in the context of the CCAM Partnership.

Luisa Andreone talked about L3Pilot, the biggest project funded by the European Commission in Horizon 2020 on piloting for automated vehicles. The project has just ended the piloting of SAE L3 functionalities including Parking Chauffeur, Traffic Jam Chauffeur,

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Motorway Chauffeur and Urban Chauffeur. Data has been collected and stored in a database in a standardised data format for evaluation of the performances of the functions and the reactions of the users. 70 vehicles have been equipped with L3 functionalities and pilots have been run in 2019 and 2020 despite the pandemic. As concerns limitations, while the Parking Chauffeur is already a well-advanced functionality that relies on trajectory learning and simultaneous localisation and mapping, the most challenging is Urban Chauffeur. In an urban scenario, prediction of intention of vulnerable road users (VRUs) presents a significant challenge. Furthermore, the presence of multiple obstacles in the urban scenario limits the possibility for the vehicle to sense the environment. In terms of the ODD, construction zones and tolling gates, for example, are still not included. Another important challenge, in situations with high traffic, is the evaluation of the space for a lane change. As regards mapping, the main challenges have been identified in a white paper drafted by the project called “Safety first for Automated Driving”. Highly dynamic maps and precise positioning are needed, severe weather conditions need to be addressed as well. Prediction of intention is very difficult for an automated vehicle. The HiDrive EU Funded project assesses how connectivity can support vehicle automation. To achieve safe automation, redundancy is very important while also extending the visibility of current sensors. Furthermore, it is necessary to receive information on potential changes of the ODD (e.g. weather condition) in the next kilometres of the journey. The project has also addressed the need for a large dataset of automatically annotated traffic scenarios (from cameras, LIDARs and RADARs) to train supervised machine learning algorithms for classification and tracking of road users. Machine learning can also support prediction and trajectory planning.

Sven Beiker stressed that there are many challenging situations that an automated vehicle needs to deal with in the everyday scenarios, including e.g. object (including traffic signs) obstructed, faded or unclear, misleading sensor information, multiple objects combined, the recognition of small but serious objects or large but benign objects, etc. These can lead to a wrong application of steering, acceleration or braking by the automated vehicle with potentially dangerous consequences. Cameras, RADARs and LIDARs have different strength and weaknesses. Cameras can have issues with the many information that are able to collect, with a risk of being overwhelmed by the amount of data. Cameras are very good at recognising colours, but they do not work well in adverse weather conditions. RADARs can track every object that is in the field of view but are not as precise as LIDARs. They can work in adverse weather conditions, but they do not recognise lane marking or give information on the vehicle length. Instead, LIDARs are precise in recognising objects but not very good at lane tracking. Hence there is the need for combining different sensor types via data fusion. In this regard, costs and production readiness are still unclear. There are many ways to perform data fusion. Combining raw data may result in difficulties in identifying objects also due to different positions and angles of the various sensors. On the other hand, tracking can be done before the data fusion. This might result in high calculation performances needed. A third solution, that can address both the previous issues, is to perform data fusion after features extraction in order to only perform tracking. A lot of work on sensors and data fusion still needs to be performed. These systems also require further calibrations after potential reparations on the vehicle (e.g. replacement of windshield or bumper) to be able to continue to perform safely.

According to **Samia Ahiad**, various advantages and limitations can be seen looking at each separate sensing technology. The knowledge of each sensor capabilities and limitations is very important when designing automated vehicle architectures. In the automated driving

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system (ADS) architecture both top-down and bottom-up approaches are needed. In the top-down approach, the end-user expectations and safety constraints are used to identify the required sensing technologies. In the bottom-up approach, the starting point is the experience gained using such environment perception technologies in real word applications. The ADS architecture needs an ECU capable of fulfilling many safety requirements including offering a fall-back solution. Many strategies (including minimum risk manoeuvres) need to be defined to manage potential faults during the operation and to keep the system and the occupants safe.

Andree Hohm mentioned that driverless mobility is coming in various forms with a combination of many different vehicles, including shared shuttles and private cars. In terms of technology, driverless mobility relies on many different hardware components and functions such as sensors, localization, computing and many more. Their combination in the architecture will enable driverless autonomous mobility to become a reality. Focusing on the environment perception, the advanced driver assistance systems (ADAS) currently on the market can be used as a solid foundation for progression towards driverless cars, but optimised sensing still remains one of the biggest technical challenges. Cameras, RADARs and LIDARs are needed, also combined with data coming from the infrastructure (V2X Communication) to complete data fusion. To combine all the information requires also a sufficient computing power to process the data. In terms of Homologation, further steps have been taken: e.g., it is expected that Level 3 systems can be approved this year under UNECE regulations up to 60kph. This is not a fully driverless functionality, but still represents a significant step towards removing the driver from the vehicle control loop. Consensus among all stakeholders in required to give driverless mobility a significant push. Finally, in terms of acceptance, a responsible, step-by-step introduction of automated functionalities with further developed human-machine interfaces is needed.

For **Anna Rossi**, life-on-board is an important aspect of high level automation. Moving towards high levels of automation, the driver will increasingly become a passenger. This will increase the possibilities for other activities to be performed within a vehicle and therefore will directly impact the design of car interiors. Furthermore, new seating positions need to be addressed and evaluated in terms of safety, also in combination with new in-vehicle furniture such tables, displays or tablets. New improved infotainment systems will be needed. As regards vehicle safety moving towards full vehicle automation, it is also important to address situations where the driver needs to take back control and provide the necessary strategies to alert him/her. This includes the need to monitor driver distraction or fatigue as well as providing energising features to facilitate the hand-over from the system to the driver. With automated vehicles, driving expertise is expected to be lower and it is important to take this into account when considering hand-over procedures. With high levels of automation, it is also expected that new services will be created. In the case of driverless shared automated vehicles, it is important to still ensure the proper inclusiveness and passengers' privacy and security also to ensure user acceptance.

4.4.2. Results from the interactive polls

The audience was asked to give their opinions at several points during the session. Here are the questions which they were asked to answer to and the results to these polls:

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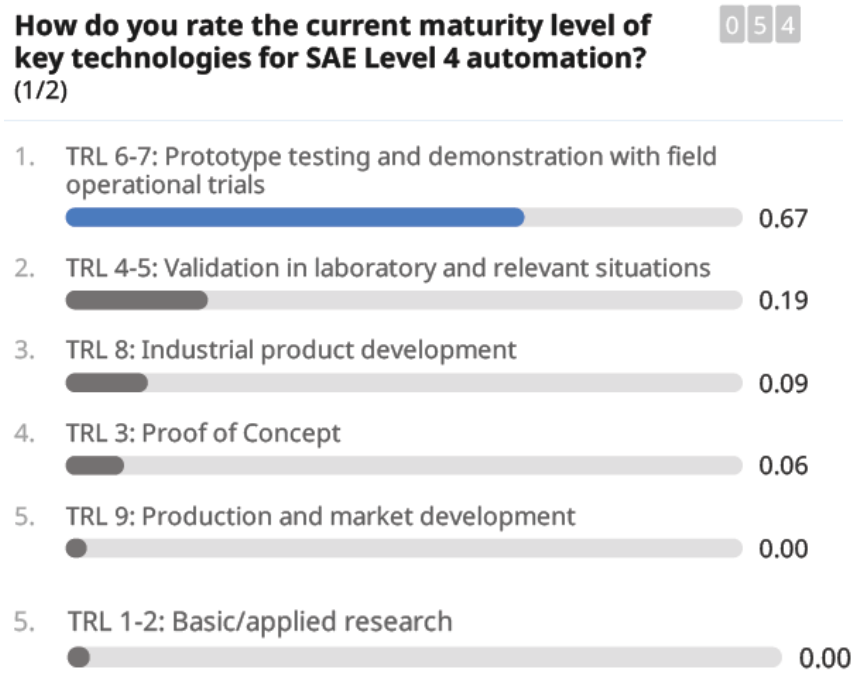
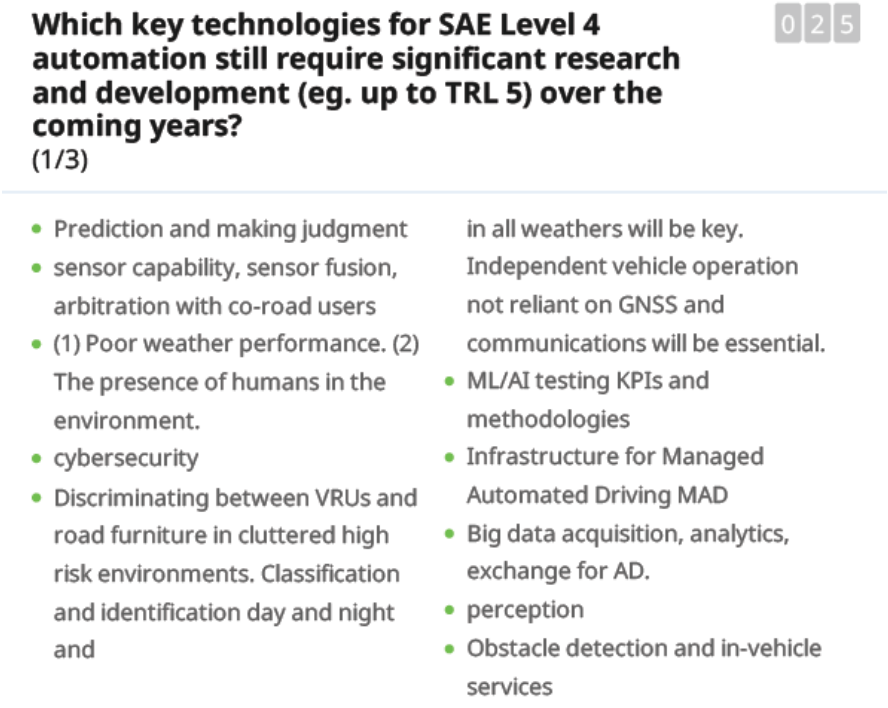


Figure 26: BO4 – results from poll question 1



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- LiDAR (costs must come down)
- Fusion// Connexion with infrastructures exploitation system
- Evaluation of different situation which could easily be detected by a human but must be programmed into a vehicle. In addition the problematic who decides what to do/how to react (ethical question), etc. hitting the child or the old lady....
- safety, reliability, handoff,

Therefore, the "brain" of the vehicle needs big improvements. So, summing up, the AI.

- algorithms and sensing
- Adverse weather capability for year around use
- Testing and validation methods
- Prediction algorithms
- Sensors, On board decision making, HMI, Safety
- perception and scene understanding
- AI
- data fusion
- Sensor fusion and coorperation with road infrastucture
- Cybersecurity Use of AI in automated driving for robustness during adverse weather conditions and during night and day Stretch the ODD of CCAM using digital infrastructure
- Sensing can be easily improved, but the fusion and tracking phase needs way more improvements.

Figure 27: BO4 – results from poll question 2

4.4.3. Questions and answers

Elon Musk right in saying "LiDAR is a fool's errand"?

Sven Beiker believes that LIDARS are an amazing technology that definitely can be further improved. Adding a LIDAR to a vehicle makes it even safer but the technology is complex.

I see plenty of possibilities for manipulation of sensor data. How is this being mitigated?

According to Samia Ahiad, there is a risk to be hacked or to have cyber-attacks. This is considered in the early stages of the design in order to implement mitigation measures. Sensors need to be robust also with regard to this kind of risks as well.

When will we see higher automated vehicles of driverless vehicles on the road?

For Andree Hohm, it depends, with limited ODDs we will see commercial applications very soon. On the other hand, for applications with extended ODDs and high speeds in mixed traffic, we will need to wait for the end of this decade.

We talked a lot about environment perception and the opportunities offered by the various sensors and systems. We need to consider how to understand all these data coming from the

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environment perception and prediction. How to use the opportunities of AI? How can they help us making the system reliable or safer compared to a human?

Luisa Andreone answered that it is a matter of learning - an extensive and reliable set of data is needed. Without this, it will never be possible to address a situation in which, for example, an umbrella hides a VRU on the road. In this case a human, using intuition, will recognise the pedestrian. How can do that the automated system? There are millions of such cases. In parallel, unsupervised and reinforced learning are also necessary.

What is your perspective about using AI to make the system safer?

For Samia Ahiad, data is a key challenge, training in the right way is very important. Machine learning exists already on sensors that are on the market since many years ago. In the future I expect that there will be at least 3 dimensions for the evolution of the machine learning. The first one regards the capability of detection and prediction of intentions in the surrounding. The second one is linked to the evolution and capability of self-assessment of sensor performances to have more confidence about what they can give as an output. The third one is the capability to be used in a safe manner in the architecture including a clear understanding of the capabilities of such algorithms. Testing will be also important. The performance needs to be tested to understand the limits and boundaries of the algorithm.

If we consider a lidar or radar, and we are asking what knowledge will be needed for a more intelligence algorithm to be run on that, would it require a quite complex data set representing the environment? This is a big data set do you see that is possible to collect that?

Sven Beiker thinks that there are many approaches trying to do that. The ones who will have such data will be the one that succeed. There is also a way of thinking that reflects on the possibility that we are complicating this too much. Should we need a less data intense approach? It is not always good to say the more data we have, the better; quality of data is also important. The overall challenge is that we mix machines and humans on the road. Data is very important and we need to understand how to collect and process it. At the same time, we need to manage complexity.

How do you see the trend of combining Cameras and RADARs together in comparison to LIDARs? Will LIDARs be superior anyway?

Sven Beiker answered that it depends on the ODD and the Use Case we are trying to deploy. For every-day complex traffic scenarios, it might be good to start with all three solutions (Camera, RADAR, LIDAR) equipped on the vehicle and then assess if it is still feasible to do that with only two. You can accomplish a lot of things with only Cameras and LIDARs. Some suppliers are already introducing mixed solutions.

How far are we with combining different technologies for environment perception?

Andree Hohm does not like the discussion about removing one sensor like a LIDAR, and thinks that first we should achieve safe automation with all the solutions that we have and then trying to remove some of the various sensors to see if it is still feasible. A first possible step can be using Camera, LIDAR and RADAR together to achieve full automation even if data fusion is very complex. Once achieved such milestone, it can be possible to make the solution easier and cheaper with less sensor and same performance. Another possible approach can include

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the use of less sensors and technology, while still checking that the vehicle remains in the safety boundaries. If the vehicle goes out of the safety boundaries that it can request the driver to take back control, reduce speed or reach a safe state. This would reduce the complexity avoiding the necessity of big calculation performances.

Coming back to the question of people exposed to automated vehicles as pedestrians or cyclists. Would you believe that the intelligence of an automated vehicle will be able to predict intention of people on the road?

Anna Rossi thinks it is a big challenge - intentionality is partly linked also to psychology or cognitive science. The information in the vehicle needs to be coupled with the experience that we see about the reaction of the people. Furthermore, a big challenge is also to see how the automated vehicle can communicate with third road users. Infrastructure will play a role on that as well.

If you compare vehicle sensing and infrastructure sensing. Which one should we focus on?

For Samia Ahiad, both are complementary. We have concrete cases and scenarios where the perception from infrastructure is needed. It is also important to have the right confidence and reliability on the information given.

If you compare vehicle sensing and infrastructure sensing. Which one should we focus on?

Sven Beiker believes that without an approved infrastructure L3 and L4 will not be possible. Connectivity is important but for me the basis are lane markings and readable traffic signs by the onboard sensors.

How far do you believe that vehicle technologies will further develop in the future? Will be the human still important?

Luisa Andreone answered that users will tell us what they will adopt. There is a huge difference between adoption and acceptance. The point is: let's focus on what we need to do to achieve it. The previous example on infrastructures is also important.

4.5.BO5 - Infrastructure support – how can it extend the Operational Design Domains?

The conditions in which Connected and Automated Vehicles are capable of operating safely can be augmented by support from the physical and digital road infrastructure. While concepts have been defined for both the operational domain and infrastructure support, no clear picture of their interplay exists at this stage. As a first step in a series of planned workshops, this session brings together the building blocks of this interplay with presentations of completed or advanced R&I projects and initiatives for a knowledge mapping and initial alignment.

The fundamental research question addressed can be formulated as follows: How can the interplay between ODD and ISAD be orchestrated in a cross-sector collaboration for the benefit of Connected, Cooperative and Automated Mobility (CCAM)?

The breakout session has featured results of recently completed Research and Innovation projects as well as the contribution of CCAM Platform enabled work on the question how road infrastructure can support Automated Driving. Four panellists have presented results and guiding ideas.

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Moderator: Torsten Geißler, Scientific Officer, BASt

Speakers:

- Sandra Ulrich, Founder, consu
- Bettina Erdem, Market & Business Entry Strategies, Continental, Germany
- Panagiotis Lytrivis, Head of Sector ITS & Mobility, ICCS Greece
- Geert van der Linden, Policy Officer, DG MOVE, European Commission

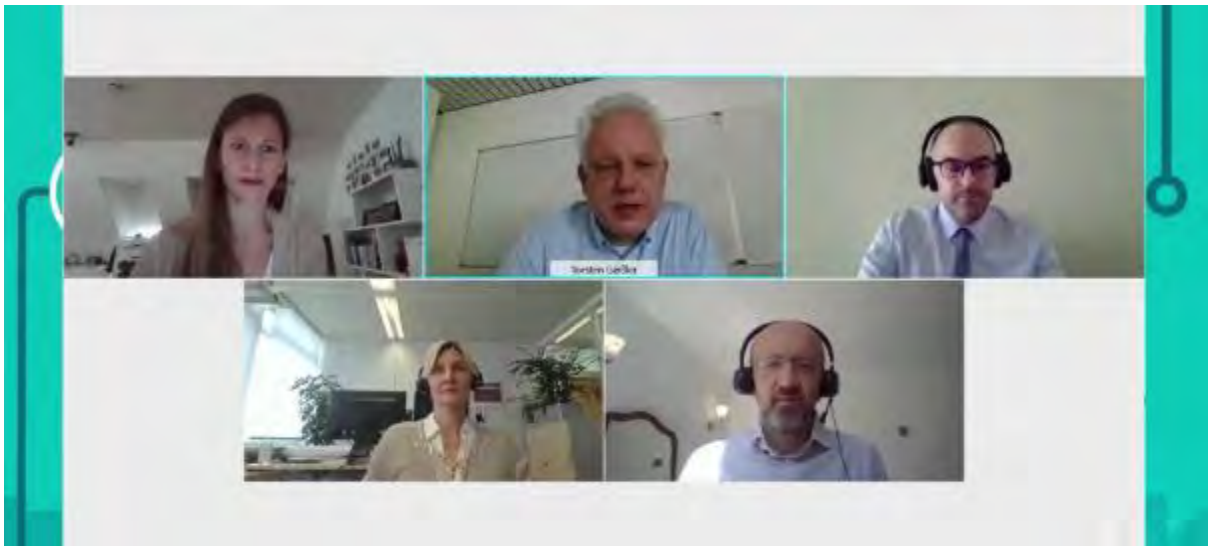

Figure 28: BO5 - (from top left to bottom right) Sandra Ulrich (consu), Torsten Geißler (BASt), Panagiotis Lytrivis (ICCS), Bettina Erdem (Continental) Geert van der Linden (EC)

4.5.1. Key points of interest

The session has successfully taken stock of the state-of-play with regards to infrastructure support to extend ODDs. The key points of interest and challenges are to a significant extent already identified and reconfirmed and are part of the CCAM Partnership Strategic Research and Innovation Agenda (SRIA), the respective Work Programme 2021-22 and the first Horizon Europe calls aiming at implementing the CCAM Partnership.

- physical and digital infrastructure (PDI) related attributes of the Operational Design Domains (ODDs)
- performance (requirements) of cooperative traffic management services
- infrastructure classification scheme and its potential to provide infrastructure support
- impact assessment of mixed traffic including opportunities for road operators
- convergence of the domains Cooperative, Connected and Automated (Mobility) from policy shaping towards deployment
- C-ITS success ingredients consisting of interoperability, trust and scale
- PDI matrix to support driving tasks as a guiding tool,
- collective perception is crucial to many advanced and more inclusive mobility services
- functional safety aspects of information provided that is intended to facilitate automated driving.
- investment in digital infrastructure is beneficial, even more in the long run.

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- disposing of real time, accurate and up-to-date information on e.g. speed limits will largely benefit both, human drivers as well automated vehicles.

Main challenges

- investment focus on digital infrastructure compared to physical infrastructure
- considerable transition period towards higher levels of automation
- need for investment coordination and certainty, especially on infrastructure side
- opportunities of cross-sector agreements and data sharing towards building a CCAM ecosystem
- challenges of functional safety requirements of information that originates from outside vehicles
- making data available also implies costs (though when the information matches the requirements stated before, maintenance costs can be reduced or even avoided in the longer term).

Next steps

- Expert dialogue should be extended and deepened in a suitable (multi-session) workshop format and/or in relevant conferences (e.g. ITS World Congress).
- Newly identified or highlighted aspects will be taken on board as research and innovation topics in regular update intervals of the CCAM Partnership SRIA (and subsequent Work Programmes and calls).
- As it is crucial to efficiently link development and deployment activities, the synergies between the CCAM Partnership under Horizon Europe (HE) and the Connecting Europe Facility (CEF) should be comprehensively explored.

Sandra Ulrich presented the results of the MANTRA project[2] on ODD requirements and other consequences of defined automated vehicles to physical and digital infrastructure into a wider context. MANTRA has looked into the central research question "How will automation change the core business of National Road Authorities (NRAs)?". The project has analysed the implications on a variety of use cases, comprising highway autopilot incl. highway convoy, highly automated freight vehicles on open roads with platooning, commercial vehicles as taxi services as well as driverless maintenance and road works vehicles on highways. She stressed the necessity of a good cooperation between automotive manufacturers and NRAs for a future with well-defined ODDs (list of road operator related ODD attributes presented). This will require a cooperative traffic management comprising of a Common Operational Picture, Digital Twins to support CCAM and ODD Aware Traffic Management (e.g. aware of Minimum Risk Manoeuvre).

Panagiotis Lytrivis presented the findings of the Horizon 2020 INFRAMIX project on how physical and digital infrastructure can support CCAM. Road infrastructure has to deal with mixed traffic situations for substantial transition period. It is important to focus on maintaining conventional traffic's safety and efficiency from the beginning of the transition period. In the long term the goal is to provide PDI support to enhance safety, efficiency and comfort. INFRAMIX has implemented the latest C-ITS communication standards, surveyed road signs

[2] CEDR Transnational Research Programme, https://www.cedr.eu/peb-research-call-2017-automation

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for coexistence needs of conventional and automated vehicles, proposed a new traffic sign indicating the lane dedicated to automated vehicles and implemented advanced simulation tools (co-simulation environment coupling microscopic with sub-microscopic simulation, hybrid testing involving a real autonomous vehicle coupled with virtual mixed traffic). The traffic simulations have shown encouraging results, a.o. efficiency enhancement due to time gap adaptions, congestion reduction at bottlenecks due to variable speed limits. In the longer run, the infrastructure equipment can be gradually reduced, resulting in less costs for road operators. The infrastructure classification provides the basis for the infrastructure support for automated driving (ISAD) scheme. It intends to provide guidance to target investment to support higher levels of automated driving.

Geert van der Linden provided a broad and framing perspective how road infrastructure support for automated driving is embedded into European policies and strategies, most recently into the Sustainable and Smart Mobility Strategy: the CCAM Platform is the expert group (involving four Directorates General) where the ideas that have led to the CCAM Partnership have been elaborated and where (in WG3) OEMs and infrastructure owners have come together in order to really understand how PDI can support the vehicles and which measures (beneficial for human drivers and automated vehicles) are feasible. Three elements are crucial for the success of C-ITS: a) interoperability, b) trust and c) scale. C-Roads as a platform, the EU Security Credential Management System and CEF 2 are key instruments to guard the success. The increased agreement and sharing of data between private and public stakeholders (see also near-term EC activities towards forming a Mobility Data Space) could help to trigger investments on both sides.

Bettina Erdem provided a deeper insight in the work of CCAM Platform WG 3 on the PDI matrix and the key conditions under which Digital Road Infrastructure can extend Automated Driving functions and Operational Design Domains. She presented the methodology behind the work-in-progress on the PDI matrix, namely linking physical road attributes (e.g. lanes, traffic signs, traffic lights) and their digital representation (e.g. HD Map, C-ITS) with the Automated Driving support that they can provide in terms of sensing and perception, planning as well as actuation. In most scenarios, both physical and digital infrastructure investments are necessary. Digital road infrastructure can indeed help to extend ODDs, contribute to Collective Perception services, as infrastructure can “see” many things from above, helping reliably to detect objects in Non-Line-of-Sight or obstructed sight conditions, and eventually, to prevent collisions with Vulnerable Road Users. On top of the quality digital information itself, the main ingredients are secure and trustful information (certificate of the European C-ITS Security Credential Management System) as well as reliability information (safety qualifier in terms of meeting functional safety requirements).

4.5.2. Results from the interactive polls

The audience was asked to give their opinions at several points during the session. Here are the questions which they were asked to answer to and the results to these polls:

Nearly half of the session participants (47%) have rated themselves as “informed” (I have quite a good overview on the state-of-play), followed by a quarter (25%) “aware” (I have heard of the topic and that it is important for CCAM), 16% “experts” (This is part of my (almost) daily work and responsibility in research, policy development, etc., and 13% “newcomer” (I found the breakout topic interesting but I am not yet familiar with the topic), opening poll 1 (n=32).

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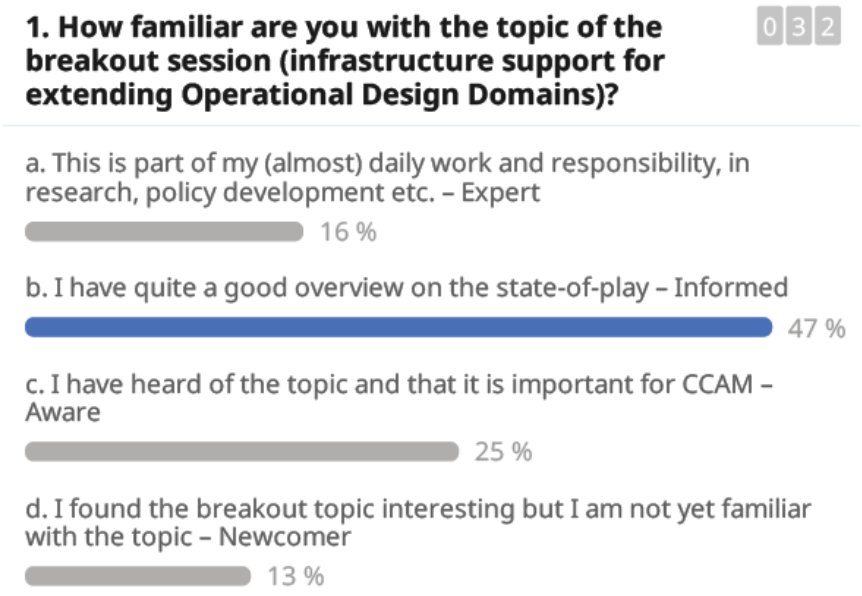

Figure 29: BO5 – results from poll question 1

The agreement among NRAs that the main impact is digital infrastructure, and that dependencies on physical infrastructure need to be limited because of time and cost impact, was confirmed by the results from Poll 2 (n=43): 70% have attributed the biggest value-for-money potential to positively impact the CCAM introduction indeed to the core business area of planning and building digital infrastructure and ITS whereas only 5% see this in planning and building physical infrastructure. A fourth of the poll audience expects the biggest potential related to road operation (14%) and traffic management (12%).

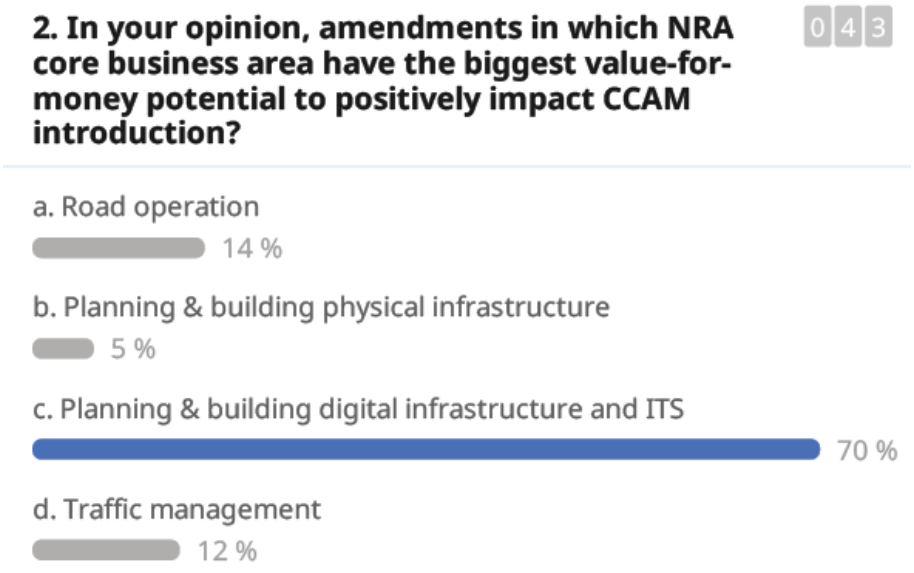

Figure 30: BO5 – results from poll question 2

The poll question (poll 3, n=45) on where investment in PDI support should be focused has broadly reconfirmed the priority setting on digital infrastructure. 47% see a focus on both physical and digital infrastructure, 40% only on digital infrastructure and 9% on physical infrastructure (4% not sure, do not know).

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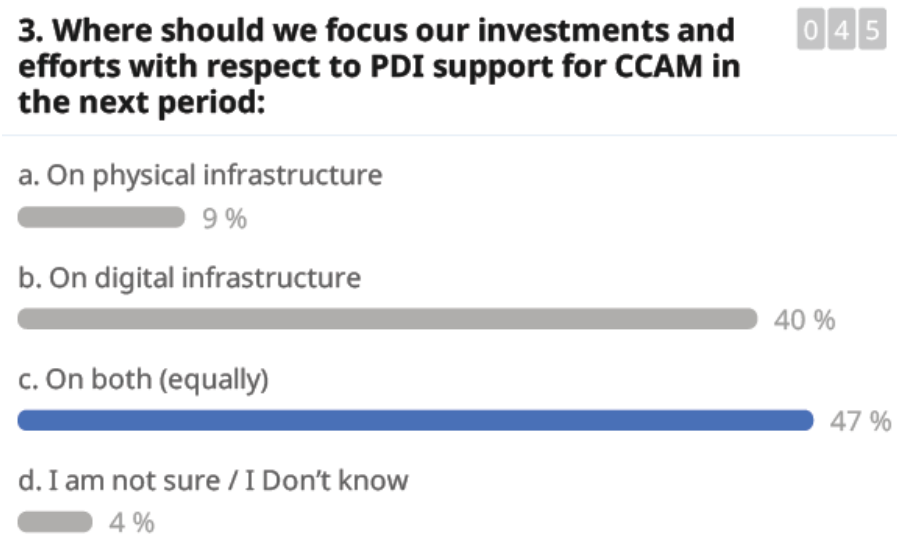

Figure 31: BO5 – results from poll question 3

The strong collaboration needs were also reconfirmed by poll 4 (n=50) on requirements of an infrastructure support for extending ODDs-framework. Only a minority of 12% (actually 4% for each category) stated the opinion that the requirements should be based on the views of either a) Vehicle and AD system developers, b) Road operators/ infrastructure managers or c) Driver/ traveller needs. 20% preferred a combined industry and road operator view whereas a broad majority of more than two thirds (68%) stated that all three views on requirements have to be included.

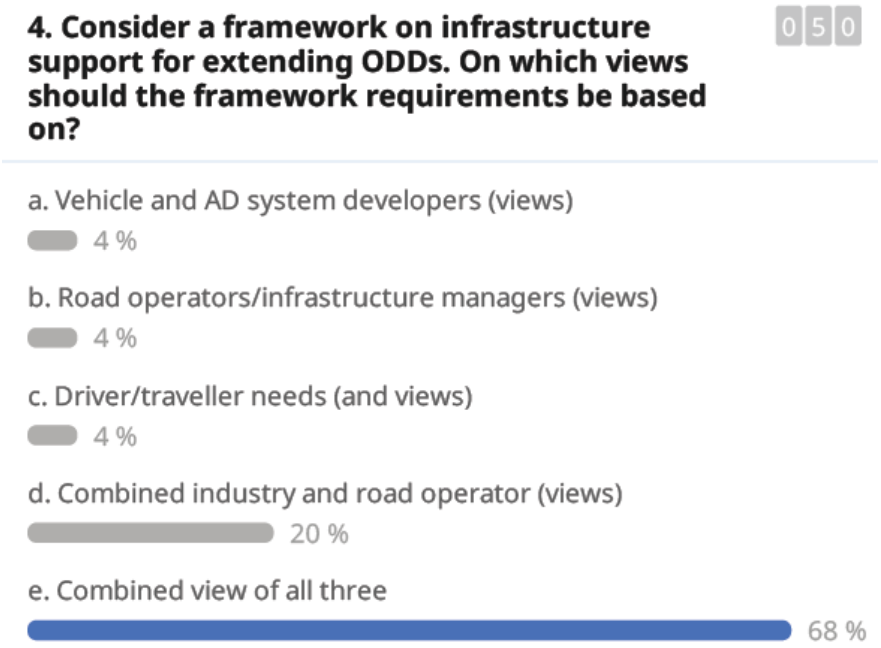

Figure 32: BO5 – results from poll question 4

Two additional polls have asked for the biggest achievement and the greatest challenge in the area of infrastructure support for extending ODDs (poll 5 – n= 21, poll 6 – n =24). The results show that the open questions have led to a reduced number of replies, reaching approximately 50% compared to the other polls. The answers were broad and diverse, with referring to

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MANTRA (translated into successful project in the field) and BIM connections as achievements with at least two mentions. In the same way, digital infrastructure, interoperability and standard interfaces were mentioned as the greatest challenges.

Figure 33: BO5 – results from poll question 5

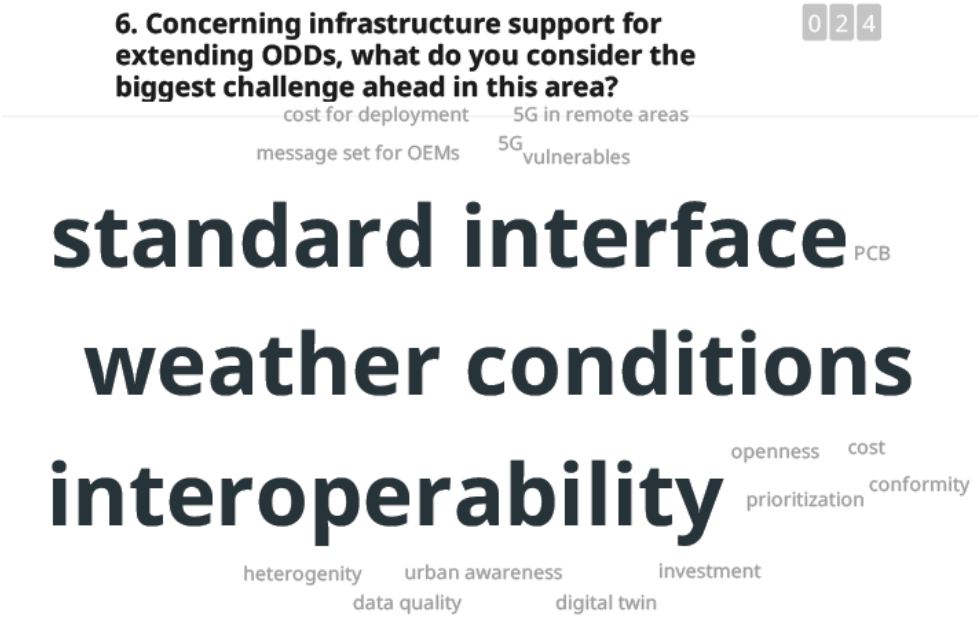

Figure 34: BO5 – results from poll question 6

4.5.3. Questions and answers

The Question & Answer part of the session started with a few reflections on the poll results:

- Are the poll results surprising to you or do they confirm the overall picture?
- What can be suitable next steps for road operators to prepare for CCAM?
- Which could be the next steps for expanding the PDI support for CCAM considering INFRAMIX work/results?

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- How should road infrastructure fulfil automotive requirements regarding functional safety?).

A feasible path for next steps would include connecting the connectable equipment of road operators (cameras, sensors, etc.) in order to improve traffic management and make the information available to connected vehicles in order to extend ODDs. When we look at road markings, then it is highly unlikely that road operator budgets are sufficient to ensure the visibility of road markings at all times. But at the same time, when the road marking quality is known to the traffic management or becomes part of a Digital Twin and is available to vehicles, it would form another key element of road operator next steps towards extending ODDs.

Already completed projects have concentrated on relatively simple highway scenarios, have developed basic messages for C-ITS Day One services, etc. All in all, they have naturally concentrated on low hanging fruits. Suitable next steps comprise a.o. more complex scenarios involving intersections, additional efforts to support standardisation and interoperability of C-ITS messages, not to forget physical infrastructure (beneficial for conventional vehicles/human drivers in mixed fleets) and enhancing the operational part of the infrastructure (e.g. traffic management).

Functional safety represents common terminology in the automotive sector (ISO 26262) but also on the infrastructure side (e.g. traffic lights). IEC 61508 serves as a cross-sector generic standard for functional safety in systems. Obviously, there is common ground already and ideas around on how to combine the two “worlds” of infrastructure and automotive. Clearly, there is a lot of research work ahead which should contribute to a standard how the information provided by infrastructure can be taken up in vehicles meeting the functional safety requirements.

The second part of the Q&A session was devoted to questions provided by the audience. The insights shared can be summarized as follows:

- Linking ODDs and ISAD levels represents a complex exercise. There are different ODD taxonomies (SAE J 3016, BSI PAS 1883) on vehicles side and the ISAD levels that started with a focus on motorways. ODDs are used in the automotive sector whereas ISAD resides in the infrastructure. It is expected that the combination of the two approaches is done by the next wave of projects (e.g. Horizon Europe). It should be noted that the relation between the two approaches is not one-to-one but complex (e.g. one-to-many relations).
- INFRAMIX checked whether any physical traffic signs are missing on three scenarios of road works, dedicated lanes and bottlenecks on highways. It was found that a sign representing dedicated lanes for automated vehicles was missing (see presentation Dr. Lytrivis). In addition, there are studies aiming at machine readability of traffic lights (e.g. by QR codes). Comprehensive studies addressing both topics at once are not yet in place.
- Legal considerations for automated vehicles should start with the question under which conditions automated vehicles are allowed on the road to begin with. Today there is a clear separation of two parts, vehicles which undergo the type approval process and human drivers who get a driving license. The two parts however need to be combined for automated vehicles as for example the technical capabilities of an automated vehicle include driving. There is still work to be done on how to provide a driving test

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for vehicles and the question “How safe is safe enough?” has to be answered. The advantages however comprise more intense testing (compared to humans) and the possibility of virtual testing.

- With regards to headways between vehicles, this is typically not set for human drivers. Automated vehicles communicating with each other – making use of C-ITS – provide the opportunity to reduce distances without compromising safety. Before these modifications can be done, a thorough analysis of the reliability of communication systems, reaction times of vehicles, vehicle inter-brand communication issues, etc., has to take place. Illustrated by the example of a Heavy Goods Vehicles platoon, there are still many open questions on what should happen when the platoon e.g. passes an exit or an entry.
- In a longer term future, we hope to have a digital twin as a kind of ground truth of the conditions at a given time and place. This should enable a more condition-aware traffic management putting the emphasis away from fixed rules to a more fluid management of the traffic.
- The infrastructure equipment depends very much on the operating environments. At higher speed as on motorways the safety requirements are higher. On the contrary, Vulnerable Road Users in urban environments pose different challenges.
- With regards to the layered approach, ISO standards put the physical communication at the bottom (bound to the requirements) and on top there is a service layer where the applications take the data they need. Safety related applications have to match strict requirements (reliable, low latency etc.) whereas infotainment requirements are less strict.

4.6.BO6 - Ethics for CCAM: how can Responsible Research and Innovation answer to ethical challenges?

CCAM is a disruptive technology. The timely, systemic and strategic integration of ethical and societal considerations in the design, development and deployment of CCAM will be essential to ensure its ethical use and positive impact. Panellists will discuss the importance of Responsible Research and Innovation in anticipating unintended or undesirable effects of CCAM, thereby allowing its transition to be safe, just and socially inclusive.

Moderator: Suzanna Kraak, Policy Officer, European Commission, DG RTD

Speakers:

- Jack Stilgoe, Senior Lecturer in Social Studies of Science, Department of Science and Technology Studies, UCL
- Aida Joaquin Acosta, Head of Unit, Spanish Ministry of Transport, Mobility and the Urban Agenda, Affiliate, Berkman Klein Center for Internet and Society, Harvard University
- Filippo Santoni de Sio, Associate Professor in Ethics of Technology, Section Ethics/Philosophy of Technology, TU Delft
- Ebru Dogan, Human Factors & Ethical issues raised by CAV, VEDECOM
- Mikael Ljung Aust, Driver Behaviour Specialist, Volvo Cars

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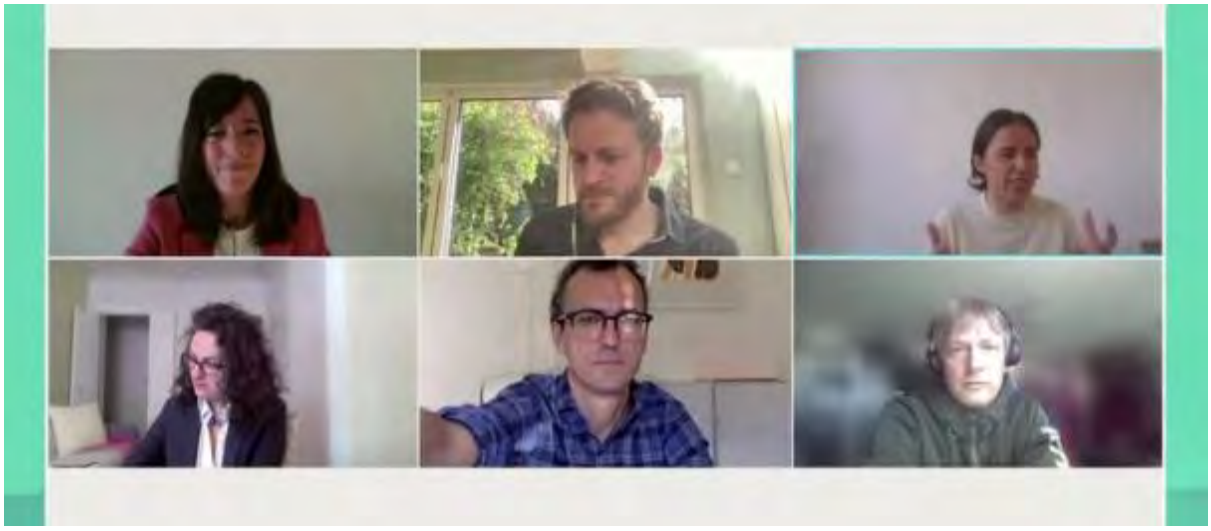

Figure 35: BO6 - (from top left to bottom right) Aida Joaquin Acosta (Spanish Ministry of Transport & Mobility), Jack Stilgoe (UCL), Suzanna Kraak (EC), Ebru Dogan (VEDECOM), Filippo Santoni de Sio (TU Delft), Mikael Ljung Aust (VOLVO)

4.6.1. Key points of interest

- CCAM is a disruptive technology. It can play an essential role in making transport more desirable, healthier, inclusive and sustainable. However, lacking an effective strategy to align its development with societal values, CCAM systems and services can also produce or reinforce inequalities;
- Whether this takes the form of unequal access to specific mobility services, algorithmic bias and discrimination in key enabling technologies, or simply reduced road safety, there is a need to make sure that the transition to CCAM is safe, just and socially inclusive, on both an individual and systems level;
- That is why the timely, systemic and strategic integration of ethical and societal considerations in the design, development and deployment of CCAM will be essential to ensure its ethical use and positive impact;
- Only then will it be possible to truly foster public acceptance and trust in this new form of mobility, and to answer to the grand societal challenges of today and tomorrow, which lie at the intersection of mobility, technology, and democracy;
- Technology is not neutral;
- Responsible research and innovation can increase anticipation, inclusion, reflexivity and responsiveness within innovation systems;
- Shared values, principles and socially desirable goals must be embedded early in the technology and in the governance structures thereof;
- Automation is not an end in and of itself: it will not solve complex societal issues. Public authorities play a crucial role to make the governance of new technologies open, inclusive, transparent and trustworthy;
- Public acceptance of CCAM does not revolve around educating people into adopting new technologies.
- Key question of CCAM: who will benefit?

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Main challenges

- Ethical issues are too often framed in technological terms, in line with the narrative of autonomy, which sees CCAM as a software problem aiming to solve human error, instead of seeing CCAM as a nuanced solution to local and contingent societal challenges;
- Lack of multidisciplinarity in CCAM governance: need for a holistic approach.

Next steps

- Responsible research and innovation must be included early on in the CCAM development process to ensure responsible technological design;
- Initiatives that favour open science, living labs, citizen engagement must be promoted in the development of CCAM;
- Legal and regulatory frameworks that redistribute responsibility and accountability evenly across the entire CCAM network must be developed;
- CCAM developments must be aligned with AI guidelines and frameworks in order to tackle explainability and trustworthiness issues;
- Multi-stakeholder cooperation and public deliberation will be key to address ethical issues and to make sure that CCAM is safe, trustworthy and acceptable by all.

Jack Stilgoe talked about Responsible Research and Innovation (RRI). There is a tendency to hype up technologies, but in parallel forget what their purposes are, and crucially, who will benefit from them, beyond solving human error. RRI is a toolkit to think about technologies in the making. RRI is about increasing anticipation, inclusion, reflexivity and responsiveness within innovation systems. With CCAM, what are the possibilities for building these criteria into the systems, and what are the barriers? There are already some problems: there is a narrative of technological determinism and an emphasis on public acceptance where the role of the public is to accept pre-determined technologies and help realise the potential of new technologies. Under the Driverless Futures project, there was an initiative to have a public dialogue on CCAM run by ScienceWise. 150 people were asked about their hopes and fears in relation to CCAM. The findings were complex and nuanced, and stood in stark contrast from the tech industry narrative in which autonomy privileges AI (i.e. CCAM is a software problem) and which sees solutions as scalable and universal, instead of local and contingent. This narrative is also intentionally disconnected from many stakeholders that are interested in CCAM in relation to cities, specific regions or use-cases. We must think of CCAM as heteronomous technologies that do not just appear out of nowhere and that we have to properly engage with. Important ethical discussions will not come from the narrative of autonomy but from the attachments that these technologies have with the road. These attachments occur within the car (safety drivers, digital connectivity), on the road (relationships of the vehicle with the road and other vehicles, but also bystanders and pedestrians) and with the wider world (regulatory attachments, but also broader social spaces).

Filippo Santoni de Sio explained that philosophy should be part of political and technological discussions. There is a need for interdisciplinary when it comes to understanding technology and politics. Responsibility is a meta condition for other principles and values to be achieved in CCAM, as was presented in the Expert report on Ethics of CAVs. It is also at the core of RRI. Legal liability is leading, as expected. This illustrates well our understanding on responsibility: there is a forward and backward looking conception of responsibility: who will

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pay in case of a crash, who can be legally pursued? Another important notion is forward looking responsibility, so before any accidents happen, to steer the technology into the right direction. This is also a question of governance. An important result of the report was to identify the different responsibilities that are needed in the complex CCAM network in order to answer the question: who needs to do what? This is to avoid responsibility gaps, which is not only about gaps in legislation but also gaps in the understanding of responsibility and on who is supposed to do what. The Meaningful Control project aimed to define the idea of control that surrounds the CAV, in a broader sense, going beyond technical features and looking at the system as a whole: who is meaningfully, politically and technically in control? To achieve meaningful control, it is not just about having a driver or supervisor steering the vehicle, but the vehicle should also respond to the values, principles and reasons of the agents that are both directly and indirectly involved in designing, developing, deploying and operating these vehicles. This will allow these vehicles to display behaviour that is consistent with the intentions and goals of society in general.

Aida Joaquin Acosta described the main challenges in the field of ethics and CCAM, the main one being how to put ethical principles into practice. Many reports have been published to guide the development of AI; we are now coming to a consensus when it comes to these principles, what they look like, and how to put them into practice. Translating ethics and safety into something practical is a complex exercise. Ethics requires a nuanced discussion: a multistakeholder and multidisciplinary approach is crucial, not just in the design of the technology but also in engaging with the users of the technology. Ethics has to be incorporated as soon as possible in the process of designing any new technology. Finally, different stakeholders have different priorities, which can create tensions between the principles. Governments and policymakers have a role to play in prioritising the principles and values we would like to see reflected in the technology and promote a correct integration of these technologies in society, looking at broader implications.

Mikael Ljung Aust talked about the concept of safety in bringing automated vehicles to the market, which takes place in three stages: before the ADS is deployed, before the ADS is activated, and after a crash. From an ethical perspective, two things need to be argued: 1) the automated vehicle should not repeat or fall prey to known human errors in traffic and 2) the automated vehicle should not make robot errors that lead to new types of crashes. As long as the automated vehicle is better than the human driver and achieves better results; there is an incentive to further develop ADS. Yet only simulating human error is not enough: we do not want robot errors that humans would not do, which is why we also look at standards and best practices in hardware and software applications. If we can show that the development of automated vehicles took into consideration current human crashes and variants, then we can say that these will likely be avoided, which relates to accountability and responsibility. Technically speaking, if we follow all safety standards then a crash can be avoided. However, fulfilling safety standards and demonstrating crash scenarios are different problems and they should not be mixed.

Ebru Dogan talked about the AVEthics and SuuAVe projects. In order to build trust in automated vehicles, we have to identify what people worry about and how these worries can be addressed. Research on risk perception shows that laymen and experts have different ways of judging risk, which can be perceived either as 1) how great is the risk and how likely is it to occur; or 2) how acceptable is the risk? Public acceptance of new technologies is more complex than quantitative analyses. So what are public perceptions of ethical issues raised

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by automated vehicles? Results from surveys assessing the acceptability of CAVs ethics policies, in unavoidable accident situations, show that acceptance is very much related to fairness: procedural fairness (fair decision-making process) and outcome fairness (not focusing on the procedures but on the output). Ethics policies that respect procedural fairness and that protect vulnerable road users were considered fair, acceptable and trustworthy by pedestrians and passengers. Yet when passengers had to judge ethics policies that protected only pedestrians, while most found the policy to be fair, they also showed a high level of negative emotions. One of the conclusion is that there is a clear demand for a fair decision-making process. Yet how does fairness relate to trust, and what could be the role of governance to foster this type of trust? When people do not have access to or knowledge of new technologies, they turn to the trustworthiness of authorities, which can be problematic. People have fluctuating levels of trust in authorities and often question the legitimacy of governance bodies, which shows that there is a gap in addressing trust in decision-making and a stronger role to play for public authorities in building trust between citizens and new technologies.

4.6.2. Results from the interactive polls

The audience was asked to give their opinions at several points during the session. Here are the questions which they were asked to answer to and the results to these polls:

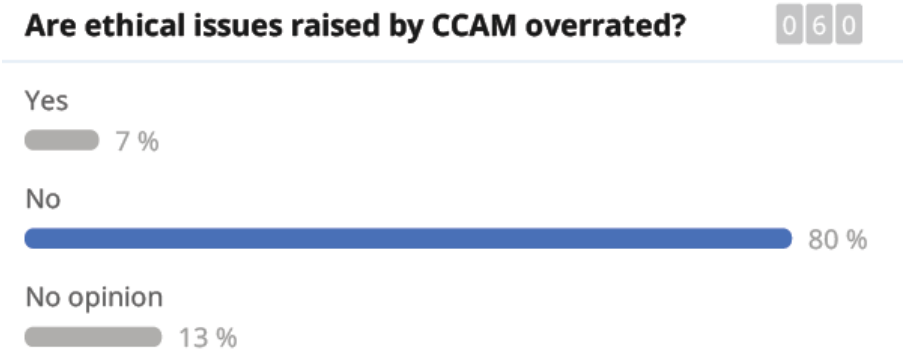

Figure 36: BO6 – results from poll question 1

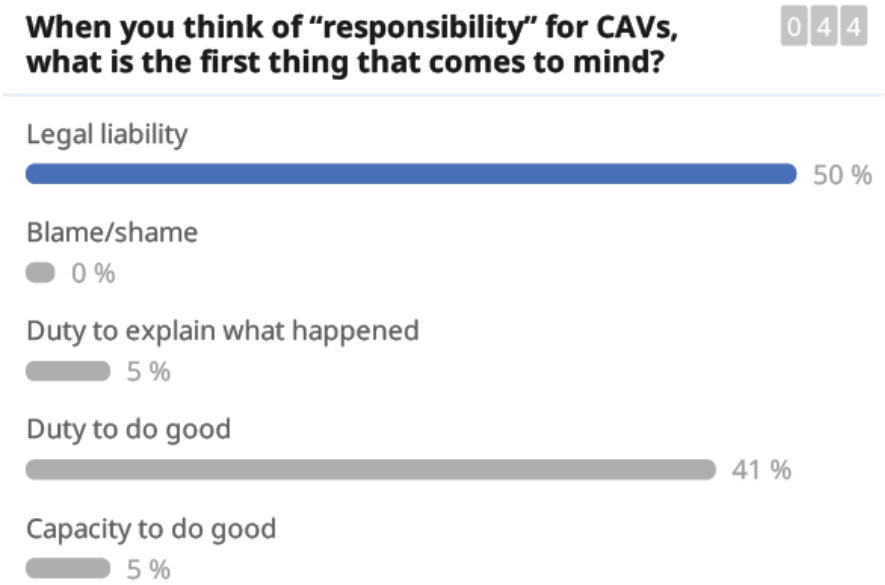

Figure 37: BO6 – results from poll question 2

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80% of participants think the AV should have a stop button. The main argument in favour of a stop button relates to safety: technology can fail, is hackable, so you need to have a human in the loop. Another argument is that a stop button can increase the perception of trust in cities and societies: people have control of the machine so this increases their acceptance. Arguments against a stop button relate to human-machine interactions: how do you safely transfer driving tasks between humans and machines? Another argument against are design constraints: if you have a stop button, you need a wheel or a joystick for a passenger to take over, who also needs a valid driver's licence.

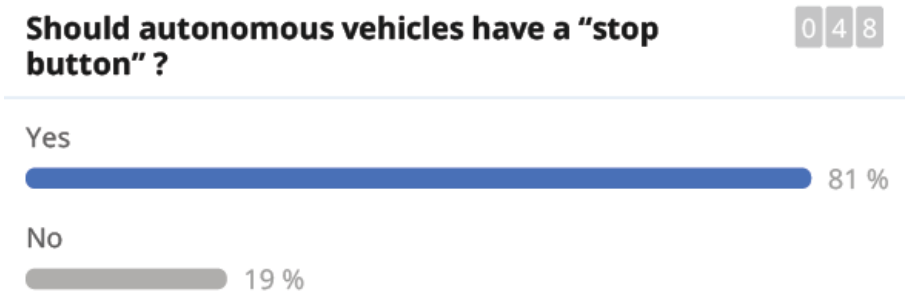

Figure 38: BO6 – results from poll question 3

4.6.3. Question and answers

What is the added-value of addressing ethics in CCAM?

For Filippo Santoni de Sio, ethics is not overrated and we must engage in ethical discussions because there is no alternative and because technology will always be driven by specific goals, principles and values. Either we accept the dominant, existing political structure that is pushing for the technology, or we discuss, as a society, if we agree with it or not. Ethics is unavoidable, it should be open, democratic and consistent with shared principles that we endorse as European citizens. A usual objection to ethics is that it is too subjective or that it changes too often, but in reality, across the centuries, we have managed to agree on solid basic principles, especially in the EU. This should be our starting point to translate these principles into elements that can be used in policy and responsible technological design.

How can we understand the underlying goals that are pushing for specific technologies?

Jack Stilgoe thinks that ethics is not overrated and we must discuss together the world that we want to see, because technology left to its own devices will not be able to answer these questions to our satisfaction. Are these questions best framed in terms of ethics?: no. Instead, the actual questions we have to look at are the three questions of politics: who benefits, who pays, who decides? The real problem is technological determinism: some innovators take the question of ethics and think it is solvable or fixable. Ethics then becomes too easily framed in technological terms, whereas the question of "who benefits" is much harder to frame and answer.

Is ethics the right starting point when looking at the impact of new technologies?

Regardless if it is, said Aida Joaquin Acosta, the most important part is the content: every implementation of technology has ethical stands, values and interests. Technology neutral does not exist: designers, engineers, policymakers each have unconscious biases that shape

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the technology, which in turn shapes and affects society as a whole. Technology puts forward values and principles and is certainly not neutral.

Ebru Dogan added that it does not matter how we call it but it should provide recommendations that we need to respect when it comes to new and emerging technologies. Safety is a key pillar of the Expert Group report: what new, safety benchmarks do we need to put ethical principles in practice?

For Mikael Ljung Aust, the safety question changes when you put a timeline on it. Engineers would want to do a trillion tests before they release a product to make sure it is safe. But if you want to put a product on the market, you notice that there is no real ethical discussion in the philosophical sense within the industry side, so that is a challenge. One way people talk about CCAM is to anthropomorphise it, which people often do for any inanimate object in order to give it a soul or a personality. For CCAM, people tend to create a personality for ADS, and when CCAM will be deployed on our roads in the future, people will ask about the personality of this “driver” and what kind of person it is. And in that sense, the system will have to share the same views as humans: for example, it should make the necessary distinction when identifying living things on the road, whether they are animals or children, as real humans do. If you are on a timeline, these safety questions will distribute your development budget because if you cannot protect children with high reliability than you cannot deploy your ADS. Therefore, a key question is how to distribute the right resources during the development.

How does the idea of redistribution relate to CCAM, for example in terms of responsibility, risks?

Filippo Santoni de Sio thinks that this is linked to the narrative of autonomy, which presents technology as taking responsibility away from humans, but really, automation redistributes responsibility in a new way. The ethics expert report calls for a mapping of these new responsibilities within the socio-technical system so that every actor is assigned a fair share of responsibility and the right mental, cognitive and moral capacities to discharge these responsibilities. This also goes for safety: automation will not create systems with no human supervision whatsoever. You cannot eliminate people from the road; people will still be in and around the vehicle. Who, then, should be safe and how is safety distributed? How can we manage these safety trade-offs? We should actually be more demanding than simply look at safety benchmarks that need adjusting, and have a societal discussion on what are the expectations in terms of safety.

Jack Stilgoe added a point about clearing ‘people’ off the road to enable AVs, which seems inevitable and happened with the arrival of the motor car a hundred years ago: safety promises were realised was by domesticating streets and giving them over to cars. The same will happen with CCAM where we will need closed systems in order to protect people and ensure their safety. This is not fundamentally bad if the safety benefits are great. Yet it is a big thing to do to the fabric of a city, to roads and to social spaces and thus necessitates a democratic discussion.

How can we have these democratic discussions? And also increase the perception of trust?

According to Aida Joaquin Acosta, perception is subjective so it depends on how we encourage people to use new technologies. Governance plays a big role in that and can shape the technology for the public good, right from the designing phase, thereby maximising the

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potential benefits and minimising risks, whether related to safety or exclusion, for a positive impact on our cities and our roads. If active public policies are closely aligned with industry, then proposed solutions can really be tailored to people's needs, show the benefits of CCAM and ultimately increase trust. Safety is one way to increase trust but there are many elements to consider from a public policy perspective: we need a holistic approach.

How can we foster a common understanding of CCAM between experts and non-experts?

Ebru Dogan mentioned that non-experts are worried about responsibility in moral terms, and not just in legal terms. One way to address this gap and to communicate to non-experts is public deliberation: Europe is investing in citizen science and in living labs, which are great initiatives to bring people together and have these deliberations.

How does explainability relate to CCAM? Is it a part of legal liability as well?

For Filippo Santoni de Sio, explainability is certainly a key element, under the broader concept of accountability. Accountability is at the same time a technical, legal, moral or organisational issue. You cannot impose legal accountability on subjects that do not have the technical, moral, mental capacity and motivation to do so. We need legal incentives and regulation to promote explainability and accountability, but then we must also structure the organisations, educational programs and the technology to make these explanations possible. Explainable AI is a technical solution but it will not be enough, you need legal incentives as well.

Mikael Ljung Aust added that explainability comes in many flavours: e.g. explaining crashes that look like mistakes humans can make so that these are not repeated. On the other hand, there are also unpredictable robots' errors for which we cannot attest with full certainty that a human would do better. In addition, there are other ways of arguing that the product is safe, such as adherence to standards, transparent process and documentation, etc.

This is all in line with reducing the complexity of CCAM. How can reducing complexity help to achieve complementary solutions?

Jack Stilgoe answered that safe driverless systems already exist for decades but they are boring; they will not excite the attention of European innovation policymakers. We have to start by looking at what our needs are, not at what is technologically exciting.

How can explainable AI initiatives go hand in hand with future CCAM developments?

Aida Joaquin Acosta said that autonomous vehicles can be seen as a case study for AI, and the learnings we are gathering can eventually be generalised to other applications of AI. A sectoral approach is good to get started, after which we can extrapolate results to a more general use of AI. Starting with different sectors allows us to imbed ethical values and principles into concrete examples. The recent European Commission's proposal for a legal framework for AI is a great start, pending input from the European Parliament and Council. This will help us to approach risk in relevant AI systems so that these systems make explainable decisions. This is also a question of having unbiased data feed into the algorithms of automated vehicles.

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How can we collectively invest in societal values? Can a multi-stakeholder approach harmonise these values and principles?

Filippo Santoni de Sio mentioned the GDPR as an example in Europe of attempts to integrate political values into technology. Under the GDPR, we agreed that privacy should be an important value. Yet we realised too late that it should be embedded in the technical systems early on. Ethics by design is crucial. We should build up on the GDPR experience in Europe, not to repeat the same mistakes for CCAM, and have conversations with companies at the inception stage to design responsible CCAM technologies, to embed the right values, via legislation but also through education and engagement with society.

Jack Stillgoe added that the right democratic question about explainability would be: explainable to whom? Who is responsible for explaining what went on when things go wrong? Legitimate access to the data in case of a crash is needed, as we do with airplanes. The owner or the designer of the airplane will not have access to the data to explain what happened in case of a crash, there are independent bodies that do that. So there are proposals for ethical black boxes for CCAM and we should push for that.

4.7.BO7 - Human Factors of remote control operation: what are the lessons learned and future challenges?

Tele- and remote-operation involve the remote connection and control of automated systems and vehicles by human operators. This session includes presentations and discusses about how we manage the human factors and safety challenges of this methodology, such as ensuring good operator situation awareness, aiding decision-making and overcoming latency issues.

Moderator: Natasha Merat, Professor, Head of Human Factors & Safety Group, ITS Leeds

Speakers:

- Azra Habibovic, Senior Researcher, RISE (download presentation)
- Joanne Harbluk, Human Factors Specialist, Transport Canada (download presentation)
- Rose-Marie Hellqvist, UX Engineer, Volvo (download presentation)
- Satoshi Kitazaki, Director, Automotive Human Factors Research Centre, National Institute of Advanced Industrial Science and Technology (AIST) (download presentation)

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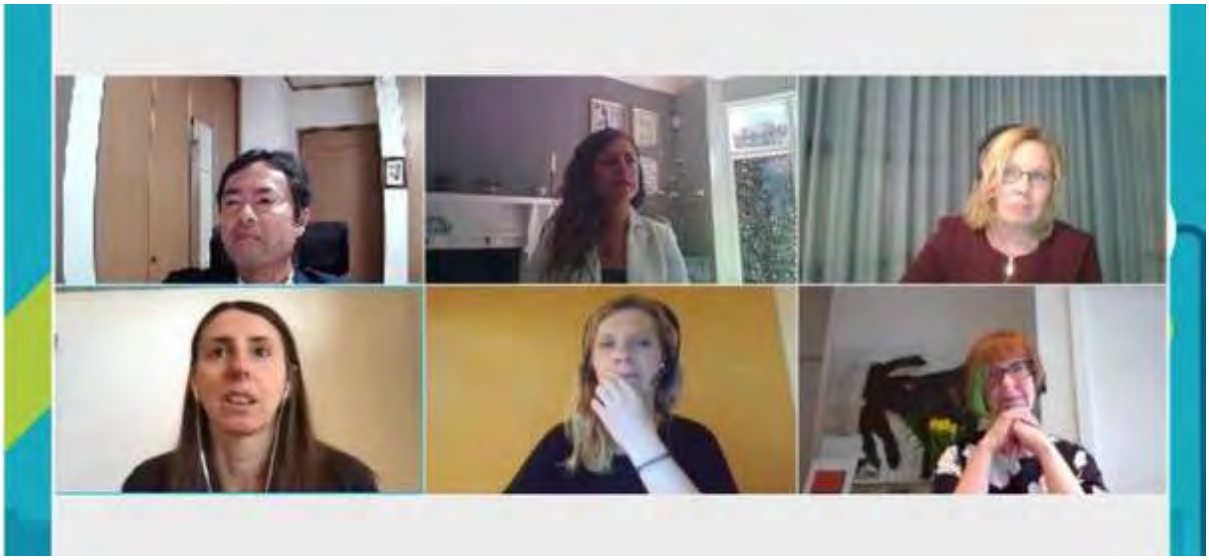

Figure 39: BO7 - (from top left to bottom right) Satoshi Kitazaki (AIST), Natasha Merat (LEEDS), Rose-Marie Hellquist (Volvo), Azra Habibovic (RISE), Emma Johansson (Volvo), Joanne Harbluk (Transport Canada)

4.7.1. Key points of interest

This session included presentations and discussions about how we manage the human factors and safety challenges of this methodology, such as ensuring good operator situation awareness, aiding decision-making and overcoming latency issues. Presentations included different type of remote control suggested by different actors on the market, overview of identified research gaps as well as examples of research activities and pilots. Most questions from the audience were about training and education of the operator, how to design the interaction between the vehicles/machines and the remote operator in order to ensure appropriate situational awareness, etc. Other questions concerned the issue with latency/lag both with regard to being able to handle critical situations (*if* that is expected) but also for being able to handle normal operation without feeling nausea, etc.

- Tele- and remote operation involve the remote connection and control of automated systems and vehicles by human operators.
- About 30% of the session participants had some experience of working with remote/teleoperation (manual or automated) and the majority of them felt that teleoperation could accelerate the deployment of automated vehicles both before and after the session.

Next steps

The key priorities for future work are:

- building a common framework including for example a common taxonomy, etc.
- highlighting situations where remote operation might not be appropriate;
- the need for international collaboration in both performing research as well as sharing of the results and finalise;
- work on common standardization.

Azra Habibovic presented an overview of what different actors (e.g. ArgoAI, Cruise, Yandex, Nuro, Volvo, Waymo, Ericsson and Scania, Einride) suggest as part of their plans for remote control. Some suggest remote control on a more *strategical* level, i.e. the remote operator can

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plan trips by feeding destination goals to the vehicle, etc., on a more *tactical* level, i.e. enables the remote operator to help the vehicle understand and handle a given situation, as well as to provide it with guidance on how to proceed) or on an *operational* level, i.e. active control where the remote operator can "drive" the vehicle (e.g., when the vehicle is stuck in a complex situation). An overview of identified research gaps in the field of remote operation and human factors was given (see Figure below), dividing topics into e.g. organization, individual operator, tasks, Human Machine Interface/Interaction and in the operational design domain.

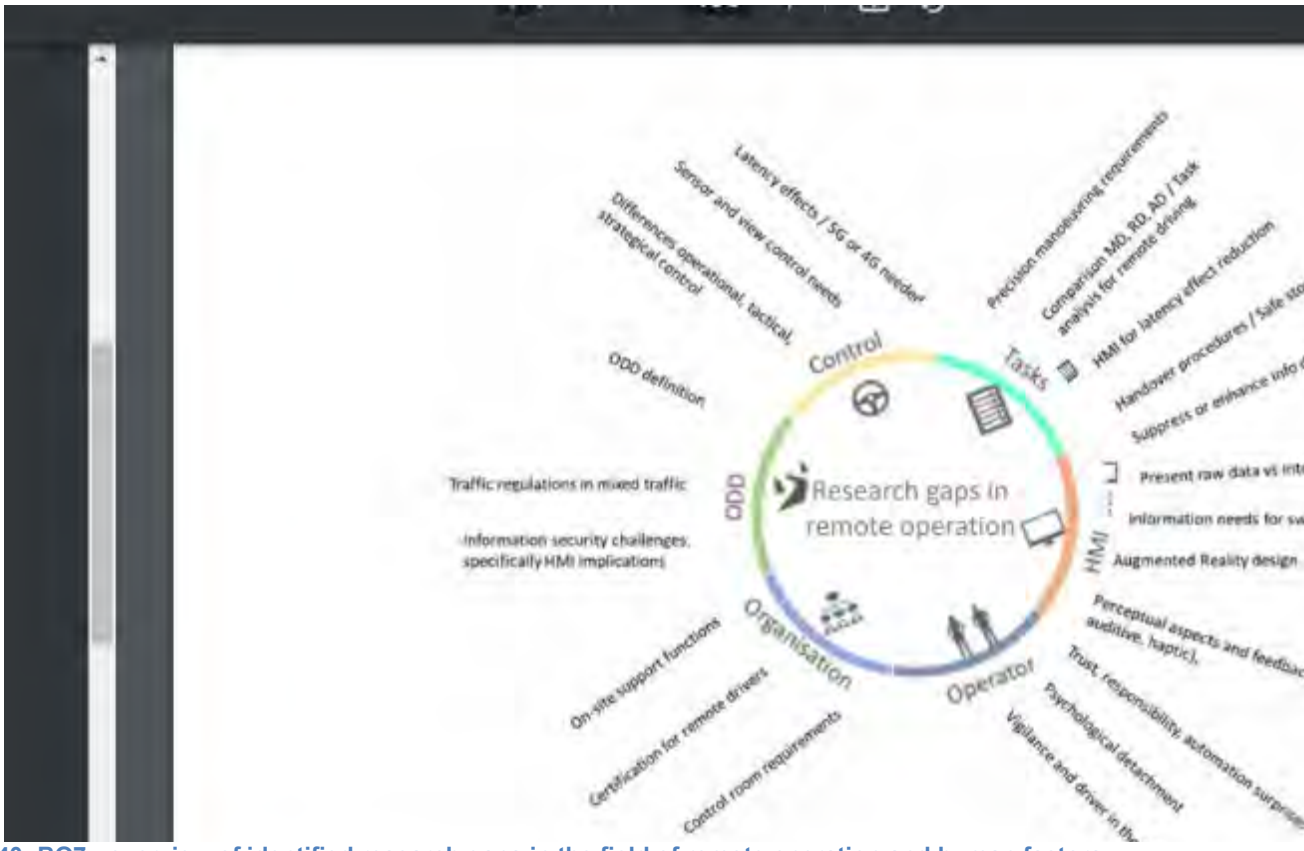

Figure 40: BO7 - overview of identified research gaps in the field of remote operation and human factors

Joanne Harbluk continued with an overview of the different types of remote operation foreseen as well as identified research needs from a Human Factors perspective. She gave a brief overview of the position paper written by the group 'Human Factors in International Regulations for Automated Driving Systems' (HF-IRADS) which was provided as input to support UNECE activities addressing the safety of automated driving systems. She continued with a presentation of work done by the Automated Vehicle Safety Consortium (AVSC, an industry program of SAE) on a use case for a 'Passenger-Initiated Emergency Feature' which outlined the potential interaction between a passenger onboard and a fleet operator.

Rose-Marie Hellquist presented examples from several on-going projects which include autonomous and remotely operated solutions within the Volvo Group. Different feedback and control solutions are currently explored in order to understand what human factors as well as technical requirements needs to be placed on the communication between Volvo's remote-control platform and the machine(s). Rose-Marie emphasized the importance of collaboration both with Volvo's commercial customers as well as with the research community.

Satoshi Kitazaki presented some of the insights into safety related human factors in automated shuttle and bus services in Japan. The experiments presented took part on public

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roads in different locations in Japan and involved on-board staff as well as a remote operation set-up. In addition to the vehicle's perception platform, the vehicles were equipped with front, side and rear-view cameras for the remote operator. The remote operator's task was to respond to alerts although s/he was not supposed to continuously monitor the road events and respond to sudden events. A monitoring system ensuring the attentiveness of the remote operator was also in place. The vehicles were equipped with on-board emergency button to be used by passengers if needed as well as external HMI in order to communicate automation state, when controlled remotely, etc. In addition to the above studied Satoshi Kitazaki presented work done to assess how many vehicles would be reasonable for a remote operator to supervise and control when needed, in what operational design domain, what speed thresholds, etc.

4.7.2. Results from the interactive polls

Participants in the session were asked the same question at the beginning and at the end of the session, to see if opinions were different after hearing the speakers' presentations. Less participants were without an opinion at the end of session, and both sides were reinforced, with still a majority believing that teleoperation can accelerate automated vehicles' deployment.

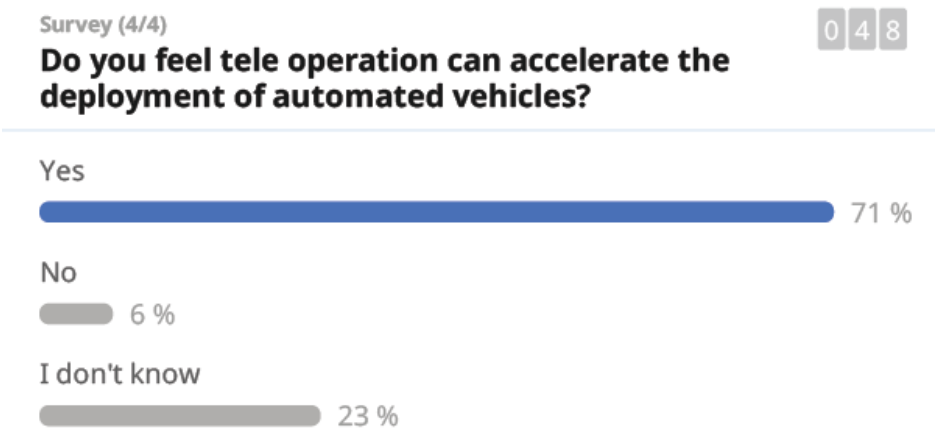

Figure 41: BO7 – results from poll question at session's start

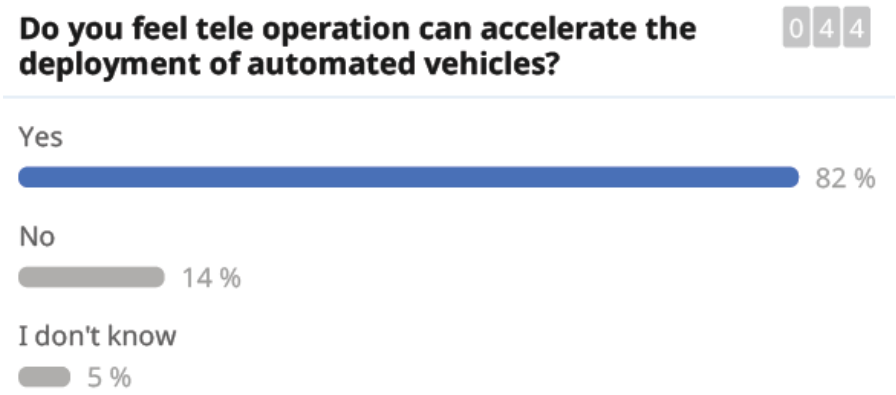

Figure 42 BO7 – results from poll question at session's end

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4.7.3. Questions and answers

The following questions were received from the audience and are grouped into categories.

Are there different challenges for different domains?

- Open road vs. Confined areas. There are differences if you run your operation on open road in mixed traffic vs. if your vehicles/machines are running in more confined areas. The latter are more well-defined and it have an impact on the role of the operator etc.
- Safety criticality. If the operator makes a mistake in one field it might not be as dangerous as in others.
- Heavy automated vehicles vs. small autonomous pods. These might operate in very different areas /Operational design domains (e.g. speed thresholds, infrastructure) and this might result in different Human Factors requirements.

Training

- The learning/training time to be able to run something in normal conditions isn't necessarily very long. Experience is that it might take 3-4 days for an operator to learn how to remotely operate machine/vehicles in very confined areas. However, the difficult part has not been to learn to perform quite difficult tasks but to avoid complacency with the technology and make sure the operator remains very conscious about safety.
- There is a worry about sk. edge cases for the remote operator and especially if the remote operator is supposed to actively operate the vehicle through such a situation. This is nothing that the operator easily will be able to practice and it's something that might happen very seldom.

Situational awareness – what is needed for the operator to be able to interact

- For most concepts there are several screens to present the surroundings of the vehicle. Often you might have more info and a better view than in the actual vehicle. You also have information available about sensors and confidence levels of the system, etc. The challenge here is to avoid information overload and design a good workstation where the design sorts out what information to present at the right time. Classical issues with cognitive workload, vigilance and distraction are all very important.

Latency/Lag – what are the issues?

- Important to consider the chain of interaction and how it might affect the operator. Something happens in the vehicle. Information is sent to the operator. The operator needs to synthesize it. Need to make sense of it and then respond. Time lag throughout this chain of interaction is important to take into account when designing the interaction.
- In the Japanese on-road studies the time lag was roughly 500 ms. In those experiments trained operators could control these vehicles in low speeds but only after training. It was possible to do with the existing lag. It depends though on the task of the operator (surveillance vs. active control) and how many vehicles the operator are monitoring and what the operator is supposed to do in a given situation.

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- Some evaluations were done in Sweden on latency and its effect on the operator when it comes non-safety critical situations. It was for example important to reduce lag to avoid nausea etc. At the same time, it highly depends on the application and the task of the operator (e.g. strategic or hands on driving).
- What connections are needed? 5G was not used in the Japanese studies or not foreseen as a must by Volvo but for time critical situations RISE foresee that 5G is needed.

Interaction with passengers

- Transport Canada has done some research on the interaction between passengers and the remote operator. In these studies, the degree of trust and comfort depended on the speed of the vehicle and the operational design domain in general. Research indicated that passengers might need more possibilities of more sophisticated interaction at higher speeds.
- In the Japanese shuttles the remote operator interacted by checking that the passengers were seated properly in order to start and not more than that. However, the trial was running in very low speeds and the route was very short.

What about standards and a general knowledge framework?

- We need to create more standardized ways for communication with remote operator
- Standardized taxonomy and definitions
- In the just recently updated SAE J3016 the section on remote operation is more extensive and Azra foresee an even larger focus on dedicated vehicles and remote control there in the future.
- It is important to bring in the regulatory and ethical perspectives to ensure liability etc. What happens if a crash is caused while the remote operator is in control?

4.8.BO8 - Standardisation and roadworthiness in CCAM: what are the achievements and next steps?

Moving from Driving Assistance to Automated Driving functions, new challenges come into play, demanding new standards, in particular for safety validation and roadworthiness of Automated Vehicles. This session addresses the current and planned R&I contributions to standards and explores the latest regulations for CCAM and how they would benefit from standardisation activities. In particular, this session highlights the major challenges and open questions that slow down or even impede a safe and widespread commercialisation of Automated Vehicles.

Moderator: Filippo Visintainer, Technical Fellow, FCA-CRF

Speakers:

- Nikki Kidd, Manager, Strategic Initiatives, CSA Group (Canadian Standards Association) | Geoff Knapp, Principal Consultant Smart Mobility, WSP Canada
- Thomas Zielke, Professor and Researcher, Faculty of Mechanical and Process Engineering, Hochschule Düsseldorf
- Oihana Otaegui, Head of ITS and Engineering Department, Vicomtech
- Marta Tobar, Project Manager Research & Development, Applus+ IDIADA

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- Maria-Cristina Galassi, Scientific Project Officer, Joint Research Centre (JRC), European Commission

Figure 43: BO8 - (from top left to bottom right) Maria-Cristina Galassi (JRC), Filippo Visintainer (FCA-CRF), Marta Tobar (IDIADA), Geoff Knapp (WSP Canada), Oihana Otaegui (Vicomtech), Nikki Kidd (CSA), Thomas Zielke (HS Düsseldorf)

4.8.1. Key points of interest

- Importance of cooperation within different stakeholders in order to develop new standards
- Trustworthiness and the inclusion of AI is very relevant as it can be a very disruptive element in the CCAM ecosystem
- Standards in the testing toolchain of Connected and Automated Driving are key for its correct implementation
- Safety validation in automated vehicles is a challenge not just from the regulatory point of view, but also for those that need to work with regulations:
- Regulation of AVs is currently under development within Europe including a new approach that involves audits, physical testing and monitoring during the operation of the vehicle

Main challenges

- Several challenges identified by GSA as key for the standardisation process: Harmonization and interoperability; uncertainty with Enabling Communication Technologies; Compliance verification; Physical infrastructure; AI and new enablers
- Identify and define methods and workflows that can assess the robustness of AI.
- Technical services need to keep up the pace for new testing needs: qualified staff, appropriate facilities, continuous training in different disciplines, participation in the rulemaking process
- From the regulatory point of view, there is a need to make a prioritisation between the various scenarios available

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Next steps

- GSA: Roadmap definition and cooperation with the US.
- JRC: Continue the development of the regulation towards the safe deployment of CCAM systems

The activities within the GSA in Canada have highlighted the importance of cooperation within different stakeholders in order to assess the how to proceed with standardisation processes and commonly agreed codes that support the deployment of AVs. GSA has also highlighted the different challenges that have to be faced in the context of standardisation.

Among them, trustworthiness and the inclusion of AI is very relevant as it can be a very disruptive element in the CCAM ecosystem. **Tomas Zielke** showed the different initiatives on standardisation of AI in the context of automation and how one of the main goals is to identify and define methods and workflows that can assess the robustness of AI.

Standards in the testing toolchain of Connected and Automated Driving are key for its correct implementation. **Oihana Otaegui** presented the latest initiatives within the framework of ASAM and its standard families and has shown how the EU funded HEADSTART Project is integrating and considering these standards as part of its validation methodology.

Safety validation in automated vehicles is a challenge not just from the regulatory point of view, but also for those that need to work with regulations. Technical services need to keep the pace with the technology to be able to fulfil their role in the type approval process. **Marta Tobar** identified within these challenges which are not just technical but also related to expertise. We are moving from a mechanical engineering world into a multi-disciplinary one which requires knowledge from all the participants in the value-chain.

Maria Cristina Galassi from JRC made an overview of the position of the EC and how regulation is not just foreseen but also currently being implemented in Europe through different tools (e.g. EU guidelines) and/or regulations in Europe (e.g. General Safety Regulation) as well as at UNECE levels (R.155, R.156 and specially R.157). And that regulation will move forward and will include shuttles, advanced ADAS and SAE Levels 3 and 4 in general.

4.8.2. Results from the interactive polls

The audience was asked to give their opinions at several points during the session. We have been able to discuss with the panellists the result of the polls. From a general point of view, the audience has supported/voted those options that rely on safety as one of the most important challenges for CCAM deployment.

Data related to safety incidents, accidents or near misses was voted as the kind of data that is more relevant to acquire. But this data requires also of tools to get the most of it (e.g. big data) and take into account to which stakeholder group are targeted (policy makers, road operators, developers, general audience, etc.). It was also highlighted that communication of this data is beneficial for all stakeholders. For example, aviation has the good practice of sharing data and lessons learned as a way to improve overall safety.

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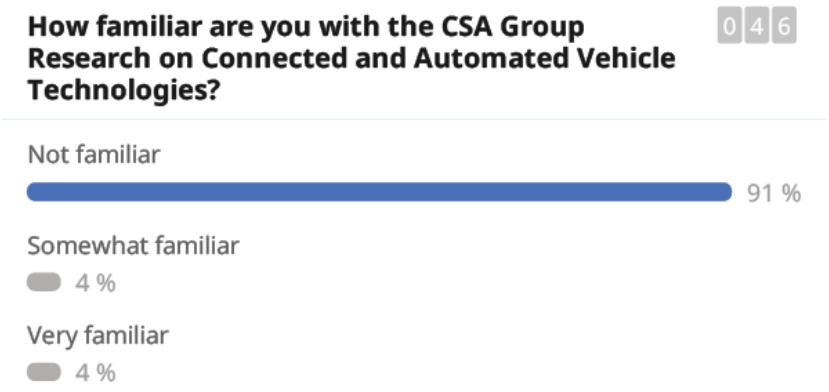

Figure 44: BO8 – results from poll question 1

Figure 45: BO8 – results from poll question 2

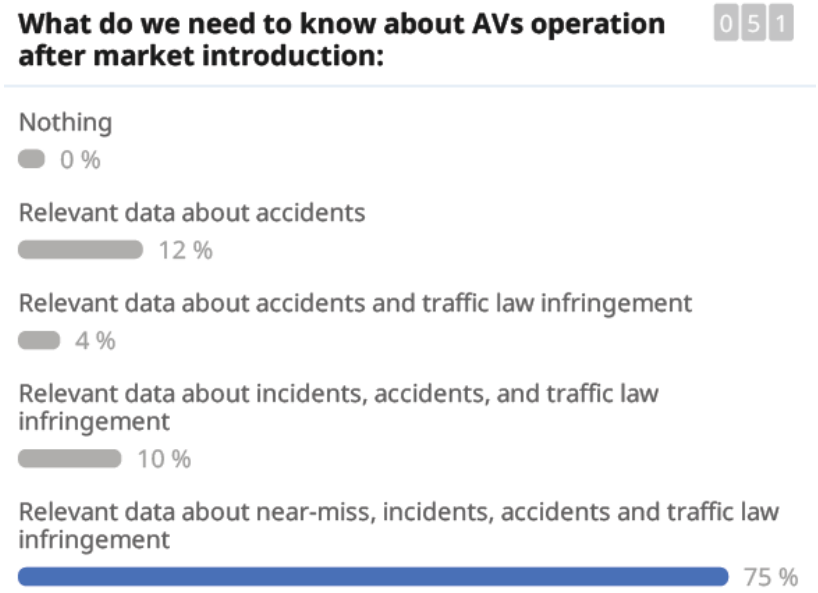

Figure 46: BO8 – results from poll question 3

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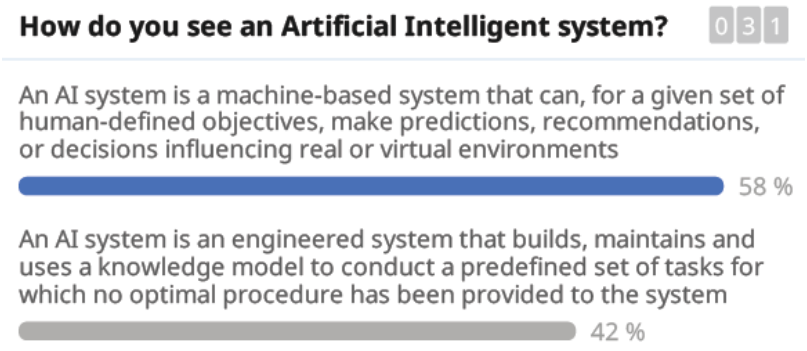

Figure 47: BO8 – results from poll question 4

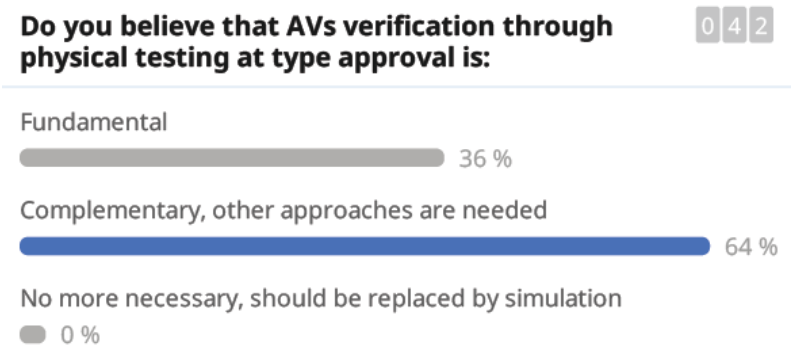

Figure 48: BO8 – results from poll question 5

4.9.BO9 - Accessible & Meaningful: what does it take to make CCAM stand for Citizen's choice?

The CCAM evolution can bring desired impacts only if it is appreciated and used by citizens. Panellists will share practical and unique findings from different approaches to involve citizens in CCAM developments, including citizen dialogues based on deliberation, living labs and co-creation events to ideate and collaborate on possible solutions (ideathons). The audience is invited to an interactive workshop with panellists about opportunities and limitations of the different approaches when it comes to foster appreciated and attractive CCAM developments.

Moderator: Ingrid Skogsmo, Senior Research Leader Future Transportation, Swedish National Road and Transport Research Institute (VTI) (download presentation)

Speakers:

- Jordi Ortuño Ribé, Mobility & Urban Innovation Manager, Barcelona City Council
- Delphine Grandsart, Research Officer, European Passengers' Federation
- Maria Alonso Raposo, Scientific / Technical Project Officer, Joint Research Centre (JRC), European Commission
- Vaike Fors, Associate Professor of Pedagogy, Halmstad University
- Manon Potet, Citizen Participation Consultant, Missions Publiques

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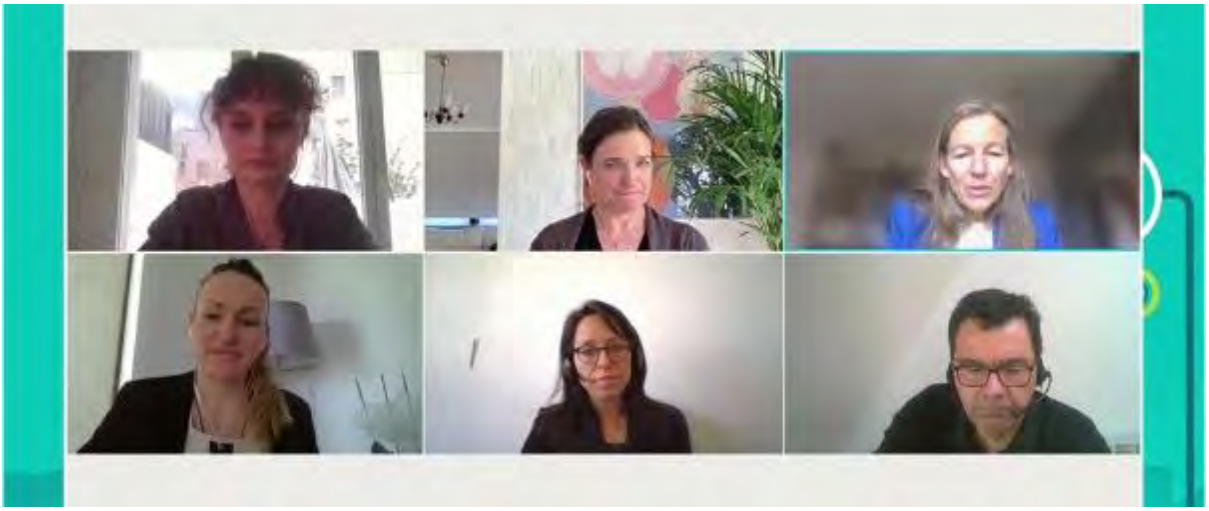

Figure 49: BO9 - (from top left to bottom right) Manon Potet (Missions Publiques), Vaike Fors (HH), Ingrid Skogsmo (VTI), Maria Alonso Raposo (JRC), Delphine Grandsart (EPF), Jordi Ortuño Ribé (Barcelona City Council)

4.9.1. Key points of interest

- It is time to truly involve the citizens, throughout the process, to listen to what they value, and be prepared to act on input. There are several approaches to create public engagement for a meaningful CCAM development.
- It is very important to move from “consumerist view” of “users out there” to think about how we can really encompass the persons that we are in society and make CCAM meaningful for them.
- Technology must have a purpose, and we need to make sure that deployment aligns with expectations and needs of citizens. For that we need to involve citizens for the long term.
- “User acceptance” puts the users in the back seat – for them to accept solutions. In addition, it’s not just what citizens individually need that has to be in focus, but also what they value, what they know, what they already do.
- Public engagement is needed from people to engage in the technology solutions that are open for them, but also for researchers, developers, policy makers to engage in what is not only good from your own agenda but also what seems to work, in what way can we move into these communities and talk to people that engages them.
- Let the citizens be involved in the process – take into account people from the beginning and empowering them in the process you have their engagement. When starting thinking about actually installing and actually implementing a new service: involve citizens and invite to provide feedback at all the stages of development: is the new service valuable? What value can it have? (vs asking only in hindsight)
- First step is listening to the citizens, asking them what are their needs, and really also listening to them – the next step is the willingness to act upon input –implementing the input and having the will to do something with it – will also lead to user acceptance and willingness to be involved.
- Provide the opportunity to share information with citizens and foster deliberative discussions between different societal groups, adopt inclusive approaches, and at the same time provide them with spaces where they can co-create so they can be creative and provide ideas and be part of the process.

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- Long term structural involvement is also needed: Citizens and passengers could have representation e.g. in transport operators' boards.

Main Challenges

- The CCAM evolution can bring desired impacts only if it is appreciated and used by citizens.
- There are numerous roadmaps for CCAM development. Several of these portray new types of vehicles in adequately designed infrastructures that will be introduced over time, with limited attention to the public at large which includes all kinds of people.
- There are large expectations on CCAM's contribution to reach societal targets.

Next steps

- Experimenting with an electrical vehicle in the living lab: first validate technology, then deploy real on site mobility service for people to experience.

Only by making CCAM accessible and meaningful can it come to stand for "Citizen's Choice – Accessible & Meaningful". But what does it take? The theme was addressed by five invited panellists representing five different approaches to involve and approach citizens.

Jordi Ortuño Ribe gave a brief overview of Decidim, a digital tool for Engaging Citizens in a co-creation process on Urban Mobility. It is a free and open source software, flexible and adaptable to any needs and strategy, and it has been applied in decidiUM, a project of European Institute of Innovation and Technology Urban Mobility (EIT UM) in its call about citizen engagement. Challenges identified during the project were to create awareness of EUIT UM among citizens and end-users, and create opportunities to experience new products, systems and services. One example of collaboration between EIT UM and different interest groups was Bybus, a bus service for areas with low density traffic. Lessons learnt include that it takes time to get user's engagement in providing feedback, and it is important to make the means of interaction simple and easily accessible.

Delphine Grandsart presented the approach and first insights from the SHOW (SHared automation Operating models for Worldwide adoption) H2020 project Ideathon in January 2021, which is a brainstorming session with citizens and local stakeholders to co-design and co-create ideas, and get input possible conditions for user acceptance. Results/ ideas feed into the rest of the project, or are used for hackathons to develop prototypes which in turn are intended to be used in SHOW pilots.

Maria Alonso Raposo talked about engaging citizens as co-creators of CCAM in real-life living lab environments. The future mobility solutions living lab (FKS-Lab), implemented at JRC (Ispra, Italy) has undertaken a mobility survey targeting ISPRA staff population about their mobility habits and needs, to understand the mobility context, including post-pandemic commuting practices among respondents. More than 75% of respondents use personal car to commute and expect to continue to do so also after covid, but many are ready to also embrace more climate friendly forms (e.g. bike). 60% would use on-site planned automated solutions such as on-demand delivery service (mainly for lunch delivery), 53% would use autonomous shuttle on-site, most at least 1 /week.

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Vaike Fors spoke about co-creating future mobility in design ethnographic urban living labs. AHA – a human approach – is a design ethnographic lab for future urban mobility, design with instead of for people. Project participants (including municipalities, car manufacturer, public transport provider), in 2 residential areas (urban living labs) selected to find people that are normally not asked about R&I development (lower income, urban area, mainly populated with people born outside Sweden, strong social community). After getting to know the people's local values and knowledge – not only needs, one topic investigated was first/last mile of the travel (FMLM): people talked about FMLM as a valuable part of their travel, during which they do social things. Conclusion: prototypes need to be created around values, it's not only about efficiency.

Manon Potet talked about the Citizens' Dialogue on Driverless Mobility, organised by Missions Publiques worldwide and started in 2018, which have covered so far more than 2500 citizens in 25 countries (EU, N Am, Asia) to discuss futures of mobility and arrival of driverless mobility. The key features of Citizens' Dialogue are deliberative methods, quantitative and qualitative data, citizen argumentation (individual and group), diversity of participants, global comparison / local anchorage, one part of the session devoted to local issues. People reject the idea to develop technology without societal purpose – one of these should be to improve the quality of life for all. Four main expectations: (1) public authorities should really control the impact and take the time to study socio-economic impacts of deployments; (2) improve flows, decrease congestion; (3) be inclusive, also accessible for persons with low incomes, with disability; (4) provide safety – decrease accidents and injuries from crashes.

4.9.2. Results from the interactive polls

Each presentation was introduced by a poll to the audience, which furthermore was invited to an interactive workshop with panellists about opportunities and limitations of the different approaches when it comes to foster appreciated and attractive CCAM developments.

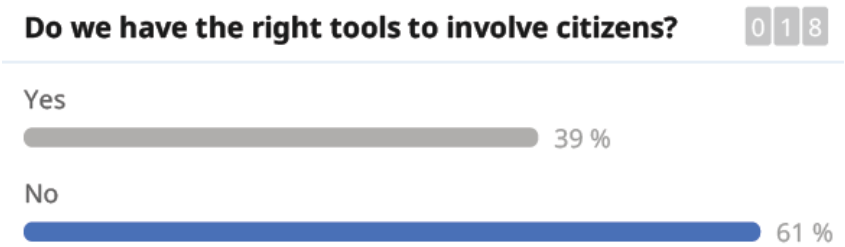

Figure 50: BO9 – results from poll question 1

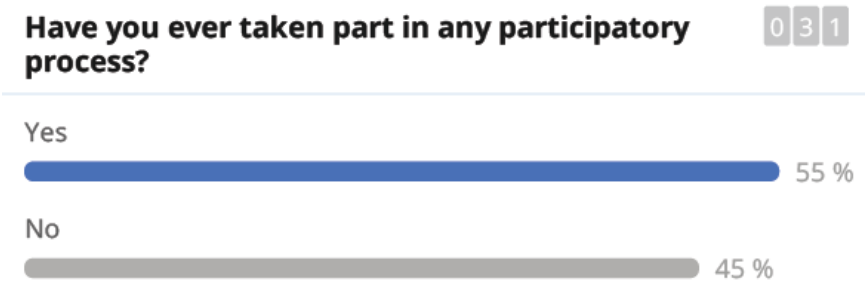

Figure 51: BO9 – results from poll question 2

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45 % of the respondents haven't, despite tools ans platforms having improved, and the public is getting increasingly familiar with them. It is important that people are indeed involved from beginning!

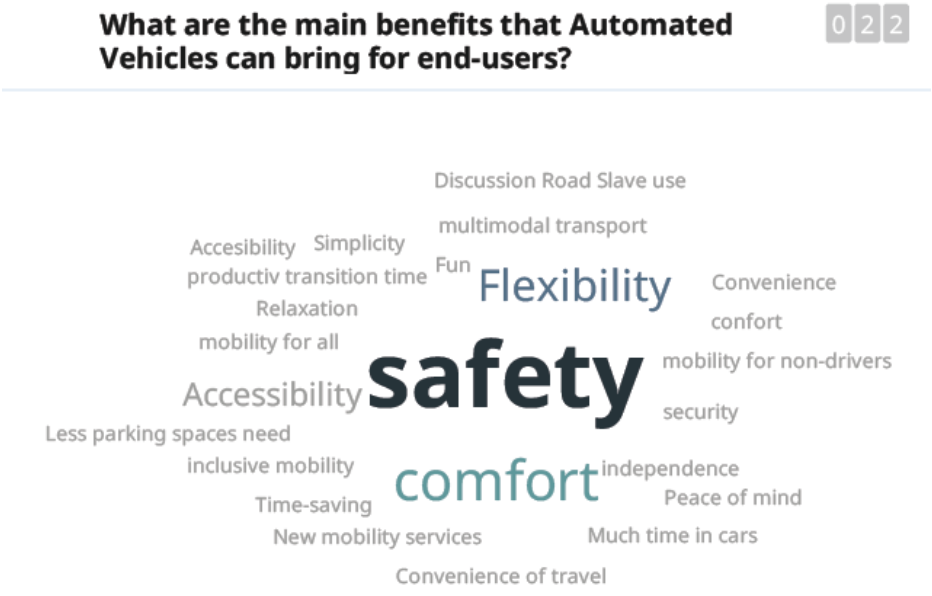

Figure 52: BO9 – results from poll question 3

Safety, comfort, inclusion and accessibility come up frequently: it is important to think about how we include everyone, especially vulnerable groups. Safety is indeed a major concern

Figure 53: BO9 – results from poll question 4

The result from the poll is in line with Ms Alonso Raposo's presentation. We need to encourage more cooperation, e.g. regarding different views and expectations, and to set more realistic expectations together. More citizen engagement should also be promoted

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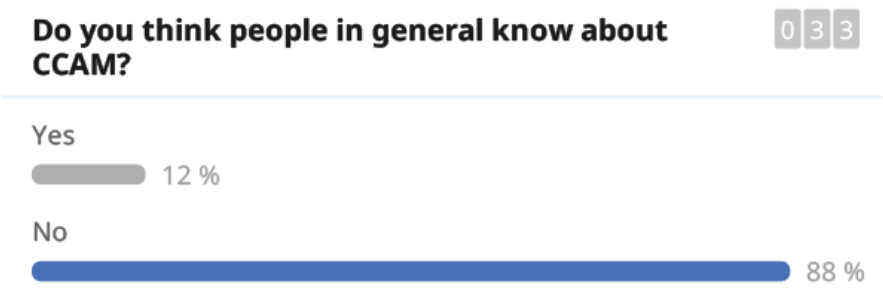

Figure 54: BO9 – results from poll question 5

One of the big insights of hanging around with the people in the selected areas (of AHA) is that they have no idea about CCAM, and they don't care.

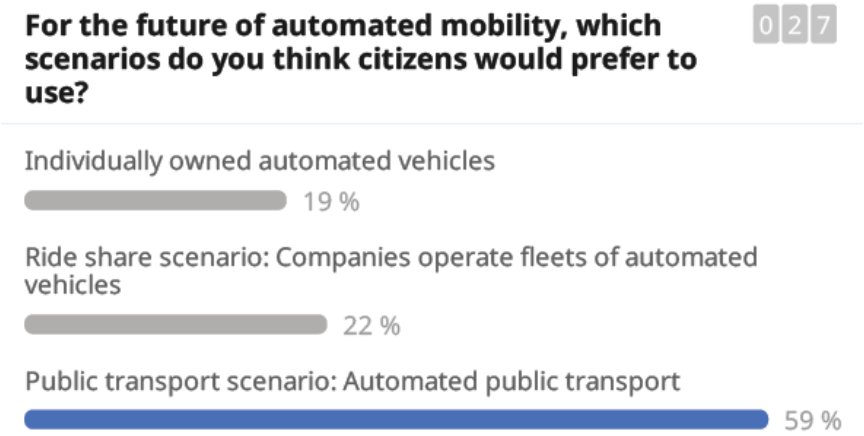

Figure 55: BO9 – results from poll question 6

If you could combine scenarios, the result would be similar to what was noted in the Citizen Dialogue. One of the most important findings from the dialogue is the strong hope that this deployment will allow more shared mobility solutions.

4.9.3. Questions and answers

What is the difference between democratic and participatory processes? - State it different: What to do if the preferences of people/citizens differ from the expert opinions (or even are contrary to societal goals)? - Eg: comfort vs access

Participatory processes try to engage people, not only as users but also participants in the process. Experts in CCAM can produce a bias and will not really get what is the stake of the user.

How do we make researchers and experts more engaged in engaging more in normal people in their everyday lives?

Think about people as people and not users – it's as part of participatory as well as democratic processes. If we think of people as "users" we get into a lingo that is concerned with technology development and industry. If we think about people as "citizens", we are more inclined to think about societal goals.

Make the different stakeholders understand that this is a mindset shift: to think about people more than users and more than citizens but actually people living their lives.

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Are focus groups enough to explore public acceptance? How can we take into account a broader understanding of citizens needs and expectations when discussing CCAM?

No, we cannot only take into account users directly affected by CCAM, but also the context, the environment, e.g. letting elderly people play a role can help to develop the process, which in turn can increase the number of participants as well as the diversity and enrich the process.

Do you see any synergies between the presented ways of engaging with citizens?

Every method has its limitations so it is important to combine and share to increase citizen engagement. Users should be involved in all stages: from concept phase but also in implementation when it gets more practical. Different kinds of users need to be involved, also the less obvious ones, including those with less digital skills to make sure no one is left behind. In addition to involving users about ideas, it is also about experiencing the service, to learn how to use it, to give feedback and to gain some positive experiences which will lead to higher acceptance and willingness to use it in the future.

4.10. B010 - Boosting CCAM with AI: how to ensure effectiveness and acceptability?

AI has a huge potential to change the (in-vehicle) decision making process as well as new services or safety solutions supported by AI. It can play an essential role especially in critical and complex situations and in integrating vehicles and the overall transport system. AI can bring incremental improvements in CCAM, in its developments and deployment, provided it has a clear and proven effectiveness. To unlock this, a major challenge is to understand and boost user acceptance of the AI-supported CCAM technologies, as well as safety and effectiveness. Furthermore, specific automotive requirements such as safety, security and real-time functionality put high demands to CCAM. The session discussed what is a possible joint approach to achieve this, together with the roles several stakeholders will have in the execution of this approach.

The session discussed topics like:

- AI can be used of situational awareness, for decision making and triggering of actions, especially for time critical and safety critical scenarios/applications. How can this be achieved, what is needed?
- How does AI then move these to a state beyond the state of the art, what are the most eminent and urgent benefits?
- How can we de-mystify AI for mobility? How can we ensure people have trust in our technologies? How to deal with the fact that people have a higher tolerance for people failing than for technology failing, in traffic situations?

Moderator: Margriet van Schijndel-de Nooij, Program Director Smart Mobility, EARPA

Speakers:

- Clara Otero Perez, Senior Director of Systems Innovations, NXP Semiconductors
- Patrick van der Smagt, Director of AI Research, VW Group, argmax.ai
- Nandita Mangal, Platform Owner – HMI Vehicle Experience, APTIV
- Grigori Parfjonov, Transport Department Traffic Expert, City of Tallinn

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- Marieke Martens, Professor Automated Driving & Human Interaction, Eindhoven University of Technology (TU/e)

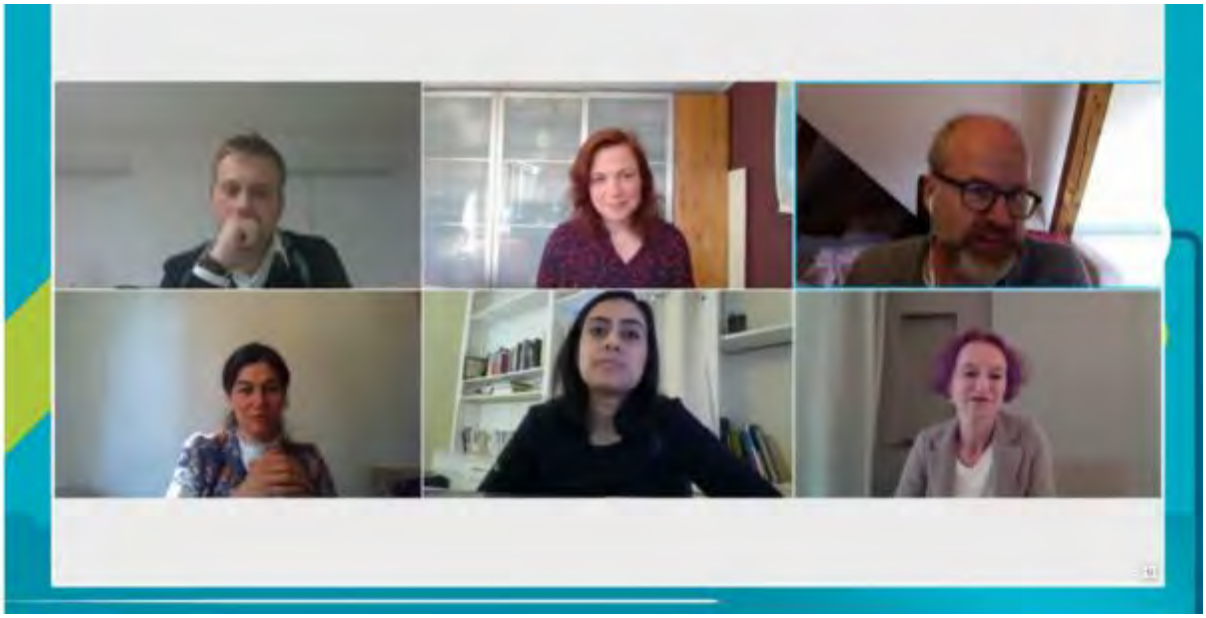

Figure 56: BO10 - (from top left to bottom right) Grigori Parfjonov (City of Tallinn), Margriet van Schijndel-de Nooij (EARPA), Patrick van der Smagt (VW), Clara Otero Perez (NXP), Nandita Mangal (APTIV), Marieke Martens (TU/e)

4.10.1. Key points of interest

- We need to demystify AI to unlock its potential to boost CCAM (new services, reduce casualties, enable sustainability)
- The Safety of the overall function is a must
- AI is boosting and is a main enabler
- Using Advanced Algorithms on a lot of data is key. And good data is a requirement to build trust on AI, and trustworthy AI
- Ethics and AI is an important topic that needs to be addressed
- User acceptance and user trust will play a key role in the uptake of AI based CCAM.
- The first job is to build the tools and knowledge to gain trust and acceptance (the term “user embracement” of new (technological) options would be more appropriate).

Main Challenges

- We need to educate the consumer of what AI does (what is capable of and what is not). This should be part of the very essential work on user acceptance and user trust. Different levels of trust need to be taken into account, when users are facing a new technology. The lack of user acceptance threatens to become a major barrier for deployment. This work actually starts with understanding the user and his/her behaviour and mobility choices.
- Using Advanced Algorithms on a lot of data is key. And good data is a requirement to build trust on AI. How do we qualify data? How do we collect it, and merge it when it comes from multiple sources?

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- We need to educate the consumer of what AI does (what is capable of and what is not). The challenge is how to do this in an effective way. To tackle this, we first need to understand the user, and the choices he/she makes in mobility.
- Stakeholders' involvement is crucial; we need to ensure we have the right and complete set of stakeholders on board. Furthermore, we need to ensure we have an aligned vision on the matter.

Challenges

For ethics and AI, which is of high importance, there are rules and regulations, but:

- There is a lack on how to use/apply these rules and regulations in actual operation -> from regulation to operational

Next steps

- Creation of application standards
- Address ethical principles: Transparent AI, Trustworthy AI and push standards in this direction

Clara Otero explained that from NXP point of view, each car has 3 missions:

1) Self-driving car: self-aware, decision capable, ability to learn
2) Convenient, service oriented: with specific service purpose
3) Sustainable vehicle: efficient, battery management, cooperative with the infrastructure (charging)

For making the missions a reality, a technology-supported vector is required

1) Sensing tech
2) Thinking (understanding)
3) Acting
4) Connectivity to the environment

The safety of the overall function is a must. AI is boosting and is a main enabler. AI is already there in many functions and modules, and it is growing. AI has a clear objective of having real driving capabilities (driver replacement) but still is acting more as a helper for the drivers. Before facing complex driving functions, we already have AI-based ADAS functions, with increasing extensions to the domain of cooperative actions

Patrick van der Smagt explained that basic research on AI is required. The use of probabilistic Neural Networks for an unsupervised learning is going to play an important role in the near future since it is impossible to deal and annotate all the data that we are gathering. AI and Ethics is an important topic for Transparent AI, Trustworthy AI that needs to be addressed. Rules, regulations and guidance are emerging, but the step from the paper to reality is still quite big and complicated. The operationalisation of these rules and regulation is a big issue with many uncertainties.

Nandita Mangal said that one of the main barriers for AI acceptance and trust is how we ensure the trust of the consumer. We need to educate the consumer of what AI does (what is

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capable of and what is not). In the AI-enabled CCAM deployment path, trust is not binary: there are different levels of trust when facing a new technology, from completely new and not knowing how the behaviour is, to some experience and understanding of the behaviour of the new technology until we reach the maturity in experience and understanding the real behaviour. The objective is that the user does not turn off the Assistance function during the first phases and not rely again in such systems. The approach is to build a system that understands the behaviour of the driver:

1) Create and holistic model that represents each of us in an individual manner
2) Contextualization of the AI applied to specific situations
3) Machine Contextually Aware

Grigori Parfjonov presented how Tallin is supporting the use of new technologies and services based on AI: Traffic Modelling. Tallin was part in several piloting projects and activities with automated vehicles and automated vehicles are allowed in Tallin streets. It seems that the promised (generated hype on) automated driving is behind schedule. The automated driving and AI based solutions are facing challenges that need to be addressed and overcome. From technical standpoint: Mission planning, Localisation, Trajectory planning, cybersecurity, communication, technical infrastructure, etc. From social standpoint: Demand, Safety, Reaction/acceptance of users and the public, Trust, Safety Accessibility. From political standpoint: Fit with overall transport policy, need for regulation. From economic standpoint: Charging models, insurance models, impact on established industry sectors, business models, benefits, etc. From environmental standpoint: Energy use, Emissions, Network optimisation, impact on congestion. From legal standpoint: Liability issues, Global standardisation, safety standards, data ownership.

Marieke Martens declared that we have always heard that in order to reduce human errors we need to improve the technology, but the inclusion of new technology is always a potential source of new human error caused by the unknown behaviour of the new technology. We need to understand people and their behaviour if we want to include AI in a safely manner. The question of “How safe is a vehicle” is not that simple. The question has deep dependencies: How safe is this specific car, with these specific sensors, in this specific situation and with this specific driver.

<u>Main recommendations</u>:

- Automation should only be offered if reliable for an extensive period of time
- Predictability of actions CAV for humans (inside and outside the car)
- Large potential for AI for driver state monitoring and prediction
- Invest in AI for intent prediction (estimating what others will do)
- Demand that “AV+driver” is safer than “driver” only
- Governmental bodies should set Ethical Goal Functions for CAV (e.g. EC, UNECE WP1)

4.10.2. Results from the interactive polls

The audience was asked to give their opinions at several points during the session. Here are the questions which they were asked to answer to and the results to these polls.

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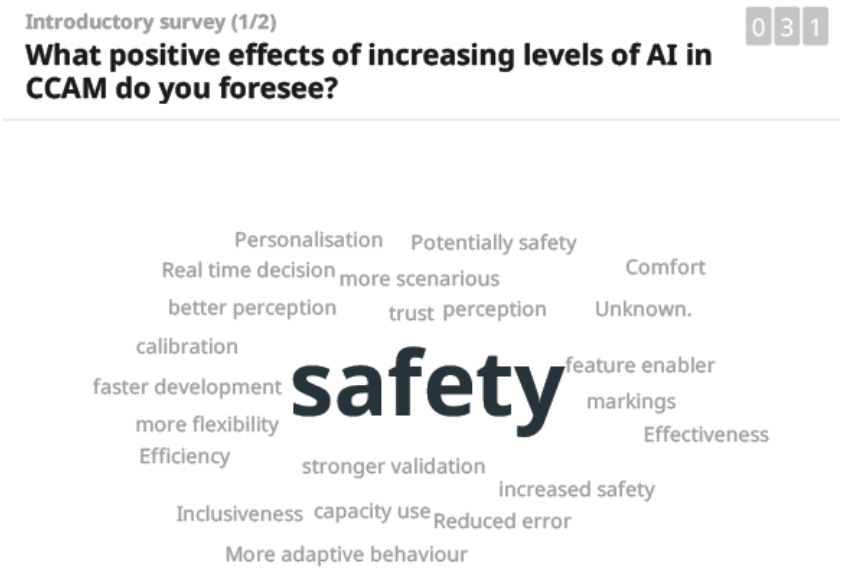

Figure 57: BO10 – results from poll question 1

Figure 58: BO10 – results from poll question 2

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Figure 59: BO10 – results from poll question 3

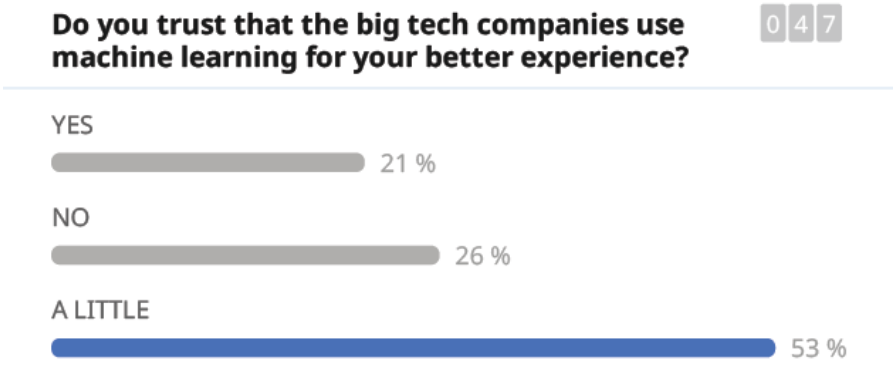

Figure 60: BO10 – results from poll question 4

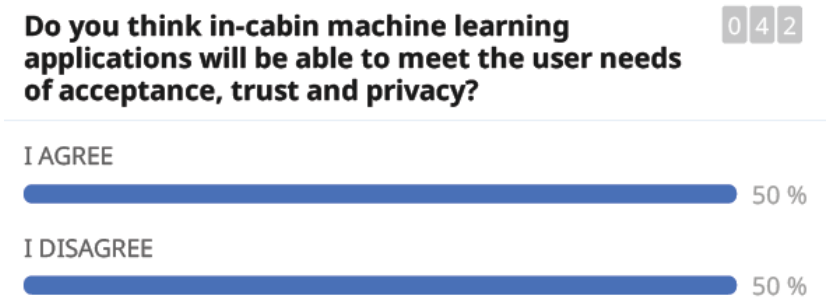

Figure 61: BO10 – results from poll question 5

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Figure 62: BO10 – results from poll question 6

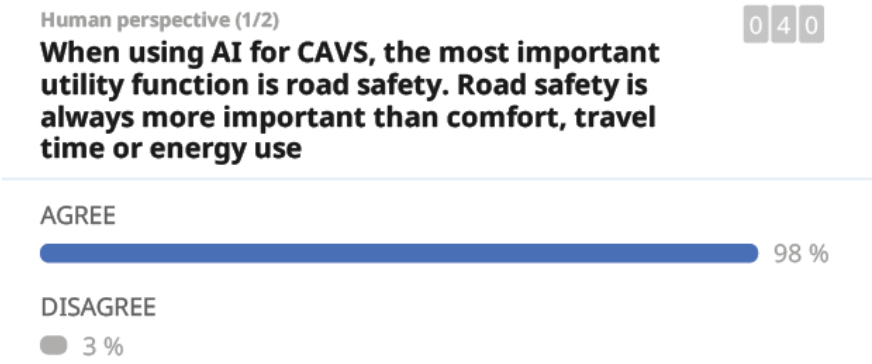

Figure 63: BO10 – results from poll question 7

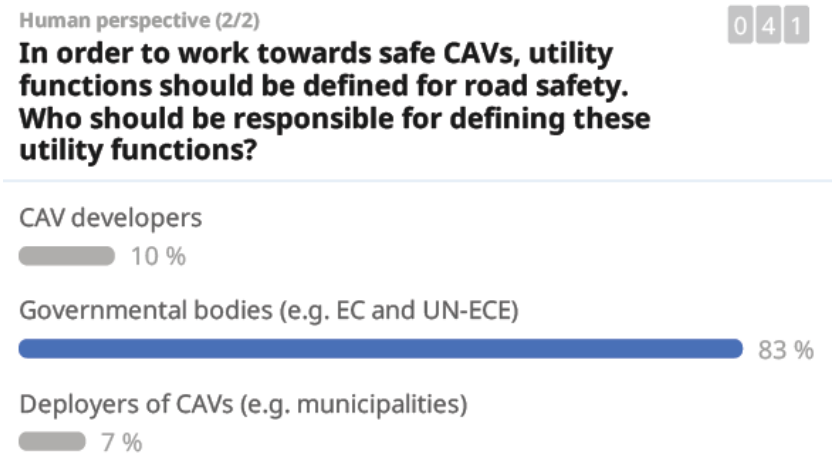

Figure 64: BO10 – results from poll question 8

4.10.3. Questions and answers

In achieving high user acceptance, responsible AI and ethics can play a significant role. How can we ensure these are integrated in the development processes?

We need to solve first a frame problem before addressing data. First question would be to address the user needs and once we have that clear then select which data (real/simulated/combined, etc.). Review the dataset used interactively – the data is evolving with the time and could be enriched. Avoid big gaps in the dataset not to bias the result

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AI can be used of situational awareness, for decision making and triggering of actions, especially for time critical and safety critical scenarios/applications. How can this be achieved, what is needed?

It is good to follow a stepwise approach: 1) Specify which part need to be automated; 2) Automate & test; 3) Activate next step. Always start first with what is most important to be automated.

How does AI then move these -decision making, triggering of actions- to a state beyond the state of the art, what are the most eminent and urgent benefits? Any risks?

Predictability is a very important one. NXP focuses on the development of the HW where the AI modules are going to run, they need to build predictable HW. Repeatability is also another key point for the secure deployment of these systems. Having the coexistence of 2 systems for ensuring the coverage and the safe decision making is crucial.

What is the panel's view on the very recently published EU legal framework for AI and its risk-based approach? Does it provide a balance between boosting innovation and protecting human rights?

The approach is very good. The risk based approach is a good point to maintain the balance, however the regulatory does not apply to vehicles since it is supposed that this sector is going to be regularized by other means (laws). Furthermore, the only way to get this going, is by actually start doing these things, together!

What are the top design challenges for AI and why are they challenges in your domains (is it hardware, trustworthiness or safety/architectures that are safe by design to make these a reality)?

The main challenge is the standardisation of AI and ML but not only the algorithm but the complete pipeline. Standardization on interpreting data, data collection and processing. Standardization on how to select the right algorithm for each specific case (if it is going to be deployed on the cloud, on the edge, etc.)

Would it be important to define kind of data lifecycle management to help in the process of developing a trustworthy AI? ((diversity, fair data))

It is important to manage the data; it is paramount for ethics. It is also very important to monitor what the algorithm is doing while it is being used. We are just at the beginning of understanding the data and its impact.

How to avoid bias in data?

It is very hard to detect bias in the data. We need steps for accurately check content and bias (KPIs), ensure the dataset and search for bias in the whole process even in production

Explainable AI, why would we need it?

It is important to have explainable AI however it is also key to select what information needs the used. Passing information on probabilities to a regular (non-technical) end-user might impact on their trust because they do not understand/interpret the data correctly. Explainable AI does not mean that we need to explain everything to everyone. It is important to explain

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(the approach to) decisions if these are deviating from human decisions. Overexplaining should be prevented.

4.11. B011 - Scenarios for validation: what data sources do we need?

A scenario database is key for the validation of connected and automated driving. The scenarios of such a database are built out of different data sources, which might have different characteristics, quality and quantity. This session focused on the analysis and discussion of different real-world data sources to create validation scenarios. It aimed to provide an overview on how to fill scenario databases for validation, which are under discussion in various projects, initiatives, regulations etc., and to show what benefit can be created by scenario data from different sources.

Moderator: Adrian Zlocki, Head of Automated Driving, fka

Speakers:

- Felix Fahrenkrog, BMW Group
- Annie Bracquemond President/ Founder, SAFER MOBILITY Consulting
- Julian Bock, Manager Artificial Intelligence, fka
- Barbara Metz, Researcher, WIVW
- Emmanuel Arnoux, Expert Automated Driving System Test & Validation, Renault Group
- Maria Elli, Data Scientist, Intel Corporation

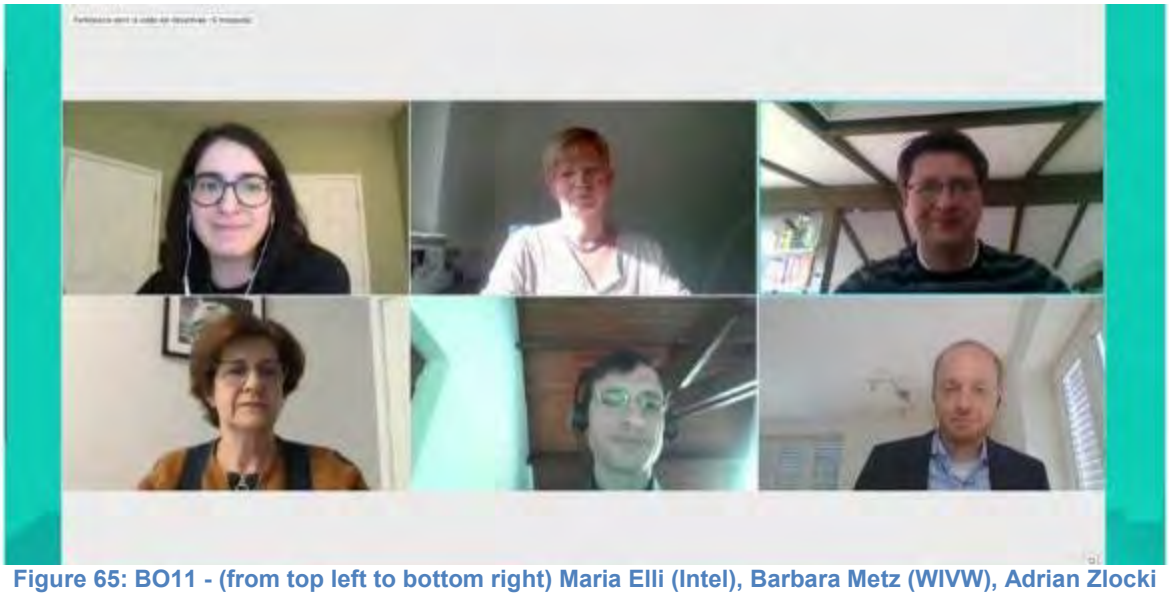

Figure 65: BO11 - (from top left to bottom right) Maria Elli (Intel), Barbara Metz (WIVW), Adrian Zlocki (fka), Annie Bracquemond (SAFER MOBILITY Consulting), Emmanuel Arnoux (Renault), Julian Bock (fka)

4.11.1. Key points of interest

Currently scenario based testing is a key element in the validation process for automated vehicles. A scenario database is key to collect and store scenarios, which can be used for testing in simulation, simulator or on a proving ground. Filling the scenario database with scenarios can utilise different data sources, which might have different characteristics, quality and quantity. In this session the focus is to analyse and discuss different data sources for scenario based testing and validation of automated driving.

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Main challenges

- Data sources are available for validation scenarios
- Useful data sources to create scenarios for validation of automated driving
- Data extraction for the validation process
- Validation scenarios

Felix Fahrenkrog talked about the usage of Accident data in the development of automated driving. The presentation discussed the importance of accident data for the development of automated driving. Starting from the principle of achieving a positive risk balance that has been request by the German Ethics commission on automated driving as well as is mentioned in the ethic of connected and automated vehicles report of the European Commission, the tasks within the develop process for ensuring a positive risk balance is presented. In the presentation, the focus is on define the safety threshold at the start of the development and on determining the safety impact of an automated driving function when it is about to enter the market. In both step accident data play a key role. The thresholds are directly derived from today's accident situation, whereas for the safety impact calculation accident provide the scenario and scenarios parameters for simulation. Although accident data play important role, the availability of detailed accident data is still a challenge and varies over Europe.

Annie Bracquemond's presentation was about the decision criteria for data collection, including the risks, performance and testing ability. Many projects and experiments with Automated/Autonomous vehicles and shuttles around the world are looking for the "right" methodology for data collection, for an efficient platform to process the data, and to select scenarios.

You must first answer the following questions before you can work on an effective solution:

- What are your strategic objectives? Traffic congestion in urban areas, traffic flow on motorways, efficiency of freight transport, enabling optimal autonomous mobility, a fleet of autonomous taxis or delivery vehicles, the most vulnerable people, etc.?
- What are your ODDs, your usage specifications?
- Who needs the data? (OEM, suppliers, Regulators, Government, etc.)
- What are the needs of your customers, what are your targets?

Julian Bock talked about "LevelXdata", i.e. trajectory data for validation scenarios. In the presentation, drones were introduced as a data source and measurement method for the development and safety validation of automated driving. With this method, drones are flying over certain traffic segments and are capturing high resolution videos from the bird´s eye perspective. Those videos are processed with a state of the art computer vision pipeline, which is strongly optimized on the use case. The advantages and limitations of drones were compared with traditional methods such as using measurement vehicles. Finally, datasets from several locations around the world were presented.

Barbara Metz presented experiences from vehicle data collection. In the presentation, challenges and solutions for processing and analysing vehicle data within in the large scale EU-project were presented. In L3Pilot, vehicle data coming from various tests sites are analysed in a harmonized and combined approach while keeping the confidentiality of the data sources. Therefore, a complex data processing process was implemented in which

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harmonization is reached by using driving scenarios as the basic unit of analysis and confidentiality is kept by setting up a database in which anonymized data from the test sites is merged. The different steps and challenges of the approach were explained in detail.

Maria Elli's presentation was about AV Safety Metrics, evaluation and calibration based on Naturalistic Driving Data. The definition and evaluation of driving safety for automated vehicles (AVs) is a key element to enable safe and wide AV applications. Utilizing the responsibility-sensitive safety (RSS) model, a new methodology is proposed to calibrate the safety model based on naturalistic driving data captured with a drone in Los Angeles freeways. Without significantly relying on (large) safety critical or unsafe driving data, the proposed method presented defines an optimization framework to calibrate the RSS model parameters and describe AV driving safety through both safe and safety critical observed data.

Emmanuel Arnoux talked about scenarios from real life, proposals for AD safety validation French scenario library. In the presentation the main safety goals "positive risk balance" and "avoidance of unreasonable risk" are stated. A scenario library based on real world driving data is introduced. The scenario manager as well as data and software tools within the workflow of the projects MOOVE and MOSAR are explained. The collected data so far amounts to 1,2 M km for a 2 year driving period in western Europe. The industrialisation of the scenario library is initiated in the ADScence project in 2021.

4.11.2. Questions and answers

Aren't there also EDR (even data recorder) and ADR (Accident Data Recorder) in preparation that could also help in the validation and statistics?

Felix Fahrenkrog answered that there are many activities in this area. It is required to proof your actual safety performance in the field. However, it will take certain time to get the safety performance, since accidents are very rare events. We need data already now.

Do you need any personal data for validation?

Interest in trajectories and conditions when accidents happen, according to Felix Fahrenkrog. It is not so relevant who had the accident.

How do you see data sharing for a scenario?

Annie Bracquemond said that common scenarios can be shared, since ODD is very large. Risk can be shared. Sharing raw data is rather not possible.

Why aren't more AI approaches that include to find scenarios in data?

According to Annie Bracquemond, recognition of complex and relevant scenarios in data is complex already for humans. Therefore, implementation of AI can only be applied after the task is clear for humans.

What kind of traffic participants can be tracked in data today?

Julian Bock answered that there is basically no limitation. All different traffic participants can be detected individually.

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What kind of data was not used in L3Pilot due to company information?

Barbara Metz answered that raw data is not shared. Video data is not fully shared. The OEM decide, which data is shared

What are the obstacles to be overcome to enable data similar to the L3 Pilot data to be used for independent safety assurance such as EuroNCAP and certification purposes?

For Barbara Metz, the obstacles are more in data sharing due to different OEM involved. Using the L3Pilot common data format in the project enables data processing from several different car owners.

4.12. B012 - How will CCAM contribute to reducing environmental impact?

Achieving zero net GHG emissions by 2050 is arguably the most central, ambitious and challenging goal set out by the European Green Deal. The intermediary target for 2030 is set to at least 55% GHG emission reduction. CCAM is mentioned as one of the key tools to deliver on the targets of the Green Deal. Now is the time to raise the debate on how this will actually be done. This session discusses which CCAM applications have proven effects on decarbonisation and what still needs to be done to deliver on these highly ambitious targets.

Moderator: Zeljko Jeftic, Deputy Director Innovation & Deployment, ERTICO – ITS Europe

Speakers:

- Jos van Vlerken, ITS Project Manager, City of Copenhagen
- Pierre Chehwan, VP Strategic Alliance & Institutional Relations, NAVYA
- Margarida Coelho, Professor, University of Aveiro
- Richard Bishop, CEO, Bishop Consulting

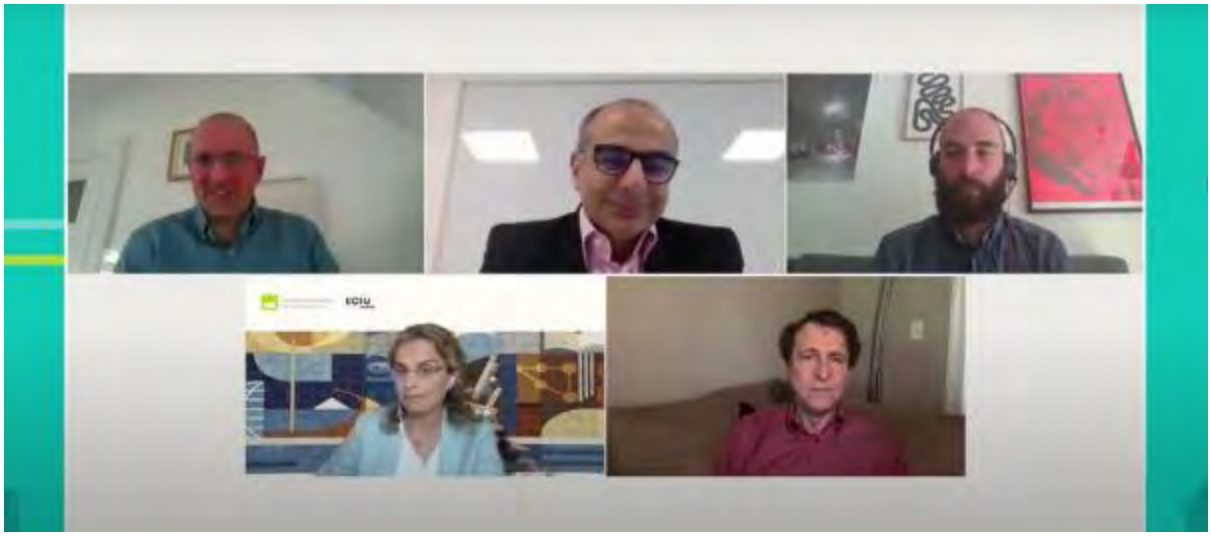

Figure 66: BO12 - (from top left to bottom right) Zeljko Jeftic (ERTICO), Pierre Chehwan (NAVYA), Jos van Vlerken (City of Copenhagen), Margarida Coelho (Aveiro University), Richard Bishop (Bishop Consulting)

4.12.1. Key points of interest

- While it is worth looking forward to potential impact of CCAM on climate change, it would make sense first to speed up deployment of emission saving ITS solutions

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already available on the market to benefit from short term impacts before 2030. We need to use all of the technology services and policies to reduce the GHG emissions from the transport.

- Automation can significantly influence environmental performance positively/negatively depending on the driving techniques. The biggest advantages occur when AVs are on the national roads and motorways.
- Joint adoption of automated driving with electric mobility and shared mobility (integrated with public transport) could pave the way to emissions mitigation and a significant reduction of traffic congestion.
- On-demand solution for transport in rural areas, with elderly population and scattered public facilities, are an alternative to personal cars and thus contribute to decarbonisation.
- For long hauls, truck platooning provides substantial benefits in reducing emissions.

Main challenges

- Lack of research indication related to wider benefits of CCAM, impact on fuel reduction/ decarbonisation
- Risk that CCAM would actually lead to an increase in GHG emissions
- Transition period (coexistence between AVs and conventional vehicles).
- There is abundance of CCAM, C-ITS, and ITS solutions and services that already exist for cars, but in significantly lesser degree for cyclists.
- Multi modal traffic model including AVs

Next steps

- Exploring how data from automated cars and trucks can improve conditions for cyclists and multimodal traffic management

The session was opened with the most recent news from the last three days prior to the event when the EU, UK and USA had set historic decarbonisation targets. EU with the European Green Deal set out in 2019, adopted a New Climate Law for the CO2 emissions reduced by at least by 55% by 2030, compared to 1990. UK announced that they are going for 79% reduction on greenhouse gas Emissions by 2035 and in the USA a major challenge by 2030 is to reduce carbon greenhouse gas emissions by 50%- 52 % compared to 2005 levels.

On a regional level, ERTICO partnership's City Moonshot is currently interviewing 300 cities worldwide on three topics – sustainability (air pollution and climate emergency); data sharing and Mobility as a Service (Maas) / Mobility on Demand (MoD) and provided the initial results. The results will feed directly into the understanding in-depth city plans considering sustainability, and to a certain extent their views on CCAM.

Prof Margarida Coelho talked about emissions Impacts of CCAM. In Europe, 31% of energy consumption comes from transformation sector and vehicle emissions are important sources of air pollution. Understanding and quantifying the emission impact is the main motivation of the research. An integrated approach was used to measure emissions from traffic and fuel consumption/emissions. Results show emission and environmental impacts of gasoline and diesel CAVs in the metropolitan area.

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Challenges that emerge rely on the transition period (coexistence between AVs and conventional vehicles. Results suggest that automation can significantly influence environmental performance positively/negatively depending on the driving techniques.

The most negative impact occurs in the urban situations – total emissions of CO_2 and NOx are increased by 4%-88% and the biggest advantages occur when AVs are on the national roads and motorways, if speed is optimised at ~90km/h CO_2 emissions are reduced by 18% up to 32% of NOx.

In the second scenario – effect of automated driving and electric mobility emissions (from electricity production and local emissions). Simulation on national roads shows that with 50% AVs fleet CO_2 is reduced by 50% and NOx by 56%. CCAM with electric vehicles have higher potential for reducing emissions and improving air quality (~30% reduction of emissions).

Third scenario - effect of automated driving with electric mobility and shared mobility showed that joint adoption could pave the way to emissions mitigation and a significant reduction of traffic congestion. New mobility forms could also potentially lead to adverse emissions, but they do not imply reduction of traffic congestion. Therefore, integration with behavioural shift (e.g. shared mobility) is a key factor.

Mobility that we strive for the future is a holistic integration of CCAM with public transport, active mobility (e.g. 15 min city) – smart, inclusive, safe and sustainable mobility.

Lifecycle approach revealed that maximum vehicle shared capacity yielded a reduction of more than 41% of environmental impact, compared to single usage trips. Electricity generation based on wind power is the most promising way to reduce the environmental impacts up to 49%.

Jos van Vlerken presented the focus in the City of Copenhagen, i.e. how ITS, data and new technologies can be used to improve and increase cycling in cities. Copenhagen has set a climate plan to be CO_2 neutral by 2025 and increase share of trips on bike by 50% by 2025 focusing heavily on promoting cycling as the main mode of transport for medium (2-15 km) and long distance (15-30 km) trips. The main challenge is that there is abundance of CCAM, C-ITS, and ITS solutions and services that already exist for cars, but in significantly lesser degree for cyclists. The idea is to promote cycling as a green mode of transport already available. Copenhagen has multi modal traffic management central system for data gathering and traffic management and modular design incorporating tools for cyclist traffic. Cyclist data are gathered from loops/coils and radars and cameras with automatic image processing. Scenario management is employed to control traffic signals and equipment, and it's triggered by the input from the sensor network, prioritizing cycling and other modes when needed. A new multi modal traffic model is being tested and a next challenge is how to modal traffic with AVs. The goal is to further increase convenience, primarily for cyclists and reduce the number of stops, via the Green Catch App that helps the user adjust the speed and improve flow to reduce the number of stops, based on the real time traffic signal data, position and heading of the user. Copenhagen is exploring how cars and trucks via CCAM can improve conditions for cyclists and multimodal traffic management by providing and sharing the data for traffic safety reasons.

Pierre Chehwan talked about how NAVYA autonomous shuttles are deployed on the roads in 23 countries, from Florida to Japan, and can be adapted to industrial sites. They also have

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shuttles without the operator on board, so called no-op. These vehicles are answering different challenges and needs of the cities: they provide shared and public transport in confined areas, private sites or on open roads in urban locations, including transport of vulnerable population groups in cooperation with cities and PTAs. Cities mostly deploy them to enhance and extend the public transport, respect eco transition and prepare for the future urban design. Industrial and business parks mostly use such vehicles for internal transport, reducing the use of privately owned cars. Campuses, touristic sites and airport use them for eco transit (reducing footprint and innovation purposes), while hospitals use them as comfortable, low speed on-demand solution adapting them to the needs of patients and vulnerable groups. One example of observed benefits is from a business park and transport of the employees from the last tramway stop to their facilities, to see how many of them would use shuttle instead of their own vehicles. Flexible, on-demand electric shuttle usage rose of up to 20%. Their shuttles are also used in rural areas with elderly population and scattered public facilities, as on-demand solution for transport and decarbonisation.

Richard Bishop presented the perspectives on CCAM and its contribution to fuel reduction in the US. Goods movement concerns four sectors: streets, controlled environments, roads and highways. Streets applications of B2B and B2C: very complex environment, customer facing and strong market growing, with low speeds, using driverless vehicles and driverless deliveries of parcels and goods. In the controlled environments (e.g. logistics yards, semi-controlled industrial roads): low speeds, small, specialised markets with high user needs are excellent settings for introducing automation and electrification. One of the companies (Outrider) is replacing people moving trailers around shipping yard by its electric automated trucks. Resource roads (such as forest roads) are less talked about, truck operation is done in remote areas, on unpaved roads with medium speed and the market is modest. The research is done by FP (Canadian not-for-profit research centre) on automated follower platooning, since the driver shortage is a key pain point and the project is launched to adapt commercial systems for rural public roads. Highways are where the majority of players and money are. It's a well ordered environment, the speed is very high, as well as risk and kinetic energy, yet the huge market is driving things. Two operational modes are present – platooning and solo driverless. When platooning is done safely, fuel use is reduced ~4% for the leader and 10% for the follower truck at 60ft gap at 60mph. This fuel economy scales with speed. In US the truck speed is on the same level with cars, compared with Europe, where the speed is significantly lower. This enables larger savings in platooning and fuel savings that translate to reduced emissions. The goal is close following via "connected braking" between trucks, using low-latency vehicle-to-vehicle communications focused on highways because of higher speeds. Initial major use case –for hub-to-hub operations where platooning equipped trucks are dispatched together at the same time. The sustainability factors for long haul trucking - truck platooning provides substantial benefits in reducing emissions. Solo driverless trucks will have optimal "drivers" for fuel economy improvement (~10%) and their hauls can shift to overnight hours, reducing congestion for others during the day.

4.12.2. Results from the interactive polls

The audience was asked to give their opinions at several points during the session. Here are the questions which they were asked to answer to and the results to these polls:

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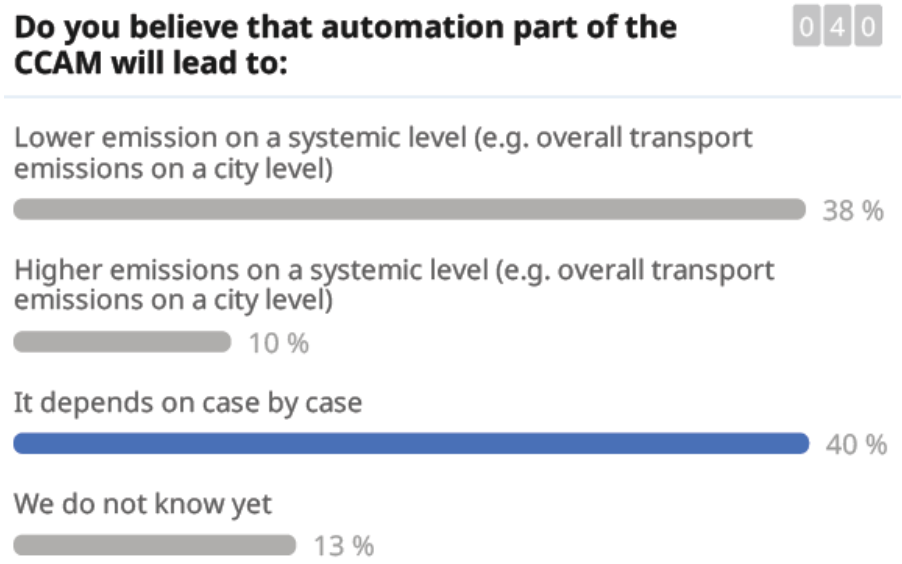

Figure 67: BO12 – results from poll question 1

4.12.3. Questions and answers

What are the next needs and what should be researched more to understand the benefits of the CCAM?

Dr Coelho answered that the presented results are very up-to-date and novel, with research still going on. There are several challenges in order to address the environmental effects of automation. The access to the real data is crucial, and how to get these open data not only from the automotive industry, but also from the smart mobility platforms in order to calibrate and validate properly the modelling platforms. In terms of the research needs, the integration of modelling platforms – how can we address the impacts of automation together with the other road users (e.g. bicycles, pedestrians, etc.) to understand the whole mobility ecosystem? Another main everyday challenge is to integrate data from different equipment and modelling platforms with big data coming from automation. When we have terabytes of data, how can we turn them into useful data, not only for the researchers, but also for the policy makers? It is essential that European guidelines are aligned with guidelines for CCAM and with European Union Sustainable and smart mobility strategy, and we have to involve researches from different fields and other players. For the future, we will need to join different skills and expertise, automotive industry, ICT companies, operators working together, because from the intersection of this knowledge and skills comes the innovation.

Are you aware of studies that analyse the energy consumption and its environmental impact of CAVs due to processing of data?

Dr Coelho said that with the life-cycle assessments approach we were taking into account the energy use related with the data processing and the sensors and material related to them that have to be installed on the vehicles. Richard Bishop added that it is true that more power is consumed by the processing and the sensors, but compared to the power needed to move heavy vehicles, people and goods it's a very minor increment in power consumption.

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Pierre Chehwan said that some might argue that we need 5G and that it will consume a lot of power for using the data, but it has to be taken into account that the vehicle is autonomous and 5G will be there to support and guide as a tool, and not used for sending all the data, having huge farm servers everywhere in order to analyse all the data using a lot of energy to do that.

So far you have implemented 80 vehicles in different locations, what were the biggest difficulties for you when trying to implement them in the real life locations (e.g. hospitals)?

For Pierre Chehwan, the main one is expectation. Most of the clients were seeing autonomous vehicle as an automatic solution for all the situations, with zero problems. However, this is science fiction and not a real life. When we meet with city and PTO representatives to see what needs to be put in place, we explain the difference from the marketing they saw on the internet or in the media, and the real life, and explain what we can set up and what is needed in order to solve the problems. For the project in Île-de-France, we had a problem with our vehicles being stopped all the time because of the walking area, with around half a million people. We had a positive feedback at first, turning into a negative one, because the vehicles could not go fast. However, the idea was not to go fast, but to move people and bring the solution.

There are studies indicating that people are sometimes a little bit hesitant towards vehicle automation. City of Copenhagen is a leader in Europe working on changing this behaviour. You have managed to support your citizens to change their behaviour, to becoming one of the cycling champions of Europe. Can we learn anything from the process of how you have actually engaged your citizens to be more positive towards the vehicle automation as a part of the broader mobility and public transport?

Jos van Vlerken answered that the essential thing to do is to make it as convenient as possible. We believe that the initial motivation, like health or environmental benefits, usually lasts for approximately 2 weeks, so if you want the people to continue cycling, increasing the convenience is the key. When introducing the automated vehicles and PT what we do not want to achieve is the modal shift from cycling. Benefits (public health, social and economic) of cycling are enormous. To us, the primary benefit of the automated vehicles is for the PT or shared vehicles type of transport.

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5. Virtual exhibition

A virtual exhibition featuring EU-funded as national/ other R&I initiatives active in the CCAM field, was accessible throughout the event, on the B2Match event platform[3]. This was an opportunity for these initiatives to raise awareness and promote their activities and results.

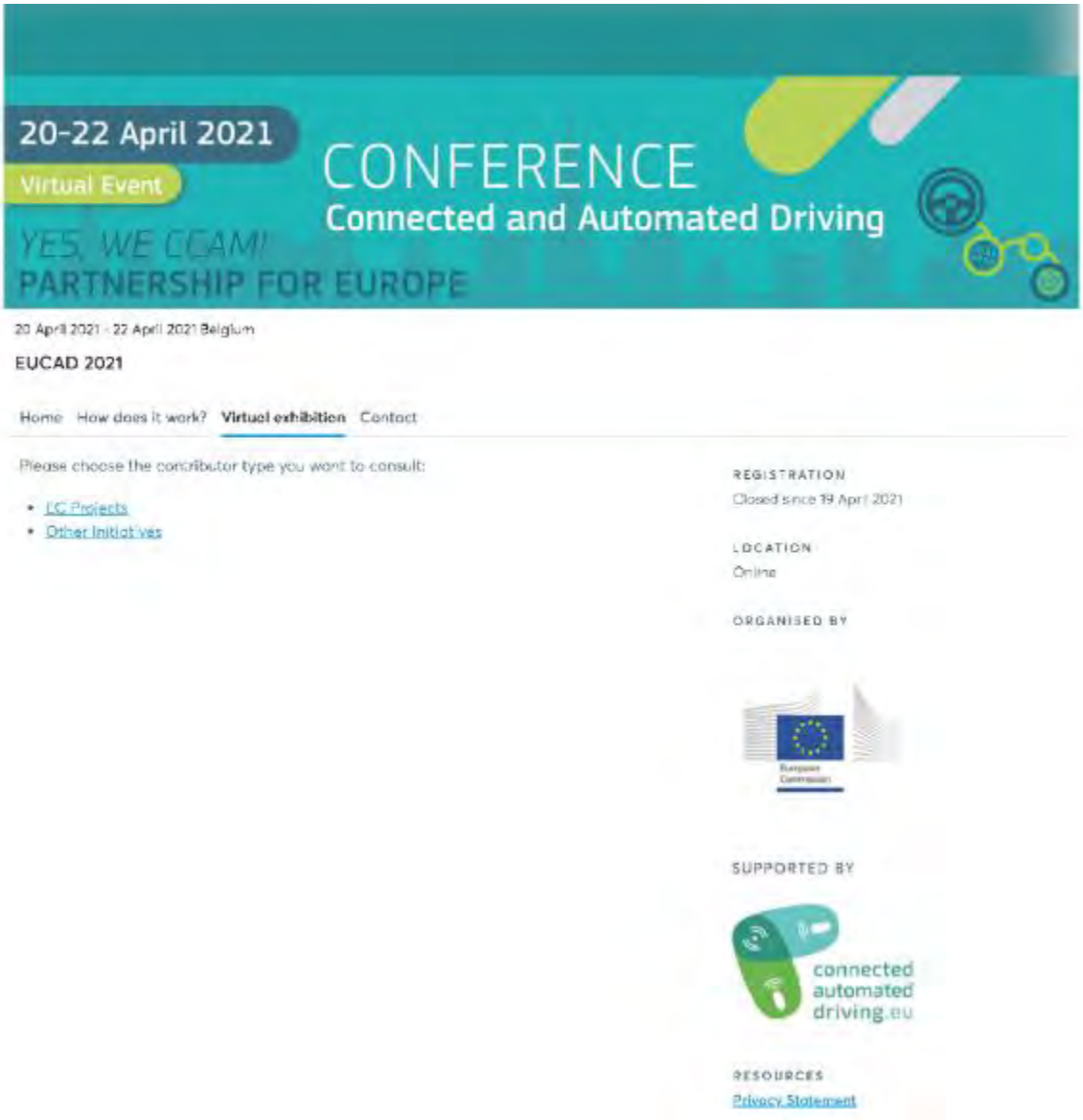

Figure 68: Homepage of EUCAD 2021 Virtual Exhibition

Each exhibiting project had a dedicated page in the Virtual Exhibition area of the event website, on which downloadable documents and promotional material could be displayed, e.g. leaflets or presentations and/ or videos, or clickable links to any relevant external webpages.

[3] Different from www.eucad2021.eu and discontinued after the event

In addition, the event participants had the opportunity to book 1:1 meetings with the exhibitors, namely during the breaks or at the end of the first two days. The virtual exhibition also remained available online after the end of the event[4].

5.1.EC Projects

The 37 projects had a dedicated space in the EUCAD 2021 virtual exhibition (a copy of their specific "Exhibitor" page is available in Annex to this report):

- 5G-LOGINNOV
- 5G-META
- 5G-MOBIX
- AUTOPILOT
- AVENUE
- AWARD
- BRAVE
- CLASS
- C-MobILE
- CoEXist
- CONCORDA
- Drive2TheFuture
- Dynaxibility4CE
- ENSEMBLE
- ESRIUM
- FABULOS
- HADRIAN
- HARMONY
- HEADSTART
- INFRAMIX
- interACT
- ICT4CART
- L3Pilot
- LEVITATE
- MobilityE
- PAsCAL
- PAV
- PRYSTINE
- SAFE-UP
- SHOW
- SUaaVE
- TransAID
- Trustonomy
- TrustVehicle
- UP2DATE
- WE-TRANSFORM
- WISE-ACT

Figure 69: EUCAD 2021 Virtual Exhibition – EC Projects section

[4] The event platform was discontinued 6 months after the end of EUCAD 2021

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5.2.Other initiatives

The following initiatives had a dedicated space in the EUCAD 2021 virtual exhibition (a copy of their specific “Exhibitor” page is available in Annex to this report):

- GLAD
- HAVOC
- REDO/ Remote Driving Operation
- UNICARagil
- Zenzic

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6. Statistics on participation

A total of 1052 unique visitors from 58 different countries attended the EUCAD 2021 Virtual conference over the three days.

Albania	Australia	Austria
Belgium	Bosnia And Herzegovina	Brazil
Bulgaria	Canada	Chile
China	Colombia	Croatia
Czech Republic	Denmark	Dominica
Egypt	Estonia	Finland
France	Germany	Greece
Hungary	India	Ireland
Israel	Italy	Japan
Jordan	Korea, Republic Of	Latvia
Lebanon	Lithuania	Luxembourg
Malta	Nepal	Netherlands
New Zealand	North Macedonia	Norway
Pakistan	Poland	Portugal
Romania	Russia	Saudi Arabia
Serbia	Singapore	Slovakia
Slovenia	Spain	Sweden
Switzerland	Taiwan	Turkey
Ukraine	United Arab Emirates	United Kingdom
United States		

Figure 70: Countries represented among EUCAD 2021 participants

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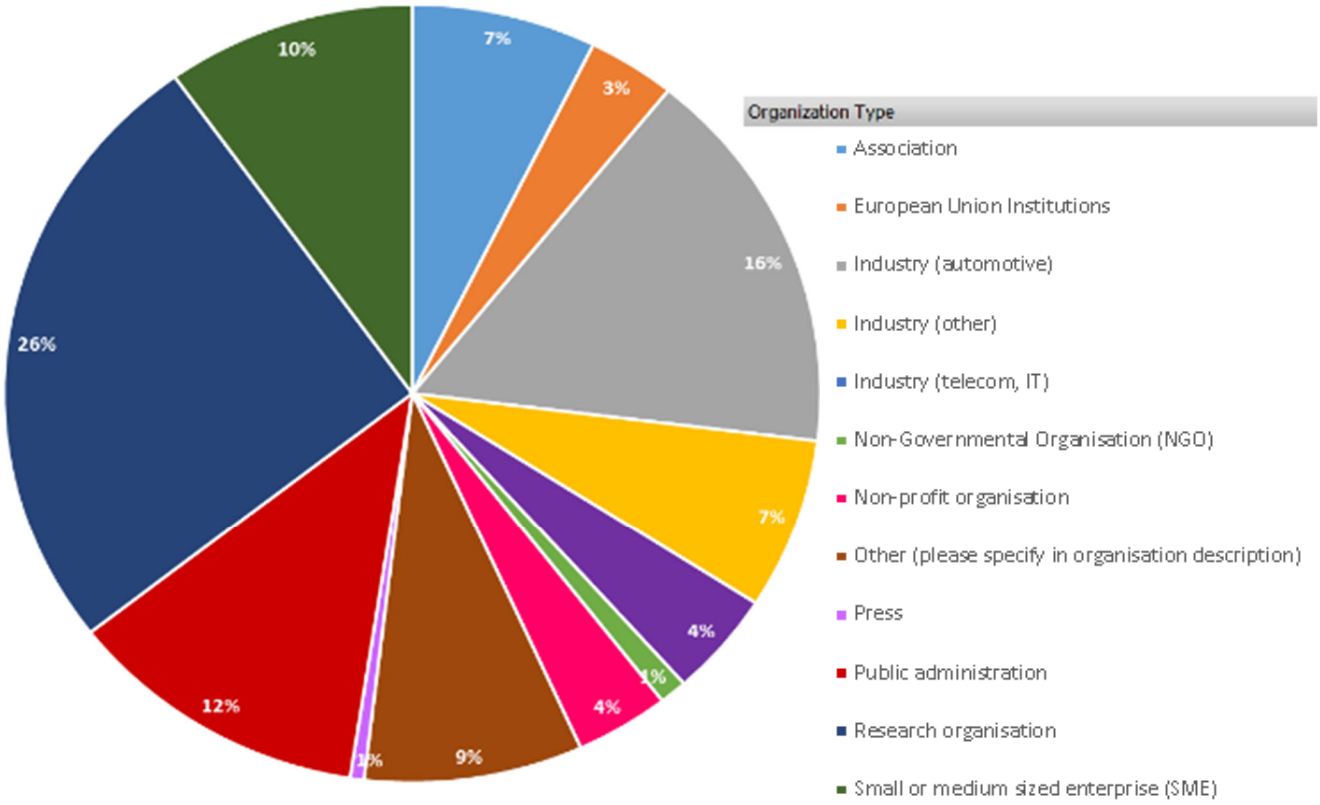


Figure 71: Representativity per stakeholder category of EUCAD 2021 participants

The interactivity tool SLIDO was used across the sessions to engage with participants, collecting their feedback through polls and their questions for the sessions' speakers.

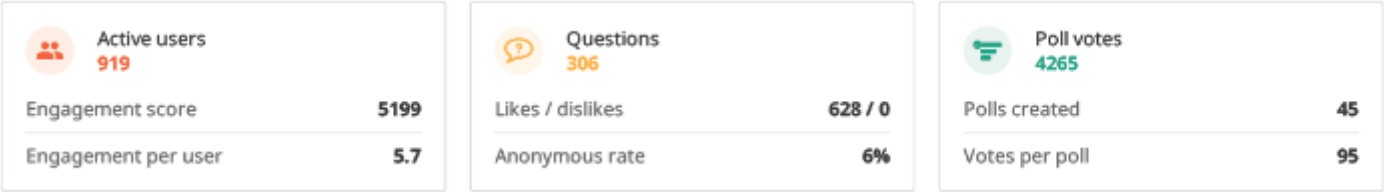
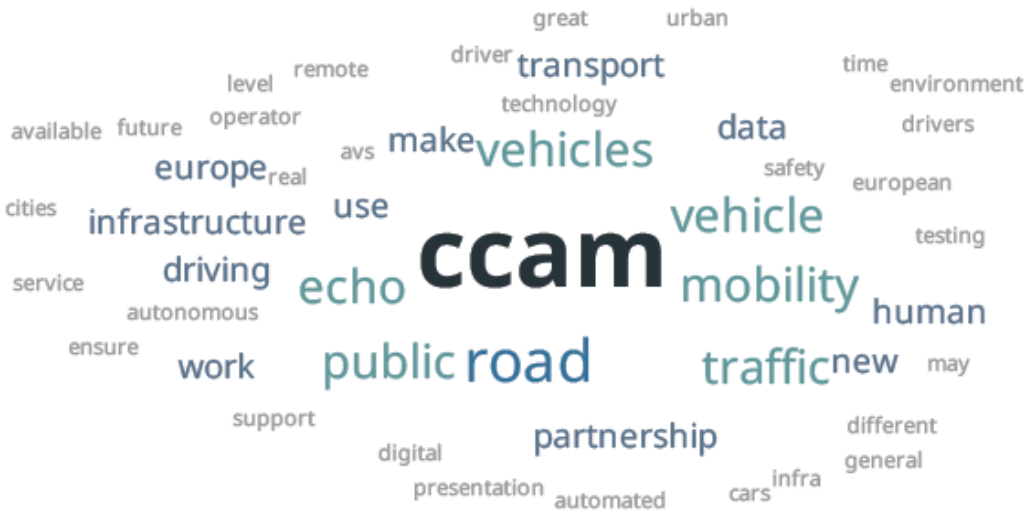


Figure 72: SLIDO engagement statistics



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6.1.Satisfaction survey

At the end of the conference, participants were asked to fill in a satisfaction survey. The overall content of the conference was rated an average of 4,25 (on a scale from 5-1, 5 excellent – 1 poor).

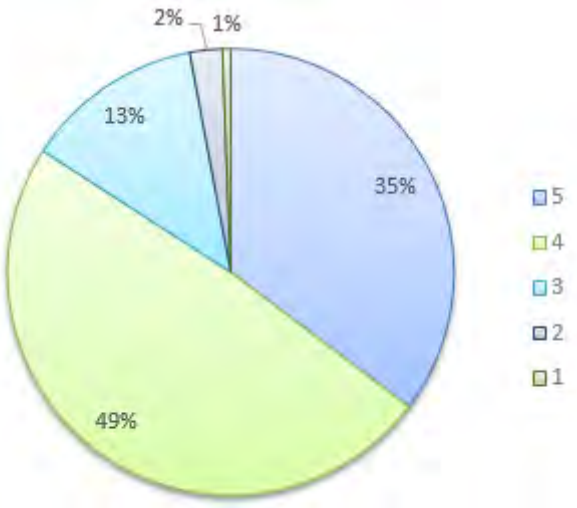

Figure 74: Satisfaction with the content of the event. (5 excellent - 1 poor)

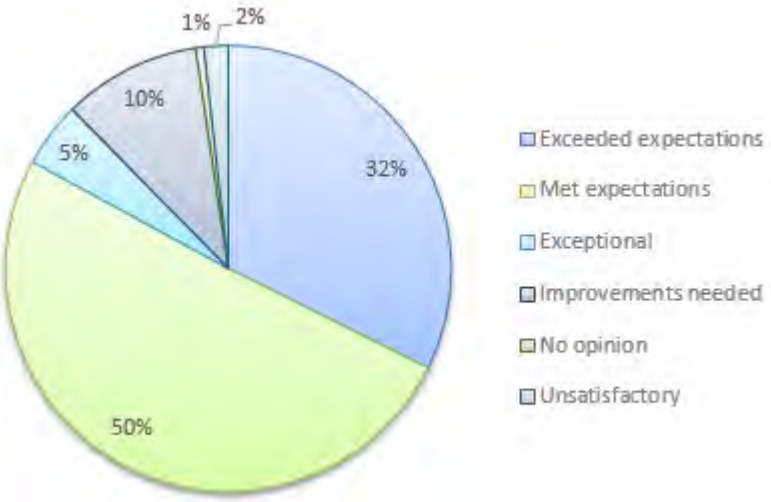

Figure 75: To what extent did the conference meet your expectations?

The qualitative comments, for the most positive ones, appreciated the good balance between technical/operational and policy level information, and the efforts of interaction within a virtual event. The most negative ones, on the other hand, would have expected/ preferred less general content and high-level messages and more “new”, real cutting-edge content and concrete actions, more actual links to real policies or upcoming updates. Some comments are pointing out the lack of newcomers among the speakers. It was also flagged that connectivity and liability aspects were missing from the discussion

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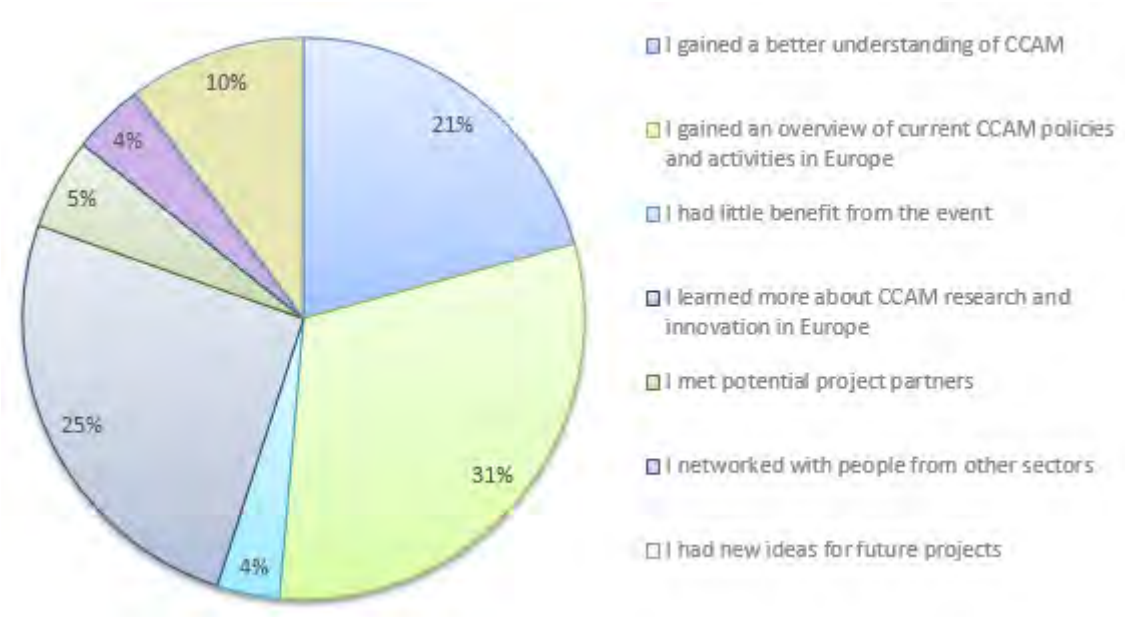

Figure 76: How did you benefit from attending the event?

Recommendations for the next EUCAD conference include the involvement of more general public as well as public transport operators, civil society and start-ups. Also suggested was the formulation of recommendations, roadmap for national Public and Road Authorities on how to support development and implementation of CCAM, from the legislation to digitalisation and physical implementation.

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7. Conclusion (and next steps)

In the closing session, participants were asked through one last poll what was the biggest challenge to CCAM (short-term) deployment. User acceptance, the role of public authorities and the European Commission as well as the cooperation of all stakeholders were also recurrent themes in all the conference sessions.

Figure 77: Closing session poll on biggest challenge to CCAM deployment by 2030

Indeed, multi-stakeholder, public and private sector cooperation along with working with a global perspective, ensuring harmonisation of standards and regulations, are essential to advance CCAM. These messages were repeated throughout the conference, which moto was "*Yes, we CCAM! A Partnership for Europe*" as the conference also marked the launch of the CCAM Partnership (European Partnership on Connected, Cooperative and Automated Mobility).

European Partnerships bring the European Commission and private and/or public partners together to address some of Europe's most pressing challenges through concerted research and innovation initiatives. The new European Partnership on CCAM will help to make cooperation between the different actors of the value chain (including industry, researchers, road operators, cities and public transport operators) and between public and private stakeholders a reality. It will also help making Europe's automotive industry more competitive globally by pooling resources and exploiting synergies: the Partnership should help to structure the investments of industry and Member States (aligning national Programmes, ensuring that the roll out does not only take place in some frontrunner, but all Member States.

Preparing the road infrastructure for CCAM requires heavy investments. Road operators are heavily investing in the digital twins of road infrastructure, which will be used not only for CCAM, but for the whole operation, planning and maintenance of infrastructure. Connectivity along the whole road network to support higher levels of automation, better engagement of Member States and alignment of national research programmes remain major challenges.

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The increased agreement and sharing of data between private and public stakeholders (see also near-term EC activities towards forming a Mobility Data Space) could help to trigger investments on both sides.

The new Partnership should actively seek coordination, synergies and alignment with other European Partnerships and other Funding Programmes such as InvestEU, Connecting Europe Facility (CEF).

EC has invested a lot through the CEF over the last years (and CEF2 is coming soon). EC will also revise the TEN-T regulation, integrating the necessary evolutions triggered by digitalization, the ITS Directive and the related Delegated Regulations on Real Time traffic Information and on Multimodal Traffic Information (enlarging geographical coverage and datasets, as well as making the link between data and services).

If we want to realize a common vision on CCAM, we need also to develop a long-term common funding agenda. The EU Partnerships and funding instruments such as CEF or Horizon Europe (the next EU's research and innovation framework programme) are multi annual planning instruments, which encourage additional investments at national, regional or local levels. Complementarity of funding enhances efficiency and that is why we need a coordinated long-term funding agenda, which gives visibility and stability to the actors involved, public but also industrial actors, who need to be able to calculate their business cases and return on investment before making decision on resources.

The CCAM Partnership contributes to the CCAM Strategic Research and Innovation Agenda[5], which is implemented through CCAM Calls for projects under Horizon Europe. The CCAM Research Agenda must be defined in such a way, that a seamless transition between the outcomes of the research and demonstration projects to large roll out can be ensured.

Demonstrating the potential

More pilots and demonstrations should be organised at local level (urban, peri-urban and rural areas) to test the potential of CCAM to address mobility needs and challenges, but also raise public awareness on the possibilities and opportunities presented by CCAM.

Public authorities play an important role, first in supporting and facilitating such tests and demonstrations, but also in building trust between citizens and new technologies (when people do not have access to or knowledge of new technologies, they turn to the trustworthiness of authorities). Such demonstrations are an opportunity to explain and communicate about the added value as well as the potential problems/ risks of CCAM in a transparent way.

We need to focus on large-scale demonstrations with limited ODDs on specific areas on public roads, not just experiments but demonstrations of real services. Moreover, the knowledge and information gathered from these large-scale demonstrations should be shared and eventually facilitate the impact assessment on all aspects of CCAM-enabled mobility.

[5] https://www.ccam.eu/wp-content/uploads/2022/05/CCAM_SRIA-report_web.pdf

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Assessing impacts

A comprehensive assessment of the positive and negative impacts of CCAM on the long-term and along the entire value chain is necessary to plan and implement CCAM solutions on the ground. Further research is needed to develop related methodologies.

Users' mindset

Real-life demonstrations and reliable and robust information on CCAM impacts for mobility and society will allow to communicate the capabilities of automation to the public, to build the confidence in the technology so that society is ready for automation.

However, CCAM solutions will have to reflect the needs and expectations of future users for society to trust, accept and embrace these innovative services. This is why we have to collaborate and work (co-create) with the users from the beginning, in the design process. Users should be involved at all the stages of development: from concept to implementation phase. Different kinds of users need to be involved, various and relevant social groups, including those with less digital skills. In addition to involving users about ideas, it is also about experiencing the service, to learn how to use it, to provide feedback and to gain some positive experiences which will lead to higher acceptance and willingness to use it in the future.

Ethics should also be involved early on, at the inception stage, in the design of the technology, but also in engaging with the users of the technology, so as to embed the right principles and values and promote a correct integration of these technologies in society, looking at broader implications.

Governments and policymakers have a role to play in prioritising these principles and values. We need legal incentives and regulation to promote explainability and accountability. The European Commission's proposal for a legal framework for AI is a great start and will help approach risk in relevant AI systems so that these systems make explainable decisions.

The right question about explainability would be: explainable to whom? Who is responsible for explaining what went on when things go wrong? Legitimate access to the data in case of a crash is needed, as we do with airplanes: independent bodies (not the owner or the designer of the airplane) have access to the data to explain what happened in case of a crash. Similarly, there are proposals for ethical black boxes for CCAM.

CCAM systems should be developed in a way that they can contribute to achieving our sustainability goals, mainly by supporting new, shared, mobility concepts (integrated with public transport) and making transport flows more efficient. This is key to get the broad support from policy makers and society.

Eventually the questions that should guide CCAM deployment are: what kind of cities and communities do we want? Do we want more traffic? What is the role of cars, buses, mobility in general? And not: do we want self-driving cars?

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Annex I – Projects and initiatives involved in the virtual exhibition

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EC Projects

Scroll through the list of virtual stands to discover contributors, set up meetings and more:

5G-LOGINNOV

5G-LOGINNOV is an H2020 project aiming at optimising freight and traffic operations at ports and logistics hubs by using innovative concepts, applications and devices supported by 5G technologies and CCAM.

Read more

5GMETA

The 5GMETA open platform aims to leverage car-captured data to stimulate, facilitate and feed with them innovative products and services.

Read more

5G-MOBIX

5G-MOBIX will develop and test automated vehicle functionalities using 5G technological innovations along multiple cross-border corridors and urban trial sites.

Read more

AUTOPILOT

AUTOPILOT contributed significantly to the progress needed to ensure that an automated vehicle detects all external obstacles along its self-driving path by implementing IoT technologies and standardized service architectures..

Read more

AVENUE

The AVENUE project, now in its 3rd year, has developed and operates on-demand, door-to-door fully automated mini-bus public transport services in several European cities, offering personalized services,

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AWARD

AWARD paves the way for the roll-out of driverless transportation, whatever the weather conditions are. It will deploy safe and efficient connected and automated heavy-duty vehicles in real-life logistics operations.

Read more

BRAVE

BRAVE project aims to promote an increased confidence in automated vehicles by the society.

Read more

CLASS

The European project CLASS is developing a novel software architecture, able to efficiently distribute real-time big data analytics workloads across the compute continuum, from edge to cloud, demonstrated on a smart-city use casein a real life lab for automated driving in Modena, Italy.

Read more

C-MobILE

Large-scale deployment of C-ITS services in an interoperable way thanks to the C-MobILE European reference architecture.

Read more

CoEXist

CoEXist was an H2020 EU project which ran from 05/2017 – 04/2020 and worked on preparing for the transition phase during which automated and conventional vehicles will co-exist on urban roads.

Read more

CONCORDA

CONCORDA contributes to the preparation of European motorways for automated driving and high density truck platooning with adequate connected services and technologies.

Read more

Drive2theFuture

Drive2theFuture aims to prepare future "drivers", travellers and vehicle operators to accept and use connected, cooperative and automated transport modes and the industry of these technologies to understand and meet their needs and wants.

Read more

Dynaxibility

Dynaxibility4CE aims to increase the ability of public authorities to deal with new mobility trends (Maas, CAD and UVAR) by developing strategies and tools that can strengthen their planning capacities and capabilities.

Read more

ENSEMBLE

ENSEMBLE will pave the way for multi-brand truck platooning in Europe, demonstrating it under real traffic conditions and providing the specifications at the tactical layer for both levels of platooning-support function and autonomous function.

Read more

ESRIUM

ESRIUM is fostering safer and more efficient roads towards a smarter, safer, greener transport system through an ENGSS-based digital map of road surface damage and road wear.

Read more

FABULOS

Pre-Commercial Procurement of Future Autonomous Bus Urban Level Operation Systems.

Read more

HADRIAN

The project investigates the extent to which road infrastructure information distributed via C-ITS infrastructure could increase predictability and transparency of automated driving and improve operational safety and acceptance.

Read more

HARMONY

HARMONY's spatial and multimodal transport planning tools are enabling metropolitan area authorities to lead a sustainable transition to a low-carbon new mobility era through updated Sustainable Urban Mobility Plans.

Read more

HEADSTART

The HEADSTART project is an EU funded project which started on the 1st of January of 2019. The project aims to define testing and validation procedures of CAD functions.

Read more

INFRAMIX

INFRAMIX has shown the importance of automation readiness of road infrastructure for the upcoming period of mixed traffic with automated and non-automated vehicles and successfully developed solutions for specific scenarios.

Read more

InterACT

interACT worked towards the safe integration of automated vehicles into mixed traffic environments. interACT analysed todays' human-human interaction strategies, implemented and evaluated solutions for safe interactions between automated vehicles and humans.

Read more

ITC4CART

ICT4CART aims to bring together, adapt and improve technological advances from the telecommunication, automotive and IT industries to provide the ICT infrastructure to enable the transition towards road transport automation.

Read more

L3Pilot

L3Pilot tests the viability of automated driving as a safe and efficient means of transportation by large-scale piloting of automated driving functions of different SAE levels on public roads.

Read more

LEVITATE

Levitate is building tools to help European cities, regions and national governments prepare for a future with increasing levels of automated vehicles in passenger cars, urban transport services and urban logistics.

Read more

Mobility.E

The Mobility.E Lighthouse is a networking and collaboration platform for technical and non-technical stakeholders working jointly toward the deployment of electric, connected and automated mobility.

Read more

PAsCAL

The PAsCAL project aims at improving the understanding of the implications of connected and automated vehicles on society. It will create a "Guide2Autonomy" to capture this new knowledge.

Read more

PAV

PAV aims to stimulate the up-take of electric, shared AVs by developing green transport and spatial planning strategies that incorporate AVs.

Read more

PRYSTINE

The ambition of PRYSTINE is to strengthen and to extend traditional core competencies of the European industry, research and universities in smart mobility and in particular the electronic component and systems and cyber-physical systems domains.

Read more

SAFE-UP

SAFE-UP is an EU-funded H2020 project proactively making future mobility safer for people inside AND outside of the vehicle.

Read more

SHOW

SHOW aims to support the deployment of shared, connected and electrified automation in urban transport, to advance sustainable urban mobility.

Read more

SUaaVE

SUaaVE aims to enhance the public acceptance of CAV by leaning on a Human-Driven Design approach, where users actively contribute and lead the definition of concept, technology and testing.

Read more

TransAID

Automated driving will not be possible everywhere. TransAID investigated infrastructure-based measures to reduce negative impacts of transitions of control and minimum risk maneuvers on traffic safety and efficiency.

Read more

TRUSTONOMY

Building Acceptance and Trust in Autonomous Mobility by addressing technical and non-technical challenges through a well-integrated and inter-disciplinary approach, bringing domain experts and ordinary citizens to work closely together.

Read more

TrustVehicle

TrustVehicle aimed at advancing technical solutions for automated driving to better assess critical situations in mixed traffic and even under harsh environmental conditions, hence increasing safety far beyond the current levels.

Read more

UP2DATE

UP2DATE is an International research project funded by Horizon 2020 which targets a new software paradigm for SAfe and SEcure (SASE) software updates for intelligent and resource intensive Mixed-Criticality Systems.

Read more

WeTransform

WeTransform is an EU-funded project addressing the impacts of transport automation on the workforce. Using collective intelligence, it will generate an evidence-based and action-oriented agenda for politicians to tackle identified challenges.

Read more

WISE-ACT

WISE-ACT is a large multidisciplinary network of 200 experts in 42 countries focusing on the regulatory, social, business impacts of autonomous and connected transport under diverse deployment scenarios.

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WISE-ACT

COST ACTION CA16222
WISE-ACT
Wider Impacts and Scenario Evaluation of Autonomous and Connected Transport

About us

Autonomous Vehicle (AV) trials are currently taking place worldwide and Europe has a key role in the development of relevant technology. Yet, limited research exists regarding the wider implications of the deployment of such vehicles on existing road networks and infrastructure, since it is unclear if and when the transition period will start and be concluded.

It is anticipated that improved road safety and increased accessibility will constitute the primary benefits of the widespread use of AVs, whilst co-benefits may also include reduced energy consumption, improved air quality or better use of urban space. Therefore, the focus of WISE-ACT is on observed and anticipated future mobility trends and implications on travel behaviour, namely car sharing, travel time use, privacy concerns and employment implications to name a few. Other important issues to be explored under different deployment scenarios are specific social, ethical, institutional and business impacts.

WISE-ACT objectives are achieved by culminating co-operation between a wide range of stakeholders at a local, national and international level, including academics and practitioners. Key outputs through co-ordinated activities include an edited book, two Special Issues, individual county reports and a large international survey. Consequently, WISE-ACT facilitates collaboration among 200 experts among 42 countries in Europe and beyond about this emerging topic of global interest.

Video section

- **Video 1**
  Prof. Maria Attard is an experienced COST Action participant and explains how WISE-ACT contributes in understanding the implications of Autonomous and Connected Transport, particularly in car dependent places such as Malta.

- **Video 2**
  WISE-ACT Chair Dr. Nikolas Thomopoulos gave a public lecture at the Institute for

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Technology and Society of Rio de Janeiro, which was followed up by a response of the ITS Executive Director Dr Fabro Steibel and a lively debate with members of the public. Issues covered revolved around data management and ethics, informing participants about the opportunities and challenges of ACT for Europe and Brazil. This event was organised within the Varandas series of the Institute for Technology and Society.

Gallery

Additional resources

- Milakis, D., Thomopoulos, N., van Wee, B. (2020) ***Policy Implications of Autonomous Vehicles***, Oxford: Academic Press.
- Information about past, ongoing and forthcoming reports, publications and other WISE-ACT outputs
- WISE-ACT survey focusing on User Preferences about Autonomous Vehicles
- WISE-ACT flyer/brochure

Contact

- Dr Nikolas Thomopoulos | chair@wise-act.eu
- Dr Tibor Petrov | webmaster@wise-act.eu
- Website | https://wise-act.eu/

Manage a 1:1 Meeting with Nikolas Thomopoulos

Manage a 1:1 Meeting with Tibor Petrov

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WeTransform

About us

To keep up with new customer demands, technologies and environmental goals, the transport sector is increasingly turning to automation to deliver sustainable, affordable, and accessible mobility services. This is transforming labor requirements, demanding new skills and competencies. As a result, mobility stakeholders must be able to understand and prepare for these changes.

WeTransform adopts a cross-sectoral approach. Addressing changes in labor requirements demands a coordinated response which engages manufacturers, operators, policy makers and unions alike, understanding where priorities are aligned, and where they may diverge. The project identifies key barriers, needs, skills, competences, examining best practices and facilitating the co-creation of targeted and durable solutions.

To do this, it will:

1. **Establish and foster a collaborative platform** for the discussion of the effects of automation on transport labor with relevant stakeholders;
2. **Co-create user-friendly and shareable knowledge** related to automation impacts on transport labor;
3. **Enable and support durable and effective dialogue** on innovation and the reality of workforce requirements and conditions.

Additional resources

- Project leaflet

Contact

- Manon Coyne, POLIS Network | mcoyne@polisnetwork.eu
- Website | https://wetransform-project.eu

Manage a 1:1 Meeting with Manon Coyne

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UP2DATE

About us

Mixed-Criticality Cyber-Physical Systems (MCCPS) deployed in critical domains like automotive and railway are starting to use Over The Air Software Updates (OTASU) for functionality improvement, bug fixing, and solving security vulnerabilities (among others). But, applying OTASU on such systems entails several difficulties regarding safety, security and availability aspects. Additionally, computing performance needs are bigger and therefore complex hardware platforms based on multicore processors and accelerators are increasingly used.

Bringing together these two trends, OTASU and complex hardware platforms, is the main motivation that inspired UP2DATE to work on a new software paradigm for SAfe and SEcure (SASE) software updates for intelligent and resource intensive systems. The UP2DATE approach builds around composability and modularity as main properties to enable a dynamic (post-deployment) validation of safety and security properties of updates.

To work towards this objective, the project is comprised of a high quality and complementary consortium including knowledge generators (IKERLAN, BSC and OFFIS), technology integrators (IAV and TTTech Auto) and two end users from the automotive and railway sectors (Marelli and CAF Signalling).

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Additional resources

- Poster
- Twitter
- LinkedIn

Contact

- Irune Agirre | iagirre@ikerlan.es
- Website | https://h2020up2date.eu

Manage a 1:1 Meeting with Irune Agirre

20 April 2021 - 22 April 2021 Belgium

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TrustVehicle

About us

Automated vehicles will be accepted by customers and society only when they will be deemed easy-to-use and fully reliable and safe regarding the planned manoeuvres and their execution. A key challenge is to ensure safe vehicles handling with reduced driver attention. Especially for level 3 automated driving systems, an effective interaction between the driver and the automated vehicle plays an important role. To act in harmony with driver expectations, these systems should be engineered following a user-centric approach. User acceptance is particularly important for the design of driver interfaces that will facilitate the transitions between human and automated driving. Moreover, the automated driving systems should be resilient to both system and driver failures and guarantee sufficient reliability and robustness in every situation in real world traffic.

The TrustVehicle project aimed to address exactly these challenges with the following systematic approach:

TrustVehicle vision: Turning a vehicle into a TrustVehicle - a vehicle which the end user can trust.

TrustVehicle mission: Developing technologies that work reliably and predictably to gain the end-user's trust.

Altogether TrustVehicle focused on 4 different vehicle classes (passenger car, electric bus, truck and light-commercial vehicle) within 6 different use cases.

TrustVehicle Final Video

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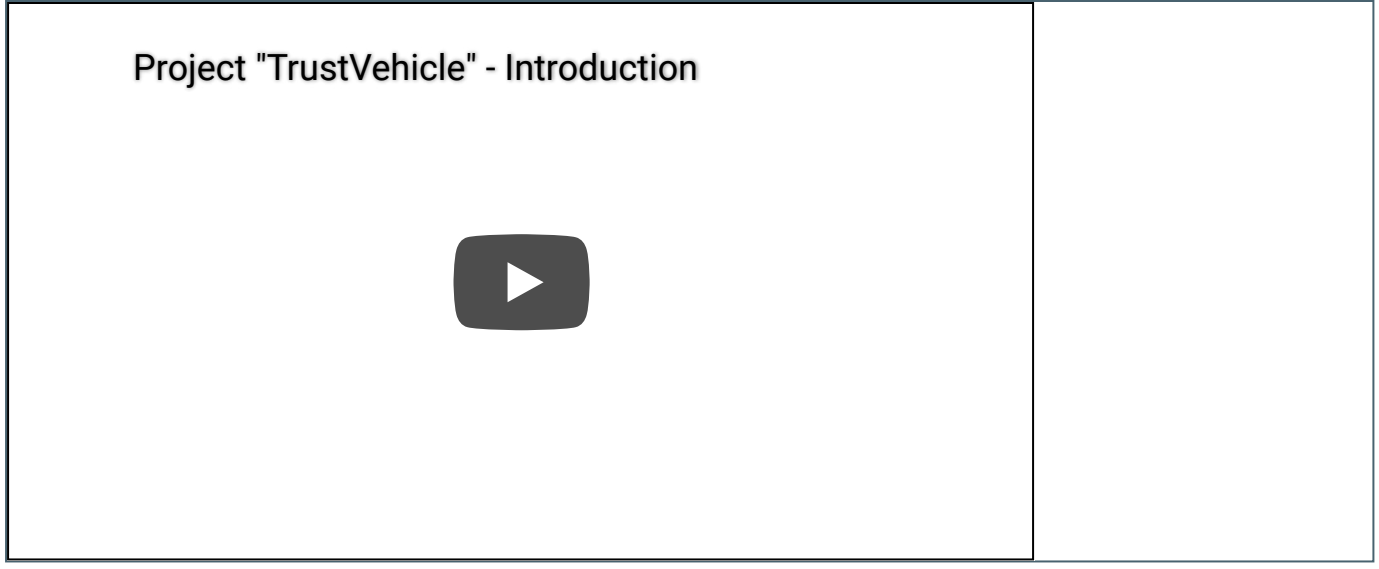

Additional resources

- Improved trustworthiness and weather-independence of conditional automated vehicles in mixed traffic scenarios
- TrustVehicle book
- Project Poster
- White Paper: Catalogue of Critical Scenarios
- White Paper: Catalogue of Assessment Criteria for Level 3 Autonomous Vehicles

Contact

- Lisa-Marie Schicker
- Website | www.trustvehicle.eu

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TRUSTONOMY

About us

Automated driving raises several challenges, from evaluating the driver's ability to intervene in a driver-vehicle interaction and adequate driving training to ethical and legal perspectives and properly designed human-machine interfaces. All these factors encompass a trust dimension that is crucial for the successful interaction between human drivers and increasingly automated driving systems and vehicles. The EU-funded Trustonomy project aims to raise safety, trust and acceptance of automated vehicles. It aims to investigate, set up, test and assess relevant technologies and approaches in autonomous driving and request to intervene scenarios. This will be done taking into account key considerations such as types of users, road transport modes and driving conditions.

Trustonomy - Trust the Autonomy! (updated version)

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Additional resources

- Project Leaflet
- Operational Context Analysis
- Trustonomy Requirements
- Trustonomy Framework Definition
- Trustonomy Methodological Guidelines
- Trustonomy Functional Architecture
- Find a project

Contact

- Laura Franchi | laura.franchi@ttsitalia.it
- Alessandro Barisone | alessandro.barisone@algowatt.com
- Stefano Bianchi | stefano.bianchi@algowatt.com
- Website | https://h2020-trustonomy.eu

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TransAID

About us

TransAID is a recently finished H2020 project investigating the effects of automated driving, esp. in areas where automation is reaching its limits. Besides modelling the behavior and impact of automated vehicles in such so called "Transition Areas", the project also developed infrastructure measures to avoid negative impacts. TransAID revealed that infrastructure measures can drastically improve safety and efficiency in a variety of situations by using ITS-G5 communication and collective perception. This could be shown in simulation and real-world prototypes. Finally, a guideline and roadmap document summarized the required stakeholders' steps to enable a smooth introduction of automated vehicles.

Video section

- **Video 1:** The TransAID project: Infrastructure supports automated vehicles in critical situations TransAID develops and demonstrates traffic management procedures to enable smooth coexistence of automated, connected and conventional vehicles. The researchers are focusing in particular on transition areas where the automated vehicle hands over control to the driver. The project shows that supporting automated vehicles with infrastructure components in difficult situations drastically reduces negative impacts on following traffic.

- **Video 2:** Several TransAID use cases have been demonstrated on the Testbed Lower Saxony in November 2020.

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TransAID Demonstration on the Testbed Lower Saxony

- **Video 3:** Merging assistance for automated vehicles using smart infrastructure.

TransAID WP4 motorway merging assistant for scen...

Additional resources

- The iTETRIS version used in TransAID for complex simulations of traffic and communication
- List of all TransAID publications
- TransAID channel

Contact

- Julian Schindler | julian.schindler@dlr.de
- Meng Lu | Meng.Lu@dynniq.com
- Evangelos Mintsis | vmintsis@certh.gr
- Website |https://www.transaid.eu/

Manage a 1:1 Meeting with Julian Schindler

Manage a 1:1 Meeting with Meng Lu

Manage a 1:1 Meeting with Evangelos Mintsis

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Home How does it work? **Virtual exhibition** Contact

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SUaaVE

About us

While the deployment of connected automated vehicle (CAV) turns into reality, its acceptance has been called into question. Societal issues regarding public acceptance, user awareness and ethics become priority concerns. The approach based on the technology push, jeopardizes social viability of CAV, as it creates a gap between the technical reliability and public acceptance.

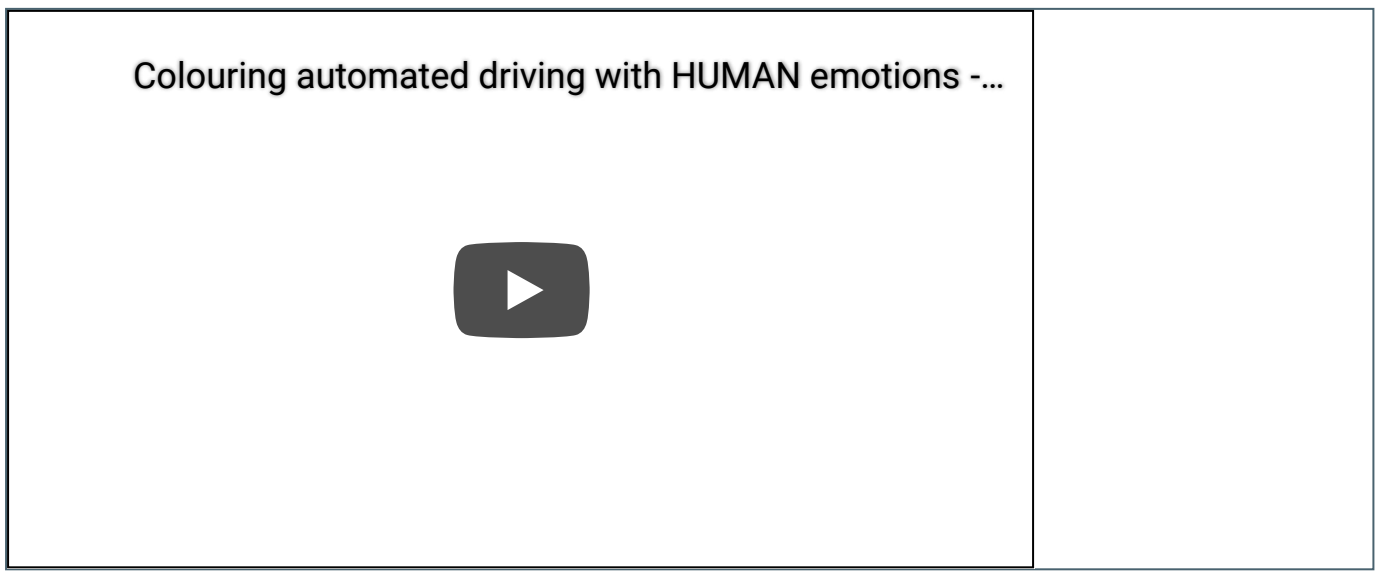
SUaaVE will solve this gap by leaning on a Human-Driven Design (HDD) approach, enhancing synergies social science, human factors and automotive market by means of an iterative process of assessment, co-design and prototyping. Participatory process will involve above 4.000 users (passengers, traditional and future drivers) and 100 experts and stakeholders along the project.

The main outcomes will be:

- A new paradigm of automation: ALFRED -Automation L4+ Reliable Empathic Driver-, that will "colour the decision-making processes of the CAV with human emotions".

- An immersive Virtual Human Centred Design (V-HCD) platform, allowing the simulation of CAV focused on Human factors to assess their acceptance.

- Guidelines to support Public Authorities, representing a breakthrough in the public acceptance of future CAVs for both the society and, in particular, for all road users.



Additional resources

- SUaaVE leaflet
- Automotive

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Contact

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- Website | https://www.suaave.eu

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SHOW

About us

SHOW aims to support the deployment of shared, connected and electrified automation in urban transport, to advance sustainable urban mobility. During the project, real-life urban demonstrations taking place in 20 cities across Europe will see the integration of fleets of automated vehicles in public transport, demand-responsive transport (DRT), Mobility a Service (MaaS) and Logistics as a Service (LaaS) schemes.

SHOW is the biggest and most holistic ever initiative piloting automated vehicles in urban environments. It gathers a strong partnership including 69 partners from 13 EU-countries and fosters international cooperation by collaborating with organisations from the US, South Korea, Australia, China, and other countries.

Additional resources

- SHOW Leaflet
- SHOW Poster
- SHOW Roll-up
- SHOW Presentation
- Towards safer, sustainable cities: launch of SHOW project marks major milestone for automated transport

Contact

- Dr. Henriette Cornet, SHOW Project Coordinator | henriette.cornet@uitp.org
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SAFE-UP

About us

As innovations like connected automated vehicles (CAVs) disrupt mobility as we know it, new safety challenges will keep emerging. That's why SAFE-UP is identifying future safety-critical scenarios to develop new safety systems that will protect car occupants and vulnerable road users (VRUs) – for EURO NCAP protocols.

The project is developing 4 demonstrators which will integrate active and passive safety systems:

- Demo 1 will test new seating positions for highly automated vehicles. This demo is focused on highway safety critical scenarios and its final assessment will be carried out in the passive safety sled test facilities at IDIADA HQ.

IDIADA's CTAG facilities

- Demo 2 will enhance the interaction between vehicles and VRUs under bad weather conditions and will be tested at the CARISSMA research and test center, part of the Technical University of Ingolstadt (THI).

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CARISSMA research and test center

- Demo 3 will integrate advanced intervention functions to avoid critical events.


Applus IDIADA facilities

- Demo 4 will consist of a safety solution based on C-ITS to enable timely warning provisions.


Applus IDIADA facilities

SAFE-UP will also produce targeted education, training and awareness schemes for fostering the safe integration of automated driving functions.

The consortium brings together leading researchers, manufacturers and industry suppliers in automotive, connected and automation technology, as well as experts in road user safety and training.

Related works

Applus IDIADA – SAFE-UP project coordinator

The final testing for SAFE-UP demos 2, 3 and 4, as well as the final event, will take place at Applus IDIADA HQ. The tracks that will be used for the testing can be seen below.

Applus IDIADA facilities

Applus IDIADA facilities

- Vehicle-in-the-loop testing
  Vehicle-in-the-loop testing is a cost-effective solution that allows ADAS and Automated Driving systems development and validation in multiple complex or dangerous scenarios, with less requirements for proving ground resources (as it requires only simple tracks, with virtual targets), reduced logistical effort and guaranteeing high tests accuracy and repeatability.

- CAVRide – an LV self-driving vehicle
  CAVRide is an L4 self-driving vehicle that meets the functional requirements necessary for the automation system to safely operate whilst maintaining overall car performance. This demonstrator vehicle is capable of predicting and understanding the environment to navigate within IDIADA's premises without human input.

Aimsun

SAFE-UP's future safety-critical scenarios will be designed and analysed in a highly automated and mixed traffic environment in the Aimsun Next traffic simulation platform.

- Next 3D model: pedestrian behaviour
- Next dynamic 3D flyover of London in the UK
- Next microscopic 3D model of pedestrian and vehicle interaction outside Camp Nou football stadium in Barcelona

TrustVehicle (Coordinated by SAFE-UP partner Virtual Vehicle)

This project focused on advancing technical solutions for automated driving to better assess critical situations in mixed traffic scenarios and even under harsh environmental conditions - increasing safety far beyond the current levels.

- Video: Final results
- White paper: Catalogue of critical scenarios
- White paper: Catalogue of Assessment Criteria for Level 3 Autonomous Vehicles

Additional resources

- About the project
- Special blogpost from advisory board member ERTICO – ITS Europe. ***"Taking a holistic approach to mobility with ERTICO – ITS Europe"***
- Paper summary by UNIFI · Dipartimento di Ingegneria Industriale – ***"Communication between automated vehicles and vulnerable road users in future traffic"***
- Sign up to the **SAFE-UP newsletter**
- Follow SAFE-UP on **Twitter**
- Join the SAFE-UP **LinkedIn** community

Contact

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- Ignacio Magallón (Bax & Company) | i.magallon@baxcompany.com
- Professor: Christian Birkner (Technische Hochschule Ingolstadt) | christian.birkner@thi.de
- Dissemination lead: Amy McCready (Bax & Company) | a.mccready@baxcompany.com
- Website | www.safe-up.eu

Manage a 1:1 meeting with Núria Parera

Manage a 1:1 meeting with Ignacio Magallon

Manage a 1:1 meeting with Christian Birkner

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PRYSTINE

About us

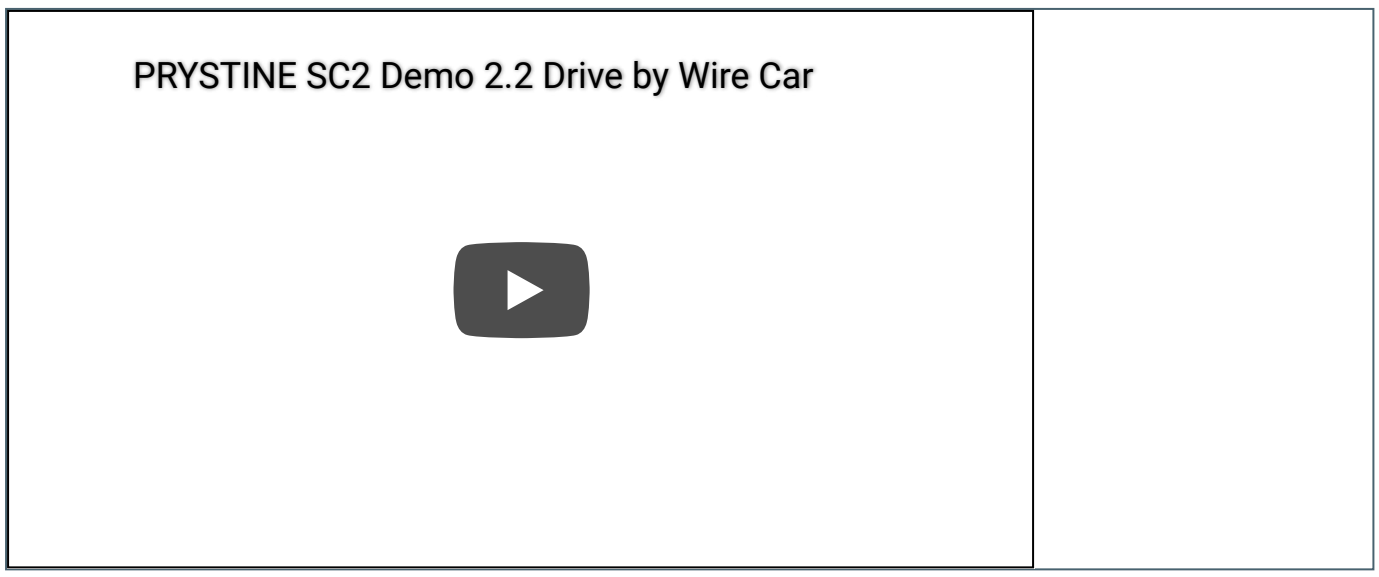
PRYSTINE's target is to realize Fail-operational Urban Surround perceptION (FUSION) which is based on robust Radar and LiDAR sensor fusion and control functions to enable safe automated driving in urban and rural environments. Therefore, PRYSTINE's high-level goals are:

1. Enhanced reliability and performance, reduced cost and power of FUSION components
2. Dependable embedded control by co-integration of signal processing and AI approaches for FUSION
3. Optimized E/E architecture enabling FUSION-based automated vehicles
4. Fail-operational systems for urban and rural environments based on FUSION

PRYSTINE is ready to deliver (a) fail-operational sensor-fusion framework on component level, (b) dependable embedded E/E architectures, and (c) safety compliant integration of Artificial Intelligence (AI) approaches for object recognition, scene understanding, and decision making within automotive applications. The resulting reference FUSION hardware/software architectures and reliable components for autonomous systems will be validated in 22 industrial demonstrators.

Video section

Video 1: PRYSTINE SC2 Demo 2.2 Drive by Wire Car.
A novel approach to software component integration: developed COMPAGE framework (fail-operational system component management framework) and AI-based algorithms capable of identifying faulty sensors by analyzing data of different types, e.g. LIDAR, Radar, cameras.



Video 2: PRYSTINE SC2 Demo 2.3 Data Fusion and Fall back.
A fully integrated security engineering process for realizing secure autonomous driving and a trust model for evaluating the trustworthiness of sensors data with the data fusion module for

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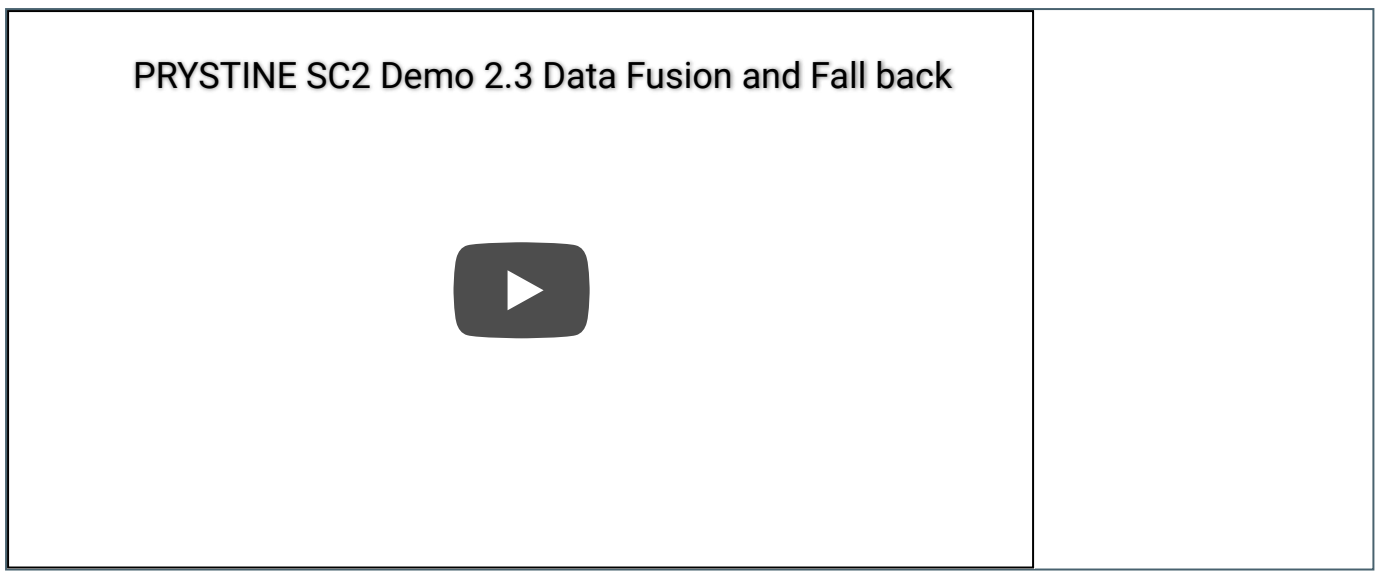
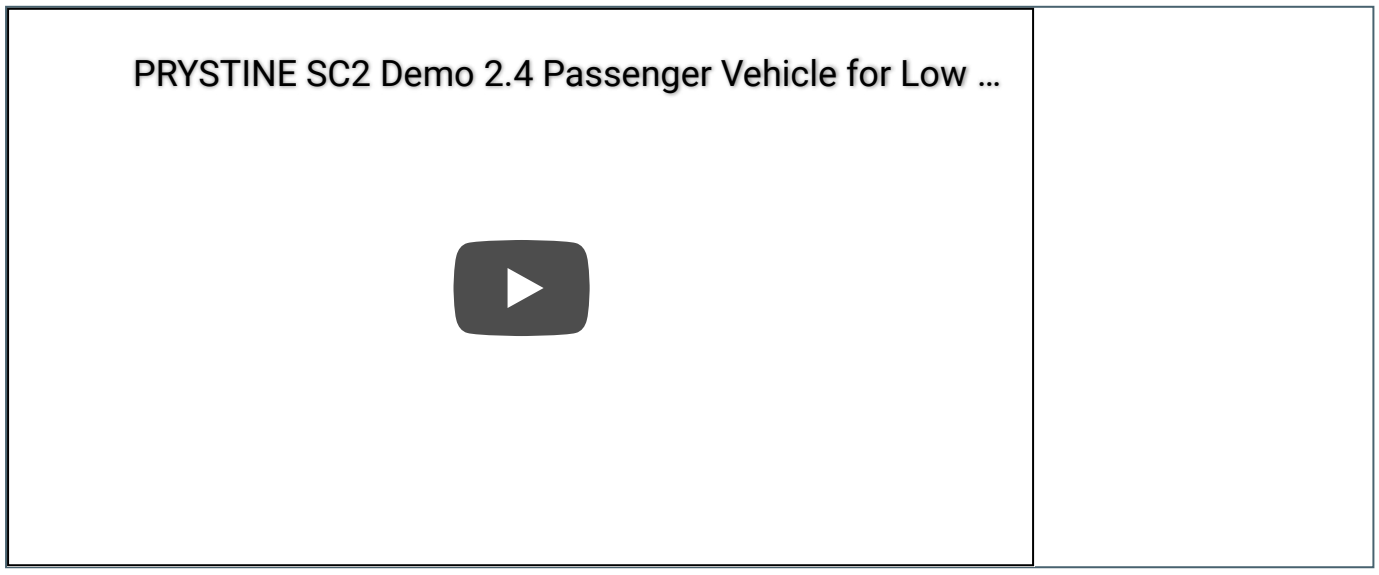
improving the accuracy of object detection and tracking



Video 3: PRYSTINE SC2 Demo 2.4 Passenger Vehicle for Low Speed Autonomy.
Fusion algorithms and perception components to be utilized by SAE Level 3+ equivalent autonomous parking and low speed autonomy solutions (related to Automated Parking Vale Systems) providing fail-operationality and robustness by the utilization and fusion of multiple sensor sources including cameras and Radar.



Video 4: PRYSTINE SC3 Demo 3.1, 3.2, 3.3.

- Demo 3.1 E/E architecture demonstrator for automotive electronics enabling AD.
- Demo 3.2 Simulation, development and validation framework for fail-operational sensor-fusion E/E architecture
- Demo 3.3 Dynamically shaped, reliable **mobile communication**

Video 5: PRYSTINE SC7 Demonstrators 7.1, 7.2, 7.3

- Demonstrator #7.1: Shared control to study driver interaction with automated vehicles considering the driver state and the driving environment (DiL Simulator).
- Demonstrator #7.2: Traded control to study automatic transitions between different levels of automation in complex environments, while cooperating with a bus for enhanced perception (V2V).
- Demonstrator #7.3: Autonomous control to study AI-based decision algorithms for highly automated vehicles in highway and urban scenarios, considering a traffic state predicition network

Additional resources

- PRYSTINE project overview presentation
- PRYSTINE poster
- PRYSTINE full flyer
- Prystine partners map

Contact

- Gabriele Keraite | Gabriele@metisbaltic.lt
- Website | https://prystine.eu/

Manage a 1:1 Meeting with Gabriele Keraite

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PAV

About us

Many cities have already started experimenting with AVs in Europe or are planning to in the near future. But AVs have yet to be implemented in local authorities' spatial planning. The PAV project takes a new approach and aims to stimulate the uptake of electric, shared AVs by developing green transport and spatial planning strategies that incorporate AV. To develop such strategies, local and regional authorities need to gain a deeper understanding of the potential paths of development, potential impacts, and chains of causality. By linking the insights from PAV research partners with the identified local challenges, opportunities and priorities of the local, regional and transport authorities, PAV partners will be able to develop strategies to steer the future arrival of AV efficiently and in line with local policy goals.

PAV brings together four local/transport authorities (UK, DE, NL and SE), four knowledge groups and four network organisations that will:

- Develop and improve green transport and spatial planning strategies for the four participating local- and transport authorities;
- Prepare a publicly available series of expert analysis on the socio-economic impact of AVs;
- Create an open and scalable innovation community connecting cities, regions and knowledge providers on AVs;
- Implement four urban/regional AV pilots integrated with other, existing transport modes.

Additional resources

- Report on long term socioeconomic impacts of AV
- Documents and Publications
- Future Mobility Expert
- PAV Polis Booth

Contact

- Laura Babío Somoza, POLIS | lbabio@polisnetwork.eu
- Website | https://northsearegion.eu/pav

Manage a 1:1 Meeting with Laura Babío Somoza

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PAsCAL

About us

The aim of the PAsCAL project, is to improve the understanding of the implications of connected and automated vehicles (CAVs) on society. The project will create a "Guide2Autonomy" to capture this new knowledge. Outcomes from the project will contribute to the training of future drivers and passengers and will help decision-makers to move towards the new forms of individual and collective mobility made possible by the spread of driverless cars.

During the PAsCAL project, the perceptions and expectations of citizens regarding the new autonomous and connected driving technologies will be examined, as well as the behavior of drivers in semi-autonomous vehicles and that of all other road users. To these purposes, specific surveys will be prepared and accurate behavioral analysis will be carried out with extensive use of modern technologies, such as driving simulators and virtual reality platforms. The results of the simulation experiments will provide a better understanding of the reasons for the distrust towards CAVs expressed by many European citizens. In addition, PAsCAL will finally create 5 road-transport pilot projects, conducted in different countries of the European Union.

All of this new knowledge will be incorporated into the "Guide2Autonomy" which will be made available to all relevant stakeholders.

PAsCAL Mobility Future is near. Ready to Go?

Additional resources

- LinkedIn
- Facebook
- Twitter
- PAsCAL Brochure
- PAsCAL Flyer
- PAsCAL Factsheet Pilots
- PAsCAL Factsheet Acceptance

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Contact

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- Website | http://pascal-project.eu

Manage a 1:1 Meeting with Luc Vandenabeele

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Mobility.E

About us

The Mobility.E Lighthouse of the ECSEL JU is a networking and collaboration platform serving to connect stakeholders along and beyond the automotive value chain, bringing together the Electronic Components and Systems (ECS) and application side as well as non-technical experts to ensure European competitiveness for Electric, Connected and Automated (ECA) mobility and to meet the demands of the 2030 customer.

The COSMOS project supports the Lighthouse with a strategy development process (including the prioritisation of research topics) and network support activities.

The following projects are part of the Mobility.E Lighthouse: AutoDrive, ENABLE S3, BRAVE, interACT, TrustVehicle, PRYSTINE, SECREDAS, NewControl, VALU3S, ArchitectECA2030, 1000kmPLUS, InSecTT and COREnect.

Mobility.E Projects

Video section

- AutoDrive on YouTube

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The AutoDrive project | Infineon

- ENABLE S3 on YouTube

ENABLE-S3 project video - with background music

- BRAVE on YouTube

BRAVE - Project presentation

- interACT on YouTube

interACT H2020 Project Video

- TrustVehicle on YouTube

- PRYSTINE on YouTube

- VALU3S on YouTube

- InSecTT on YouTube

Additional ressources

- Mobility.E Lighthouse
- Survey on Research Priorities
- AutoDrive
- ENABLE S3
- BRAVE
- interACT
- TrustVehicle
- PRYSTINE
- SECREDAS

- NewControl
- VALU3S
- ArchitectECA2030
- 1000kmPLUS
- InSecTT
- COREnect
- AutoDrive Flyer
- ENABLE S3 Flyer
- BRAVE Flyer
- interACT Flyer
- TrustVehicle Flyer
- PRYSTINE Flyer
- SECREDAS Flyer
- NewControl Flyer
- VALU3S Flyer
- ArchitectECA2030 Flyer
- 1000kmPlus Project Overview
- InSecTT Press Release
- COREnect Press Release

Contact

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Manage a 1:1 meeting with Benjamin Wilsch

Manage a 1:1 meeting with Yasmin Halil

Manage a 1:1 meeting with Alexandra Erfort

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LEVITATE

About us

The main ambition of the LEVITATE project is to enable policy makers and other stakeholders to estimate short, medium, and long-term impacts of connected and automated transport systems (CATS) and to establish the most effective policy pathways for the introduction of CATS to achieve predefined objectives. CATS are expected to be introduced in increasing numbers over the next decade. Automated vehicles have attracted the public imagination and there are high expectations in terms of safety, mobility, environment, and economic growth. With such systems not yet in widespread use, there is a lack of data and knowledge about impacts. Furthermore, the potentially disruptive nature of highly automated vehicles makes it very difficult to determine future impacts from historic patterns. Estimates of future impacts of automated and connected mobility systems may be based on forecasting approaches, yet there is no agreement over the methodologies nor the baselines to be used. The need to measure the impact of existing systems as well as forecast the impact of future systems represent a major challenge. The dimensions for assessment are themselves very wide, including safety, mobility, and environment but with many sub-divisions adding to the complexity of future mobility forecasts. The aim of the LEVITATE project is to prepare a new impact assessment framework ("Policy Support Tool") to enable policymakers to manage the introduction of CATS, maximise the benefits and utilise the technologies to achieve societal objectives.

LEVITATE - Societal Level Impacts of Connected and ...

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Webinar: the future impacts of automation in freight t...

Webinar: The impacts of automation in urban transp...

Additional resources

- The visualization of the online Policy Support Tool
- LEVITATE Project leaflet
- Backcasting City Dialogues: Feasible paths of interventions – the case of Vienna
- Can the impacts of connected and automated vehicles be predicted? - Danish Journal of Transportation Research
- Twitter

Contact

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- Website | https://levitate-project.eu

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L3PILOT

About us

L3Pilot tests the viability of automated driving as a safe and efficient means of transportation on public roads. The project focuses on large-scale piloting of automated driving functions of SAE Levels 3 and, partially, Level 4 on public roads across Europe. The functionality of the systems is exposed to variable conditions across seven European countries, including cross-border routes.

The technologies being tested cover a wide range of driving situations, including parking, overtaking on highways and driving through urban intersections. The tests will provide valuable data for evaluating technical aspects, user acceptance, driving and travel behaviour, as well as impact on traffic and safety.

With the comprehensive piloting of automated driving functions in test vehicles, L3Pilot will pave the way for large-scale field tests of series cars on public roads. L3Pilot partners will define a set of rules for system engineering and safety validation of automated systems, captured in a Code of Practice for Automated Driving.

L3Pilot across Europe

Additional resources

- L3Pilot project brochure
- L3Pilot factsheet
- L3Pilot map of tests
- L3Pilot applications teaser
- Downloads

Contact:

- Co-ordinator - Aria Etemad, Volkswagen AG

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- Head of European Mobility Systems - Hristiyan Stoyanov, EICT GmbH
- Dissemination Manager - Sarah Metzner, EICT GmbH
- Yves Page, Renault
- Principal Scientist - Satu Innamaa, VTT
- Website | https://www.L3Pilot.eu

Manage a 1:1 Meeting with Aria Etemad

Manage a 1:1 Meeting with Hristiyan Stoyanov

Manage a 1:1 Meeting with Sarah Metzner

Manage a 1:1 Meeting with Yves Page

Manage a 1:1 Meeting with Satu Innamaa

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ICT4CART

About us

The main goal of ICT4CART is to design, implement and test in real-life conditions a versatile ICT infrastructure that will enable the transition towards higher levels of automation (up to L4) addressing existing gaps and working with specific key ICT elements, namely hybrid connectivity, data management, cyber-security, data privacy and accurate localisation. ICT4CART builds on high-value use cases (urban and highway), which will be demonstrated and validated in real-life conditions at four project test sites in Austria, Germany, Italy and at the Italian-Austrian border. ICT4CART adopts a hybrid communication approach where all the major wireless technologies, i.e. cellular and ITS G5, are integrated under a flexible "sliced" network architecture. This architecture will ensure performance and resilience for different groups of applications according to the needs of higher levels of automation. As part of the ICT4CART infrastructure architecture, a distributed, interoperable and cloud-based data management IT environment will be implemented to facilitate seamless and efficient exchange of data (in low latency), thus enabling real-time analytics. Cyber-security and data privacy are important aspects to address existing gaps. Novel localisation services, based on high precision GNSS supported by the cellular networks, will also be implemented and tested. For ICT4CART, standardisation is also of great importance, to ensure a smooth transition towards future technologies and interoperability between the architectural components and across geographic sites.

Additional resources

- ICT4CART-Brochure
- ICT4CART-Factsheet
- ICT4CART-Overview presentation
- ICT4CART-Roll up banner

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Contact

- ERTICO - Caroline Deketele | c.deketele@mail.ertico.com
- Website | https://www.ict4cart.eu

Manage a 1:1 Meeting with Caroline Deketele

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InterACT

About us

The interACT project worked on the safe integration of automated vehicles into mixed traffic environments by designing, implementing and evaluating solutions for safe, cooperative and expectation-conforming interaction of the Automated Vehicles with both its onboard user and other road users.

With a total budget of 5.5 million Euros funding by the European Commission, eight partners from four European Countries worked together from 2017 to 2020 and joined their expertise to contribute to the vision of designing a cooperative interaction of Automated Vehicles with other road users in mixed traffic environments. The project results were implemented, demonstrated and evaluated in two Automated Vehicle demonstrators and presented during a virtual final event in Summer 2020.

Gallery

BMW Demonstrator

CRF Demonstrator

REGISTRATION

Closed since 19 April 2021

LOCATION

Online

ORGANISED BY

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RESOURCES

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Additional resources

- Project youtube channel
- interACT Final Event
- Key results of the project
- Interview with project coordinator (English) and (German)
- Project brochure
- Project poster
- Project vision (pic)

Contact

- Anna Schieben | Anna.schieben@dlr.de
- Website | https://www.interact-roadautomation.eu/

Manage a 1:1 Meeting with Anna Schieben

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INFRAMIX

About us

INFRAMIX - *'Road Infrastructure ready for mixed vehicle traffic flows'* was an EU funded project and its duration was 36 Months (June 2017–May 2020). Within the project, the 11 partners AustriaTech (Coordinator), ICCS, Asfinag, Fraunhofer, Siemens, Virtual Vehicle, Technical University of Crete, Autopistas, Enide, TomTom and BMW collaborated targeting to design, upgrade, adapt and test both physical and digital elements of the road infrastructure, ensuring an uninterrupted, predictable, safe and efficient traffic. To meet this high-level objective INFRAMIX worked on different technologies, combining simulation, traffic flow modelling, traffic estimation and control algorithms etc. This work included ways of informing all types of vehicles about the control commands issued by the road operator and the proposal of new kind of visual and electronic signals for the needs of mixed scenarios. The outcomes were assessed via simulation and in real stretches of advanced highways. Key aspects considered throughout the project were to ensure that the proposed adaptations will not jeopardize safety, quality of service, efficiency and will be appreciated by the users. INFRAMIX has stressed the importance of automation readiness of European road infrastructure for the upcoming period of mixed traffic with automated and non-automated vehicles on highways. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 723016.

INFRAMIX Final Video

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LOCATION

Online

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RESOURCES

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Inframix - Testing Days Girona

Inframix hybrid testing

Inframix testing days in Graz

Additional resources

- Booklet
- Evaluation, impact analysis and new safety performance criteria
- Public demonstration phase and data delivery report
- Infrastructure Classification Scheme
- Roadmap towards fully automated transport systems
- INFRAMIX YouTube

Contact

- Martin Dirnwoeber
- Website | https://www.inframix.eu

Manage a 1:1 Meeting with Martin Dirnwoeber

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HEADSTART

About us

The HEADSTART project will define testing and validation procedures of Connected and Automated Driving (CAD) functions including its key enabling technologies (i.e. communications, cyber-security, positioning) by cross-linking of all test instances such as simulation, proving ground and real world field tests to validate safety and security performance according to the needs of key user groups (technology developers, consumer testing groups and type approval authorities). The project aims to :

1) Create a dynamic catalogue of existing methodologies, procedures, tools for testing, validation and certification considering multi-stakeholder requirements ;

2) Harmonise the existing testing and validation approaches taking into account other industries and domains ;

3) Define and develop test, validation and certification methodologies and procedures for CAD functions building upon existing initiatives ;

4) Demonstrate the developed methodologies, procedures and tools through the testing of 4 CAD use cases;

5) Reach consensus by creating and managing an expert network of CAD testing to promote adoption of the project results considering multi-stakeholder needs.

HEADSTART Project Video

Additional resources

- HEADSTART brochure
- HEADSTART banner
- HEADSTART General Presentation

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LOCATION

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RESOURCES

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Contact

- Alvaro Arrue | Alvaro.Arrue@idiada.com
- Nikoletta Karitsioti | nikoletta.karitsioti@iccs.gr
- Website | https://www.headstart-project.eu

Manage a 1:1 Meeting with Alvaro Arrue

Manage a 1:1 Meeting with Nikoletta Karitsioti

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HARMONY

About us

HARMONY is developing a new generation of spatial and multimodal transport planning tools harmonized in a Model Suite that will enable metropolitan authorities to sustainably lead the transition to a low carbon mobility. Stakeholders are engaged in co-creation labs to understand their needs in terms of integration of traditional and new transport modes, as well as regional spatial and transport planning feeding the development of the HARMONY MS' functionalities. New mobility technologies and concepts, such as electric autonomous vehicles and drones, are demonstrated and integrated with the traditional transport modes to derive the real-world challenges, social acceptance and policy requirements. The HARMONY model provides an integrated approach necessary for authorities which quantifies the multidimensional impact of various concepts, soft and hard policies on citizens' quality of life, sustainability, economic growth, while identifying the most appropriate solutions and recommending ways to exploit advances in mobility concepts. The model suite is already linked to six EU metropolitan areas assisting research: Rotterdam, Oxfordshire, Turin, Athens, Trikala and Upper Silesian-Zaglebie Metropolis.

HARMONY launch event

HARMONY interview to Maria Kamargianni

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LOCATION

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RESOURCES

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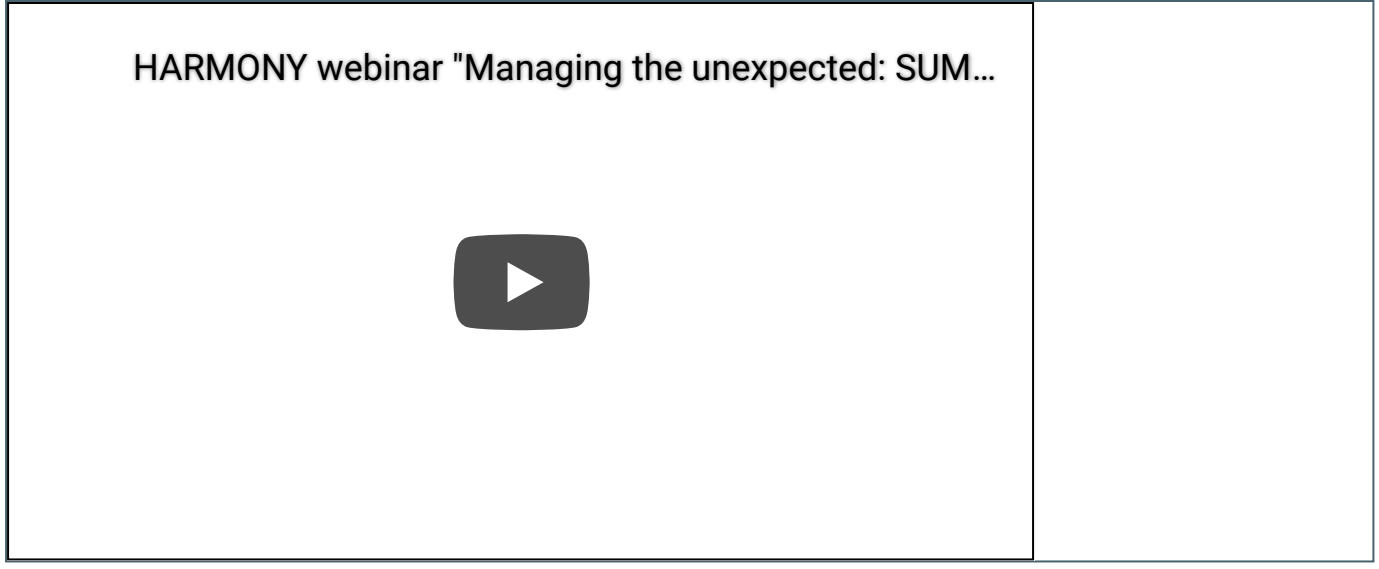

Additional resources

- Project leaflet
- Project poster
- End Users' Group
- Newsletter
- LinkedIn
- Twitter
- YouTube channel

Contact

- Ms. Maria Kamargianni, Project Coordinator | m.kamargianni@ucl.ac.uk
- Website | https://harmony-h2020.eu

Manage a 1:1 meeting with Maria Kamargianni

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HADRIAN

HADRIAN
Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs

About us

Partial and conditional automated driving is becoming a reality across Europe. Thereby, the human driver will retain responsibility for monitoring and supervising the automated driving functions, as well as taking back control when needed. This makes the human driver a critical enabler of safety, comfort, and economic benefits of automated driving. The HADRIAN project investigates a three-pronged approach to define safe and acceptable human driver roles for automated driving. First, in order to help drivers to understand the availability of automated driving before and during a trip, the opportunities of Collaborative Intelligent Transport Systems (C-ITS) to communicate upcoming road conditions and relevant traffic and environmental events to the vehicle are investigated. This is intended to create longer (and even guaranteeable) transition times from highly automated driving back to manual driving while at the same time facilitating more expectable and desirable Non-Driving Related Activities (NDRAs) for the vehicle occupants. Secondly, adaptive interactions "scaffold" the driver during safety critical monitoring and transition events and provide information only when it is needed. And thirdly, the driver is helped to get to know the automated driving system via interactive tutoring during and before the drive. The combination of these interventions is evaluated for their potential to improve safety as well as acceptability and also facilitate mobility of stakeholders with individual restrictions such as elderly drivers.

Projektvideo HADRIAN

Additional resources

- HADRIAN Newsletter 1
- HADRIAN overview presentation
- CORDIS - Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs

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Contact

- Dr. Peter Moertl | peter.moertl@v2c2.at
- Website | https://hadrianproject.eu/

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FABULOS

About us

The FABULOS project (Horizon2020) ran from January 2018 until March 2021. In the project, last-mile automated mobility solutions and technologies were developed, refined and tested, in order to prepare cities for the future of mobility. These novel transport solutions were developed via a Pre-Commercial Procurement (PCP), which allowed the 6 Procuring Partners to closely cooperate with various technology suppliers and also share the risks and benefits. Between April 2020 and March 2021, three different vehicle fleets were tested in mixed-traffic conditions in 5 European cities. Therefore, one of the outcomes of the FABULOS project are three different tried-and-tested scalable automated minibus services as part of the public transport system. Nearly 14.000 kilometres were driven in real-life urban conditions, involving 6 different vehicles – including two retrofitted regular passenger vans. Average speeds of up to 20 km/h, max. speeds of 30 km/h in both Norway and Finland. In addition to the successful pilots, policy recommendations, lessons on regulatory aspects and user acceptance studies were published and can be found from fabulos.eu/deliverables.

Video section

- FABULOS Project video: pilots in Norway, Netherlands, Greece, Finland and Estonia:

- Video Helsinki pilot (Finland). Sensible4-Shotl Consortium. GACHA shuttle and retrofitted CM7 van in busy urban environment:

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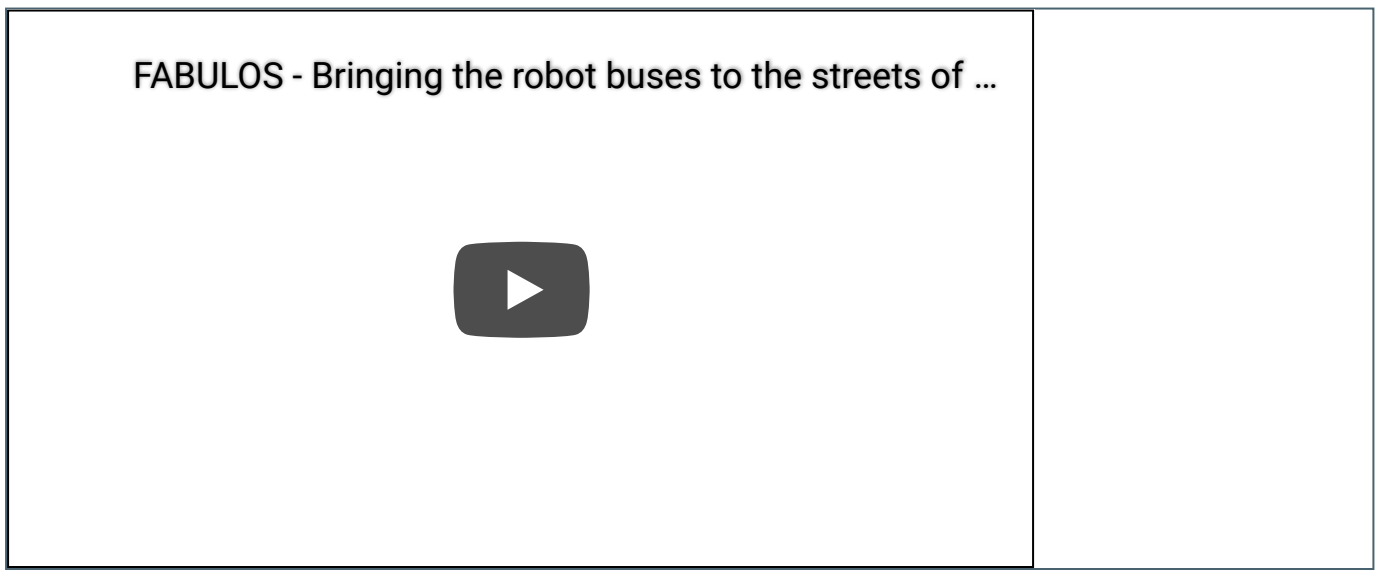
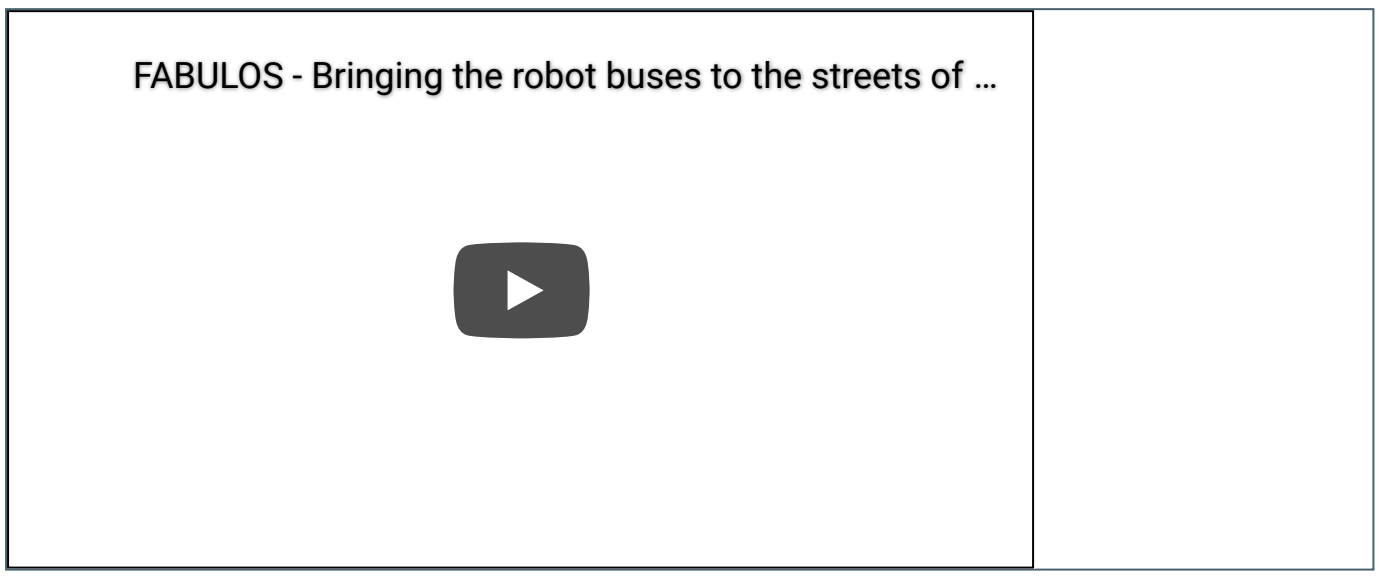
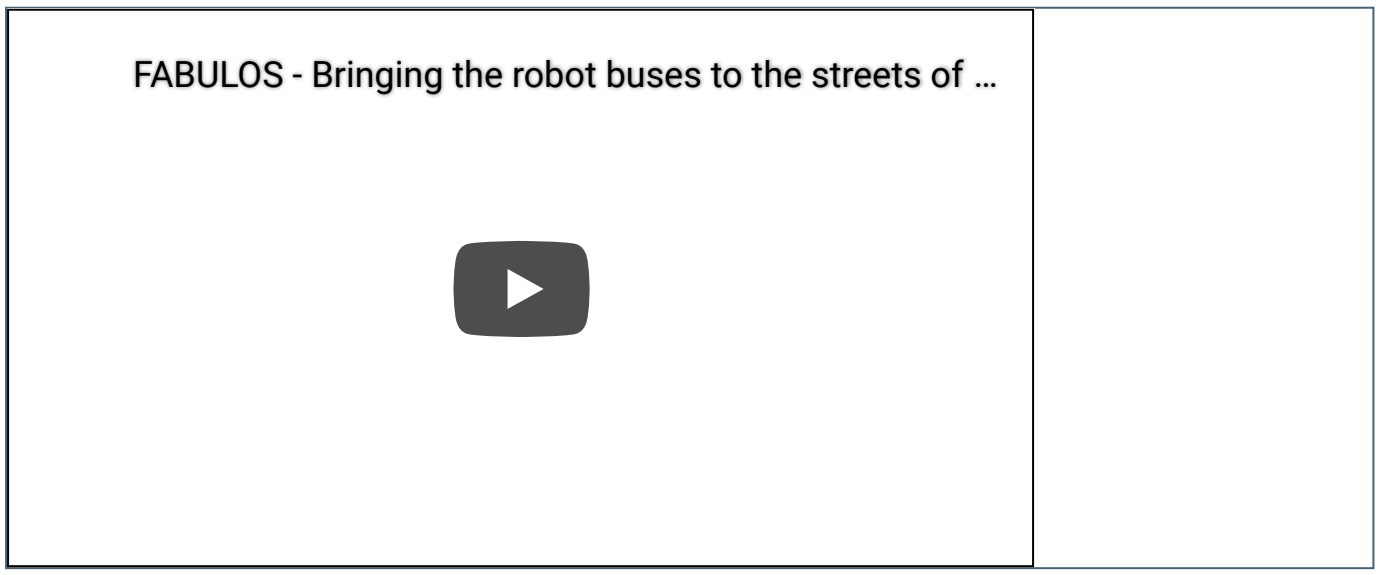
- Video Gjesdal pilot (Norway). Saga Consortium. 2 Navya shuttles in a hilly environment:



- Video Helmond pilot (Norway). Saga Consortium. 1 Navya shuttle from automotive campus to train station:



- Video Tallinn pilot (Estonia). Mobile Civtatem Consortium. 2 Iseauto shuttles driving between airport and business district



- Video Lamia pilot (Greece). Mobile Civtatem Consortium. Iseauto shuttle driving in mixed traffic in Greece for the first time:

FABULOS - Bringing the robot buses to the streets of ...

Gallery

Additional resources

- Final Conference videos
- Deliverables
- User acceptance research
- Policy paper on future applications
- FABULOS User Acceptance summary report and non-user survey report
- Final results event

Contact

- Renske Martijnse-Hartikka| renske.martijnse-hartikka@forumvirium.fi
- Website | https://fabulos.eu/

Manage a 1:1 Meeting with Renske Martijnse-Hartikka

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ESRIUM

About us

ESRIUM is fostering greener and smarter road usage, road maintenance, and road safety. The key innovation will be a homogeneous, accurate and recent digital map of road surface damage and road wear. ESRIUM's core proposition is a data platform, which hosts highly detailed EGNSS-referenced map data of road damage and associated safety risks at centimeter-level resolution. Thanks to the information contained in this "road wear map", road operators will be able to lower the road maintenance effort by optimal planning and increase traffic safety especially for heavy vehicles. Considering the market introduction of partly automated truck fleets, the precise track of these vehicles can be adjusted by communicating precise routing recommendations in- and cross-lane. Truck fleet operators following these recommendations can increase the general safety for their vehicle fleet. Especially with the increasing levels of autonomy, systems will utilize infrastructure support to handle the requirements of the automated driving task and additional external requests. In ESRIUM, these opportunities are addressed by utilizing C-ITS infrastructure and EGNSS based localization in planning the trajectories of such automated vehicles. Reliable locatization information of road damages and of the vehicles using the roads is provided by Galileo, European global satellite-based navigation system.

Additional resources

- Leaflet
- Twitter
- LinkedIn
- Contact: info@esrium.eu

Contact

- Mr. Matthias Rüther, Project Coordinator | matthias.ruether@joanneum.at
- Website | https://esrium.eu

Manage a 1:1 Meeting with Matthias Rüther

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ENSEMBLE

About us

Platooning technology has made significant advances in the last decade, but to achieve the next step towards deployment of truck platooning, an integral multi-brand approach is required. Aiming for Europe-wide deployment of platooning, 'multi-brand' solutions are paramount. It is the ambition of ENSEMBLE to realise pre-standards for interoperability between trucks, platoons and logistics solution providers, to speed up actual market pick-up of (sub)system development and implementation and to enable harmonisation of legal frameworks in the member states.

The consortium behind ENSEMBLE will implement and demonstrate multi-brand truck platooning on European roads over the next 3 years. The ENSEMBLE project is led by TNO and joined by: six European truck manufacturers: DAF, DAIMLER, IVECO, MAN, SCANIA and VOLVO Group. CLEPA, representing the suppliers of automotive equipment and components and will support research, innovation and deployment as drivers for industrial growth. Suppliers supporting OEMS: NXP, ZF, WABCO, Bosch, Continental, Brembo. ERTICO – ITS Europe - the crucial link to the European Truck Platooning Community. Knowledge partners: IDIADA, UNIV GUSTAV EIFFEL, KTH and VU Brussel.

PlatooningENSEMBLE project animated video clip.

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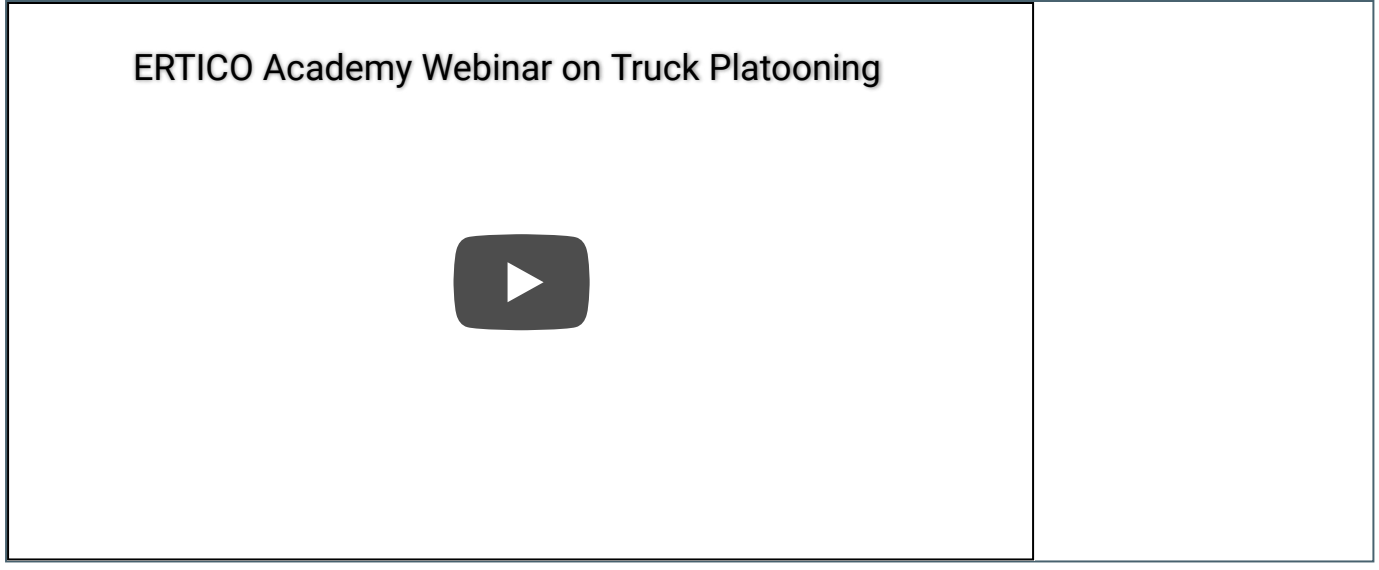

Additional resources

- ENSEMBLE project presentation
- LinkedIn
- Library

Contact

- Frank Daems, ERTICO – ITS Europe | f.daems@mail.ertico.com
- Website | https://platooningensemble.eu

Manage a 1:1 Meeting with Frank Daems

20 April 2021 - 22 April 2021 Belgium

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DYNAXIBILITY4CE

About us

Dynaxibility4CE will support cities with the preparation, analysis and planning stage of their Sustainable Urban Mobility Plan. This will include a focus on using methodological tools, like air quality measurement, as well as training and knowledge platforms to meet the challenges of their regions.

Therefore, public transport authorities and local authorities in CE will be enabled to plan more dynamically and flexibly for emerging innovative mobility solutions that provide greener and cleaner mobility systems for CE's Functional Urban Areas in future. The project promotes exchange between partners by providing opportunities to share knowledge, as well as various solutions that combat the common challenge of pollution and its associated health risks in city centres.

Dynaxibility4CE's outputs to improve low-carbon mobility planning capacities are linked to lowcarbon mobility and clean air policies and will help to attain European goals of halving conventional car use by 2030 and to reduce emissions by 60% by 2050, agreeing with the 2015 Paris Climate Agreement's call to reduce greenhouse gasses in the EU by at least 40%.

Additional resources

- DYNAXIBILITY4CE – GET TO KNOW OUR PROJECT!!
- Welcome to our first newsletter
- Dynaxibility-Leaflet

Contact

- Laura Babío Somoza, POLIS network | lbabio@polisnetwork.eu
- Website | Dynaxibility4CE - Interreg

Manage a 1:1 Meeting with Laura Babío Somoza

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Drive2theFuture

About us

Drive2theFuture is a project that aims to prepare "drivers", travellers and vehicle operators of the future to accept and use connected, cooperative and automated transport modes and the industry of these technologies to understand and meet their needs and wants. To achieve this, it models the behaviour of different automated vehicle "drivers" & prognoses acceptance for several automated driving scenarios, develops specialized training tools, content, optimized HMI for "driver"-vehicle handovers, CEA and MCA studies for selection of most favorable automated functions realisation and demonstrate them in 12 Pilots across Europe. Pilots will cover all automated transportation modes (Automated car, PTW, truck, bus, minibus, rail, workboat and drones) and involve driving/riding/rail simulators, VR/AR simulation toolkits, test tracks and real-world environments, in which over 1000 AV drivers/passengers, 200 AV operators and 20.000 involved citizens experience automation. The project addresses all types of vehicles and "driver" clusters, addressing in a balanced way the awareness and acceptance of automated vehicle "drivers", the relevant fleet operators, key stakeholders and the general public.

Video section

In Drive2theFuture, we involve multiple tools to investigate and increase the user acceptance for the upcoming large-field introduction of automated vehicles. In 12 pilots across 8 different countries in Europe different testing environments for all transport modes were implemented, including real road, simulators and Virtual Reality. Drive2theFuture puts a focus on the interaction with automated vehicles via an optimal Human-Machine-Interface and also creates trainings for future users, to prepare them for automated functions. In the following, initial results of demonstrations and user tests that were developed and performed in the first part of the project are presented.

Video 1: Real road testing of automated cars in Poland

In a real-road test in Poland, we assessed the awareness and acceptance of automated cars (Level 2 & 3) in a country with a very high average age of a car. We tested a lane keeping assist and the adaptive cruise control. During the tests we have realized that even though the safety systems are already present in many new cars, people are mostly unaware of their limitations and sometimes even of how to activate the system. First results of this test phase show that the infrastructure is not ready to cooperate with vehicle safety systems or autonomous functions. Finally, the general public's interest and understanding of autonomous vehicles is still very limited.

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LOCATION

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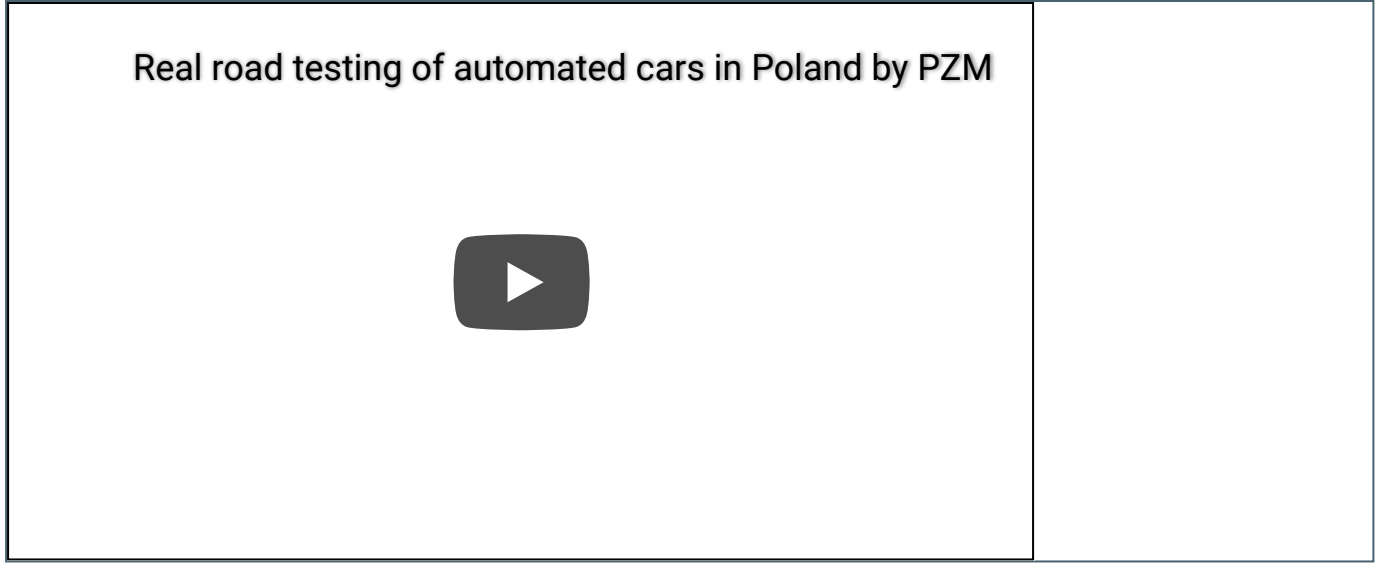

Video 2: Safety around self-driving buses in Linköping, Sweden

Autonomous shuttle busses are already running in some European cities. Drive2theFuture creates awareness for automated vehicles by creating trainings for future users. In order to prepare pedestrians and cyclists for future automated situations, this video illustrates for the Campus Valla in Linköping how to behave outside an autonomous shuttle bus, to increase the safety for those on board, including the safety driver, but also to interact in a safe way outside the shuttles.

Video 3: Interaction between passengers and automated buses at bus transit points

We also develop a co-simulation platform to evaluate how automated buses can interact with vulnerable road users, such as passengers waiting for a bus, in a safe way. In this simulation environment, we demonstrate and test alternative Human-Machine-Interface options for the vehicle-passenger and the driver-vehicle interaction. First results shows that passengers want to know if the bus is in automated mode or not and they prefer a light source that is possible to see from a longer distance. Users agree that such a interface will increase the safety and reduce the number of accidents.

Video 4: Interaction between bus drivers and automated buses at bus transit points

The developed co-simulation platform allows to experience not only the passenger's but also the bus driver's perspective in Virtual Reality. This way, the driver-vehicle interaction at bus transit points can be investigated and bus drivers can be trained on new Human-Machine

Interface-concepts, in particular on the safe transition between manual operation and the automated function.

Video 5: Interaction with a highly automated car on the highway in Virtual Reality

Virtual Reality allows to experience new Human-Machine Interfaces in an immersive way and can be used to interactively train new concepts without any risk. It allows for instance to experience an automated car in situations like an accident or construction site on the highway. We developed a persuasive and user-friendly HMI concept in a Virtual Reality Environment for driving a highly automated car (Level 4) on the highway. The concept was iteratively developed in user workshops and was evaluated with experts. The HMI puts a focus on being transparent about the system state and feedback to the user and uses the idea of cooperative driving. This means that the user can communicate to the automated car via gestures on the steering wheel, when he wants to increase or decrease speed or wants to take-over. Initial evaluations have shown that the HMI is easily understood by the users after a short setting-in phase, regarding the operation with gestures as well as the feedback on the screen.

Additional resources

- Project Leaflet
- Project Poster
- Newsletter 1
- Newsletter 2

Contact

- Evangelia Gaitanidou, Project Coordinator | lgait@certh.gr
- Website | www.drive2thefuture.eu

Manage a 1:1 Meeting with Evangelia Gaitanidou

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CONCORDA

About us

Launched in October 2017 and funded by the Connecting Europe Facility, CONCORDA has been working on providing adequate connected services and technologies in terms of interferences and interoperability to help overcome fragmentation and ensure backwards interoperability between Cooperative-ITS services and the services harmonized by C-ROADS under real traffic situations.

The main objectives of CONCORDA are the following: Assess the performance of hybrid communication systems in terms of reliability and availability; Improve localisation services; Contribute to a new standard of evaluation of the existing standards such as ETSI (European Telecommunications Standards Institute) and C-ITS (Cooperative Intelligent Transport Systems); Contribute to interoperability and continuity of services: the specifications (new or evolved standards) will be applied on all test sites according to the C-ITS Platform recommendations in order to guarantee the interoperability and continuity of services piloted in the CONCORDA project aiming at EU-wide interoperability of services; Cooperation with the European Commission, C-ROADS (a joint initiative of European Member States and road operators for testing and implementing C-ITS services in light of cross-border harmonisation and interoperability), SENSORIS (Sensor Ingestion Integration Specification), EATA (European Automotive Telecom Alliance), CEDR (Conference of European Directors of Roads), 5GAA (5G Automotive Alliance – 5th generation mobile networks) and NGMN (Next Generation Mobile Network).

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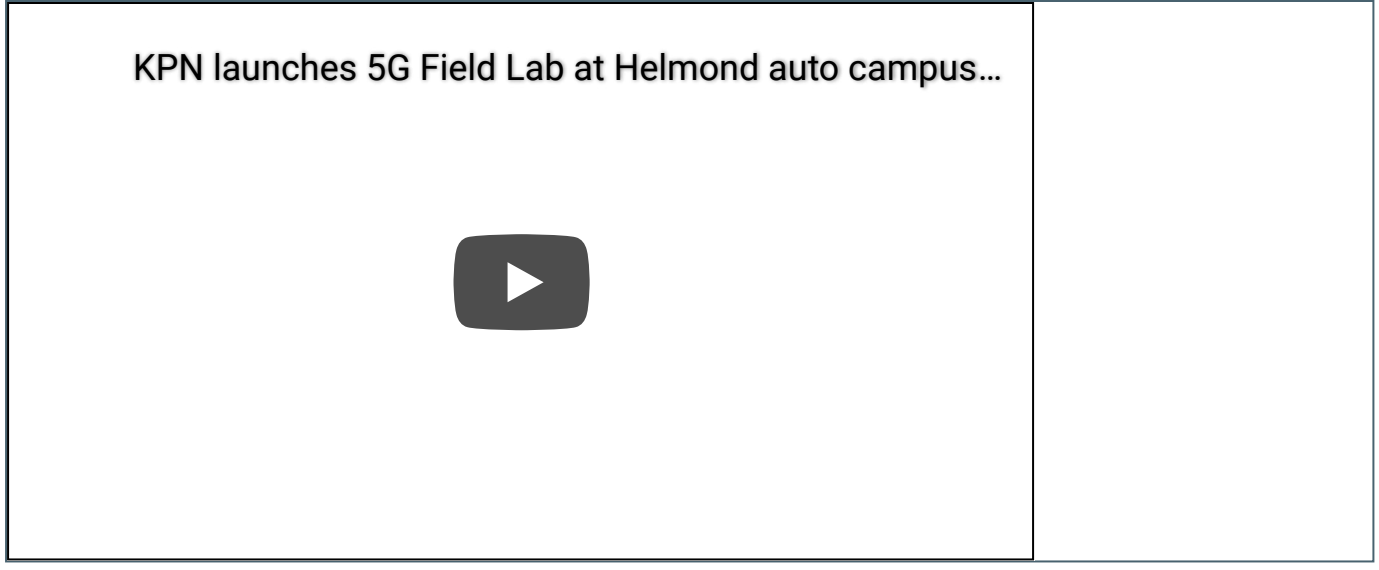

Additional resources

- CONCORDA Factsheet
- CONCORDA Project Presentation
- FIRST SUCCESSFUL TEST WEEK IN THE METROPOLITAN REGION AMSTERDAM
- CONCORDA: Towards automated driving on European motorways

Contact

- Eusebiu Catana (project coordinator) | e.catana@mail.ertico.com
- Jana Habjan | j.habjan@mail.ertico.com
- Website | https://concordaproject.eu

Manage a 1:1 Meeting with Eusebiu Catana

Manage a 1:1 Meeting with Jana Habjan

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CoEXist

About us

After three years of intense work, the CoEXist consortium is glad to present its results and conclusions. The project enhanced modelling functionalities to include different types of Connected Automated Vehicles (CAV), including a comprehensive description of their potential behaviours (e.g., driving logics and default behavioural parameters).

CoEXist has also developed road infrastructure impact assessment tools to adequately interpret modelling results. CoEXist's partner cities, Helmond (NL), Milton Keynes (UK), Gothenburg (SE) and Stuttgart (DE), tested these tools in several use cases, assessing the impacts of CAV on key aspects of urban mobility: traffic performance, space efficiency and safety. Results of these evaluations provided evidence for the opportunities of automation as well as for risks of a potential deterioration of urban mobility, especially at the initial stages of CAV deployment. These findings highlight the importance of proactive action from authorities to plan for this transition phase, and the need for further research and policy development.

Finally, CoEXist has developed an automation-ready framework, supporting local authorities in reducing uncertainties and building up their capacity to make structured decisions about CAV deployment. We hope that our project results will help urban mobility stakeholders to start a more informed planning process for cooperative, connected and automated mobility.

CoEXist - Use Case Video - Gothenburg

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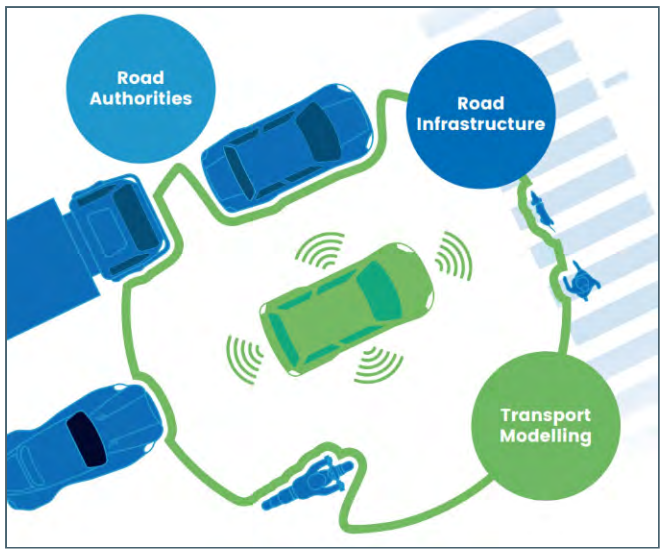
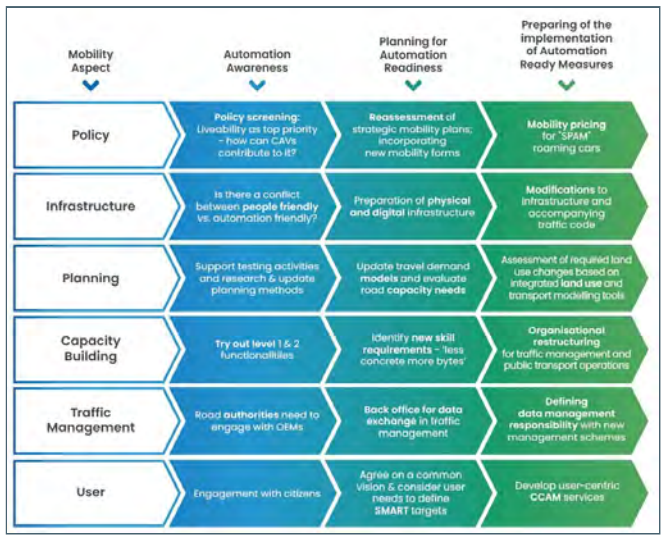
CoEXist - Use Case Video - Stuttgart

CoEXist - Automation-Ready simulation tool

Gallery





Additional resources

- CoEXist project - YouTube
- CoEXist | Rupprecht Consult (rupprecht-consult.eu)
- Resources Archive - CoEXist (h2020-coexist.eu)
- 'AV-Ready' transport models and road infrastructure for the coexistence of automated and conventional vehicles | CoEXist Project | H2020 | CORDIS | European Commission (europa.eu)
- Road-vehicle automation in SUMP – Practitioner Briefing
- Automation-ready Framework
- Enabling automation-ready transport planning
- Coexist | Leaflet

Contact

- Dr. Wolfgang Backhaus, Rupprecht Consult – Forschung & Beratung GmbH | w.backhaus@rupprecht-consult.eu
- Website | https://www.h2020-coexist.eu

Manage a 1:1 Meeting with Wolfgang Backhaus

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C-MOBILE

About us

The C-MobILE project aims to demonstrate C-ITS technologies in real-life conditions across 8 European regions based on a common interoperable architecture. Solutions are demonstrated over large areas in and around the cities of Barcelona, Bilbao, Bordeaux, Copenhagen, Newcastle, North Brabant, Thessaloniki, and Vigo. The large-scale deployment of these technologies can pave the way for a standard EU-wide C-ITS network.

Potential benefits are the possible reduction of the number of causalities on the roads, smoother traffic flows, shorter journey times and lower environmental impacts.

From an economic perspective, C-MobILE aims to improve transport operations and contribute to more sustainable activities and economies of scale. Transport technologies and infrastructure, primarily for the public sector, will also increase return on investment, while at the micro level, it will develop economically viable products, services and applications, which can be commercially exploited.

Additional resources

- EUCAD 2021_C-MobILE brochure
- EUCAD 2021_C-MobILE Stakeholders flyer
- C-MobILE services running in the Deployment Sites

Contact

- Monica Lores | monica.lores@idiada.com
- Alex Vallejo (IDIADA), Project Coordinator | Alex.vallejo@idiada.com
- Website | https://c-mobile-project.eu

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CLASS

CLASS Edge and Cloud Computation: A Highly Distributed Software for Big Data Analytics

About us

Big data analytics are being applied to a wide range of applications domains, including those in charge of controlling critical real-time systems, challenging the need not only to efficiently processing extreme amounts of complex data, but also processing it in real-time.

CLASS aims to develop a novel software architecture framework to help big data developers to efficiently distributing data analytics workloads along the compute continuum (from edge to cloud) in a complete and transparent way, while providing sound real-time guarantees. This ability opens the door to the use of big data into critical real-time systems, providing to them superior data analytics capabilities to implement more intelligent and autonomous control applications.

The capabilities of the CLASS framework will be demonstrated on a real smart-city use case in the City of Modena, featuring a heavy sensor infrastructure to collect real-time data across a wide urban area, and three connected vehicles equipped with heterogeneous sensors/actuators and V2X connectivity to enhance the driving experience.

CLASS. Edge and Cloud Computation: A Highly Distributed Software for Bi...

CLASS: Developing technology for smart cities and connected cars

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Additional resources

- CLASS brochure
- CLASS software architecture
- CLASS smart city use case

Contact

- Nikoleta Kiapidou | nikoleta.kiapidou@bsc.es
- Website | www.class-project.eu

Manage a 1:1 Meeting with Nikoleta Kiapidou

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BRAVE

About us

BRAVE's approach assumes that the launch of automated vehicles on public roads will only be successful if a user centric approach is used, where the technical aspects go hand in hand in compliance with societal values, user acceptance, behavioral intentions, road safety, social, economic, legal and ethical considerations.

BRAVE aims to improve safety and market adoption of automated vehicles, by considering the needs and requirements of the users, other road users concerned (drivers and vulnerable road users) and relevant stakeholders, assuring safe integration of key enabling technology advancements.

BRAVE - Project presentation

BRAVE Test conducted at UAH's Campus - Full seque...

Additional resources

- Project Flyer
- Twitter account
- Linkedin group

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Contact

- Florent ANON | florent.anon@nextmove.fr
- Website | http://www.brave-project.eu

Manage a 1:1 meeting with Florent Anon

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AWARD

About us

This project aims at developing and enabling to deploy a safe autonomous transportation systems in a wide range of real-life use cases in a variety of different scenarios. This encompasses the development of autonomous driving system (ADS) capable of handling adverse environmental conditions such as heavy rain, snowfall, fog. The ADS solution will be based on multiple sensor modalities to address 24/7 availability. The ADS will then be integrated into multiple vehicle types used in low-speed areas.
Finally, these vehicles will be deployed, integrated and operated in a variety of real-life use cases to validate their value in the application and identify any limitations: forklift (un)loading in warehouses and industrial plants, hub-to-hub shuttle service on open road, automated baggage dispatching in airports, container transfer operations and vessel loading in ports.

Logistics operations will be optimized thanks to a new fleet management system that will act as a control tower, gathering all information from subsystems (vehicles, road sensors, etc.) to coordinate the operations and protect vulnerable road users. This work should then enable commercial exploitation of the technology and policy recommendations for certifications processes.

Additional resources

- Flyer
- LinkedIn
- Twitter
- YouTube
- Mail
- Join us

Contact

- Ms. Inès Guth, Project Coordinator | ines.guth@easymile.com
- Website | https://award-h2020.eu

Manage a 1:1 Meeting with Inès Guth

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AVENUE

About us

The *AVENUE project*, funded by the European Union's *Horizon 2020* program, has been operating since May 2018 automated mini-bus public transport services in 4 different European cities. The project is entering its 4th year, and it has started operating automated mini-buses with on-demand, door-to-door services, demonstrating the full power of automated mini-buses in public transportation. Our first site operating on-demand, door to door services is in Geneva, at the Belle-Idee estate (a 38-hectare hospital site with mixed traffic and with more than 9Kms of covered routes). The site offers more than 70 virtual bus-stops, operating three automated mini-buses at almost 100% automated operation (no safety operator intervention), from trip reservation, to mini-bus dispatching, and even vehicle depot entry and exit.

During the 4th year of the project, in addition to the project other three sites, in Lyon, in Copenhagen, and in Luxembourg, 3 new sites will start operating, in Sion (CH), in Esch-sur-Alezette (LU – European Culture Capital 2022) and in Slagelse (DK), all under different levels of on-demand, door to-door operation, and deploying different sets of passenger and transport services, targeting passenger safety and comfort. The experienced gained will result in sets of recommendations and roadmap towards the adoption of automated mini-buses for public transportation in urban and sub-urban environments.

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H2020 AVENUE In-vehicle Services - First Version by ...

H2020 AVENUE autonomous shuttles at SYTRAL Nav...

H2020 AVENUE Autonomous Shuttle Route in Nordh...

Sales Lentz Mobility Pioneers

H2020 AVENUE TPG Live Demo of Autonomous publi...

Additional resources

- H2020 AVENUE Project Brochure
- H2020 AVENUE Demonstration Results Brochure
- Technical Report 7.1 : Operating public transportation with fully automated vehicles: The Belle-Idee deployment
- Technical Report 9.1 : The long road towards the Deployment of Public Transportation Services with Autonomous vehicles
- Deliverable 7.1 - First Iteration Geneva Large Scale Pilot Use Case Demonstration report
- Deliverable 7.4 - First Iteration LyonScale Pilot Use Case Demonstration report
- Deliverable 7.7 - First Iteration Copenhagen Large Scale Pilot Use Case Demonstration report
- Deliverable 7.10 - First Iteration Luxembourg Large Scale Pilot Use Case Demonstration report
- Deliverable 4.5 - Second Iteration In-vehicle services
- AVENUE Project Description
- AVENUE Demonstrator & Replicator Sites
- AVENUE Consortium Partners
- AVENUE Scientific Publications
- AVENUE Project Deliverables
- H2020 AVENUE YouTube Channel

Contact

- Prof. Dimitri Konstantas (Director/Project Coordinator) | dimitri.konstantas@unige.ch
- Website | https://h2020-avenue.eu

Manage a 1:1 Meeting with Dimitri Konstantas

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AUTOPILOT

AUTOPILOT

About us

AUTOPILOT demonstrated the convergence and technical integration of IoT, Automated Driving and Mobility as a Service showcasing across Europe and world-wide how IoT enhances the quality of mobility use cases. Especially, in the complex scenarios of urban driving and shared Mobility as a Service (MaaS), IoT technology proved to be indispensable for the early detection and awareness of obstacles such as pedestrians, cyclists or other Vulnerable Road Users which are beyond line-of-sight of autonomous vehicles.

A total of eight IoT platforms were operated to run the specific automated mobility services. The proprietary platforms were networked through the well-known oneM2M interoperability platform. This is particularly useful for sharing selected data types relevant to all automated driving vehicles and applications. The IoT enhanced automated driving use cases of AUTOPILOT helped to identify data sets and data formats towards future large-scale deployment and highlighted the need for open and dynamic horizontal data marketplaces to bring together the resources (e.g. innovators, platform providers, operators) required within the highly innovative eco-system in which IoT enhanced automated mobility services operate.

Only a full integration of traffic objects and data sources into interoperable IoT platforms will promote a future economy of scale which is the key enabler for any kind of large-scale market uptake.

Additional resources

- Brochure
- Final event press pack
- https://autopilot-project.eu/about-autopilot/
- https://autopilot-project.eu/pilot-sites/driving-modes/
- https://autopilot-project.eu/driving-services/
- https://autopilot-project.eu/deliverables/

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- https://autopilot-project.eu/open-data/
- https://autopilot-project.eu/autopilot-library/videos/

Contact

- Julie Castermans MANAGER | INNOVATION & DEPLOYMENT ERTICO – ITS Europe | j.castermans@mail.ertico.com
- Website | https://autopilot-project.eu/

Manage a 1:1 Meeting with Julie Castermans

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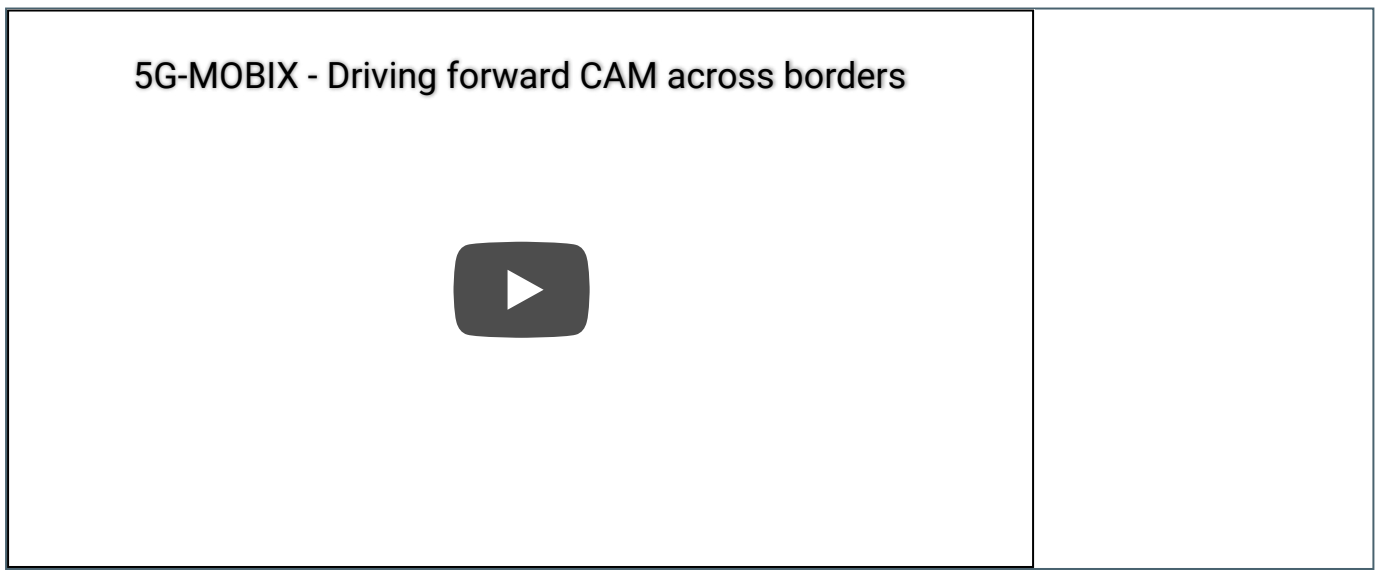
5G-MOBIX

About us

5G-MOBIX aims to match the benefits of the 5G technology with advanced **Cooperative, Connected and Automated Mobility (CCAM)** use cases in order to enable innovative automated driving applications, both from a technical and business perspective. 5G-MOBIX is executing CCAM trials along two Cross-Border Corridors (CBC) and six urban Trial Sites. **5G-MOBIX trials address five defined categories of CCAM use cases, which are aligned with the work of 3GPP: Advanced Driving, Platooning, Extended Sensors, Remote Driving and Vehicle quality of Service Support.** The trials allow 5G-MOBIX to conduct impact assessments, including business impact and cost/benefit analysis, particularly in sparsely populated cross-border areas with mild market failures of mobile network connectivity. As a result of these evaluations and consultations with stakeholders on technical requirements and operational conditions, 5G-MOBIX will identify new business opportunities and propose recommendations and deployment scenarios **to overcome challenges to cooperation, business, technical and regulatory innovations.**



Additional resources

- 5G-MOBIX flyer
- 5G-MOBIX standard presentation
- 5G-PPP joint white paper
- https://www.5g-mobix.com/hub/videos
  5G-MOBIX video repository, which collects a selection of 5G-MOBIX videos taken also by each trial site.
- https://www.5g-mobix.com/hub
  5G-MOBIX collection of publications, webinars, presentations and deliverables

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Contact

- Sara Weeks, Communications Manager | sj.weeks@mail.ertico.com
- Coen Bresser, Project Coordinator | c.bresser@mail.ertico.com
- Website | https://www.5g-mobix.com

Manage a 1:1 Meeting with Sara Weeks

Manage a 1:1 Meeting with Coen Bresser

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5GMETA

About us

Cars capture and generate huge volumes of data in real-time about the driving dynamics, the environment, and the driver and passengers' activities. With greater proliferation of connected and automated mobility applications, the value of data from vehicles is getting strategic. 5GMETA open platform aims to leverage car-captured data to stimulate, facilitate and feed with them innovative products and services. 5GMETA not only allows traditional automotive industry players to exploit data (to improve processes and reduce costs), but also gives access to car data to a wider ecosystem of the automotive sector: it will create a common platform to deliver data pipelines, sending relevant data to innovative data-based services.

Additional resources

- Standard presentation
- Flier

Contact

- Sara Weeks, Communications Manager | sj.weeks@mail.ertico.com
- Website | https://5gmeta-project.eu

Manage a 1:1 Meeting with Sara Weeks

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5G-LOGINNOV

About us

5G-LOGINNOV is a project funded by the European Commission, Horizon 2020 Research and Innovation Programme, under the Grant Agreement No. 957400 (Innovation Action). The project aims at optimising freight and traffic operations at ports and logistics hubs by using new innovative concepts, applications and devices supported by 5G technologies, Internet of Things (IoT), data analytics, next generation traffic management and CCAM (Cooperative, Connected and Automated Mobility). These concepts will support port areas and city-ports in handling upcoming and future capacity, coping with traffic congestion and environmental challenges while developing economic and innovative business opportunities for the surrounding regions. Technology and innovation in 5G-LOGINNOV comprise a range of port-driven technological and societal innovations, tailored to realise the objectives including automation for ports, generation of data about truck traffic and emission, automated truck platooning and involvement of innovative start-ups. The innovations will be implemented and tested in real operating conditions in three Living Lab environments, associated with the ports (or neighbouring city areas) of Athens, Hamburg and Koper.

Additional resources

- Twitter
- LinkedIn
- 5G-LOGINNOV General Presentation

Contact

- Ralf Willenbrock, Product Manager Logistic, T-System and 5G-LOGINNOV Hamburg Living Lab leader | ralf.willenbrock@t-systems.com
- Valeria Burlando, 5G-LOGINNOV Dissemination Manager | burlando@circletouch.eu
- Website | https://5g-loginnov.eu

Manage a 1:1 Meeting with Ralf Willenbrock

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Other initiatives

Scroll through the list of virtual stands to discover contributors, set up meetings and more:

GLAD

GLAD will develop initial knowledge on efficiency, safety and human experience of small electric autonomous vehicles for the first and last mile delivery of goods in Sweden.

Read more

HAVOC

This project addresses a portion of human behavior challenges related to remote operation of vehicles. The project will derive user needs and requirements that are posed on HMI and then design and evaluate HMI-concepts for a few selected use cases.

Read more

REDO

The goal of Remote Driving Operations (REDO) project is to build knowledge and create opportunities in the emerging field of remote operation of road vehicles.

Read more

UNICARagil

UNICARagil establishes disruptive, modular hard- and software architectures for automated vehicle concepts. Within the project, four fully automated and driverless vehicles of different characteristics are realized and demonstrated.

Read more

ZENZIC

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Zenzic is leading the move to a self-driving future. By enabling, industry, government and academia to come together, we are shaping the connected and self-driving ecosystem and establishing the UK as a world leader.

Read more

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ZENZIC

About us

Zenzic is leading the move to a self-driving future. By enabling, industry, government and academia to come together, we are shaping the connected and self-driving ecosystem and establishing the UK as a world leader.

Video section

- **Video 1: CAM Testbed UK: Connected Video Series**
  The Connected Video Series showcases the UK's comprehensive and coordinated connectivity testing capabilities for connected and self-driving vehicle technologies.

- **Video 2: Interoperable simulation across CAM Testbed UK**
  Interoperable simulation will create a seamless experience for testing across CAM Testbed UK and enable the testbeds to multiply capabilities.

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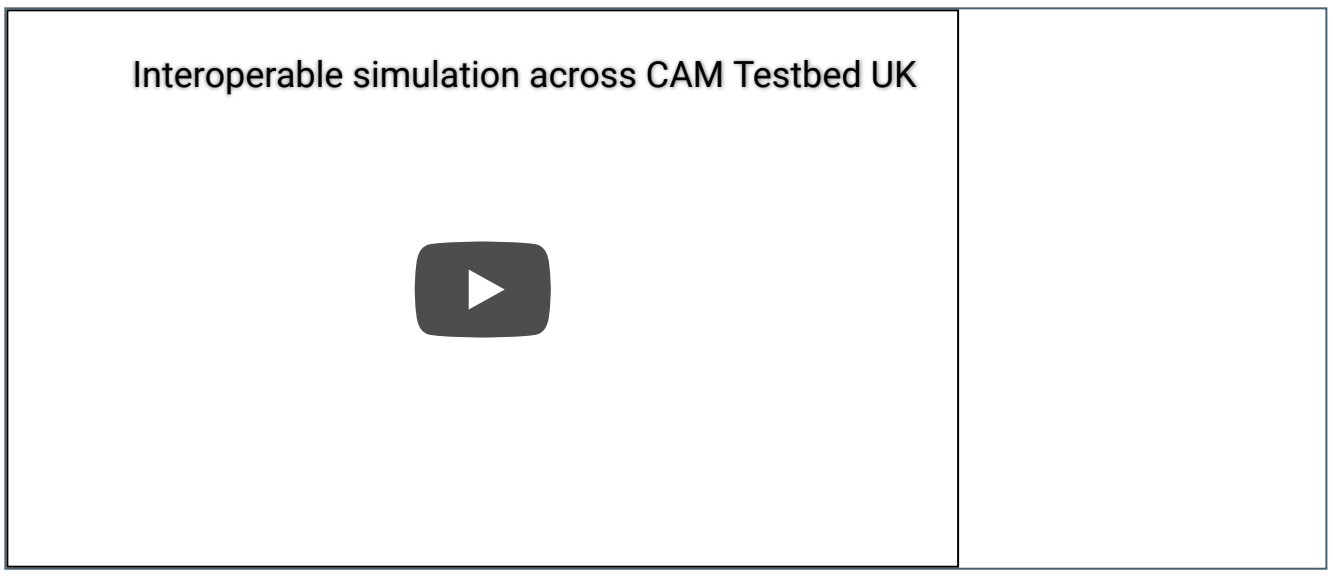

- **Video 3: Zenzic CAM Scale-Up programme**
  The CAM Scale-Up programme, run in partnership with Plug and Play, offers SMEs the chance to demonstrate their products and capabilities across CAM Testbed UK.
  Link: Will be available soon

Additional resources

- **Discover CAM Testbed UK**
  With six core facilities, CAM Testbed UK offers a unique set of environments and capabilities for the testing and development of connected and self-driving vehicle technologies and services.
- **The UK Connected and Automated Mobility Roadmap to 2030**
  The UK Connected and Automated Mobility Roadmap to 2030 is an indispensable tool for businesses, investors and legislators in the sector worldwide.
- **Safety Case Framework: The Guidance Edition**
  CAM Testbed UK-approved best practice guidance for safety case development in the UK. Save time and money, with a unified approach to safety case development.
- **Explore the UK connected and automated mobility ecosystem**
  The UK is taking a uniquely collaborative approach to connected and automated mobility – creating a world leading environment for the testing and development of technologies.

Contact

- Frances Williamson
- Website | https://zenzic.io/

Manage a 1:1 Meeting with Frances Williamson (available soon)

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UNICARagil

About us

Germany's leading universities in field of automated driving have joined forces with selected specialists from industry in the nationally funded (Federal Ministry for Research and Education - BMBF) UNICAR*agil* project to rethink automated vehicles and their architecture. Based on the latest research on connected and automated driving, disruptive modular architectures in hardware and software for automated vehicle concepts are developed.

A scalable and modular vehicle concept consisting of the driving platform and add-on modules builds the basis for the fully automated and driverless vehicle concepts, which can be adapted to a wide range of applications in passenger transport or logistics flexibly. The focus of the conducted research lies on the vehicles' functional architecture, which is connected to the cloud, the road infrastructure and to a sensor-equipped unmanned aerial vehicle (UAV), the so-called Info Bee. The development of generic sensor modules for environment detection, flexibly expandable and updatable software architecture and innovative dynamics modules that allow completely new forms of movement in road traffic mark additional focus areas of the project.

Digitales Halbzeitevent | Einführung der Projektleitung

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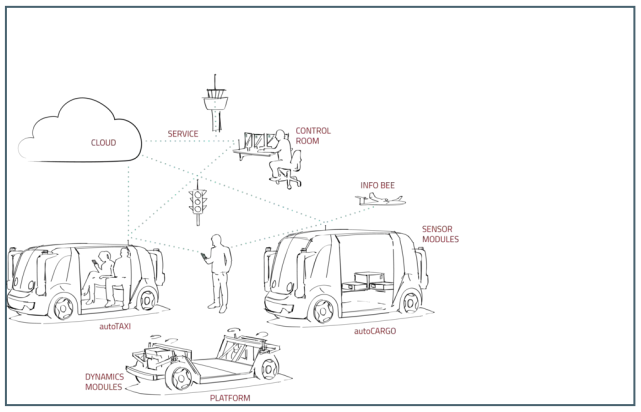

Additional resources

- Youtube channel
- More detailed Information on the project
- LinkedIn appearance
- Publications
- UNICARagil presentation
- UNICARagil newsletter

Contact

- Timo Woopen | timo.woopen@ika.rwth-aachen.de
  - Overall Project Manager UNICAR*agil*
  - Manager Research Area Vehicle Intelligence & Automated Driving
  - Institute for Automotive Engineering - RWTH Aachen University
- Website | https://www.unicaragil.de/de/

Manage a 1:1 Meeting with Timo Woopen

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REDO

REDO
remote driving operation

About us

The project will investigate different aspects related to remote driving operation, which includes:

- Challenges for the driver of teleoperated vehicles in a system of systems.
- Requirements on driver feedback and vehicles during teleoperation.
- Systems-of-systems architecture and infrastructures to support teleoperated driving and control tower operation.
- Laws and regulations concerning remote driving.

The main results from the project will be tools, methods, and demonstrations of remote driving operations. The focus is on road vehicles such as passenger cars and trucks. The project also include comprehensive studies to give valuable scientific results on technical requirements for remote driving operations, as well as overviews of related regulation and laws.

Different platforms available within the project will be used to conduct research on the topics above. These platforms are, for example, driving simulators, research concept vehicles, production vehicle equipped with remote driving system, etc. Lastly, the results will be demonstrated using the platforms.

This is a three-year project (December 2019 - November 2022), funded by Sweden's Innovation Agency (VINNOVA).

Additional resources

- REmote Driving Operation - REDO | Vinnova
- REDO project presentation

Contact

- Maytheewat Aramrattana
- Website | Project: REDO - vti.se

Manage a 1:1 Meeting with Maytheewat Aramrattana

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HAVOC

HAVOC

About us

Currently, most heavy automated vehicles (HAV) require a human safety operator in the vehicle, and it is evident that HAVs without human "fallback" might be distant. At the same time, having a human safety operator in the vehicle jeopardizes major anticipated benefits of the automated driving transport efficiency and safety. To bridge this gap, stakeholders are exploring remote operation, which enables several HAVs to be remotely operated by one human operator. But remote operation comes with its own challenges, both from technical and human behavior perspectives.

The expected results of this project include:
a) HMI requirements for a remote operation center(what should the operator do, what should the HAV do, how they interact and cooperate),

b) an understanding of differences and similarities in the HMI requirements for different applications,

c) further development of existing remote operation center ICE (developed in a former national Swedish FFI project) in terms of novel HMI-concepts, and

d) knowledge on how many HAVs can be remotely operated by an operator. The consortium of this project consists of Research Institute of Sweden (RISE) and Scania, and the project is funded by Vinnova.

Additional resources

- Heavy Automated Vehicle Operation Center (HAVOC) - Requirements and HMI design
- HAVOC Brochure
- HAVOC Slides

Contact

- Jonas Andersson, Senior Researcher at RISE | Jonas.andersson@ri.se

Manage a 1:1 Meeting with Jonas Andersson (available soon)

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GLAD

About us

Small electric autonomous delivery vehicles (ADV) are expected to transform transportation of goods under the first and last mile. The expected advantages are increased transportation and energy efficiency, but it is also important that these vehicles are safe and accepted by society. The GLAD project will develop an initial knowledge base about the potential and challenges for ADV in Sweden. The research questions are:

- What functions are ADV expected to serve in the transportation chain in Sweden, and how will business models, policies and incentives need to evolve?
- How can safe, efficient and pleasant interactions with ADV be achieved, and what are suitable evaluation methods?

To explore these questions, the project will convert an existing small electric passenger car (Zbee) into an autonomous delivery vehicle, develop a system for remote support and vehicle management, develop suitable human-machine interfaces (HMI) and evaluate these in realistic user studies. The project is co-financed by The Swedish Transport Administration and involves the following partners: RISE Research Institutes of Sweden, Aptiv, Clean Motion, Combitech and Halmstad University.

Video section

Video 1: Intro Glad Project

Video 2: Who is driving?:

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Clean Motion, Zbee - Who is driving?

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Additional resources

- Godsleverans med självkörande fordon den sista milen
- Clean Motion develops autonomous Zbee
- GLAD Brochure
- GLAD Additional info

Contact

- Azra Habibovic, Project leader at RISE | azra.habibovic@ri.se

Manage a 1:1 Meeting with Azra Habibovic