D8.1

Stakeholder consultation report (draft)

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Dissemination level:

■ PU: Public

□ RE: Restricted to a group specified by the consortium (including the Commission Services)

□ CO: Confidential, only for members of the consortium (including the Commission Services)

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Executive Summary

TransAID develops and demonstrates traffic management procedures and protocols to enable smooth coexistence of automated, connected, and conventional vehicles, especially at Transition Areas. A hierarchical approach is followed where control actions are implemented at different layers including centralised traffic management, infrastructure, and vehicles.

This document summarises the results of the stakeholder consultation activities of the TransAID project. In the context of TransAID, the most relevant stakeholders are authorities and policy makers, road operators, vehicle manufacturers and suppliers, road infrastructure and traffic service providers, test and certification institutes, academia and knowledge institutes, future product owners and standardisation bodies. The consultation activities aimed to gather feedbacks on the project results, as well as to hear the stakeholders' view on the impact of prospective automated vehicles introduction. Most importantly, the stakeholders were asked about their ambitions and interests related to role and responsibilities in future scenarios of automated vehicle presence

A summary of 7 stakeholder consultation events is provided in this deliverable:

- TransAID-MAVEN-CoExist Stakeholder workshop, 10 October 2017, Brussels
- TransAID-MAVEN-CoExist-INFRAMIX Expert meeting, 23 October 2018, Greenwich
- TransAID session and survey, 8 June 2019, IEEE-IV, Paris
- TransAID-U.S. CAMP expert meeting, 25 July 2019, Detroit
- EU EIP workshop on ODD, 1 October 2019, Turin
- TransAID-INFRAMIX stakeholder workshop, 9 October 2019, Graz
- International workshop on ODD, 22 October 2019, Singapore

For each stakeholder consultation event a description is given of the scope and aim, participants, plenary and break-out sessions, survey results (when applicable) and implications to the TransAID work.

What can be observed from the sequence of stakeholder consultation events is that there is steady progression in the collective understanding of the relation between vehicle automation and infrastructure and the possible implications to the stakeholders involved. By now it seems that there is a common interest, also by vehicle manufacturers, to develop a comprehensive standard and/or taxonomy for classifying operational design domains (ODDs) of automated vehicle systems.

The main findings from these events underline the uncertainty associated with the state-of-the-art of vehicle automation and its evolution in the coming decades. From an innovation standpoint these are exciting times, but as we have experienced, the uncertainties will not disappear soon or new uncertainties will arise. Moreover, since Cooperative, Connected and Automated Mobility and Digital and Physical Infrastructure are such new areas of innovation, the stakeholder consultation did not provide all the answers while for many subjects, nobody has the answer yet.

1 Introduction

In the following sections, we first give a concise overview of the TransAID project, then highlight the purpose of this document, and finally present its structure.

1.1 About TransAID

As the introduction of automated vehicles becomes feasible, even in urban areas, it will be necessary to investigate their impacts on traffic safety and efficiency. This is particularly true during the early stages of market introduction, where automated vehicles of all SAE levels, connected vehicles (able to communicate via V2X) and conventional vehicles will share the same roads with varying penetration rates.

There will be areas and situations on the roads where high automation can be granted, and others where it is not allowed or not possible due to various reasons (missing sensor inputs, highly complex situations, etc). As a consequence, there will be areas where many automated vehicles will need to change their level of automation to adopt more conservative operations or even give the control back to manual driving (Transition of Control, ToC in short). We refer to these areas as “Transition Areas” (TAs).

It can be expected that especially at Transition Areas the simultaneous presence of automated, connected, and conventional vehicles will be challenging and possibly negatively affect safety and traffic efficiency. To cope with these challenges, TransAID develops and demonstrates traffic management procedures and protocols to prevent or mitigate the negative effects of ToC at TAs, hence enabling smooth coexistence between different types of automated and non-automated vehicles.,. A hierarchical approach is followed where control actions are implemented at different layers including centralised traffic management, infrastructure, and vehicles.

First, simulations are performed to find optimal infrastructure-assisted management solutions to control connected, automated, and conventional vehicles at Transition Areas, taking into account traffic safety and efficiency metrics. Then, communication protocols for the cooperation between connected/automated vehicles and the road infrastructure are developed. Measures to detect and inform conventional vehicles are also addressed. The most promising solutions are then implemented as real world prototypes and demonstrated under real urban conditions. Finally, guidelines for enabling the TransAID vision on advanced infrastructure-assisted driving are formulated. These guidelines also include a roadmap defining activities and needed upgrades of road infrastructure in the upcoming fifteen years (i.e. the average life cycle of physical and digital infrastructure) in order to guarantee a smooth coexistence of conventional, connected, and automated vehicles.

Iterative project approach

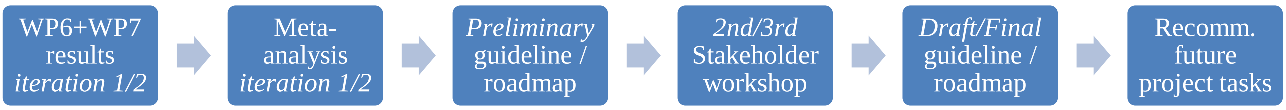
TransAID performs its development and testing in two project iterations. Each project iteration lasts half of the total project duration. During the first project iteration, the focus is placed on studying Transitions-of-Control (ToCs) and Minimum-Risk Manoeuvres (MRMs) using simplified scenarios. To this end, models for automated driving and ToC/MRM are developed and adopted. The simplified scenarios are used for conducting several simulation experiments to analyse the impacts of ToCs at TAs, and the effects of corresponding mitigating measures.

During the second project iteration, the experience accumulated during the first project iteration is used to refine/tune the driver models and enhance/extend the proposed mitigating measures. Moreover, the complexity and realism of the tested scenarios is increased by also combining multiple simplified scenarios into new and more complex use cases.

1.2 Purpose of this document: the stakeholder consultation

The purpose of this document is to give a summary of the results of the TransAID stakeholder consultation activities as part of work-package 8. In the context of TransAID, the most relevant stakeholders are authorities and policy makers, road operators, vehicle manufacturers and suppliers, road infrastructure and traffic service providers, test and certification institutes, academia and knowledge institutes, future product owners and standardisation bodies. The consultation activities aimed to gather feedbacks on the project results, as well as to hear the stakeholders' view on the impact of prospective automated vehicles introduction. Most importantly, the stakeholders were asked about their ambitions and interests related to role and responsibilities in future scenarios of automated vehicle presence. To this end, TransAID has organised multiple workshops or participated actively in them. The first workshop took place at the start of the project, the second after one year, and several others around the end of the 1st project iteration when the first project results were becoming available. Additional workshops will be organised or participated to at the end of the 2nd project iteration.

As shown by the flow diagram below, the general idea is that project results are aggregated and processed and then used as input to stakeholder workshops. The feedback gathered at the workshops are recommendations for future project tasks and will be used as input to D8.3 Guidelines and Roadmap. Finally, the stakeholder workshops are an instrument to liaise with other ART-projects under Horizon 2020.



A revised, expanded and final version of this deliverable will become available in July 2020.

1.3 Key stakeholders

The stakeholders of interest for the stakeholder consultation activities are:

- Authorities and policy makers: international, national, regional and local.
- Road operators
- Vehicle manufacturers and suppliers
- Infrastructure and service providers
- Test and certification institutes
- Academia and knowledge institutes
- Future product owners
- Standardisation bodies

1.4 Structure of this document

The following chapters each give a summary of one stakeholder consultation event:

- TransAID-MAVEN-CoExist Stakeholder workshop, 10 October 2017, Brussels
- TransAID-MAVEN-CoExist-INFRAMIX Expert meeting, 23 October 2018, Greenwich
- TransAID session and survey, 8 June 2019, IEEE-IV, Paris
- TransAID-U.S. CAMP expert meeting, 25 July 2019, Detroit
- EU EIP workshop on ODD, 1 October 2019, Turin

- TransAID-INFRAMIX stakeholder workshop, 9 October 2019, Graz
- International workshop on ODD, 22 October 2019, Singapore

In each chapter the scope and aim of the workshop is given together with an overview of workshop participants, a report of the plenary session, a report of the break-out sessions, summary of survey results (when applicable) and the implications of the workshop findings to the TransAID project. Finally, in the last chapter an overall conclusion is provided.

1.5 Glossary

ACC	Adaptive cruise control
AD	Automated Driving
AI	Artificial Intelligence
AV	Autonomous vehicle
C-ACC	Cooperative adaptive cruise control
CAV	Cooperative and autonomous vehicle
C-ITS	Cooperative intelligent transportation systems
CV	Cooperative vehicle
DG RTD	Directorate-General for Research and Innovation
EC	European Commission
GLOSA	Green Light Optimal Speed Advisory
I2V	Infrastructure to vehicle communication
ICT	Information and Communication Technologies
IEEE	Institute of Electrical and Electronics Engineers
EIP	European ITS Platform
ISAD	Infrastructure Support Levels for Automated Driving
ITS	Intelligent transportation systems
IV	Intelligent Vehicle
LV	Legacy vehicle
MRM	Minimum-risk manoeuvre
NAD	No automated driving

ODD	Operational Design Domain
OEM	Original equipment manufacturer
PRT	Personal Rapid Transit
PT	Public Transport
RSS	Responsibility-Sensitive Safety
RSU	Road Side Unit
SA	Sub-activity
TA	Transition area
ToC	Transition of control
TEN-T	Trans-European Transport Network
TOR	Take-over request
TransAID	Transition Areas for Infrastructure-Assisted Driving
US DoT	United States Department of Transport
V2X	Vehicle to anything communication
VMS	Variable-message sign
VRU	Vulnerable Road User

2 TransAID-MAVEN-CoExist Stakeholder workshop, 10 October 2017, Brussels

2.1 Scope and aim of the workshop

The H2020 projects hosting this workshop, CoEXist, MAVEN and TransAID, are all exploring the implications of increasing vehicle automation. They are mainly considering the traffic management and infrastructure aspects of connected and automated vehicles (CAVs). CoEXist is also exploring the transport planning and policy dimensions.

Consultation with, national/regional/local authorities, especially city authorities and traffic managers, was important for each of these projects. Given the projects' synergies in terms of content and timing as well as the partnership overlap, the organisation of a joint workshop targeting local authorities offered a logical and efficient way to proceed. This workshop followed a successful workshop for local authorities organised by MAVEN in Barcelona in November 2016 [1]. Neither CoEXist nor TransAID had started at that time.

The primary aim of this workshop was to gather the views and requirements of local authorities and other urban transport stakeholders on various tasks underway or planned within the projects, specifically:

- the CoEXist automation-ready framework
- the MAVEN transition roadmap
- the TransAID list of situations for which automation is inappropriate or a threat

The workshop agenda was divided into two parts:

- the morning plenary session saw an introduction to the three projects, to the CAV activities of two projects' partner cities as well as insights to research in this field and the wider city/regional authority perspective on CAVs.
- the afternoon session comprised project sessions in smaller groups to encourage interaction.

2.2 Workshop participants

The audience was targeted at urban transport stakeholders, with a particular emphasis on representatives of local and regional governments. The following charts provide a breakdown of attendance by sector and by country. Given the high number of representatives from transport authority, the workshop met its target audience goal.

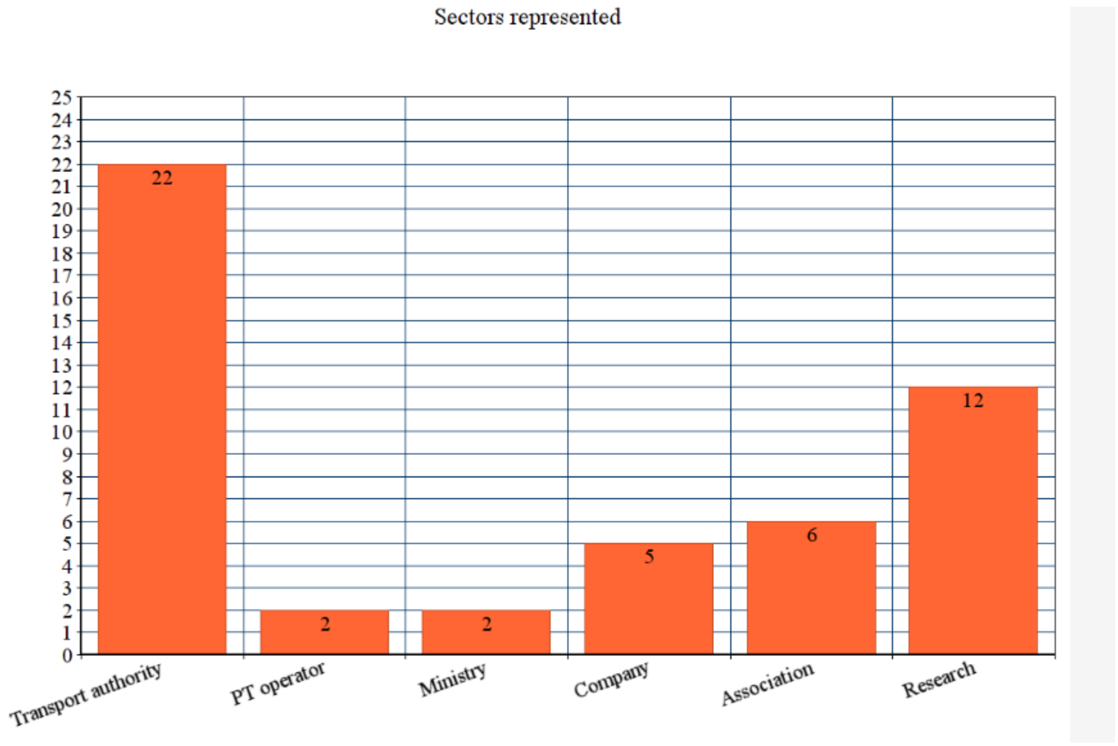


Figure 1: overview of workshop participants by sector

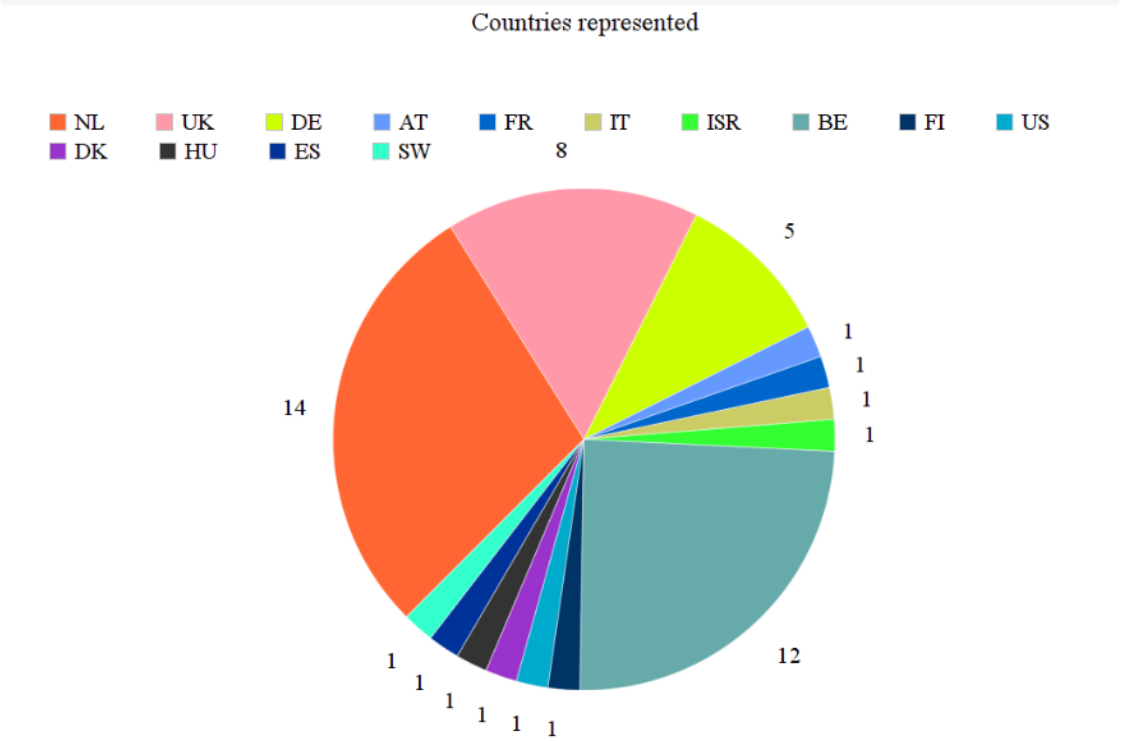


Figure 2: overview of workshop participants by country

2.3 Report of plenary session

After an introduction on the workshop' objectives and the complementarity of the CoExist, MAVEN and TransAid projects, Bip Radia from INEA[1]contributed a few words about the work of the agency on vehicle automation. While he acknowledged the value of bringing together representatives of city and regional authorities to talk about vehicle automation, he also stressed the importance of industrial policy as a key driver for this sector.

A quick overview of the CoExist, MAVEN and TransAid projects was given by the respective project coordinator or partner, as well as a brief introduction to the scope of the afternoon project breakout sessions. These project overviews were complemented by a presentation from Bart van Arem (TU Delft and advisory board member of MAVEN) who pulled together the results from a wide variety of other projects and studies on the topic of vehicle automation in cities. Some highlights of these findings include the following:

- Until the driver is fully relieved of the driving task, automation technology can only serve safety and comfort purposes.
- Automation should not be assessed in just transportation terms (safety, efficiency, etc). The economics, for instance, are equally important, notably in relation to time spent in congestion doing more productive things.
- High income males are more interested in certain vehicle technologies, such as adaptive cruise control (a key enabler of vehicle automation) than other inquired categories.
- Level 4 automation vehicles will not be commercially available on the roads for another 10 years.

The session then moved onto the automated vehicle activities of two city councils which are part of MAVEN and CoEXist respectively:

- Greenwich: this London borough is very active in European and national-funded projects dealing with transport and smart city innovation. A key driver for these projects is finding solutions to respond to the demographic and social challenges that the borough is facing: notably (i) a substantial population growth and the mobility demands it will generate that will be difficult to accommodate on an already saturated public transport network and (ii) growing poverty. The CAV projects on which Greenwich is working include some activities related to data, notably understanding what would be the demands of CAVs on the digital infrastructure (and finding that the existing infrastructure is wholly inadequate), and some others focusing on customer perception and acceptance of CAVs.
- Gothenburg: this Swedish city will undergo massive change in the next 15 years due to major urban developments and population growth. The city is exploring how innovation and new technology can help reaching its sustainable goals but admits that it's not easy to establish longer-term objectives due to the rapid pace of technological change. Gothenburg expects CAVs to help achieving its policy goal of zero-vision safety and also to reduce the cost and inconvenience of infrastructure measures designed to deliver a safer and calmer traffic environment, notably speed bumps and road signs. The city council also expects automated

[1]EC agency implementing the CEF programme and parts of the H2020 programme

vehicles to use less space and views digitalisation as being a key enabler of automation, connectivity and electrification.

In the following discussion, a number of points were raised, notably:

1) City plans and policies in terms of automated vehicles will to some extent depend on the type of service that is offered by automation(e.g.private automated cars or automated shuttles).
2) The presentations during the morning session are missing a vision for the future. The focus has been on car. Is this the future we want for our cities?
3) There is a need for cities and regions to reflect on how they can use automation to serve their own transport and societal goals.
4) In order to be proactive as a city or region and to engage with politicians, more information is needed about vehicle automation, notably when it will be here and what are its capabilities.

The morning plenary terminated with an overview of the main themes and points that are emerging from the Polis paper on 'AVs and cities and regions'[2].

2.4 Report of break-out sessions

During the afternoon session, the audience was invited to join two rounds of 3 project group discussions.

2.4.1 The CoEXist session

The CoEXists conducted three exercises to elicit input from the workshop participants. Some of the key results are listed below:

1. Defining "Automation-ready". The aim of the task was to discuss a definition of framework to enable cities to deal with the arrival of connected and automated vehicles (CAVs)
    - CoEXist initial definition: *"Automation-ready is defined as conducting transport and infrastructure planning for automated vehicles in the same comprehensive manner as for existing modes such as conventional vehicles, public transport, pedestrians and cyclists, while ensuring continued support for existing modes."*
    - The initial definition will be modified
    - The definition is highly debatable
    - Can we even reach a definition which is "future-proof"?
    - Liveability remains the top priority
    - Digital infrastructure should be mentioned, also regarding connectivity
    - CAV is not necessarily a separate mode; rather automation will enable new functionalities in existing modes
    - Maintenance and operation should also be described
    - We need to have a limit, as we cannot cover everything

[2] https://www.polisnetwork.eu/wp-content/uploads/2019/06/polis_discussion_paper_automated_vehicles.pdf

2. Vision/mobility goals. The main objective of this exercise was to ask cities about their vision and mobility goals and whether these align with the possible impacts brought by CAVs in cities
   - Priority remains with cyclists and pedestrians on top with the aim of reducing congestion and improving safety
   - In some cases, priorities or goals may change (e.g. where first- and last-mile services are more cost-effective)
   - Digitalisation and innovation in transportation should become a goal (e.g. modernisation of public transport to stay competitive)
   - Cities mentioned that the focus should perhaps be more on higher liveability goals (e.g. health, economy), or probably put the mobility goals into the context of these higher level ones
   - Open question of whether sharing becomes a mobility goal?
   - Mobility of the future will most likely be more multi-dimensional
3. Identifying "automation-ready" measures. The participants were asked to define measures cities need to take over three timespans: short (0-5 years), medium (5-10 years), long term (10-15 years).
   - 0-5 years: most measures identified
     - Awareness in general (also for decision makers)
     - Proactive rather than reactive solutions (e.g. pilots)
     - Prepare infrastructure, both physical and digital
   - 5-10 years:
     - Reallocation of opened up road spaces and parking to green and public spaces
     - Back office for data exchange in traffic management
     - Road pricing for "SPAM" roaming cars
   - 10-15 years: least measures.
     - Rethinking and prioritising investments
     - Taxation changes
     - Land use changes

2.4.2 The MAVEN session

General comments about (C)AVs

Local authorities need to deal with the arrival of AVs. However, for now cities have moved from car-centric transport planning towards sustainable mobility planning, so what now is perceived as promoting car use goes against what cities are aiming to achieve. Planning for integrating CAVs shall be part of a bigger picture, and AVs should be part of an integrated mobility plan which takes into account different cultural contexts.

AVs could work only if they provide real public service. Cities need to reduce traffic, but they do not necessarily have enough public transport (PT) capacity. Improving the efficiency of AV movements will add more traffic to streets, whereas the goal is to remove cars. This is a policy question: who do we want to prioritise? It's highly unlikely that AVs will have priority over pedestrians, cyclists and PT users

There is uncertainty with regards to competition between **AVs and public transport**. AVs can have benefits compared to PT services (e.g. in suburban and rural areas and in feeding PT hubs).

Automated mass transit is very different from conventional PT, but individual automated cars are not different from traditional cars. Investment costs in PT are important; infrastructure investment, e.g. tramways, should typically last for 40 years. The same investment process will apply to automated public transport and it certainly should not cost more.

Ultimately, policy makers will decide on the modal split a city or region should aspire to in the future and that will determine policy on AVs. An evaluation of the AV evolution also depends on freedom of choice of users. Is it possible to offer tools to the public for co-modality? That has an impact on how we design system for AV.

Open questions

- AV plannings: who is responsible, who owns the fleet? What about parking, storage, charging (assuming they will be all electric vehicles)?
- AV operations: in case of an AV ride booking, who has priority? What is the order to deal with the requests? Who defines that order? There are lots of moral questions behind these aspects, e.g. wealthier AV users can go straight and less wealthy users will have to take diversions?

Comments about (C)AVs and traffic management

Traffic and data management. No special traffic rules for automated cars are envisaged: they will be treated in the same way as normal cars. However, it is expected that automated cars will support procedures for diverting trafficeasier than conventional cars, specifically where there is vehicle-infrastructure communication (i.e., C-ITS). Connected and automated vehicles (CAVs) can support other measures, e.g. intersections could be managed in a more dynamic manner and traffic managers could envisage using the road in a more flexible way, such as using traffic lanes in one direction during the morning peak, and in the opposite direction during the evening rush hour. However, the mix with traditional cars will still be a challenge. CAVs can take the green wave strategy on congested roads to a new level. Depending on how a city is able to interact with AVs will to some extent determine the efficiencies that can be gained.

A world of (C)AVs might rely heavily on artificial intelligence in the future. Yet AI struggles to make sense of traffic management plans given their diversity and cultural specificity. A way around this could be for traffic management centres/road-side units to communicate directly with vehicles, to influence their movements for instance. However, today’s centres simply do not have the capability to influence such a large number of vehicles and it’s questionable if traffic managers will even want to do this. There is also the question of liability.

Open transport data is another way to have a well-connected system. There is a need to give information to cars to direct them. Traffic managers are in the best position to predict traffic, resulting for instance from big events. There is a need for sharing data between the appropriate players at the right moment: how to exchange information between the traffic manager and service providers will be key. On the contrary, a lack of data sharing will weaken the prediction of traffic flows and reduce traffic efficiency.

Responsibilities for traffic management vary from one city/region to the next and can even be shared between different agencies within a given city/region. For instance, in London, the task is shared between the boroughs and the strategic transport authority Transport for London.

Open questions:

- Who is responsible for the vehicle-generated and who has overall ownership of data?
- Will the traffic management be capable of dealing with the large amounts of data generated by tomorrow’s vehicle?

- What is the procedure in case of system failure?
- How does an AV interact with a traffic management centre?

Specific feedback about MAVEN Transition roadmap:

- Do we need to adapt the infrastructure to AV or should it be the other way around?
- Public acceptance: is there enough trust in technology?
- How will liability be addressed in a future of CAVs?
- How to make systems sufficiently robust to prevent hacking?
- MAVEN should also look at use cases where people want to get out of an AV, eg, parking
- How scalable is the MAVEN approach?
- The project's roadmap should limit itself to traffic management only and go deeper in one topic
- Clarify the ICT infrastructure requirements: on the roads and under ground (eg, 5G network)

2.4.3 The TransAID session

In the TransAID breakout session the concept of infrastructure assistance for CAVs was discussed. One of the aims was to identify circumstances and situations which require or justify the involvement of digital infrastructure and/or restrictions set by road authorities. In both rounds most of the debate focussed on the capabilities of CAVs (in general, by brand and by automation level), which seemed to result from a lack of facts on both the limitations of self-driving vehicles and their effects on traffic flow dynamics and traffic safety. This also includes our assumptions (and uncertainty) on how CAVs will behave under various conditions, as well as how drivers/monitors will behave. Without such facts a large part of this discussion remained and will remain hypothetical, which makes it hard to conclude on appropriate measures to achieve societal policy objectives.

Notably, it was acknowledged that the capabilities of AVs are often seen as intelligent property, which hinders sharing information. On the other hand, some participants argued that car manufacturers will ensure that their vehicles will be able to operate adequately, or will limit the use of certain functionality otherwise (e.g. by means of geofencing). Moreover, this might be true for the more predictable scenarios, which can be captured by maps, sensors, physical infrastructure, or machine learning, but does not explain how AVs will deal with dynamic expected scenarios and unpredictable scenarios.

Another on-going debate is the trade-off between safety requirements and system performance: a vehicle which preserves large safety margins will drive in a very conservative and therefore inefficient manner. To better understand the system boundaries, it was stated that the operational design domain (ODD) of CAVs should be better defined, also to inform the vehicle driver of the capabilities of his/her vehicle. This led to the question which variables must be used to classify an ODD for which a CAV is suited? Another perspective on this is a procedure for certification of roads for automated driving. Road authorities could have a huge role in this, in particular when it comes to policies and strategies.

Here the scope of the discussion became much broader than traffic operations and extended to urban mobility and land use. The presence of a control centre for automated vehicles was mentioned, one that is similar to air traffic control and may support automated vehicles depending on their capabilities and classification (certification) of the road. In addition it was stated that decentralised control could assist and manage AVs in a more pro-active manner thereby improving their performance. This concept is very much related to the TransAID vision.

Related to this it was stated that also the coexistence of automated vehicles and manually driven vehicles should be assessed in more detail. Finally, the involvement of city representatives in the global CAV debate was stipulated: when CAVs will be introduced based on the needs of cities (cities pull) and not because of technology readiness (technology push), it will become a city-guided development which will lead to different requirements. Here we note that cities need to obtain a clear view on what they want to achieve, as they are more concerned with mobility in general rather than just CAVs.

2.5 Implications to TransAID work

It was not possible to identify specific circumstances and situations where infrastructure assistance for CAVs is most needed, as the workshop participants did not (yet) have knowledge on this subject. Nevertheless, the need for some control function was acknowledged and therefore worth exploring. This requires more evidence as well as a policy framework. These might be obtained/derived from modelling/simulation studies (involving academics) and field experience (involving car manufacturers).

3 TransAID-MAVEN-CoExist-INFRAMIX Expert meeting, 23 October 2018, Greenwich

3.1 Scope and aim of the workshop

The main meeting objectives were to validate the TransAID approach and results and to gather external experts' input on some of the most challenging and crucial topics and/or topics for which knowledge/expertise within the TransAID consortium is limited.

The expected outcomes were: decisions on and agreement of solid approach for validation and impact assessment; Clarified and agreed scope, direction and next steps for transition roadmap and gap analysis; Common understanding on the wider management of CAV's in smart cities and MAVEN's contribution hereto, as well as how to (conceptually) operationalise use cases for unmanned logistics and service delivery.

Meeting agenda:

10:00 Introduction and objectives of the meeting, M. Lu

10:30 Validation and impact assessment, O. Pribyl

13:30 Transition to the traffic management of connected and automated vehicles, S. Hoadley

15:30 Management of CAV's in smart cities, J. Vreeswijk

17:00 Wrap-up and tour de table, M. Lu

3.2 Workshop participants

Name	Organisation	Representation
Meng Lu	Dynniq, Netherlands	MAVEN
Jaap Vreeswijk	MAPtm, Netherlands	MAVEN
Ondrej Pribyl	Czech Technical University, Czech Republic	MAVEN
Suzanne Hoadley	POLIS, Belgium	MAVEN, CoExist
Ben Morris	Greenwich, United Kingdom	MAVEN
Michele Rondinone	Hyundai, Germany	MAVEN
Julian Schindler	DLR, Germany	TransAID
Sven Maerivoet	TM Leuven, Belgium	TransAID
Matthew Barth	University of California, United States	Advisory Board MAVEN
Markos Papageorgiou	Technical University Crete, Greece	Inframix
Bernard Gyergyay	Rupprecht consult, Germany	CoExist
Jochen Lohmiller	PTV, Germany	CoExist
Richard Cuerden	TRL, United Kingdom	Expert
Mikael Ivari	Gothenburg, Sweden	Expert
Simeon Calvert	TU Delft, Netherlands	Expert

3.3 Report of plenary session

As it can be observed from the agenda, there were three plenary sessions. The report of the meeting is not public, therefore the sections below only summarise the discussion topics. For more information please contact the author of this deliverable.

3.3.1 Validation and impact assessment

Questions put to the experts:

1. What experiences do you have with respect to impact assessment in your project?
2. Have you considered different dimensions, such as simulations, user involvement, technology verification or others? How have you done it in the past? What are the best practices?
3. In your view, what is the state-of-the-art in the field of impact assessment of automated driving?
4. What driver model(s) for AV’s and CAV’s should be used in simulation?
5. What are the most critical issues when simulating automated vehicles in urban environment and mixed traffic?
6. What experiences do you have with respect to impact assessment in your project?
7. And others?

3.3.2 Transition to the traffic management of connected and automated vehicles

The following discussion topics guided the discussion:

1. What are the key dimensions to be considered in the phases of transition towards MAVEN from a city authority/traffic managers perspective? For example, technological, organisational, legal/liability, financial, policy and planning
2. How can authorities quantitatively assess where they are in the transition and could we derive this from them (e.g. by means of a survey)?
3. What is the ideal environment for implementing the MAVEN use cases: traffic characteristics, policy, etc.).
4. What are the ‘low-hanging fruits’, i.e., technologies, use cases, governance models, requiring the least effort and showing a reasonable rate of return in the short-term?
5. What are the factors external to the city authorities that will influence the transition towards MAVEN? (vehicle penetration levels, legal framework, user acceptance, etc).
6. What will happen if city authorities do nothing?

3.3.3 Management of CAV’s in smart cities

The following discussion topics guided the discussion:

- Realistic use cases for remote management and control of AV’s in cities.
- New ways to balance demand and supply to manage scarce space and road capacity.
- New concepts for management of unmanned vehicle (parcels, goods, empty cars, etc.) and service vehicle (waste, cleaning, inspection, etc.) fleets.
- Considerations, pre-conditions, constraints, limitations, ethics, etc. with regards to operationalisation of use cases.
- Transferability to passenger transport, including shared vehicles.
- Impact on the shape and form of cities, e.g. land use, mobility and transportation.
- Research and innovation activities beyond theory.

4 TransAID session and survey, 8 June 2019, IEEE-IV, Paris

4.1 Scope and aim of the workshop

The TransAID session was held on June 9, 2018 in Paris, France, in conjunction with the IEEE Intelligent Vehicles Symposium (IV[3] 2019), one of the major annual conferences of the *IEEE Intelligent Transportation Systems Society* (ITSS). The Symposium was titled the “3rd Workshop on Connected, Cooperative, and Autonomous Driving”, which targeted connected, cooperative, and autonomous technologies for cooperative and automated road transport. The workshop also featured an Industry Panel with experts from related industries, which fostered the interactive exchange of academia and industry.

Recent developments in telecommunications, sensor, information processing, and control technologies have enabled substantial progress in the domain of ITS. C-ITS is in a very early stage of deployment, as it is technologically achievable, but the deployment requires cooperation of multiple stakeholders. Automated driving is on the horizon, and will still need substantial and longer-term development and testing to make even the high automation levels a reality in complex situations, such as in urban environments, and in a transit period of only partial market penetration. Cooperative and automated transport are certainly complementary. They are expected to bring substantial benefits in terms of safety, comfort and (traffic and fuel) efficiency. Many challenges exist in this important domain. The workshop targeted the challenges for C-ITS applications, especially connected and cooperative systems towards automated driving. Competing communication technologies (e.g., local network (IEEE 802.11p), cellular network, and future 5G), sensor, information processing and control technologies were highlighted. The impacts of (C-)ITS applications were analysed. Requirements for strong cooperation between industry, authorities and academia in different regions were addressed.

The main conference organisers were on the one hand Dr. Meng Lu, Strategic Innovation Manager at Dynniq (The Netherlands), VP for the IEEE Intelligent Transportation Systems Society, and Steering Committee Member for the IEEE Future Networks (Enabling 5G and Beyond), and on the other hand Dr. Cristiano Premebida, Aeronautical and Automotive Engineering at the Loughborough University.

4.2 Workshop participants

As speakers and panellists, we targeted academia, OEMs, suppliers, ICT infrastructure providers, authorities, standardisation bodies, and other organisations. The workshop was moderated by Mr. Tim Leinmüller from DENSO AUTOMOTIVE (Germany).

4.3 Report of the plenary session

The workshop was composed of three different types of interaction: survey questions, invited speakers, and oral-paper presentations.

[3] https://iv2019.org/

- **Survey questions**
  - These were based on TransAID's D2.2 (Scenario definitions an -modelling requirements)
  - They were interactively posed and presented using Mentimeter (see also Section 4.4).
- **Invited speakers**
  - *ICT infrastructure systems for automated driving*
    - Dr. Meng Lu (Dynniq, The Netherlands)
  - *Assuring the Safety of Autonomous Vehicles*
    - Dr. Pete Thomas (Loughborough University, UK)
  - *Enabling L3 + driving through the generation of crowd-sourced maps*
    - Dr. Henning Hamer (Continental AG)
    - *V2X communications for cooperation between vehicle and infrastructure automation*Dr. Michele Rondinone (Hyundai Motor Europe Technical Center)
  - *Infrastructure-assisted automated driving in transition areas*
    - Julian Schindler (DLR, Germany)
  - *Preparing the road infrastructure for the introduction of Automated Driving – the INFRAMIX approach*
    - David Quesada (Enide, Spain)
  - *Management of privacy in cooperative ITS*
    - Dr. Antonio Kung (CEO of Trialog, France)
  - *Connected and Autonomous Vehicle Security: Challenges Ahead for 5G*
    - Dr. Marc Lacoste (Orange Labs, France)
  - *Base material for microscopic autonomous simulation*
    - Nouhed Naidja (VeDeCom, France)
- **Oral-paper presentations**
  - CAD
    - *In-Chamber V2X Oriented Test Scheme for Connected Vehicles*
      - Lei, Jianmei State Key Laboratory of Vehicle NVH and Safety Technology & Chon
      - Chen, Siru Beijing University of Posts and Telecommunications
      - Zeng, Lingqiu Chongqing University
      - Liu, Fangli Chongqing University;
      - Zhu, Konglin Beijing University of Posts and Telecommunications;
      - Liu, Jie China Automotive Engineering Research Institute Co., Ltd
    - *Optimal control based CACC: problem formulation, solution, and stability analysis*
      - Bai, Yu Key Laboratory of Road and Traffic Engineering, Ministry Of
      - Zhang, Yu The Key Laboratory of Road and Traffic Engineering, Ministry Of
      - Wang, Meng Delft University of Technology
      - Hu, Jia Tongji University, Federal Highway Administration
    - *Infrastructure Support for Cooperative Maneuvers in Connected and Automated Driving*
      - Correa, Alejandro University Miguel Hernández of Elche
      - Alms, Robert Deutsches Zentrum Für Luft Und Raumfahrt
      - Gozalvez, Javier University Miguel Hernández of Elche

        - Sepulcre, Miguel Miguel Hernández University of Elche
        - Rondinone, Michele Hyundai Motor Europe Technical Center
        - Blokpoel, Robbin Dynniq
        - Luecken, Leonhard DLR
        - Thandavarayan, Gokulnath Miguel Hernandez University of Elche
    - *Test and Evaluation of Connected and Autonomous Vehicles in Real-world Scenarios*
        - Premebida, Cristiano Loughborough University
        - Asvadi, Alireza Institute of Systems and Robotics
        - Garrote, Luis ISR-UC
        - Nunes, Urbano University of Coimbra
- C-ITS
    - *TARA+: Controllability-aware Threat Analysis and Risk Assessment for L3 Automated Driving Systems*
        - Bolovinou, Anastasia Institute of Communications and Computer Systems
        - Atmaca, Ugur Ilker Warwick Manufacturing Group, University of Warwick, Coventry CV4
        - Sheik, Al Tariq University of Warwick, Warwick Manufacturing Group
        - Ur-Rehman, Obaid FEV Europe GmbH
        - Wallraf, Gerhard FEV Europe GmbH
        - Amditis, Angelos Institute of Communication and Computer Systems
    - *A Test-Driven Approach for Security Designs of Automated Vehicles*
        - Suo, Dajiang Massachusetts Institute of Technology
        - Sarma, Sanjay E. Massachusetts Institute of Technology

4.4 Stakeholder survey results

This section summarises the main results from the survey polled using the Mentimeter[4] platform with the audience.

We asked questions during two different moments, one in the morning and one right after lunch. The results were then aggregated, analysed, and discussed before closing the Symposium. At the beginning of each question session, participants logged in to a specific website using their phone, tablet, or laptop. Then a series of questions was, one at a time, shown on the main screen, as well as their own devices. The question was also slowly and clearly read aloud, repeatedly if necessary. The audience members could then anonymously select various options to vote, with the poll results each time per question shown in real-time on the main screen.

To support the results from TransAID's simulations and field trials, it is necessary to get a good grasp on certain issues that require an understanding of how connected and/or automated vehicles operate on the one hand, and what the policy makers allow or require on the other hand. This forms a cornerstone to support TransAID's goal, i.e. achieve a library with applicable and scrutinised measures for transition areas. To that end, we pose questions throughout the project to several stakeholders and experts. The goal is to gain insights into legal implications, (expected) driver

[4] https://www.mentimeter.com

and/or automated vehicle behaviour and infrastructure-specific aspects with respect to automated vehicles. The answers to these questions will provide some feedback on the work done so far, some of which is based on views from experts within the project consortium, and collect insights for future work.

It is within that frame of mind that TransAID organised short surveys[5]. To that end, we used the extensive list in Appendix C of TransAID's Deliverable D2.2, and selected some of the more prone questions to pose to the present audience. Both survey moments were organised efficiently, such that they did not take much time, and thus did not impose on the time available for the presentations. The detailed, slide-by-slide results can be found in Appendix A.

4.4.1 First session results

Half of the 22 participants came from academia; one fifth were OEMs. The first session contained 8 questions.

Question #1	How would you rank the goals of managing traffic with (C)AVs?
Results	1. Increasing traffic safety 2. Increasing throughput 3. Decreasing emissions
Question #2	Level 3 is considered unsafe from an HMI perspective by some; should authorities forbid those vehicles?
Results	1 out of 4 would allow authorities to forbid L3 vehicles, about 2 out of 3 do not.
Question #3	Do you foresee areas in the road network where you do *not* want to allow automated driving?
Results	Over half of the people foresee areas where AD is not allowed, and 2 out of 3 are for dedicated lanes.
Question #4	Should the infrastructure provider put a limitation on the level of automated driving that it allows?
Results	Opinions are somewhat divided, with fifty/fifty percent of the people in the audience expressing pro/contra an infrastructure limitation on the AD level.
Question #5	Should OEMs explain the limitations of their automation?
Results	A large majority of 85% wants OEMs to explain their AD limitations. The other also want this, but just to some extent.
Question #6	Should OEMs be forced to report disengagements (ToCs) from automated driving to a road authority?

[5] For the surveys the protection of personal data compliant the EU's GDPR regulations was ensured. The execution of our surveys was in line with the ethics aspects as covered in TransAID's Deliverable D10.14. No personal data was gathered during the surveys.

Results	2 out of 3 people reply positive, wanting OEMs to report disengagements; 1 out of 4 is unsure.
Question #7	Is connectivity required for some levels of automation (cf. L3 and higher)?
Results	Connectivity is perceived as a requirement for L3+ AVs (with 4 out of 5 agreeing).
Question #8	Should authorities forbid AVs of Level 3 and higher that are not connected?
Results	Only 1 out of 4 wants to forbid these vehicles (note that this is probably a strongly biased sample, as only 4 people responded).

4.4.2 Second session results

As some people in the audience switched workshops after lunch (the TransAID session was organised in conjunction with several others), we asked them again about their background. This time, 2 out of 3 participants came from academia; others were OEMs and service providers.

Question #1	Are road authorities allowed to give advice that will conflict with traffic regulations?
Results	A large majority of over 80% of the people agreed with the statement. However, 1 out of 10 replied negative, mostly citing safety-issues as the main reasons.
Question #2	Would (C)AVs be allowed to 'break the law' if the traffic manager wants to optimise lane changing or merging?
Results	The responses to this question were somewhat mixed. About half of the audience agreed, with a third disagreeing, and the rest being unsure. The main reason for these diverse responses was because of the difficulty in trying to understand/comprehend the question, visualising a possible traffic situation.
Question #3	Would (C)AVs be allowed to 'break the law' in order to behave as all other road users?
Results	3 out of 4 people agreed with this statement, albeit that it heavily depended on the current traffic situation and context.

Question #4	Would (C)AVs be allowed to 'break the law' if this results in a safer situation on the road?
Results	1 out of 3 people replied positive, with the rest saying no or being unsure. After discussion, this mostly stemmed from the fact that the response is highly dependent on the specific traffic situation at hand.

Question #5	Is a ToC needed when another vehicle cuts in and triggers emergency braking?
Results	2 out of 3 people do not prefer MRMs after cut-in situations, with the remainder being unsure.
Question #6	Would automated driving require the support of some sort of backend?
Results	A large majority of almost 80% of the people answered positive. Some would require no support of a backend or from an OEM back-end only.
Question #7	What should a (C)AV do in case its route is blocked?
Results	All responses were mixed, evenly distributed over the available options, i.e.: • Execute an MRM • Execute a ToC • Find another route • Ask for advice

4.5 Implications to TransAID work

From a perspective of dissemination on the one hand, and obtaining stakeholder knowledge on the other hand, TransAID organised its symposium together with a large existing event to ensure a higher probability of attracting people.

Given the audience of our workshop (targeting technologies for cooperative and automated road transport), it was possible to foster an interactive exchange of ideas between academia and industry.

The contents of the workshop were three-fold: there were survey questions posed via the Mentimeter platform, we had a large cross-stakeholder coverage with the invited speakers, and finally we expanded the programme with oral-paper presentations. These latter fall into two categories, i.e. Connected and Automated driving, as well as security-related aspects of Cooperative ITS. Each time an interactive discussion with the audience ensued, providing further insights into the authors' points of view.

The survey results revealed that about half of the participants came from academia. Interestingly, a large group was in favour of foreseeing areas where automated driving should not be allowed, thereby directly confirming that TransAID's research questions and approach are sound and sensible. A very high proportion of the participants also spoke out towards OEMs, asking them to explain the limitations of their autonomous vehicles. In addition, connectivity was perceived as a requirement for Level 3 or higher autonomous vehicles. To conclude, a discussion followed some of the results related to the question whether (connected) automated vehicles would be allowed to break the law. This was seen as moderately acceptable when optimisation of the traffic stream was called for, but definitely for the purpose of increasing traffic safety.

The TransAID project partners have used the workshop on the one hand to disseminate their results and gather feedback on them, and on the other hand to obtain valuable information that was used during the second iteration's simulation activities.

5 TransAID-U.S. CAMP expert meeting, 25 July 2019, Detroit

5.1 Scope and aim of the workshop

The main goal of the workshop was to foster the exchange of information, results, and possible collaboration between the European TransAID team on the one hand, and the US CAMP team on the other hand. CAMP stands for "Crash Avoidance Metrics Partners" (https://www.campllc.org), and since 1995 is a legal structure founded by Ford and General Motors and gathering other important OEMs operating in the US market. The US CAMP is financed with 80% private funding and 20% funded by the US DOT (). It provides a framework for pre-competitive research including C-ITS Solutions using V2V and V2I communications to improve real-world safety and traffic efficiency by defining and developing pre-competitive elements and accelerating their implementation and deployment. As CAMP is currently active in the project "Traffic Optimization for Signalized Corridors" (TOSCo), which deals basically with GLOSA and cooperative ACC in the vicinity of traffic lights, this was the ideal frame for exchanging knowledge.

After an initial introduction, the workshop's discussions were held around the following presentations:

- From connected manual to cooperative automated driving: the EU automotive roadmap for V2X
- Overview of CAMP activities
- Management of CAVs through transition areas and signalised corridors
- V2X solutions for infra assisted automated driving
- Cooperative and Automated Driving: from modelling and simulation to prototypical implementation and testing
- CAMP TOSCo approach and results

Mutual discussions led to a better understanding of both groups' activities, while it offered an opportunity to interview vehicle manufacturers.

5.2 Workshop participants

From the US CAMP there were about 12 participants, coming from various OEMs such as Ford, GM, Mazda, Nissan, Honda, VW, Toyota, Hyundai/KIA, Daimler, Audi, … TransAID joined with 6 members (DLR, HYU, UMH, TML, and DYN).

5.3 Report of workshop discussions

- The US TOSCo project presented a string of vehicles that approaches a (red) traffic light and achieves a coordinated slow down / stop. When the light turns green again, or the queue advances, the vehicles enter into a so-called coordinated launch. For the moment, all vehicles in their simulations have homogeneous characteristics. TOSCo is in line with TransAID in terms of using road infrastructure for assisting semi-automated driving applications.
- Nevertheless, the TOSCo approach puts much more emphasis on the development of intelligence in the vehicle (harmonized between the OEMs) to cope with any possible situations that might arise as a consequence of receiving a given type of information from the infrastructure. For example: TOSCo is using the minimum end time of the current traffic

light phase to calculate in the vehicle the speed to pass with green or stop. As the vehicle does not know anything about traffic light controller plans, this might result in continuous in-vehicle recalculations as a consequence of the dynamicity of the traffic light controller in rescheduling this time. In TransAID (which follows the H2020 MAVEN approach[6]) the adopted strategy is to let the road infrastructure calculate advices based on its hierarchical "higher level" situational awareness and its negotiation processes with incoming cooperative cars (e.g., the traffic light controller can stabilise its plans and provide stable GLOSA to vehicles only when cooperative vehicles are arriving). Here, the intelligence is on the infrastructure side, the vehicle just applies the GLOSA received by the infrastructure. Hence, CAMP acknowledged the advantages of this approach and saw room for improvement of theirs if considering optimisation implemented at the infrastructure side in addition to their in-vehicle calculations.

- There is a difference in nomenclature:
  - Platoons of vehicles: an organised string, requires a lead vehicle
  - Clusters of vehicles: an ad-hoc string (using C-ACC) → this is where TransAID and also TOSCo resides
- C-ITS Deployment Group
  - Private initiative to move forward irrespective of the EU-blocked regulation
- The GLOSA 'problem' is encountered everywhere
  - I.e. unstable approach times because of dynamic traffic light control
- The intent to put so much efforts on the vehicle side only (not also on the infrastructure side) can be viewed as a "conservative" approach where OEMs only implement functions based on inputs they can rely- and have full control on. Relying on advices provided by the road infrastructure and implement them as an additional control input is introducing an unprecedented scenario where it is not clear where liability might reside in case of system misbehaviour. This becomes quite critical and risky for an OEM when considering the US legal environment where a company can be suited for much simpler reasons. For the same reasons, another CAMP statement was that it is reasonable to be conservative in the amount and nature of information transmitted by cars about currently supported automation levels.
- It is important to stress out that the situation in Europe is quite different. Discussions on infrastructure-assisted automated driving are ongoing in the C2C-CC and C-Roads for joint strategical roadmapping[7], ERTRAC is considering infrastructure ISAD classification for supporting given levels of connected automated driving[8], and both OEMs and Road operators are participating in collaborative research projects on this topic.
- All in all, even if the initial statement of CAMP has been as above, the CAMP participants declared not to be in the position to provide a public statement on the applicability of the TransAID approach due to the pre-competitive asset of the CAMP organisation.This means that of course a statement from CAMP may not correspond to the strategical positions of its individual members (which might or not be in favour).

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[6] http://maven-its.eu/

[7] https://www.car-2-car.org/fileadmin/documents/General_Documents/C2CCC_WP_2072_RoadmapDay2AndBeyond.pdf

[8] https://www.ertrac.org/uploads/documentsearch/id57/ERTRAC-CAD-Roadmap-2019.pdf

5.4 Stakeholder survey results

In a lighter setting, TransAID posed a handful of questions to the present OEMs in order to obtain confirmation of the modelling approach adopted in its own activities.

However, there was a difference in the approach: TransAID (EU) looks at it mostly from a top-down perspective, i.e. from authorities and policy makers, in an open and transparent fashion. The present US CAMP OEMs on the other hand, take a more bottom-up approach. After some negotiation we were able to ask about 8 questions, which received limited responses.

1. The main reason was that our questions each time dealt with topics considered competitive research, whereas US CAMP is more focused on pre-competitive research.
2. In addition, the US CAMP participants were not always in the position to provide a statement on behalf of their companies. An option though was to ask the questions to OEMs individually and privately in a consultation afterwards

Generally speaking, there have been only very limited results from the questionnaire, presented in the following:

Question #1	Should the infrastructure provider put a limitation on the level of automated driving that it allows? (Yes, all of them/Yes, but only to some extent/No, not at all/I'm not sure)?
Results	No answer was given, as this is a policy business question (not yet deemed for the marketplace).

Question #2	Should OEMs explain the limitations of their automation? (Yes, all of them/Yes, but only to some extent/No, not at all/Unsure)
Results	No clear answer was given, as they stated it mainly all depends on guidelines, regulations, and even owner manuals.

Question #3	Is connectivity required for some levels of automation (cf. L3 and higer)? (Yes/No/Unsure)
Results	Participants stated that this will help, but should not per se be required. In addition, they estimated that throughput will not be improved without communication. In any case, an automated vehicle in the absence of V2V communication is sort of a limiting factor. However, when it comes down to V2I, alignment with the road authorities should be made. Furthering the point, the consensus was that OEMs will (continue to) make conservative AVs.

Question #4	Should authorities forbid AVs of Level 3 and higher that are not connected? (Yes/No/Unsure)
Results	No answer was given.

Question #5	Should an AV visibly show to other road users (exterior HMI) that it is in AD mode? (Yes/No/Unsure)
Results	The participants were more inclined to give a negative answer. After asking why not, we learned that some other traffic participants (e.g., pedestrians) harass the

	automated vehicle (there are anecdotal stories about pestering/testing vehicles). Then, even turning the question around: do we really need to know that? There are multiple studies (EU, SAE, …) on an AV-mode indicator that give different insights.

Question #6	Would (C)AVs be allowed to 'break the law' in order to behave as all other road users? (Yes, always/Yes, but it depends on the context (e.g., safety)/No/Unsure)
Results	Interestingly, going over the speed limit would not happen (cf. the TOSCo project). Furthermore, Automate vehicles do not have and are not allowed to break the law. Interestingly, nVidia is looking into a generic framework for cooperative vehicle control (whereby all of them should follow the same set of behavioural rules).

Question #7	Would automated driving require the support of some sort of back-end? (Yes, OEM only/Yes, infrastructure provide only/Yes, both/No/Unsure)
Results	This was deemed beneficial, and in essence required (be it continuously or intermittently).

Question #8	What should a (C)AV do in case its route is blocked? (Ask advice from a back-end (OEM and/or infrastructure)/Execute a minimum-risk manoeuvre/Transfer control to the driver/Try to find another route (if possible))
Results	All of these were deemed viable solutions.

1. *Should the infrastructure provider put a limitation on the level of automated driving that it allows? (Yes, all of them/Yes, but only to some extent/No, not at all/I'm not sure)?*
    - This is a policy business question (not yet deemed for the marketplace)

2. *Should OEMs explain the limitations of their automation? (Yes, all of them/Yes, but only to some extent/No, not at all/Unsure)*
    - It depends (cf. guidelines and regulations, cf. owner manuals)

3. *Is connectivity required for some levels of automation (cf. L3 and higher)? (Yes/No/Unsure)*
    - It will help, but is not per se required, an AV in the absence of V2V communication between vehicles is considered limiting
    - But for V2I → check with the road authorities
    - OEMs will make conservative AVs
    - Throughput will not be improved without communication

4. *Should authorities forbid AVs of Level 3 and higher that are not connected? (Yes/No/Unsure)*
    - No answer

5. *Should an AV visibly show to other road users (exterior HMI) that it is in AD mode? (Yes/No/Unsure)*
    - They are more inclined to give a negative answer. After asking why not, we learned that some other traffic participants harass the vehicle (there are anecdotal stories about pestering/testing vehicles)
    - Turning the question around: do we really need to know that? There are multiple studies (EU/SAE/…) on an AV-mode indicator that give different insights

6. *Would (C)AVs be allowed to 'break the law' in order to behave as all other road users? (Yes, always/Yes, but it depends on the context (e.g., safety)/No/Unsure)*
   - Cf. going over the speed limits (TOSCo) → this should not happen
   - AVs don't have / are allowed to break the law
   - nVidia is looking into a generic framework for cooperative vehicle control (whereby all of them should follow the same set of behavioural rules)[9]

7. *Would automated driving require the support of some sort of back-end? (Yes, OEM only/Yes, infrastructure provide only/Yes, both/No/Unsure)*
   - This is beneficial, and in essence required (be it continuously or intermittently)

8. *What should a (C)AV do in case its route is blocked? (Ask advice from a back-end (OEM and/or infrastructure)/Execute a minimum-risk manoeuvre/Transfer control to the driver/Try to find another route (if possible))*

All of the above are viable solutions

5.5 Implications to TransAID work

The value of the meeting in first instance seemed to be limited for TransAID. Nevertheless, it offered very valuable insights into the OEM universe, combined with the American way which is partly in contrast to the European way and its project landscape.

Given the nature of the discussions, it also became quite clear that TransAID is on the right path regarding its modelling assumptions, based on the ideas of a large group of different OEMs. That by itself is a very valuable piece of information, implying that the concepts that TransAID is modelling and describing are both valid and sound.

[9] https://www.mobileye.com/responsibility-sensitive-safety/

6 EU EIP workshop on ODD, 1 October 2019, Turin

6.1 Scope and aim of the workshop

The first stakeholder workshop on impacts of automated driving, how to maximize the benefits; was organized by the EU EIP (EU ITS Platform) with support from L3Pilot[10] and took place in Athens, fall 2018[11]. The EU EIP is the place where National Ministries, Road Authorities, Road Operators and partners from the private and public sectors of almost all EU Member States and neighbouring countries, cooperate in order to foster, accelerate and optimize current and future ITS deployments in Europe in a harmonized way. The successful setting attracted attendees from EU EIP SA 4.2, L3Pilot, automotive OEMs, equipment suppliers, telecom industry, road operators, local and regional authorities, governments and research institutes. The workshop discussed, in a multi-stakeholder setting, the benefits of Connected Automated Driving and how the road and automated vehicle can interact through the concept of Operational Design Domain (ODD) responsibilities. With this second workshop, the organizers aimed to bring this expertise together again, this time to explore costs and benefits around highly automated driving along with identifying the role of Operational Design Domains in facilitating automated driving..

The workshop aims were:

- Day 1 - Discussion on Operational Design Domains, their evolution path and the role they can play in type approval and certification.
- Day 2 - Examination and discussion on costs and benefits of highly automated driving based upon existing research and projects.

In multiple ways the EU EIP activity 4.2 on facilitating automated driving is well aligned with the interest of the TransAID project. The objectives of EU EIP activity 4.2 are:

- Identify the requirements of higher level (SAE 3-5) of automated driving for road authorities/operators, for example road markings, traffic signs, real-time and predictive traffic information, digital maps, cooperative ITS infrastructure
- Assess the direct and indirect impacts of higher level automated driving on traffic, mobility and the core business of road authorities and operators; investigate the socio-economic benefits and costs of automated driving from the road operator's perspective
- Provide a road map and action plan, focussing on the needs of road operators to facilitate automated driving on the TEN road network
- Identify the requirements of automating road operator ITS to facilitate automated driving (i.e. self-maintenance, self-optimisation, self-management, self-healing); and automation level of traffic centre operations and services (control/management/information)
- Monitor, liaise and disseminate, to gain better understanding in global activities, R&D, deployment, and policy development, disseminate lessons learned.

The workshop comprised of plenary and break-out (parallel) sessions. During the plenary sessions different perspectives with respect to ODDs were shared by various stakeholders (i.e. European Commission, OEMs, Road Operators, and Research Projects), while scoring costs and benefits for

[10] https://www.l3pilot.eu/

[11] https://eip.its-platform.eu/highlights/impacts-automated-driving-how-maximize-benefits-workshop-summary-0

different use cases of highly automated driving was conducted during the parallel sessions. Detailed information about both plenary and break-out sessions is provided in the following subsections.

6.2 Workshop participants

Overall, 40 participants attended the workshop representing road authorities, car manufacturers, European Commission, research institutes, road operators, and consultancies. A detailed list including the names of all participants is not available, but information pertaining to invited speakers and their corresponding presentations is provided in **Table 1**.

Table 1. List of invited speakers.

Name	Presentation Title
Marko Jandristis (DG Move)	Policy objectives from European Commission in the field of CAV
Tom Alkim (DG RTD)	EC Perspective on ODD
Luisa Andreone (CRF)	OEM/L3 Pilot perspective on ODD proposal
Risto Kulmala (Traficon)	Road operator perspective on ODD proposal
Jaap Vreeswijk (MAPtm)	TransAID project: dealing with transition areas
Pirkko Rämä (VTT)	CARTRE project: scenarios and their benefits (results of the CARTRE benefit evaluation based on the four future deployment scenarios)

A more detailed overview of workshop participants will be given when the workshop report of EU EIP is available.

6.3 Report of plenary session

The plenary part of the first day of the workshop consisted of 4 presentations followed by a panel discussion. The focus of the majority of the plenary presentations was placed on ODD aspects. First Tom Alkim of DG RTD presented the perspective of the European Commission. An interesting part of his talk was that on the Gartner hype cycle for emerging technologies from 2015 to 2016 the years to mainstream adoption change from 5-10 years to more than 10 years, while in 2018 compared to 2017 level 4 autonomous driving was separated from level 5 autonomous driving. In addition he mentioned that from an EC standpoint we are still not close to rigidly defining ODD per automated driving system. Next Luisa Andreone of CRF presented the L3 Pilot perspective and introduced 8 categories of ODD. Thereafter, Risto Kulmala of Traficon summarised the road operator perspective with material from both EU EIP and the CEDR Mantra project[12]. He stressed the uncertainty associated with ODD today, but also in the future as the ODD is likely to evolve over time. Moreover, the cost involved to adapt infrastructure should not be underestimated and first calculations were provided. Finally, Jaap Vreeswijk of MAP traffic management introduced the TransAID project while linking the project activities to an integral view on ODD and the resulting TransAID rationale (see Figure 4). He concluded his talk by summarising the assumptions and

[12] https://www.cedr.eu/download/other_public_files/research_programme/call_2017/automation/project_descriptions/MANTRA.pdf

results that require validation. Finally, Marko Jandristis (DG Move) elaborated on the EC policy objectives pertaining to the field of cooperative, connected and automated driving (CCAD), while Pirkko Rämä (VTT) provided information about an ex-ante impact assessment of CCAD (8 thematic areas) that was conducted in the context of the CARTRE project.

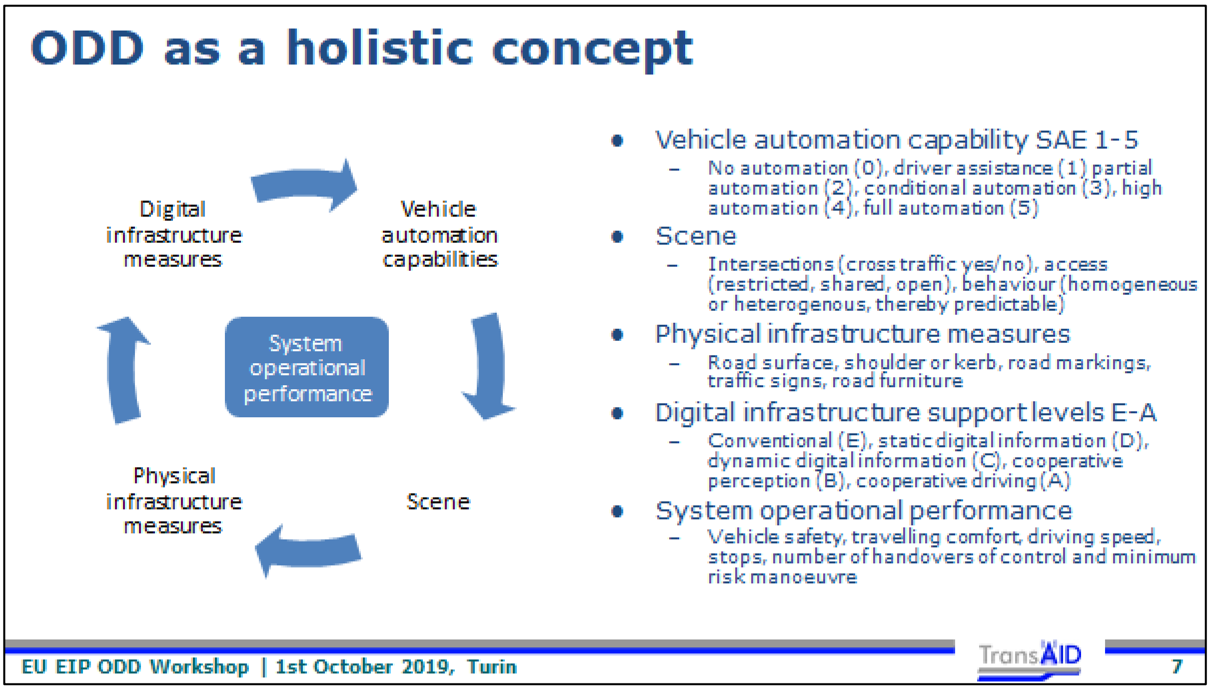


Figure 3: ODD as a holistic concept, slide from presentation

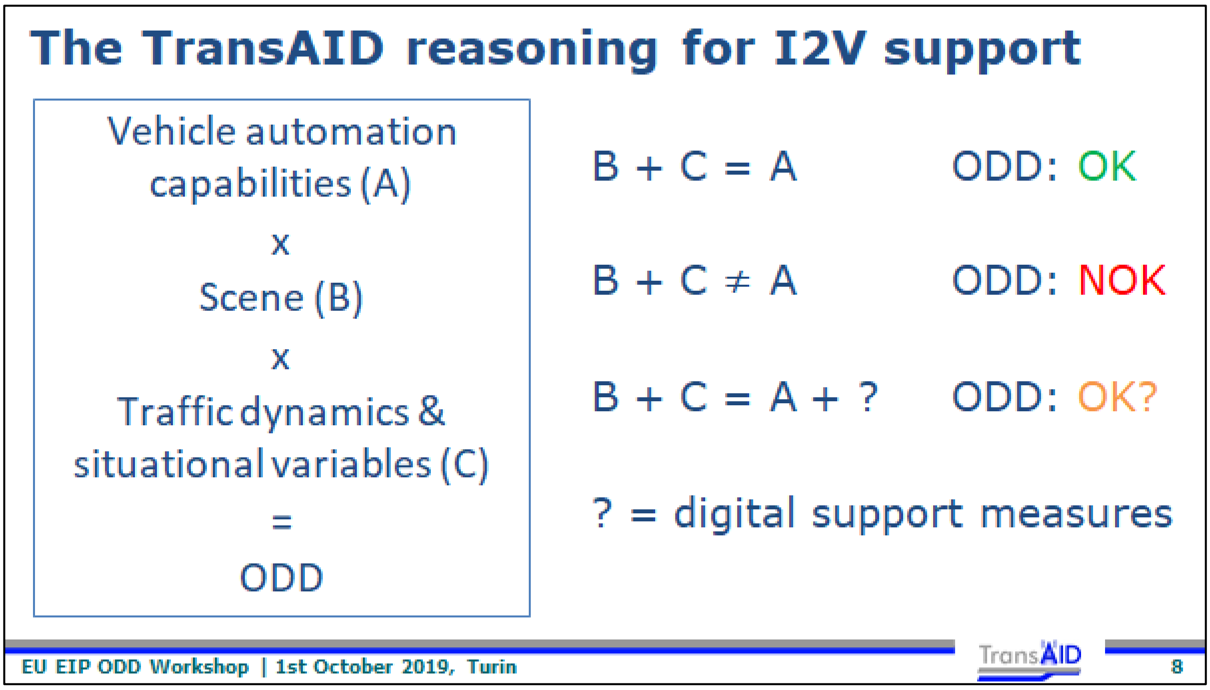


Figure 4: TransAID reasoning for I2V support, slide from presentation

In the panel one of the main topics of discussion was about the variables and their units and scales that could enable describing the ODD systematically. This would enable stakeholders to interpret the ODD unambiguously in the same way and to plan actions that could contribute to a more continuous, less interrupted ODD. ODDs should differ between different use cases and are going to be period-dependent, but they could also be manufacturer or ISAD level dependent. In addition, new reliability and liability issues would arise when factors and systems external to the vehicle (e.g. digital and physical infrastructure) would become an integrated and trusted part of the ODD. Moreover, roles, tasks and responsibilities of different stakeholders, both public and private, were highlighted as an important topic. Most of these which exist today are likely to exist in the future, therefore they need to be considered in the ODD space appropriately. On the one hand this implies that automated vehicle systems might be enabled under road authority and infrastructure authorization actions, while on the other hand it must remain feasible to inform (automated) vehicle systems and regulate the movement of traffic. Finally, the interdependency of ODD-attributes was discussed and there was consensus among the panel that few attributes are fully independent, which might imply that parts of operations can be/are enabled by multiple attributes and some attributes are interchangeable. In addition, it was highlighted that there is some kind of trade-off between the complexity of the vehicle environment, the vehicle ODD and the vehicle's driving performance, for example the driving velocity. Instead of assuming that an automated vehicle system is in or out its ODD, like a binary variable, the driving performance of the vehicle might be adapted in such a way (e.g. reduce velocity) that the automation system can cope with the situation at hand, therefore remains in its ODD. A few participants argued that for certain ODDs and sensor capabilities, road markings might not be required eventually. Additionally, it was highlighted that ODD cannot be currently used for type approval of automated vehicles (AVs), since the EC is struggling with permission rules.

6.4 Report of break-out sessions

Three parallel sessions were organised based on the use case groups of the 2019 ERTRAC roadmap[13], i.e. automated passenger cars, automated freight vehicles, and urban mobility vehicles. The goals of the sessions were to: discuss the predefined ODD attribute list and whether all relevant attributes for the use case are included, discuss the requirements for the ODD attributes and identify agreements and differences among stakeholders, and identify priority attributes for evolution from the user, infrastructure provider, and industry perspectives. Below a summary of each of the breakout sessions is provided.

6.4.1.1 Automated passenger cars

The discussion of this group first focussed on understanding the predefined ODD attributes. This showed that there are many different perspectives to most ODD attributes and that many sub-attributes exist. Interestingly, for various attributes the discussion could go into two directions. One being the assumption that ODD attributes are requirements from vehicle automation systems to their environment to enable automation. The other being the assumption that vehicle automation systems should be capable to handle most ODD attributes, hence the attributes are a requirement to the vehicle automation system. For example, high quality road markings could be seen as an enabler of automation, but reversely vehicle automation systems must also be able to cope with poor road markings. Following the panel debate on the interchangeability of attributes, or in other words the complementarity of attributes, it was suggested that it is needed to look more closely to the level of driving tasks of the vehicle automation system as opposed to use cases. For example longitudinal and lateral driving tasks. This would allow to better isolate the required capabilities of the

[13] https://www.ertrac.org/uploads/documentsearch/id57/ERTRAC-CAD-Roadmap-2019.pdf

automation system and to identify the functions of this system and their needs in order to execute the driving task. Such an approach might prevent that the importance of ODD attributes is overestimated or underestimated, which is something that easily occurred while discussing them. Finally, it was acknowledged that the precise situational and environmental conditions of the automated vehicle are very decisive when describing the ODD of use cases. This revealed an interesting balance between a desire to address specific conditions (e.g. causes for disengagement and takeover requests) on the one hand, and on the other hand the inability to be exhaustive when it comes to situational, environmental and other ODD characteristics (i.e. an infinite number of conditions). Clearly, an alternative perspective or compromise of some kind is needed here.

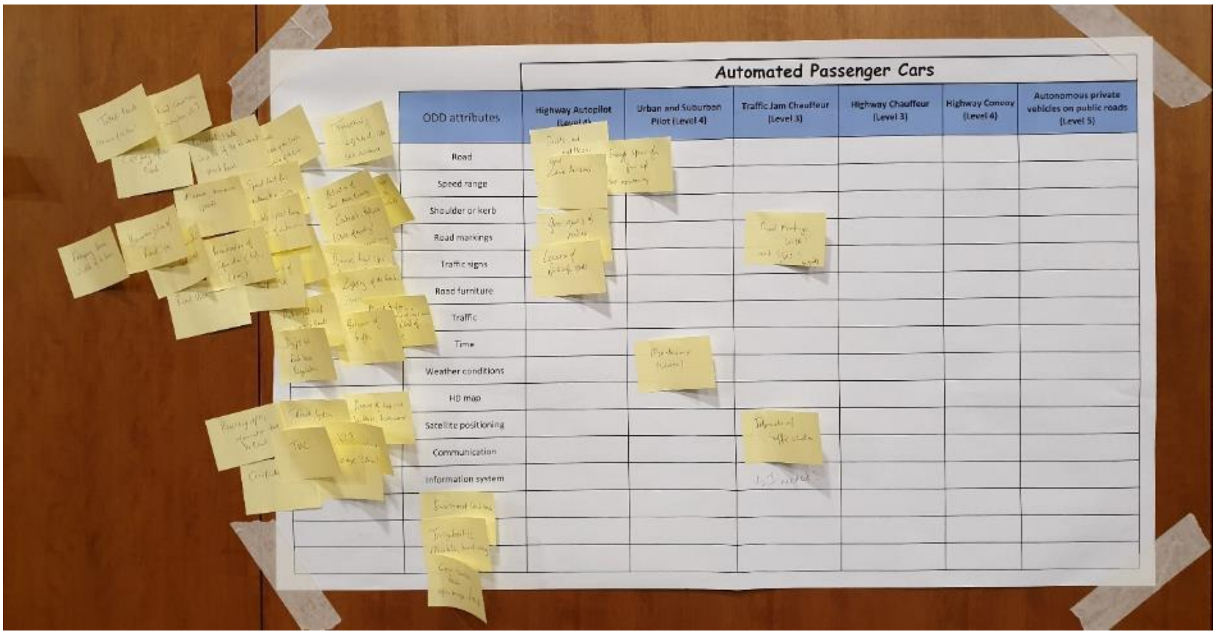


Figure 5: picture of the break-out poster and discussion

The objective of the "Automated Passenger Cars" session during the 2nd day of the workshop was to score (in a range scaling between -10 and 10) benefits and costs of a Highway Autopilot system (SAE Level 4 Automated Vehicle) in mixed traffic conditions. Initially, the participants agreed that Highway Autopilot can induce increased demand and vehicle miles travelled (VMT). Thus, it can be expected that congestion will worsen in the presence of the system. Moreover, it was noted that Highway Autopilot can be more conservative in terms of car-following and lane changing compared to manual driving in the absence of connectivity. Thus, capacity can reduce if automated vehicles are not connected as well. On the other hand, there is already evidence indicating that the system can stabilize traffic flow depending on the penetration rate. Centralized and decentralized traffic management can play a significant role towards the latter direction and possible ameliorate to a certain extent the adverse impacts of induced demand that will be generated by the system introduction. However, it was stressed that the required cost for the digitization, operation and maintenance of the road infrastructure can be substantially high. Traffic safety is expected to improve since automation will be able to minimize human errors, but on the other side the type of accidents can change due to heterogeneity in traffic stream, false negatives, false positives, control transitions and minimum risk manoeuvres (especially those not guiding the AV towards a safe harbour). Fuel efficiency of individual AVs will be increased but not on a lifecycle basis. Additionally, excessive demand due to automation can aggravate the negative environmental impacts of road traffic. Finally, the session concluded that social equity would improve considering the wider access of disabled people in motorized traffic.

6.4.1.2 Automated freight vehicles

The discussion groups that dealt with automated freight vehicles (AFVs) centred around a limited number of ‘use cases’, or more specifically, ‘environments’ for which the ODD would be discussed.

Examples of these were:

- Private terrains with only L4+ AFVs
- Hub-to-hub corridors with only L4+ AFVs
- Hub-to-hub corridors with mixed traffic
- Any road (incl. urban) with mixed traffic

The discussions started with an overview of the attributes associated with the ODDs, and to what extent they are applicable/relevant for a specific environment. Already some pertinent questions shaped the majority of the discussion. For example, is an ODD solely limited to infrastructure, or can it also encompass aspect such as weather disturbances? The debate then went on, concluding that we probably need to have the list of characteristics/attributes (digital versus physical, and static versus dynamic) to be more elaborated upon by the relevant stakeholders. In addition, discussions were less than straightforward, as we needed to define some sort of ‘frame’ under which the ODDs were valid. For example, ODDs may differ between use cases, and can even be period-dependent (2020, 2030, 2040, or even further). An interesting side track in the discussion was about the (changing) role / relevance of lane markings, as for for certain ODDs an sensor capabilities these may no longer be needed. In addition, some parts of the discussion centred on how ODDs can or even should be used for type approval of automated (freight) vehicles. Concluding that aspect, TransAID noted that currently the EC is struggling with the different permission rules, as they are dependent on the Member States and currently behind schedule. However, the SEARUB project aspires to contribute in this respect.

Central to some of the use case discussions, was the notion of mixed traffic situations, e.g., to what degree does mixed traffic modifies an existing ODD? No clear answer was found. And in addition, the discussion also tried to include the costs and benefits of certain (traffic management) systems, after which the main debate revolved around which stakeholders (i.e. road authorities versus the private sector) should make which investments.

As it stood, most of the available time for the breakout session was spent on just trying to explain the attributes, as they were perceived as being not clearly enough defined and subject to various interpretations. In hindsight, it could have been better if the specifics of each attribute were uniquely identified, perhaps in a separate session, before them being used in a discussion, even though most of the attributes are very use case specific, even too specific to ambitiously address them all in a breakout session. There were also high dependencies between various attributes, e.g., flow vs. travel time/speed vs. safety (of whom?), etc.

In addition, the uses cases themselves were not clearly defined enough to have a good, fruitful discussion about. What is understood by ‘mixed traffic’? How much is it mixed? Where do the different types of vehicles drive? Etc. Because of this, again a lot of time was spent in trying to (re)define the use case, so that everybody would be on the same page. However, this went at the cost of sacrificing the more finer points of coupling each attribute to each use case, for which we felt not enough time was remaining available. Furthermore, the absence of a critical mass of OEMs made the discussions not always straightforward, at which point the group had to resort to its own assumptions on certain vehicle behaviours (which would have a big effect on the supposed impacts). The danger is that this can create a mismatch, possibly leading to policy makers drawing the wrong conclusions.

6.4.1.3 Urban mobility vehicles

A discussion was held during the "Urban Mobility Vehicles" session to identify differences in requirements with respect to the operation of Automated PRT/Shuttles on dedicated roads/lanes and in mixed traffic. Initially, the organizers of the session clarified that dedicated lanes do not necessarily mean physically separated lanes by the rest of the road infrastructure. The participants also debated about the inclusion of robo-taxis in the "Automated PRT/Shuttles" vehicle category, but eventually it was decided that the discussion will be dedicated explicitly on shuttles. The session did not reach a consensus on the identification of specific road types where Automated PRT/Shuttles could preferably operate (especially in the case of dedicated lanes), but it was highlighted that infrastructure maintenance (e.g. road kerbs, stops, lane markings) is crucial for the correct operation of the service. Traffic signs were considered rather important for the mixed traffic scenario (especially to notify manually driven vehicles), but maybe also necessary for the dedicated lanes cases due to regulatory/legislative reasons. It was also stressed that Automated PRT/Shuttles should be able to perform tactical manoeuvring (e.g. obstacle avoidance and overpassing) in mixed traffic, since they currently run on pre-specified routes and explicitly stop in lane when safety critical situations are identified. Another aspect that received attention during the session was that of extreme weather conditions. The participants agreed that the shuttles should not operate in such occasions since stopping the service while in route will negatively impact its reliability and popularity. However, it should be expected that the Automated PRT/Shuttles should be able to function safely in regularly bad weather conditions. Finally, it was deemed important that an information service is available (especially in the case of mixed traffic) to warn the Automated PRT/Shuttles about downstream hazardous situations and provide guidance in the case of complex traffic situations.

6.5 Implications to TransAID work

It was valuable to present the TransAID project activities, vision, rationale and points of discussion to an audience that is equally active in this domain. The topic of the Operational Design Domain (ODD) of automated vehicles seems to be a common denominator for many activities, or at least a topic that focusses the debate and converges the discussion. Moreover, it was valuable to engage in more in-depth discussions on the ODD-topic specifically with stakeholders and representatives of other projects. However, the presence of vehicle manufacturers was sincerely missed, which is a point of attention for future workshops. This workshop was mostly useful for validating the appropriateness and relevance of the TransAID work and to further structure our thinking on a roadmap and guideline to plan for traffic management with vehicle automation. For example, the holistic framework to enable automation that was prepared for this workshop will be further developed based on the feedback that was received, and the next version will be used as input for the next workshop(s).

7 TransAID-INFRAMIX stakeholder workshop, 9 October 2019, Graz

7.1 Scope and aim of the workshop

In addition to networking, the joint stakeholder workshop, due to the high diversity of attendees (see next section) was a perfect opportunity for fruitful discussions and for generating feedback on key topics of the two projects. Also, the exchange of information between the two projects was regarded as very profitable. The main objectives of the workshop were:

- Explore in more detail how increasingly automated vehicles are likely to behave in various traffic situations and how this may affect the traffic management task.
- Provide insight into the role that communication technology (digital infrastructure) can play in the shorter term of connected transport and the longer term of automated transport.
- Promote reflection among public, knowledge and technology stakeholders on proposed solutions, and on their role and responsibilities as automated driving evolves.

The workshop consisted of plenary sessions in the morning and afternoon with in between two breakout rounds. The plenary sessions were also used for digital questionnaires within the scope of the two projects. Picture of the workshop can be found in Appendix C.

TransAID workshop site: https://www.transaid.eu/organised-events-workshop3/
INFRAMIX workshop site: https://www.inframix.eu/joint-stakeholder-workshop-of-inframix-and-transaid/

7.2 Workshop participants

At the workshop there were 39 participants, which comprised a very international audience as can be seen in the graphic below. Due to the location in Graz, Austria, the majority of attendees was Austrian; however, more than half were international guests, a considerably high percentage.

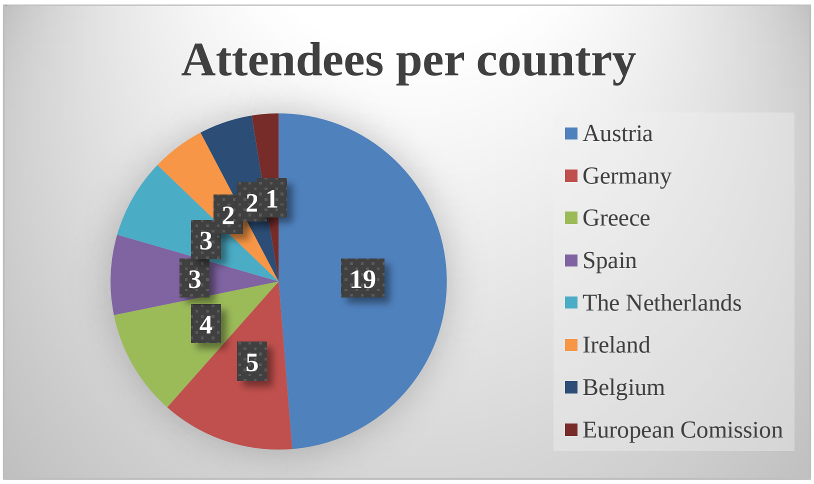


Figure 6: overview of workshop participants by country

The attendees' affiliation was also very diverse as can be seen in Figure 7. The list comprises a cross section of important stakeholders groups from e.g. Industry, Research and Government (Road Authorities). This ensured valuable input and laid out a base for interesting discussions in the breakout sessions.

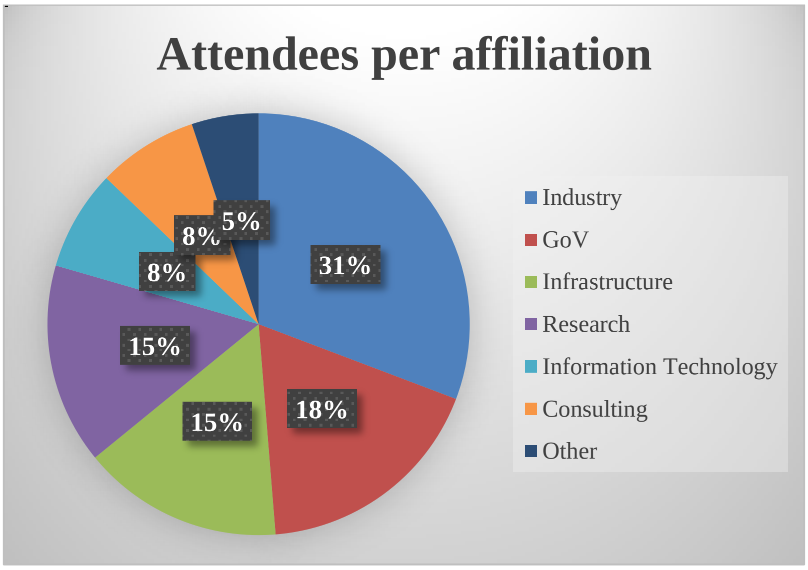


Figure 7: overview of workshop participants by sector

7.3 Report of plenary session

There were two plenary sessions, one in the morning and one in the afternoon, which were split by two rounds of break-out sessions.

7.3.1 Morning plenary session:

Time	Topic
09:00 –09:30	Registration and coffee
09:30–10:30	Welcome & introduction – Eva Hackl (ASFINAG) and Aldo Ofenheimer (VIF) • Research programmes and strategic research directions – the European Perspective – Rafal Stanecki (DG MOVE) • INFRAMIX project – Wolfram Klar (ATE) • TransAID project – Julian Schindler (DLR) • Expectation towards automated driving – Sven Maerivoet (TML) (20 minutes)

The morning plenary session was devoted to an introduction of the two projects in order to outline the main goals and approaches of INFRAMIX and TransAID to those parts of the audience who might not have been familiar with them.

The opening introduction was given by Mr. Ofenheimer from Virtual Vehicle (as Virtual vehicle hosted the workshop at their facility) and by Mr. Stanecki of the European Commission. Mr. Stanecki’ s presentation gave an insight on the EC on the H2020 projects and on the general view of the EC on important traffic and transport topics of the future.

7.3.2 Afternoon plenary session:

Time	Topic
13:15–14:15	Breakout sessions – second round
14:15–14:45	**Wrap up of breakout sessions by session moderators – Eva Hackl (ASFINAG)**
14:45–15:00	**Presentation of the three INFRAMIX use cases – Yannick Wimmer (ASFINAG)**
15:00–15:30	**Coffee break and poster exhibition**
15:30–16:00	Interactive discussion – Sven Maerivoet (TML)
16:00–16:45	**Meet the testing group – Yannick Wimmer (ASFINAG), Daniel Tötzl (SIEMENS), Stefaan Duym (BMW), Alexander Frötscher (ATE)**
16:45–17:00	**Closing remarks – Eva Hackl (ASFINAG)**

The afternoon plenary session was used on the one hand to present a wrap up of the breakout groups, on the other hand for some more questionnaires. The INFRAMIX project is required to collect user appreciation on their scenarios, therefore Mr. Wimmer gave a short introduction of the scenarios (a follow up on the presentation of Mr. Klar in the morning). The audience was then asked to fill in a digital questionnaire. Furthermore, there was a second Mentimeter session, which is described in an extra section in this report.

7.4 Report of break-out sessions

Late in the morning and in the beginning of the afternoon, there were two rounds of 4 breakout sessions. The sessions were the same both rounds with different participants. The summaries below cover both rounds.

Time	Topic
11:15 – 12:15	Breakout sessions – first round
13:15 – 14:15	Breakout sessions – second round

7.4.1 Session A - Limitations of automated driving – ODD, ToC

The break-out session was held by Alexander Frötscher (AustriaTech) from INFRAMIX and Julian Schindler (German Aerospace Center) from TransAID.

In both sessions, the idea and meaning of Operational Design Domain (ODD) was explained. While INFRAMIX is working in well-defined ODDs, TransAID focusses on the respective ends of ODDs and possible extensions by means of infrastructure. For example, there are TransAID services available, which intent to guide connected automated vehicles through areas where vehicle automation availability on its own is limited, e.g. in road works or on complex intersections (See Deliverables 2.1 [2] and 2.2 [3] for further information.

As digital and physical infrastructure comes into play both in INFRAMIX and TransAID, one of the key questions of the session was addressing the issue whether an ODD should be defined OEM-internal, without sharing it with anyone, or if the ODD needs to be defined commonly, so that the infrastructure can guarantee e.g. automation readiness independent of the OEM. On top of this, it has been discussed which parts need to be included in an ODD definition, and to which granularity.

Both parts of the workshop were visited by people from academia, industry, operators and cities. While the first part was dominated by a single OEM, the second part was dominated by cities. Therefore, the discussions were quite different: the first part very much showed that the definition of an ODD is very complex and has a lot of parameters, especially on the sensor side. Here, numerous parameters may be defined, including sensor capabilities but also environmental aspects like direction of light, glare, reflection of materials, fog conditions, etc. Therefore, it was deemed to be impossible to have a common definition which would be valid for all vehicles independent of the sensor setup.

In contrast, the second break-out-session was having much more city focus, since no OEM was in the room. During this discussion, the necessity of having a common understanding of the ODD was stressed. Cities expressed high interest in getting insights into the ODD restrictions of the OEMs and to define criteria for ODDs. The aim of this is to be in the position of allowing vehicles of different automation capabilities to use specific roads and to be able to control the use or number of automated vehicles in certain areas. As – being a lesson learned from the first break-out-session – the number of parameters for the common definition of ODDs may be too large, it has been agreed that focusing on driving capabilities instead of sensor capabilities would be helpful. Here, it could be helpful to develop AV readiness classes of infrastructure. Instead of defining low level parameters for each sensor, the classes should formulate more abstract scenarios, like “the automated vehicle is able to follow the road equipped with clearly visible road markings at day time and sunny weather conditions in urban areas with low buildings”. Of course, descriptions like that currently leave a lot room for interpretation. But the abstraction in general leads to state that the OEMs at the end of the day are responsible to have sensor setups in their vehicles which guarantee driving in the defined contexts of the classes. Further discussions of course are necessary to get a more complete definition of all aspects of such classes and to get such classes developed.

For TransAID, it is very important to foster such discussions, as the TransAID measures will take part those parts of the road, where ODDs of several vehicles end. Therefore, it is a mandatory criterion to understand where those areas are. The TransAID services nevertheless are not bound to specific parameters of ODDs, but offer solutions for different ODD-related shortcomings, e.g. by saying that there are “no-AD-zones” on the road where vehicle support from the infrastructure is needed.

7.4.2 Session B - Modelling infra-assisted automated driving and simulation findings

Selim Solmaz (Virtual Vehicle Research Center) from INFRAMIX and Evangelos Mintsis (CERTH) from TransAID presented (sub)microscopic traffic modelling approaches with respect to connected and automated driving (CAD) during parallel Session B. TransAID focused on modelling the motion of connected and automated vehicles (CAVs) (i.e. car-following, lane changing, gap acceptance and downward control transitions) in the microscopic traffic simulator SUMO, while INFRAMIX introduced a co-simulation framework (VSimRTI & ICOS) that allows the simulation of real vehicle dynamics and Advanced Driver Assistance Systems (ADAS) functions (i.e. virtual vehicle or coupling actual vehicle(s) with simulation) in a microscopic traffic simulation environment. Challenges pertaining to modelling of CAD in microscopic traffic simulation tools were subsequently discussed with the session’s participants.

Initially, car-following behaviour of CAVs was examined in the context of cut-in situations induced by legacy vehicles. The majority of the participants deemed that CAVs (even of lower automation levels) could handle these situations in automated driving (AD) mode (CAVs could resume in AD mode even after emergency braking events), and should be modelled as such in simulation tools. It was agreed that lane change behaviour of CAVs can be expected more conservative (in terms of safe gaps) compared to manually driven vehicles. However, in order to avoid increased heterogeneity in mixed traffic conditions (legacy – automated – connected and automated vehicles) (C)AVs could be developed to adopt a human-like approach in terms of lane changing. Nonetheless, determining human-like lane change behaviour (which may vary according to several different factors) might be a rather challenging task[14]. With respect to modelling/simulating control transitions and minimum risk manoeuvres (MRMs), the participants argued that drivers should be allowed to take-over vehicle control during MRMs, but the vehicle should always be guided to a safety harbour (side-street location) to prevent safety-critical situations on the mainline lanes (e.g. rear-end collisions due to stop in lane after MRM).

It was also discussed that the level of detail required in modelling CAD depends on the scope of each study. Thus, modelling of actual vehicle dynamics is required when testing individual ADAS functions on a vehicle basis, but the simulation of mixed traffic streams can be conducted with lesser detail when it comes to the vehicle/driver models due to resource constraints. Moreover, it was pointed out that new traffic rules should be adopted with respect to CAD, to enable (C)AVs to cope with certain situations (disobeying existing rules might be even necessary in safety-critical situations). Finally, the session's participants agreed that traffic separation (based on automation capabilities) should be mainly warranted according to the penetration of (C)AVs in the fleet mix.

7.4.3 Session C - Traffic control strategies for mixed traffic

During both rounds the session was moderated by Anton Wijbenga (MAPtm) and Michele Rondinone (Hyundai), both from TransAID. A presentation was given to introduce several topics about which several questions were posed to the audience. During both rounds there were 9 different stakeholders present from several backgrounds (i.e. universities, companies such as Intel and Siemens, and road authorities such as POLIS and Rijkswaterstaat).

The objective of the session was to get a common inter-stakeholder view on TransAID measures and an understanding on their advantages and possible associated risks. Below a summary of conclusions and/or additional questions is given.

- Limitations of- and restrictions to AD:
    - How an automated car can distinguish static situations (e.g. idle vehicle will not move) from dynamic ones? A solution could be AI (or rather machine learning) to recognize vehicle types/number plates and possibly the situation/ context to provide more insights. However it is expected that will not completely solve the problem because those machine learning models will learn by example and have limited reasoning capabilities which cannot solve every situation.
    - VRUs must be considered and taken into account when considering AD restrictions (i.e. no AD zones) imposed by the infrastructure (e.g. school zones).
    - What if infrastructure systems are down and enforcement is given by human operators (police, traffic regulator)? AVs might not be able to cope with such situations because it cannot recognise the instructions from the operator, hence a Transition Area emerges.
- The new role of Traffic Management in the era of AD: measures, risks/opportunities, vehicles support:

[14] Also see: https://www.mobileye.com/responsibility-sensitive-safety/

  - The TransAID approach and 5 services are positively received by road authorities (RWS and Rotterdam).
  - Most scenarios are very dynamic. There is a need of increasing infrastructure capabilities (sensing, computing and communications) to take the most advantage of TransAID measures in a dynamic way.
  - It would require big efforts to digitalise road infrastructure and to handle dynamic (traffic management) schemes. Due to the effort, there might not be a positive return of investment in urban scenarios. Therefore, it makes sense to start on motorways and then consider applicability to urban roads.
  - In the future, dedicated lanes for (C)AVs should be considered as an incentive for AD introduction to reach long term goals of safety/efficiency. However, due to possible reduced capacity (blocking a lane for remaining traffic), it is best to use dynamic assignment which considers the traffic composition.
- Trust, safety, liability, legal aspects:
  - For traffic management to be efficient, infrastructure must be authorized by road authorities to provide advices (that brake traffic rules) also in a fast dynamic way or be mandated for recurrent situations.
  - An intermediary service for implementing the TransAID measures as conceived by the project was positively received by the audience (see TransAID D4.1 [4]).
  - Road authorities or operators could assume liability for traffic management procedures. It is happening regularly already today and it could apply to the TransAID measures.
  - More dynamic situations are those that can create most problems from the liability point of view (roadworks vs. intersection & vehicle sensing).
  - From a liability point of view, it is better to provide information than instructions. The decision of finally adopting /implementing an advice lies at the vehicle side, and therefore the responsibility as well.
  - Finally, whoever has liability can be different case by case. There is the need of a governing framework for decision making.
- Legal frameworks and current implementations of traffic measures, sometimes limit the advantage of technical development. Need to adapt traffic rules for automation (Intel Mobileye RSS is trying to establish discussions on that[15]). For example, to differentiate speed/relevance areas for different categories of vehicles.

7.4.4 Session D - ISAD – how can infrastructure support automated driving?

During both rounds of the breakout session, Stamatis Manganiaris (ICCS) presented the INFRAMIX ISAD approach to the audience. The topic raised great interest, and the session was well visited both times with approx. 15 participants in each of the sessions. Below are the highlights of both sessions:

- The necessity for infrastructure classification is strong since it will promote the cooperation between critical ITS stakeholders. It can be seen as an essential requirement for smooth and efficient ITS development.

[15] https://www.mobileye.com/responsibility-sensitive-safety/

- The ISAD classification is a dynamic work with many interactions and further discussions are needed. Especially, but not limited to, with respect to HD maps.
- A detailed specification is needed in terms of automated functionalities.
- Governance Models (Global or Local) and a Regulatory Framework are topics of great importance, since liability and (cross-countries) management issues are complicated and undefined.

6.4 Stakeholder survey results

In this section, we give the main results from a survey polled using the Mentimeter[16] platform with the audience. We asked our questions during two different moments, one in the morning and one right after lunch. The results were then aggregated, analysed, and discussed before closing the workshop. At the beginning of each question session, participants logged in to a specific website using their phone, tablet, or laptop. Then a series of questions was, one at a time, shown on the main screen, as well as their own devices. The question was also slowly and clearly read aloud, repeatedly if necessary, with complementary explanations where needed. The audience members could then anonymously select various options to vote, with the poll results each time per question shown in real-time on the main screen.
To support the results from INFRAMIX's research and TransAID's simulations and field trials, it is necessary to get a good grasp on certain issues that require an understanding of how connected and/or automated vehicles operate on the one hand, and what the policy makers allow or require on the other hand. This forms a cornerstone to support INFRAMIX's and TransAID's goals, i.e. defining to what degree infrastructure is suited for automated driving and achieving a library with applicable and scrutinised measures for transition areas. To that end, we pose questions throughout the project to several stakeholders and experts. The goal is to gain insights into legal implications, (expected) driver and/or automated vehicle behaviour and infrastructure specific aspects with respect to automated vehicles. The answers to these questions will provide some feedback on the work done so far, some of which is based on views from experts within the project consortium, and collect insights for future work.
It is within that frame of mind that INFRAMIX and TransAID organised short surveys[17]. Both survey moments were organised efficiently, such that they did not take much time, and thus did not impose on the time available for the presentations.
The detailed, slide-by-slide results can be found in Appendix B and photos in Appendix C.

7.4.5 First session results

Some 30 people attended the workshop, and about a third of the audience came from research/academia, with the rest evenly split among consulting, industry/OEM, road operator, public authority, and other. The first session contained 12 questions.

[16] https://www.mentimeter.com

[17] For the surveys we made the protection of personal data compliant the EU's GDPR regulations. The execution of our surveys was in line with the ethics aspects as covered in TransAID's Deliverable D10.14. No personal data was gathered during the surveys.

Question #1	What is your background / organisation (be as specific as possible)?
Results	1. Consultant → 8% 2. Industry / OEM → 12% 3. Service provider → none 4. Road operator → 15% 5. Public authority → 15% 6. Research / academia → 38% 7. Other → 12%

Question #2	When do you expect SAE L4 vehicles to become mainstream (motorways)?
Results	2 out of 3 people expected this to happen from 2035 onwards.

Question #3	When do you expect SAE L4 vehicles to become mainstream (urban environments)?
Results	The vast majority (9 out of 10 people) answered 2040 or later, with half of the audience even stating 2050 or later.

Question #4	How do you expect V2X communication to be adopted?
Results	About 3 out of 4 assumed this to be done through deployment by OEMs, with half of the people thinking through regulation of 4G/5G by OEMs and about a quarter through regulation of G5 by OEMs. *Note that we oversaw the option to select a hybrid approach.*

Question #5	Is connectivity required for some levels of automation (cf. SAE L3 and higher)?
Results	The audience answered unanimously yes.

Question #6	Should OEMs be forced to report disengagements (ToCs) from automated driving to a road authority?
Results	About 9 out 10 people think that OEMs should be forced to report disengagements.

Question #7	Should the operational design domains (ODDs) of SAE L4 vehicles be published by OEMs?
Results	About 9 out of 10 people think the ODDs should be published by OEMs. After discussion, it was clarified that the ‘no’ answers mainly stemmed from the fact that the ODD currently is not clear enough defined, with many attributes either unsure or perhaps even insufficient. This absence of a clear description makes defining the ODD at the moment very difficult, let alone specifying how exactly an SAE L4 would adhere to it.

Question #8	Who should decide whether a specific road section is within the ODD of an SAE L4 vehicle?
Results	About 2 out of 3 people believes this should be decided by both OEMs and road operators. 1 out of 5 people believes this to be decided by another authority.

Question #9	Should each infrastructure (road) element have an associated ISAD level?
Results	3 out of 4 people believes an associated ISAD level is required; there were 6

	people that answered unsure, possibly because the concept/usability of ISAD levels was not fully clear.

Question #10	Should there, aside from homologation, be another official body that certifies SAE L4 vehicles?
Results	2 out of 3 people put forth the requirement of another official body, and 1 out of 4 saying this was not necessary. Some additional discussion was held regarding over-the-air (OTA) updates of a vehicle's software: would that for example change the behaviour significantly, so as requiring to have another certification per vehicle, or rather only at the OEMs side?

Question #11	Should an AV visibly show to other road users (exterior HMI) that it is in AD mode?
Results	This is a complicated issue which is not so straightforward to answer, as evidenced by half of the audience thinking yes and the other half answering no or unsure.

Question #12	What topics would you specifically like to discuss?
Results	1. 4G/G5 or G5? 2. Business models? 3. Certification and verification? 4. How to deal with every OEM having its own MRM solutions? 5. How and by whom is the decision made, which SAE level is allowed on a specific road section? 6. How to implement the scenarios? 7. How to keep the infrastructure databases updated? 8. Infrastructure costs? 9. Mixed traffic flows with less than SAE L3? 10. New role of road operators? 11. Public transport aspect? 12. Relation between ISAD and SAE levels? 13. Road markings? 14. Simulation approach on MRMs? 15. Stress level for non-drivers? 16. Tele-operations? 17. Testing in real conditions? 18. Traffic manager's role? 19. Urban use cases? 20. User perception? 21. VRUs?

7.4.6 Second session results

We had the following 11 questions during the second session.

Question #1	Would (C)AVs be allowed to ‘break the law’ in order to behave as all other road users?
Results	The large majority (3 out of 4 people) answered yes, depending on the context. A small group of 1 out of 10 people answered negatively, stating that there should in principle never be a reason to break the law when these kind of vehicles are on the road.

Question #2	Should non-automated vehicles be informed when AV in their vicinity behave differently in order to optimise traffic flows / create safer conditions?
Results	The results to this question were quite mixed, with a slight majority preferring yes versus being unsure. The question led to a discussion on who would decide for this optimisation process to occur, and how and to what degree it would affect vehicle behaviour and traffic flows.

Question #3	Who is responsible in case used map data is incorrect and leads to a dangerous situation / accident?
Results	Less than half of the people answered that the map provider is at fault, but the large majority stated being unsure. Their reasoning was that it depends on, e.g., how and where the contractual agreements are made, preferring rather to rank the results as opposed to only be able to choose a single option.

Question #4	Do you expect that AVs will be more conservative in terms of lane change behaviour compared to CAVs?
Results	2 out of 3 people answered positively to this question, with the remaining group being equally divided over no and unsure. The details behind their reasoning was the topic of a separate discussion session.

Question #5	Do you expect that SAE L3 AVs will be able to cope with road works in automated mode?
Results	About 2 out of 3 people assumed no, with the remainder being equally divided over yes and unsure. Their answers reflected and highlighted the expected state of evolution of SAE L3 AVs.

Question #6	Are road authorities allowed to give advice that will conflict with traffic regulations?
Results	Here the large majority (4 out of 5 people) answered yes, seeing as this is one of the main responsibilities of road authorities.

Question #7	SAE L3 is considered unsafe from an HMI perspective by some; should authorities forbid those vehicles?
Results	As there were not many dedicated HMI-experts present in the audience, the large majority was unsure, with about a quarter of the people stating no.

Question #8	Should motorways have dedicated AV lanes while we are in a transition period?
Results	This question invited a lot of debate, with the end results being an equal split between yes and no, and a small group of 1 out of 5 people being unsure. *In other sessions it was concluded it depends on the share of AVs w.r.t. the total number of vehicles because of capacity utilisation.*

Question #9	What are typical causes for unplanned handovers when considering initial SAE L3/4 automated systems:
Results	For this question, people would like to have picked multiple options. As they were only allowed to choose one, ‘Heavy rain and other adverse weather’ came out on top as selected by half of the people. Next were ‘Roadworks with reduced lanes’ and ‘Missing road markings’.

Question #10	What should an SAE L3/L4 vehicle do if it cannot continue its route (queueing at a blocked off-ramp, prohibited from turning at an intersection)?
Results	Here the majority of the people (4 out of 5 people) voted in favour of rerouting.

Question #11	What do you think are the most important issues (3 max) to solve during the next decade?
Results	A mixture of results was provided:

7.5 Implications to TransAID work

The TransAID approach and 5 services are positively received by road authorities. However, they point out that there is a need of increasing infrastructure capabilities (sensing, computing and communications) to take the most advantage of TransAID measures in a dynamic way. All stakeholders fully agree that connectivity is needed for higher levels of automation. In addition, it would require big efforts to digitalise road infra and dynamic (traffic management) schemes. Due to the effort, the services might not be feasible in the short term in urban scenarios. Therefore, it makes sense to start on motorways and then consider applicability to urban roads. *Note: TransAID focusses specifically on urban scenarios.*

In the future dedicated lanes for (C)AVs could be considered as an incentive for AD to reach long term goals of safety/efficiency. However, due to possible reduced capacity (blocking a lane for remaining traffic), it is best to use dynamic assignment which considers the traffic composition. This aspect is more related to INFRAMIX than TransAID, however, at the beginning and end of dedicated lanes there is a likelihood for a transition area which could need some form of support measures.

One cannot expect that AVs will solve all possible situations in the future via algorithms and/or machine learning. The ODD will always have limitations for the foreseeable future. Defining this ODD is very complex, has a lot of parameters and it is necessary to create a common understanding of the concept. Cities expressed high interest in getting insights into the ODD restrictions of the OEMs and to define criteria for ODDs. Some form of ODD should be shared between road authorities and OEMs. The definition of the ODD should be a joint effort.

Regarding vehicle modelling / simulations aspects, it was agreed that lane change behaviour of CAVs can be expected to be more conservative (in terms of safe gaps) compared to manually driven vehicles. However, in order to avoid increased heterogeneity in mixed traffic conditions (legacy – automated – connected and automated vehicles) (C)AVs could be developed to adopt a human-like approach in terms of lane changing which is a big challenge.
With respect to modelling/simulating control transitions and minimum risk manoeuvres (MRMs), the participants argued that drivers should be allowed to take-over vehicle control during MRMs, but the vehicle should always be guided to a safety harbour (side-street location) to prevent safety-critical situations on the mainline lanes (e.g. rear-end collisions due to stop in lane after MRM).

Finally, the topic of liability and regulation was brought up a lot. It was acknowledged that there is the need to adapt traffic rules for automation, for example, to differentiate speed/relevance areas for different categories of vehicles. In addition, infrastructure must be authorized by road authorities to provide advices (that possibly brake traffic rules) in a fast dynamic way or be mandated for recurrent situations.

8 International workshop on ODD, 22 October 2019, Singapore

8.1 Scope and aim of the workshop

The title of the workshop was: constructs of the Operational Design Domain (ODD) of Automated Vehicles. Operational design domain (ODD) is a description of the specific operating conditions in which the automated driving system is designed to properly operate, including but not limited to roadway types, speed range, environmental conditions (weather, daytime/night time, etc.), prevailing traffic law and regulations, and other domain constraints. Any automation use case of level 1-4 is usable only in its specific ODD, thereby an ODD can be very limited, for instance a segregated road or a single fixed route on low-speed public streets. The attributes of the ODD are directly connected to the way the automated driving system works and the interaction with its environment. In this session, known information about the ODD and the factors constructing it will be presented. In addition, it was discussed how automated driving can be facilitated through measures – vehicle technology, (digital) infrastructure-related and otherwise – that help preserving and extending the ODD.

One of the objectives of the workshop was to create a place to discuss authority/industry roles in development and deployment of Automated Driving Systems and ODD. It was an invitation-only gathering to ensure high level of expertise. It was setup as independent and informal exchange of information and views. The intended outcome of the workshop was a common white paper (if feasible) or at least a joint illustration of the common understanding of the interaction 'vehicle – infrastructure – regulation – use area', related to ODD.

8.2 Workshop participants

The workshop had 32 participants and about 15 persons more interested but unable to attend. The participants had a diverse background including policy makers, road operators, industry, vehicle manufacturers, research institutes and independent safety assessors. Organisations and countries were include the following: MAP traffic management, the Netherlands; Asfinag, Austria; Path Berkeley, United States; Ertico ITS-Europe, Belgium; Traficon, Finland; Keio University, Japan; European Commission, Belgium; Trafikverket, Sweden; Toyota Research Institute, United States; Rijkswaterstaat, the Netherlands; ITS Japan / University of Tokyo, Japan; ANDATA, Austria; SB Drive, Japan; Nanyang Technical University, Singapore; TÜV SÜD Asia Pacific, Singapore; Transcore, United States; Aurora Snowbox Oy, Finland; Finnish Transport Infrastructure Agency, Finland; Mitsubishi Research Institute, Japan; CSiS / University of Tokyo, Japan; Highway Industry Development Organisation, Japan; Ministry of Land, Infrastructure, Transport and Tourism, Japan.

8.3 Report of plenary session

The workshop was organised and moderated by Jaap Vreeswijk of MAP traffic management, representing the TransAID project. He briefly introduced the topic with a graphic that was derived and elaborated from previous workshops and discussion (e.g. see previous chapters in this deliverable). The graphic is shown in Figure 9. It is intended to illustrate coherence, interrelation and causality of 7 aspects related to vehicle automation systems and ODD.

Figure 8: picture of the workshop plenary room

To further introduce the topic and the workshop, four presentations were given. They addressed: why ODD is fundamental to driving automation systems and how infrastructure can facilitate driving automation; ODD management and integrated communication systems; infrastructure support classification, and attributes of the ODD - results of the CEDR and EU EIP workshops in Sep/Oct 2019. A more elaborate summary of the presentations will be given in the final version of this deliverable.

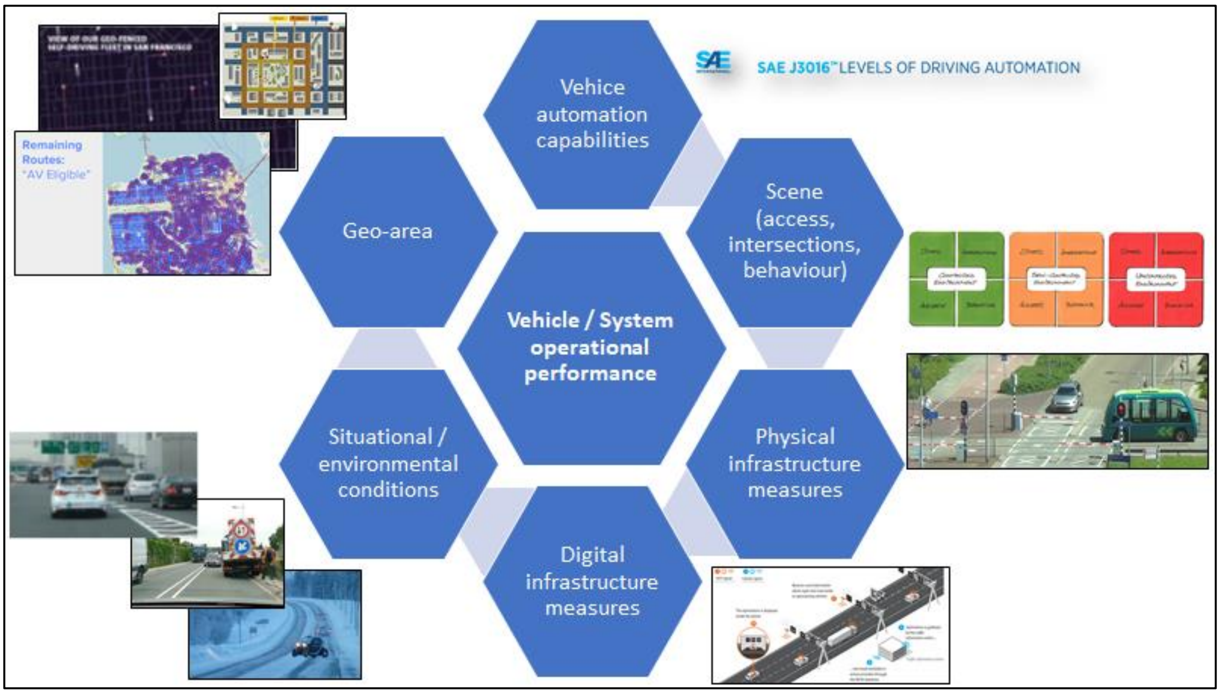


Figure 9: graphic to illustrate the coherence, interrelation and causality of 7 aspects related to vehicle automation systems and ODD

8.4 Report of break-out sessions

Three break-out groups were held, each addressing a slightly different perspective. In general the task was to approach ODD and vehicle automation system from the infrastructure side and define categories of infrastructure support that would enable different levels of automation. The three break-out groups addressed the following topics:

- ODD continuity and coverage – what will be the minimum risk state when the ODD ends, and to prepare for this, at which points, areas and situations are infrastructure/remote support services most relevant, as seen by both the automation system providers and infrastructure owners and operators.
- How different kinds of infrastructure features or modifications could make it easier for the automation systems to recognize and respond to all relevant hazards, and how are roles and responsibilities allocated among stakeholders (who should do what).
- The role of infrastructure/remote support capable of supervising automated vehicles, the need of different infrastructure services and the required redundancy of external infrastructure elements to design functional safe CAV systems.

Figure 10: picture of the workshop break-out sessions

8.5 Implications to TransAID work

A complete report of the workshop will be included in the 2nd version of this deliverable, as at the time of submission the workshop report was not yet available.

9 Conclusions

Based on the 7 stakeholder consultation events summarised in this deliverable it can be concluded that the topic of digital and physical infrastructure (DPI) for automated driving is considered a relevant topic by all stakeholders. It is with reason that one of the working-groups of the Single platform for Cooperative, Connected and Automated Mobility (CCAM) of the European Commission is devoted to this topic. The possible implications for public authorities including policy makers and road operators are significant.

It is apparent that at this early stage of the introduction of vehicle automation systems there are many questions and assumptions that require validation, which leads to uncertainty regarding the state-of-the-art of vehicle automation and its evolution in the coming decades. At the same time, the tasks, roles and responsibilities of traditional and new stakeholders are re-examined, while other developments like digitalisation, connectivity and mobility-as-a-service emerge.

From an innovation standpoint these are exciting times, but as we have experienced, the uncertainties will not disappear soon or new uncertainties will arise. Moreover, since CCAM and DPI are such new areas of innovation, stakeholder consultation did not provide all the answers while for many subjects, nobody has the answer yet. Also, it is fair to say that vehicle manufacturers are often absent or underrepresented in stakeholder consultation events and conferences.

Nevertheless, what can be observed from the sequence of stakeholder consultation events is that there is steady progression in the collective understanding of the relation between vehicle automation and infrastructure and the possible implications to the stakeholders involved. By now it seems that there is a common interest, also by vehicle manufacturers, to develop a comprehensive standard and/or taxonomy for classifying operational design domains of automated vehicle systems.

10 References

1. Pribyl, O. et al. (2017), Deliverable 2.1: User needs, conceptual design and requirements, MAVEN, Managing Automated Vehicles Enhances Network.

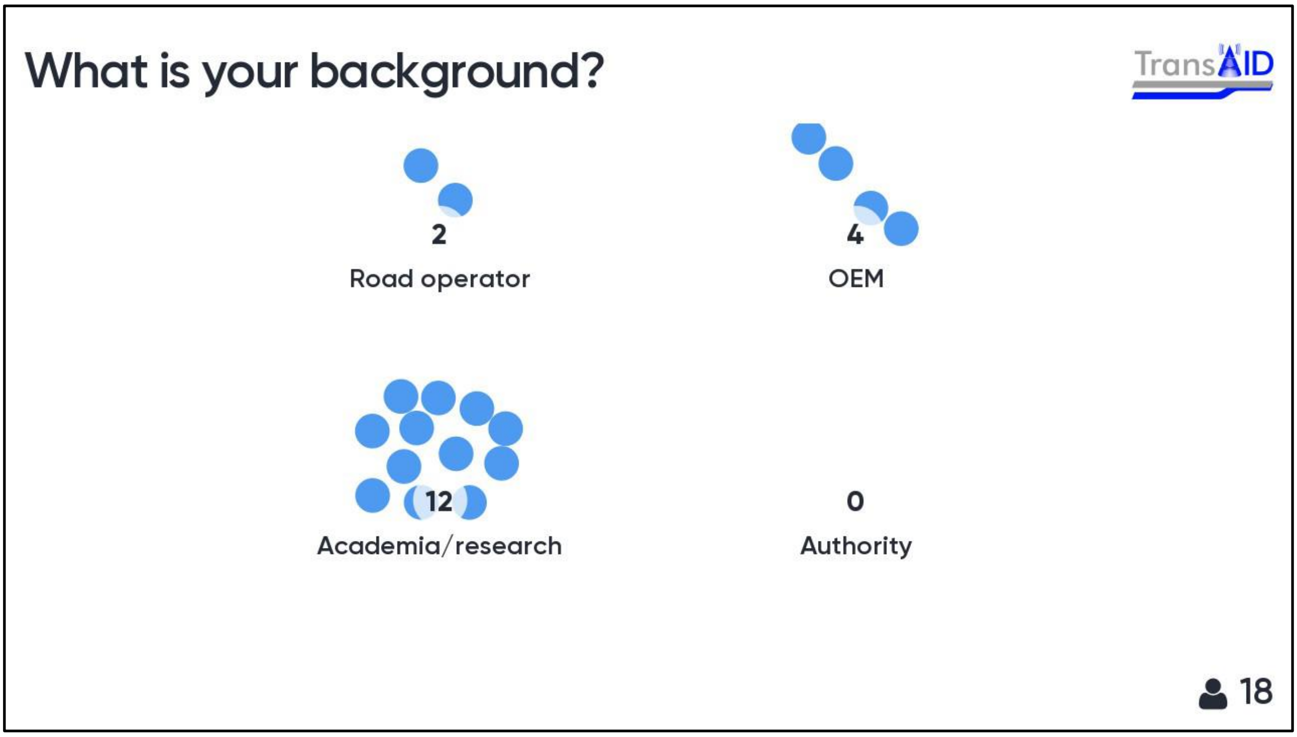
2. Wijbenga, A. et al. (2018), D2.1 Use cases and safety and efficiency metrics, TransAID project deliverable, URL: https://www.transaid.eu/deliverables/

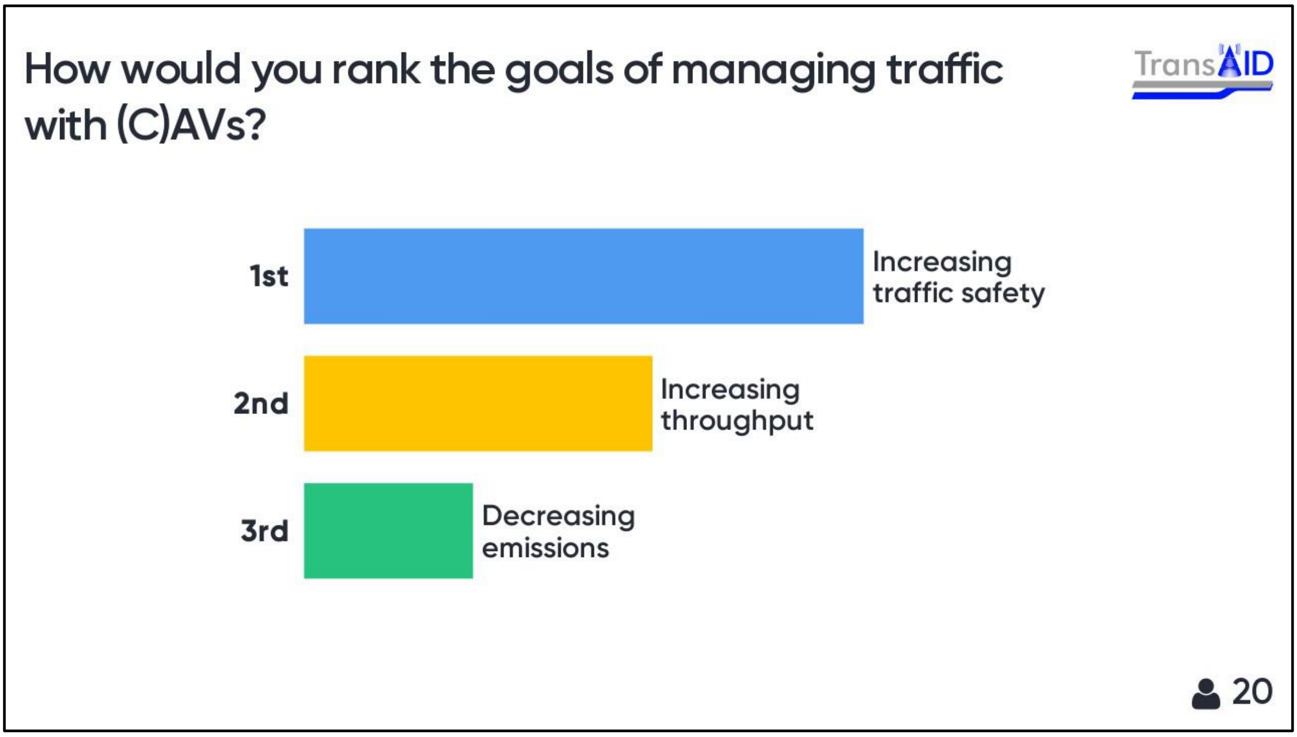
3. Wijbenga, A. et al. (2019), D2.2 Scenario definitions and modelling requirements, TransAID project deliverable, URL: https://www.transaid.eu/deliverables/

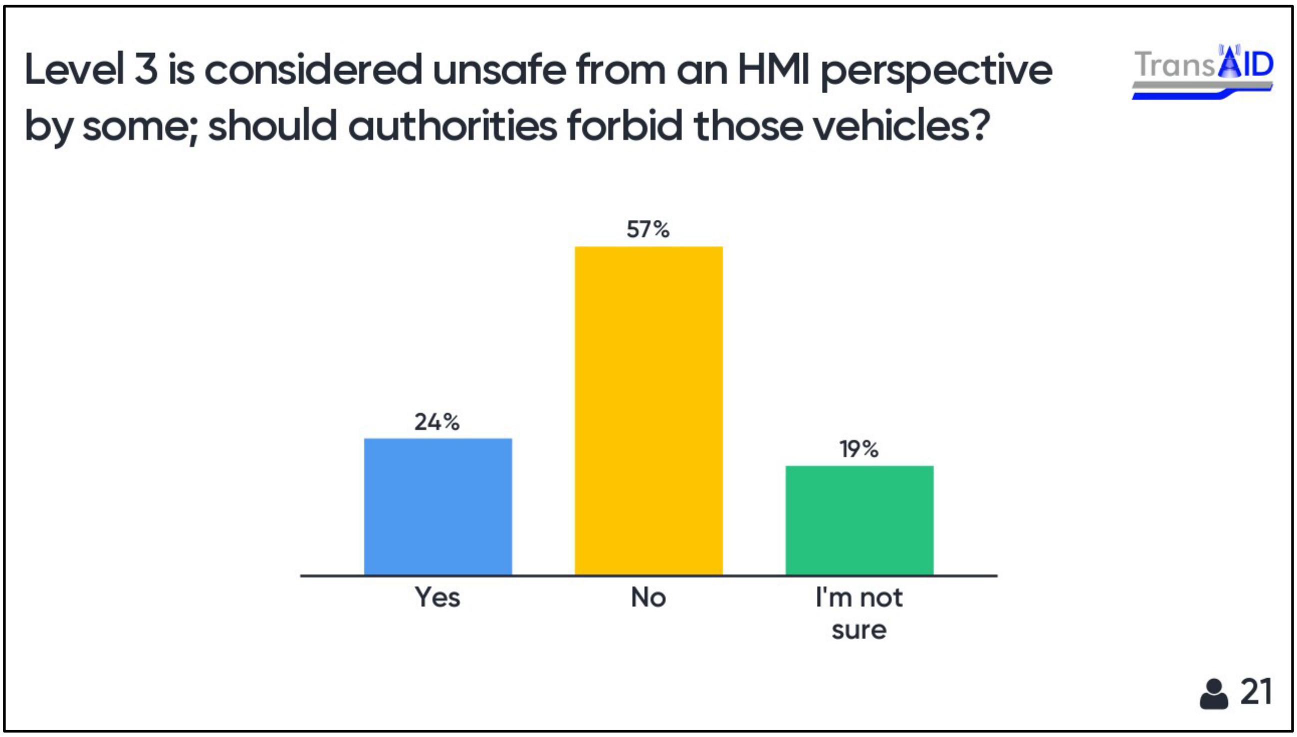
4. Maerivoet, S. et al. (2018), D4.1 Overview of Existing and Enhanced Traffic Management Procedures, URL: https://www.transaid.eu/deliverables/

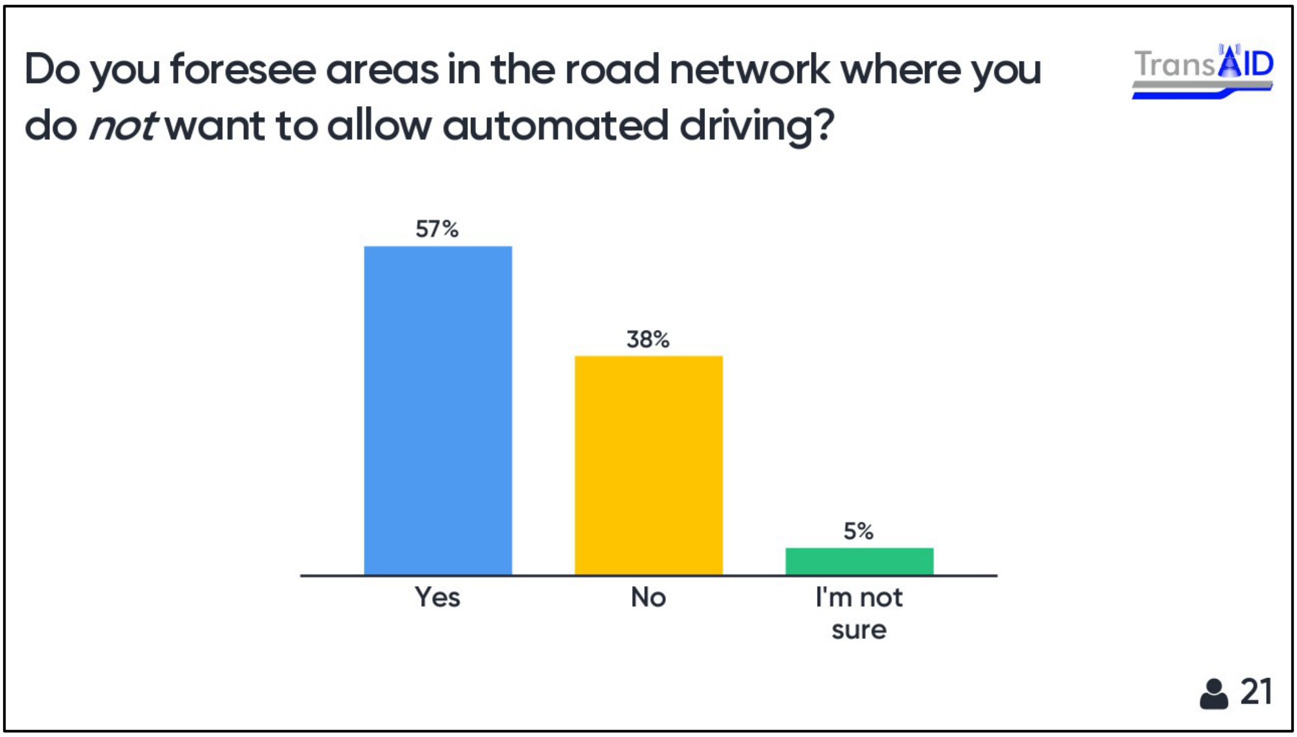
Appendix A: Detailed survey results TransAID session at the IEEE-IV conference (Paris)

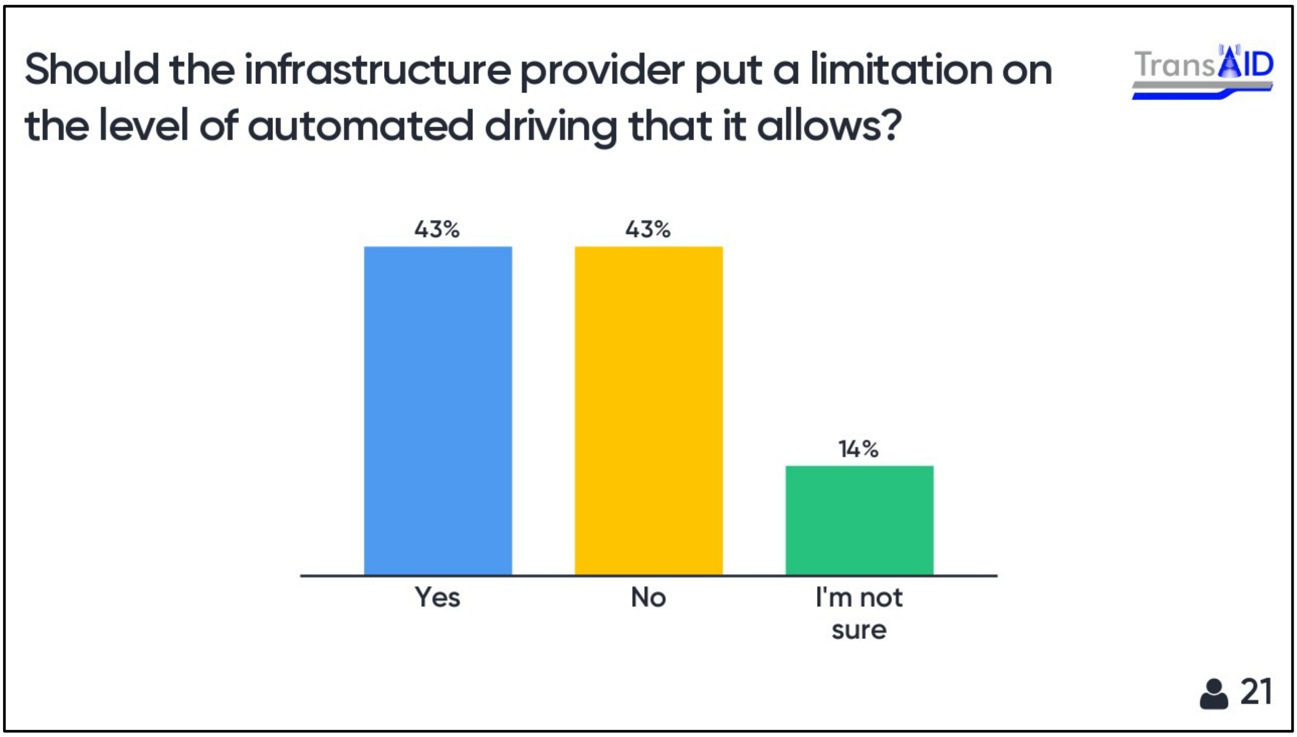
A.1 First session results

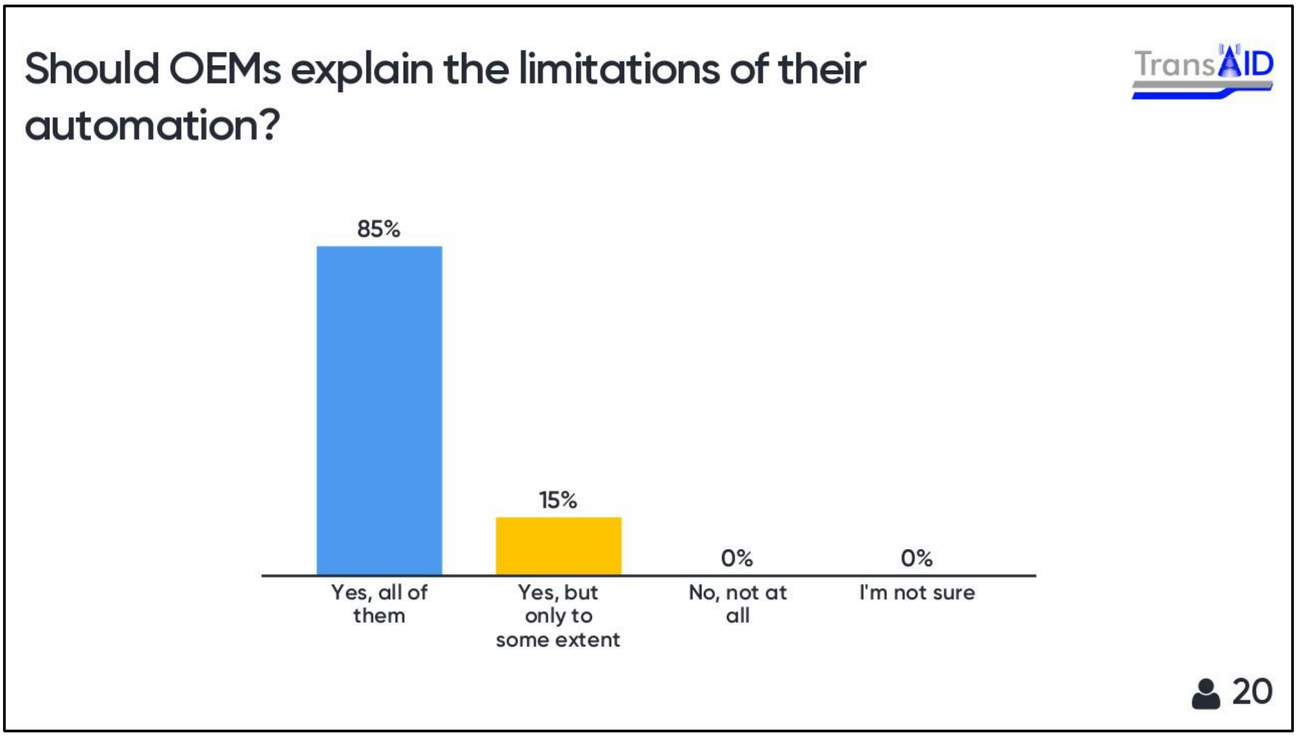


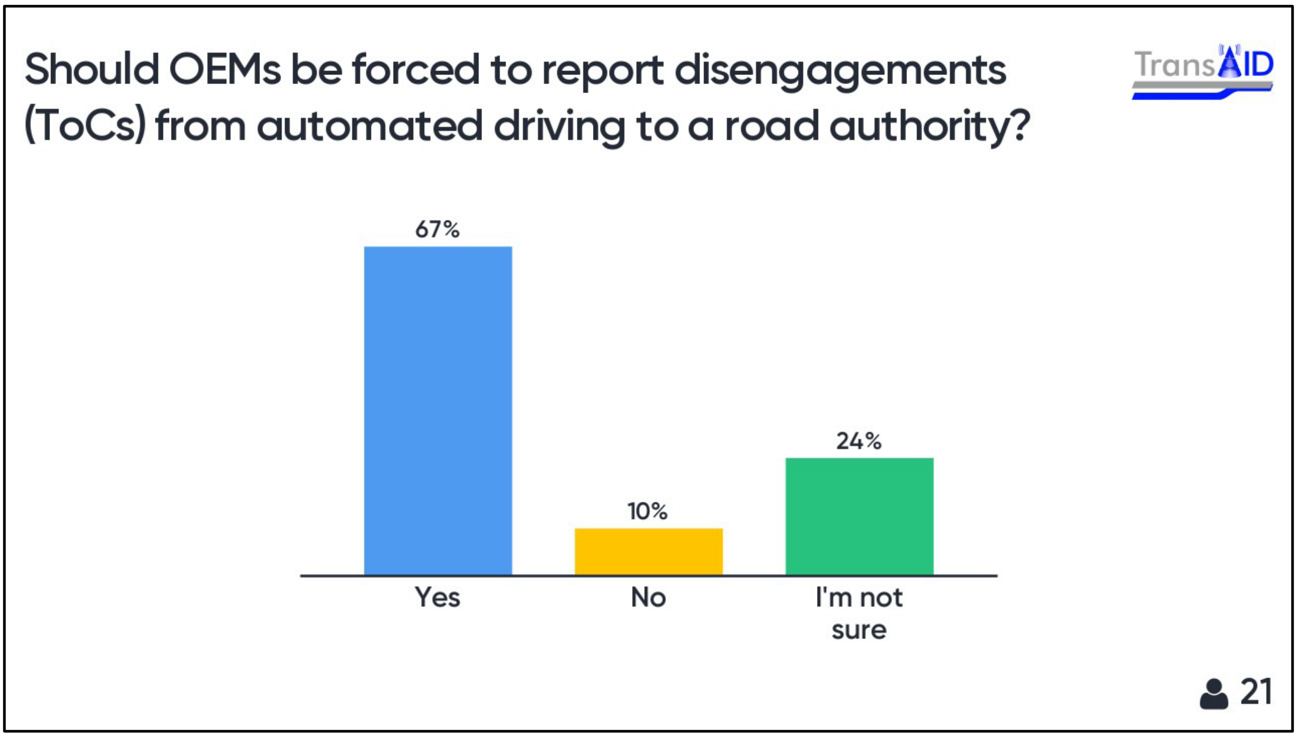


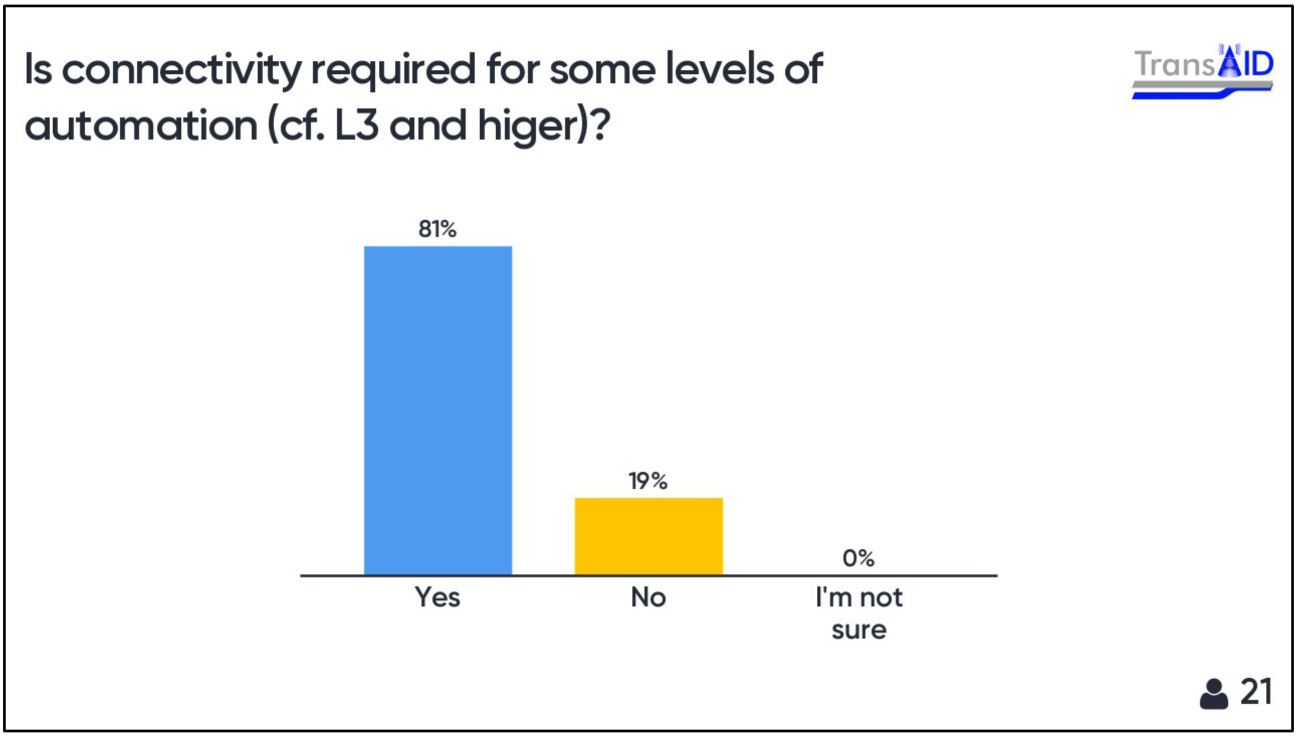

Level 3 is considered unsafe from an HMI perspective by some; should authorities forbid those vehicles?
TransAID
57%
24%
19%
Yes
No
I'm not sure
21

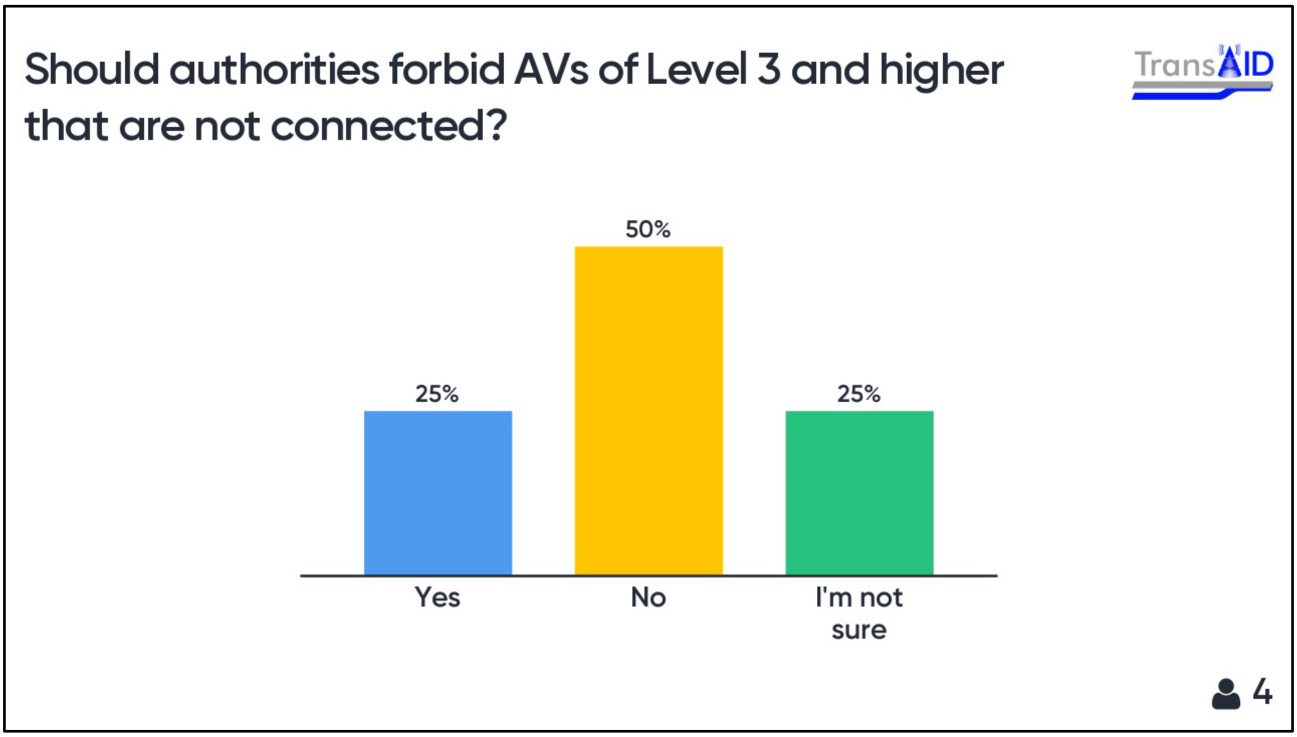

Do you foresee areas in the road network where you do *not* want to allow automated driving?
TransAID
57%
38%
5%
Yes
No
I'm not sure
21


Should the infrastructure provider put a limitation on the level of automated driving that it allows?
TransAID
43%
43%
14%
Yes
No
I'm not sure
21

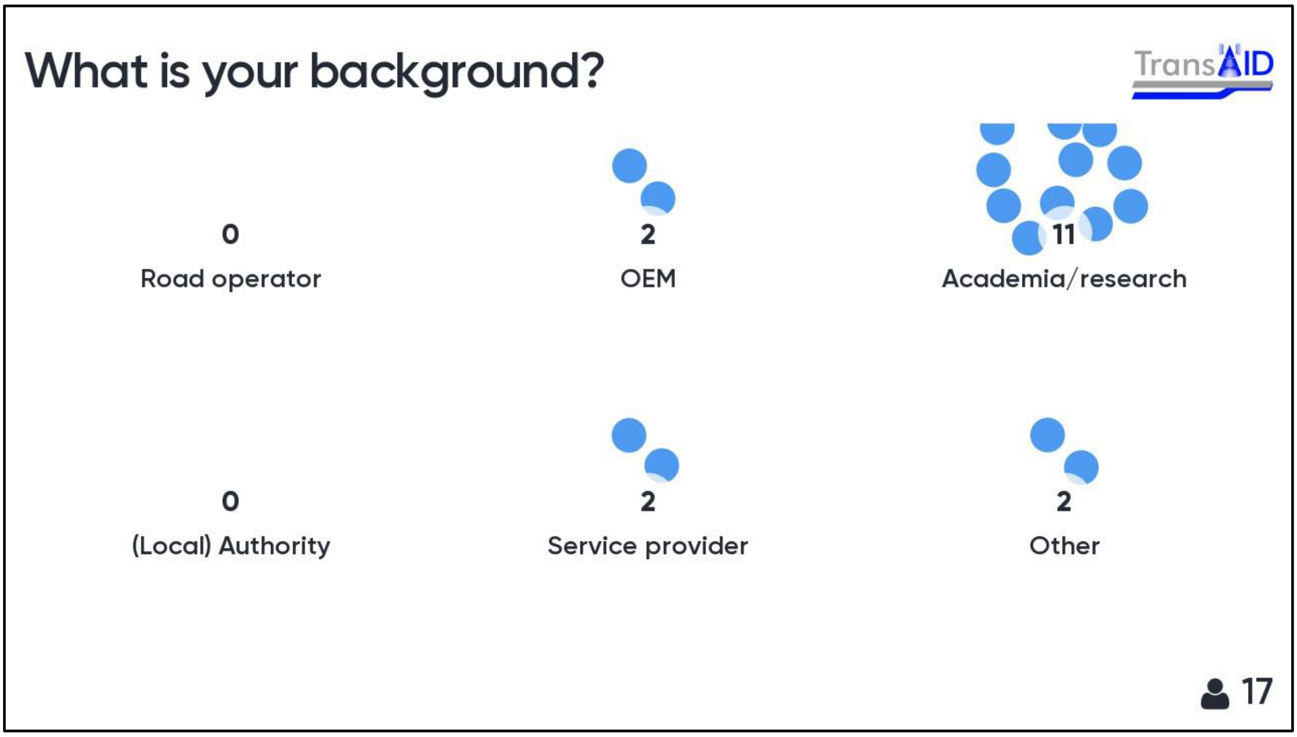

Should OEMs explain the limitations of their automation?
TransAID
85%
15%
0%
0%
Yes, all of them
Yes, but only to some extent
No, not at all
I'm not sure
20

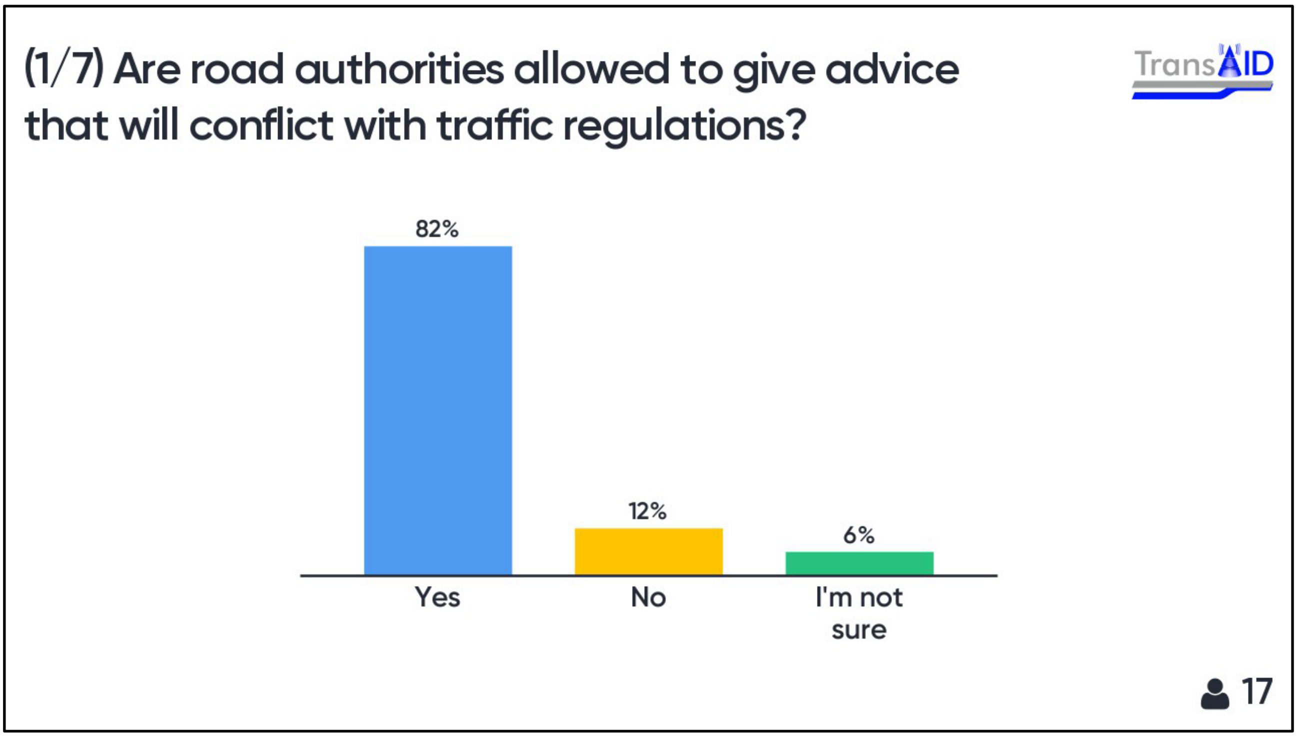

Should OEMs be forced to report disengagements (ToCs) from automated driving to a road authority?
TransAID
67%
10%
24%
Yes
No
I'm not sure
21

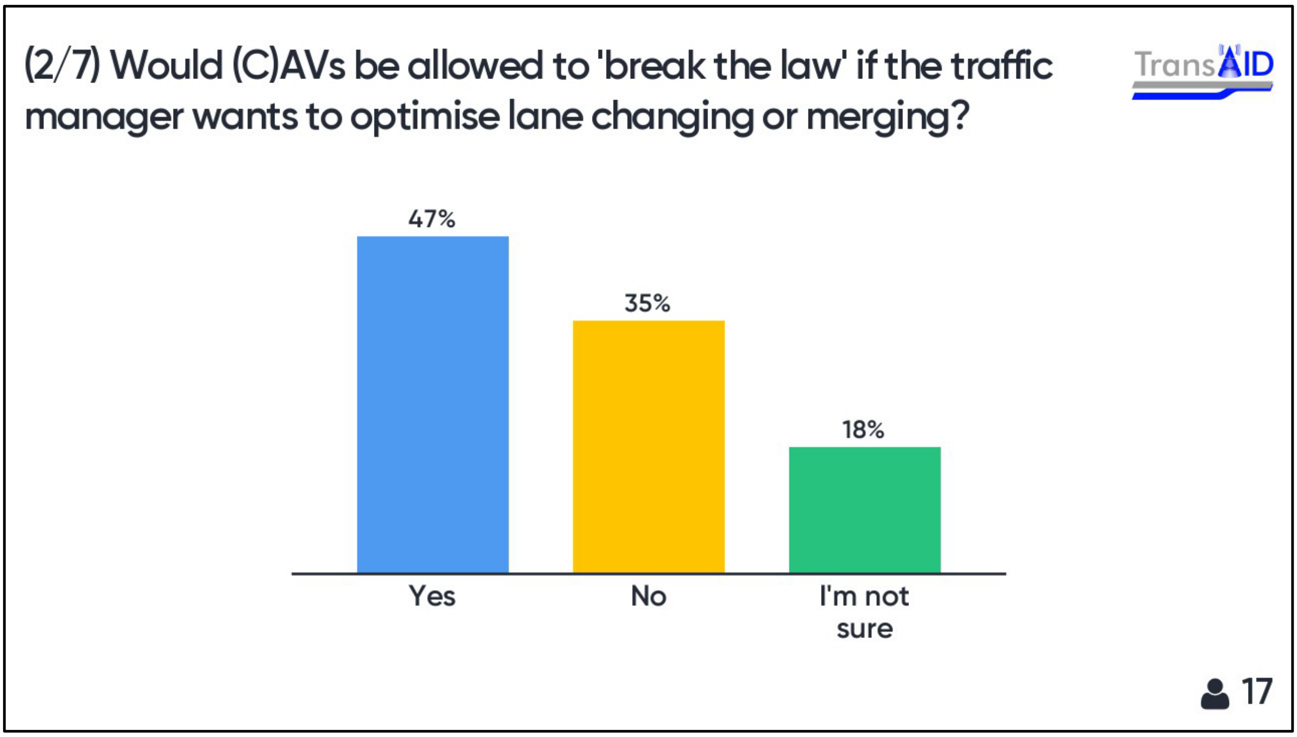

Is connectivity required for some levels of automation (cf. L3 and higer)?
TransAID
81%
19%
0%
Yes
No
I'm not sure
21

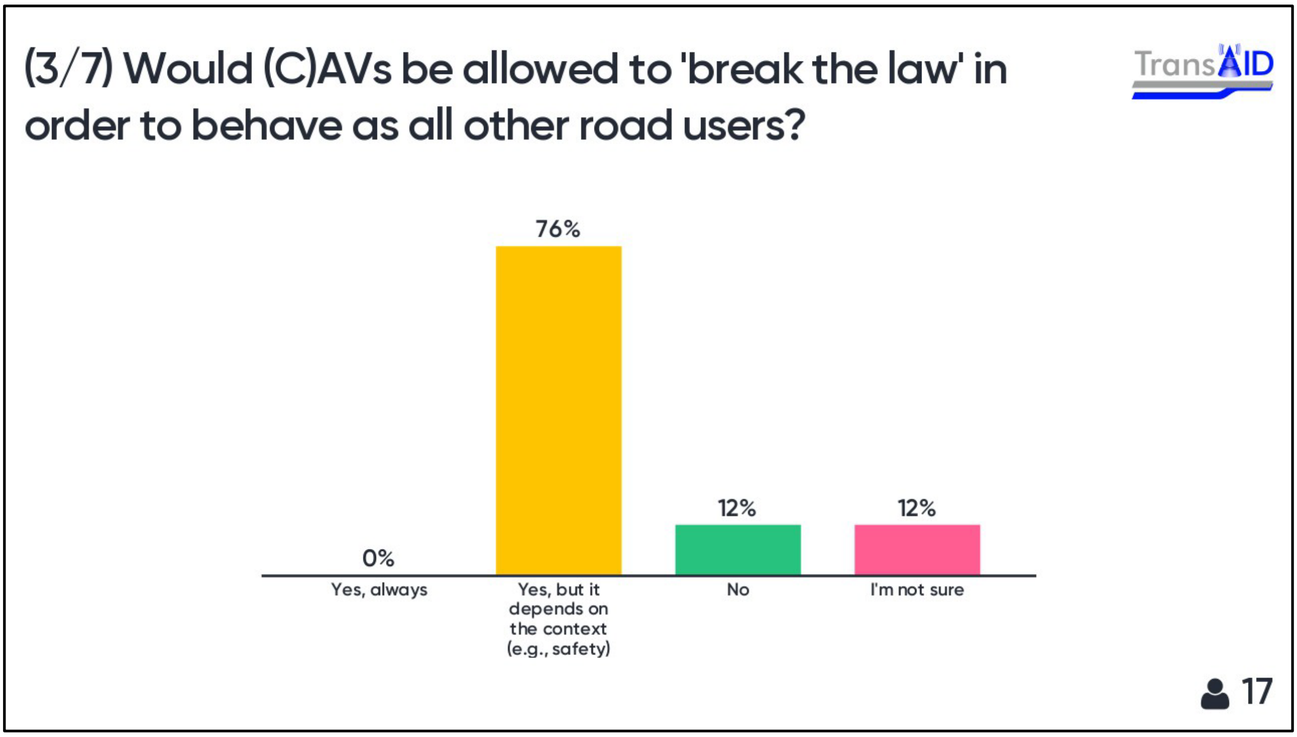

Should authorities forbid AVs of Level 3 and higher that are not connected?
TransAID
50%
25%
25%
Yes
No
I'm not sure
4

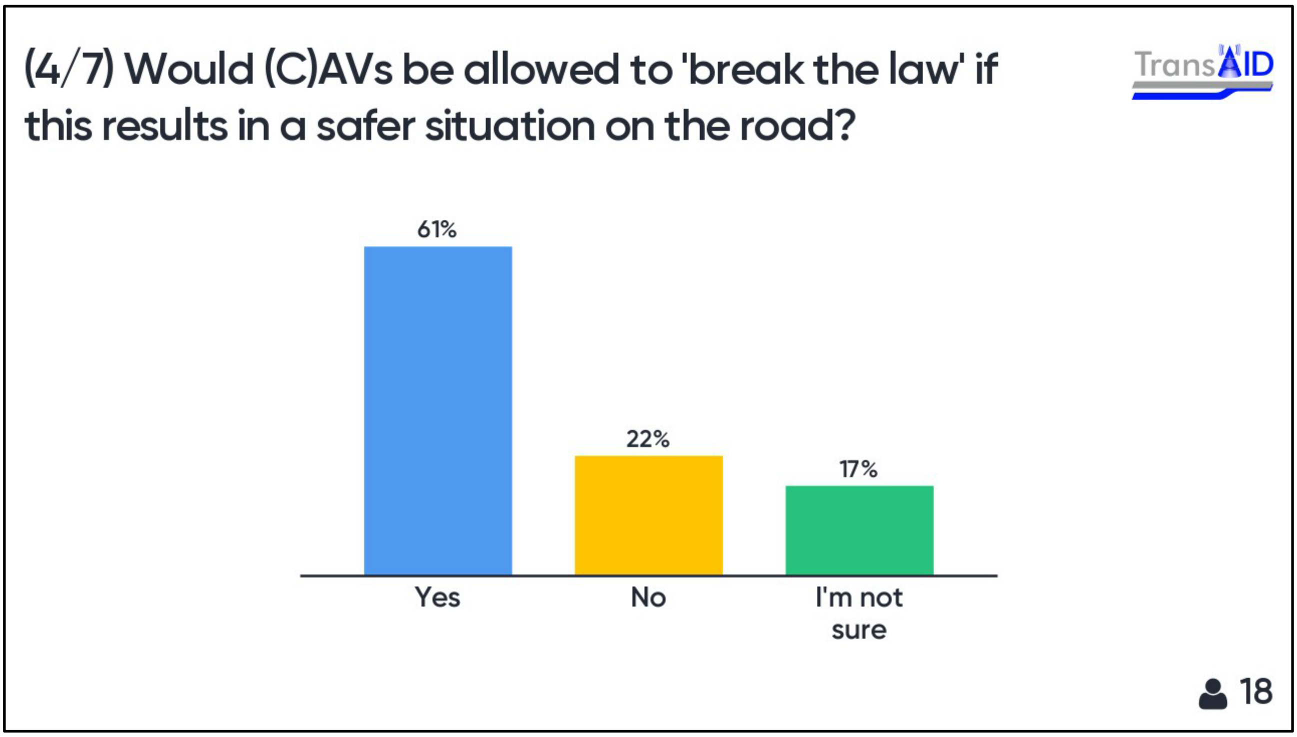
A.2 Second session results

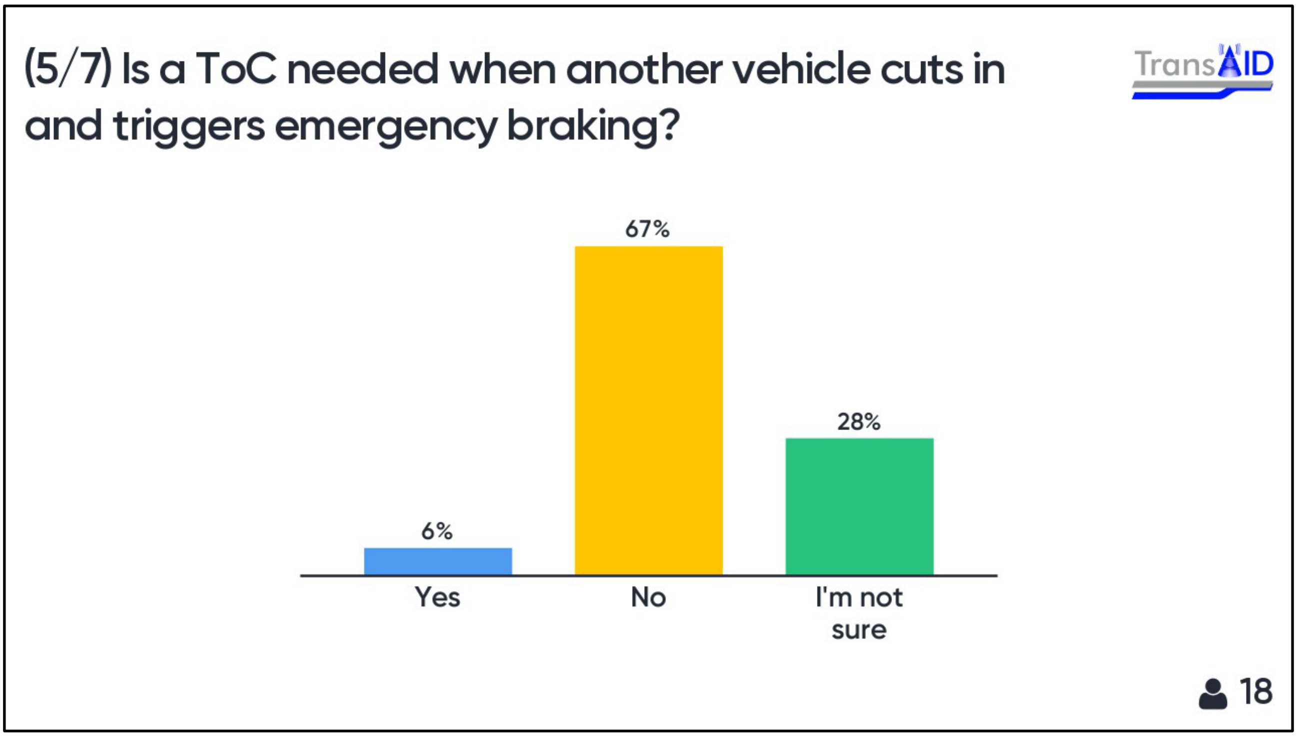


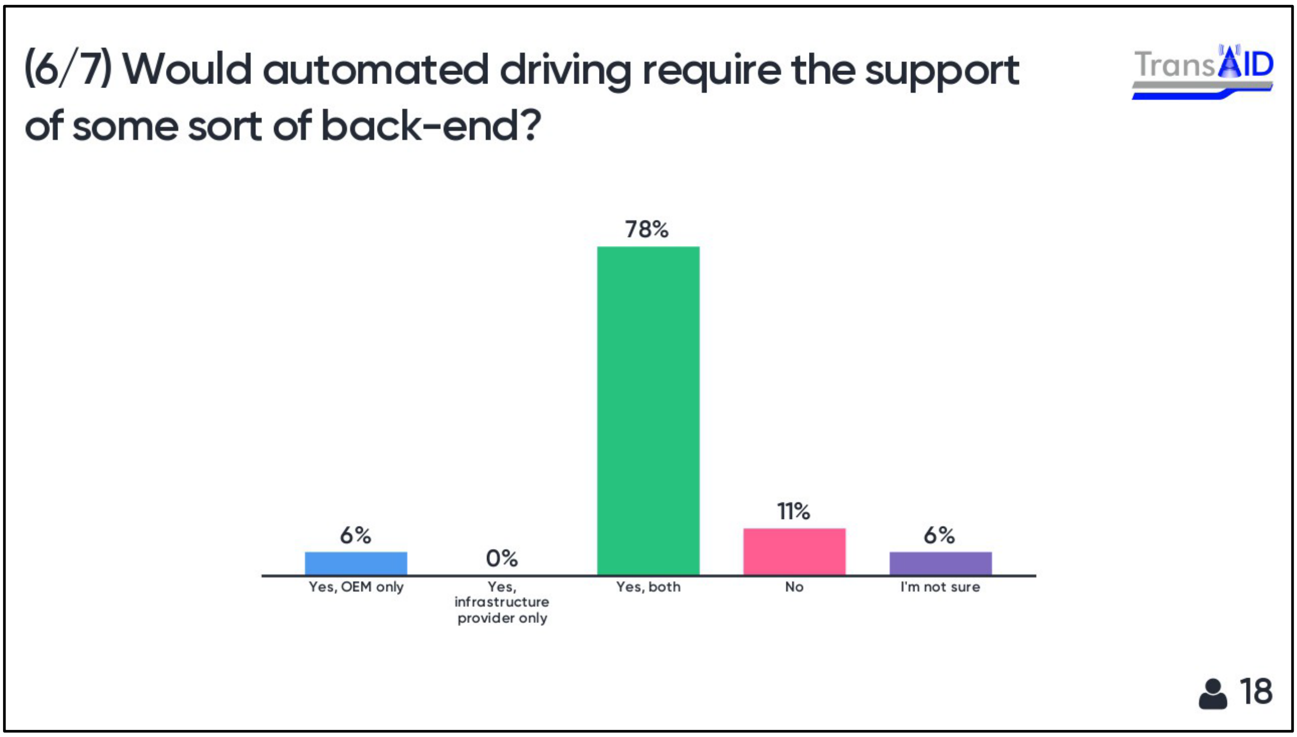



(2/7) Would (C)AVs be allowed to 'break the law' if the traffic manager wants to optimise lane changing or merging?
TransAID
47%
35%
18%
Yes
No
I'm not sure
17


(3/7) Would (C)AVs be allowed to 'break the law' in order to behave as all other road users?
TransAID
0%
76%
12%
12%
Yes, always
Yes, but it depends on the context (e.g., safety)
No
I'm not sure
17

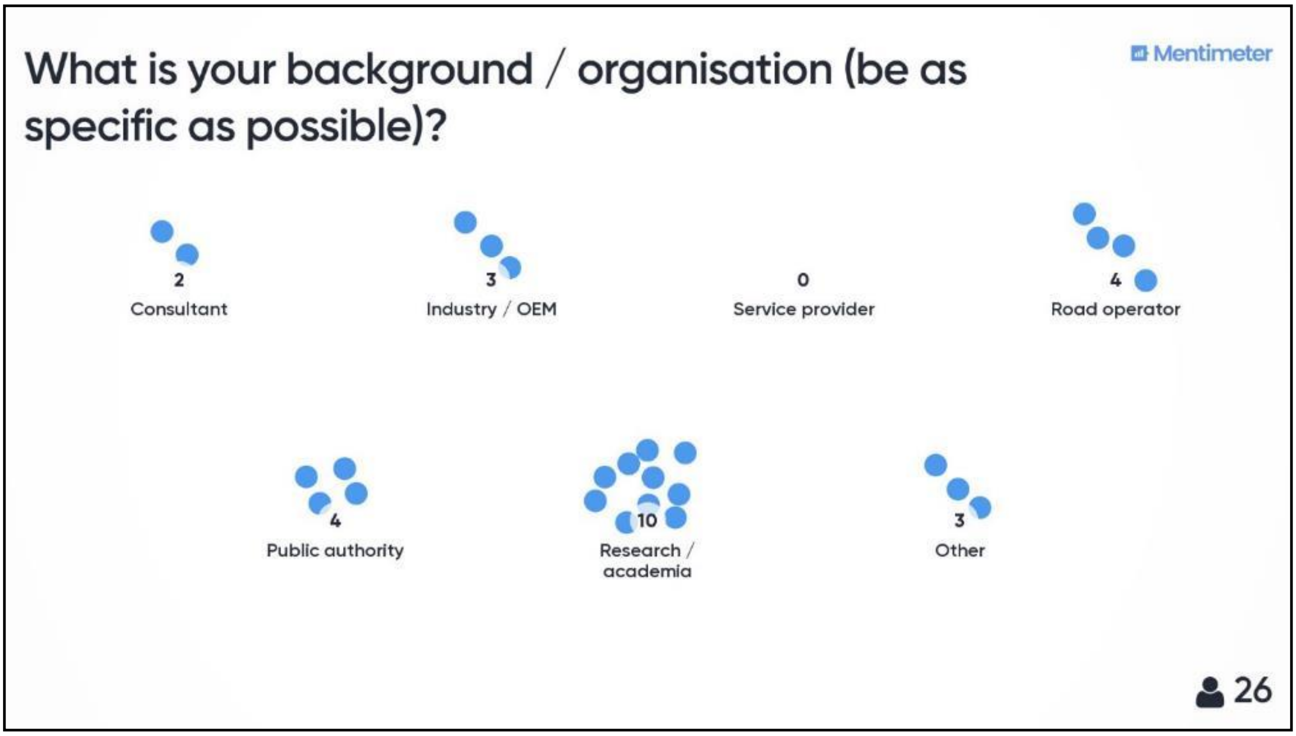

(4/7) Would (C)AVs be allowed to 'break the law' if this results in a safer situation on the road?
TransAID
61%
22%
17%
Yes
No
I'm not sure
18

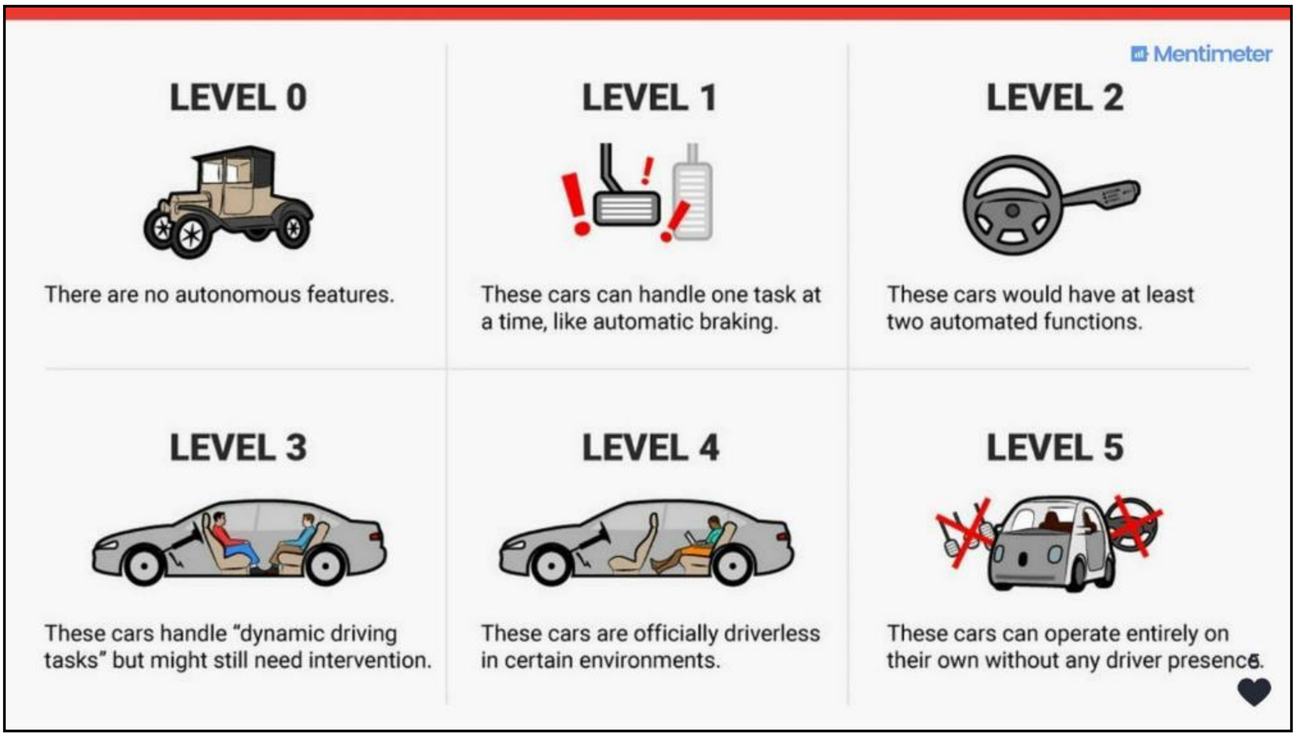

(5/7) Is a ToC needed when another vehicle cuts in and triggers emergency braking?
TransAID
67%
28%
6%
Yes
No
I'm not sure
18

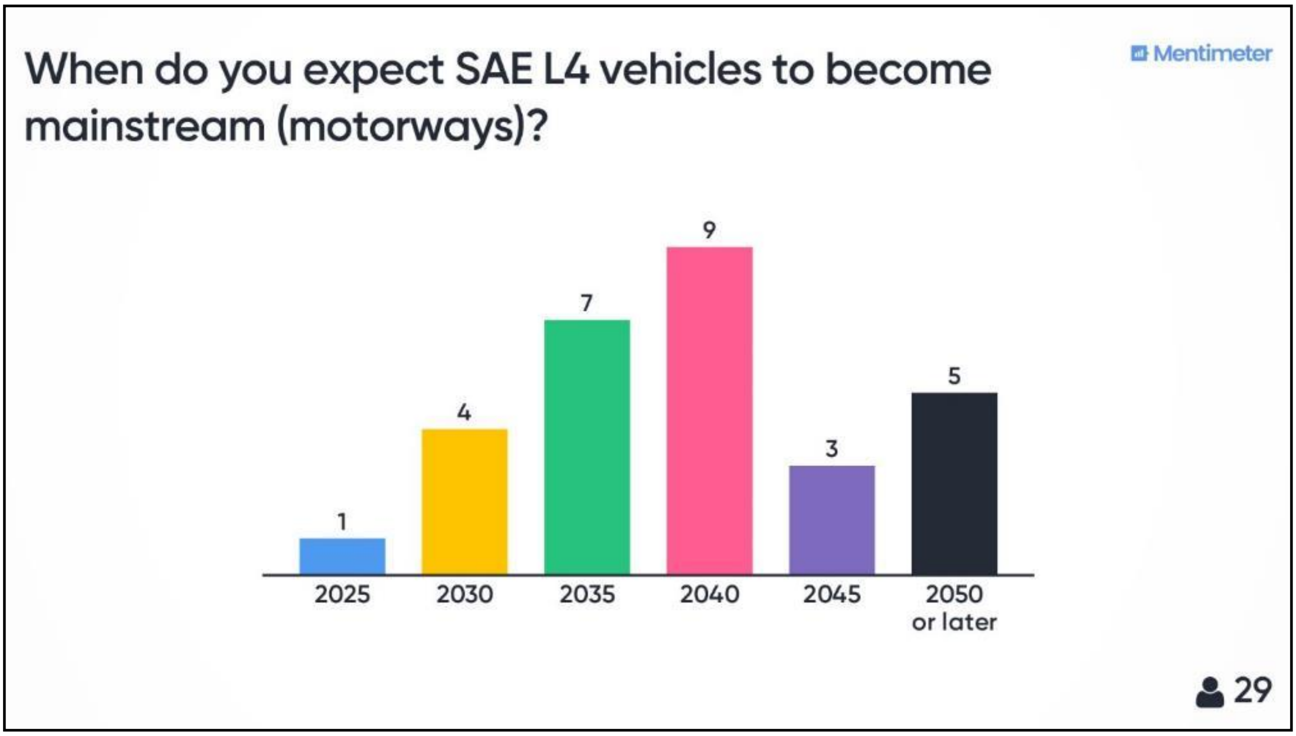

(6/7) Would automated driving require the support of some sort of back-end?
TransAID
78%
6%
0%
11%
6%
Yes, OEM only
Yes, infrastructure provider only
Yes, both
No
I'm not sure
18

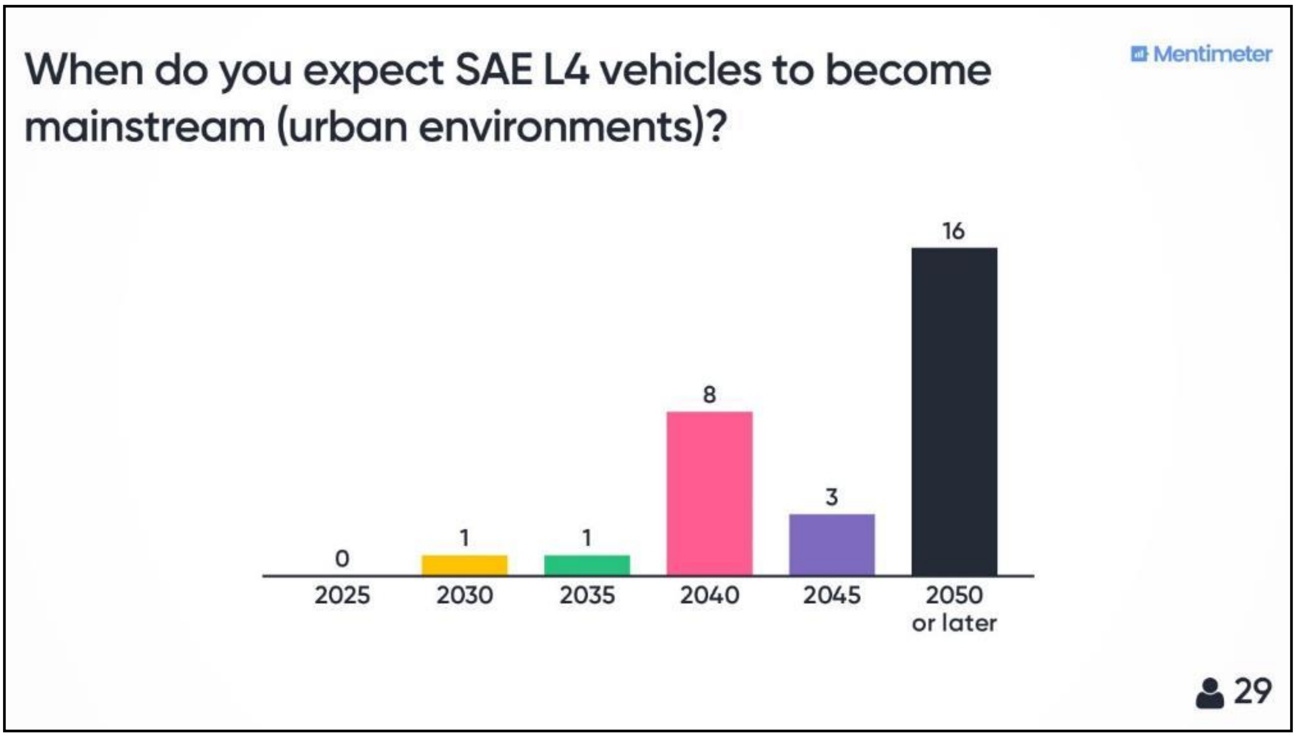
Appendix B: Detailed survey results TransAID-INFRAMIX stakeholder workshop

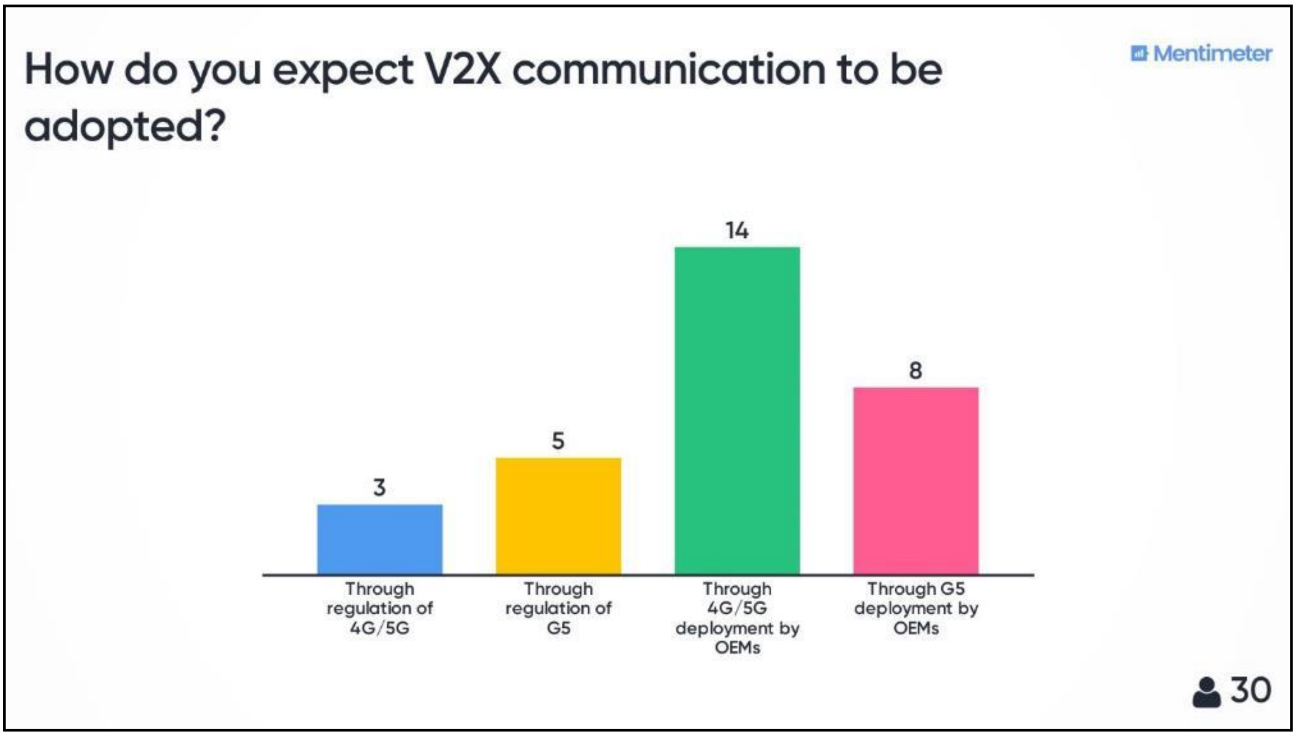
B.1 First session results

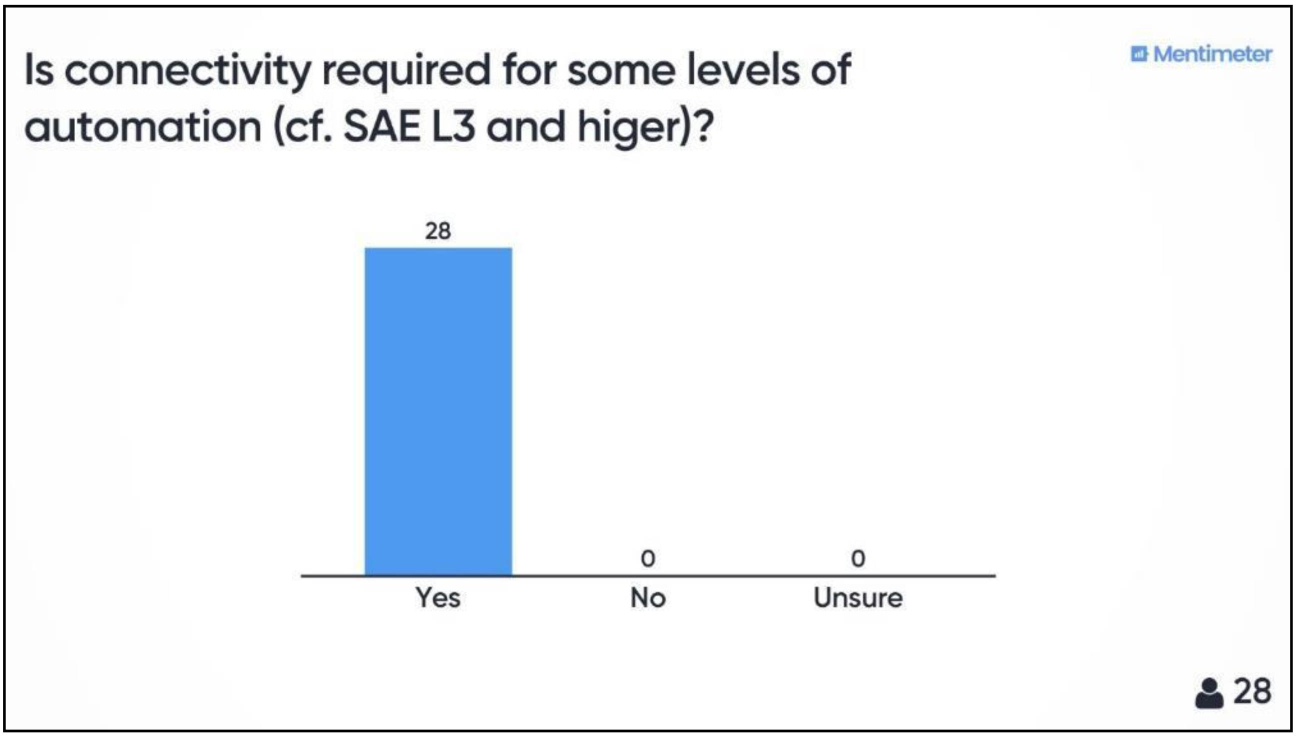


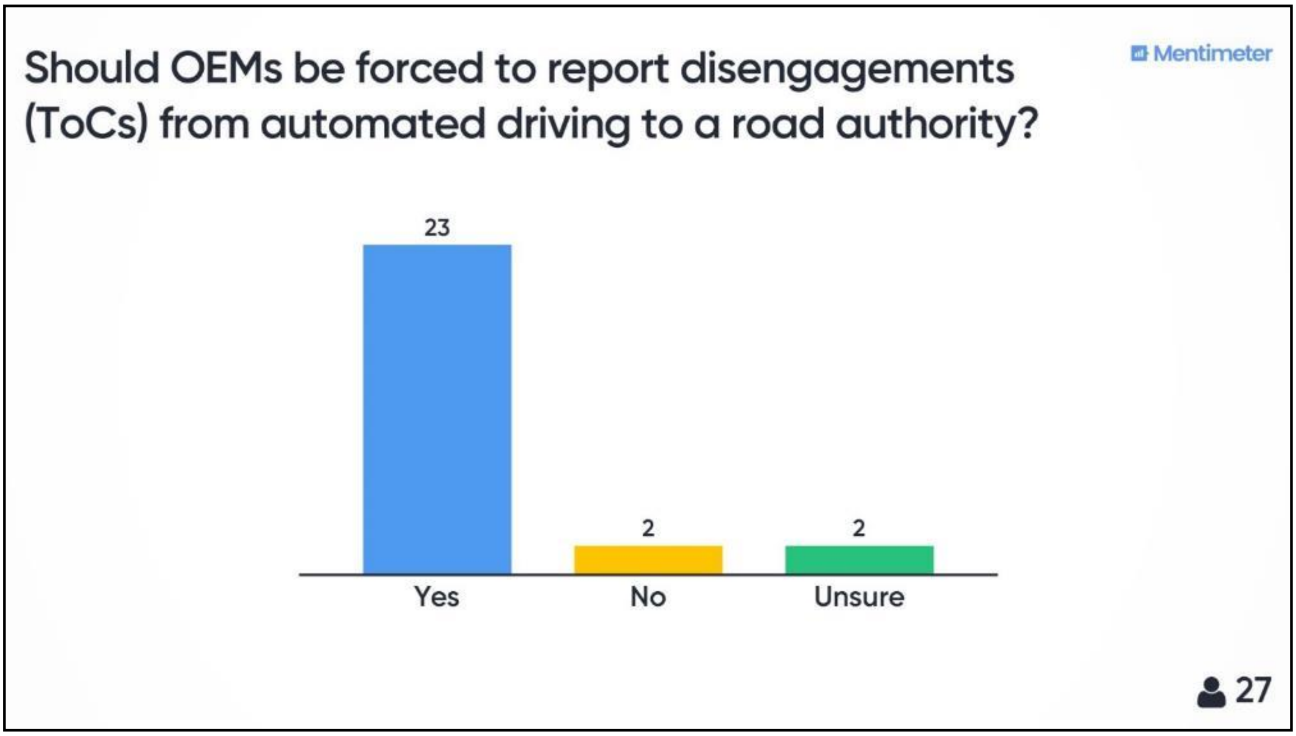

Mentimeter
LEVEL 0
There are no autonomous features.
LEVEL 1
These cars can handle one task at a time, like automatic braking.
LEVEL 2
These cars would have at least two automated functions.
LEVEL 3
These cars handle "dynamic driving tasks" but might still need intervention.
LEVEL 4
These cars are officially driverless in certain environments.
LEVEL 5
These cars can operate entirely on their own without any driver presence.
6

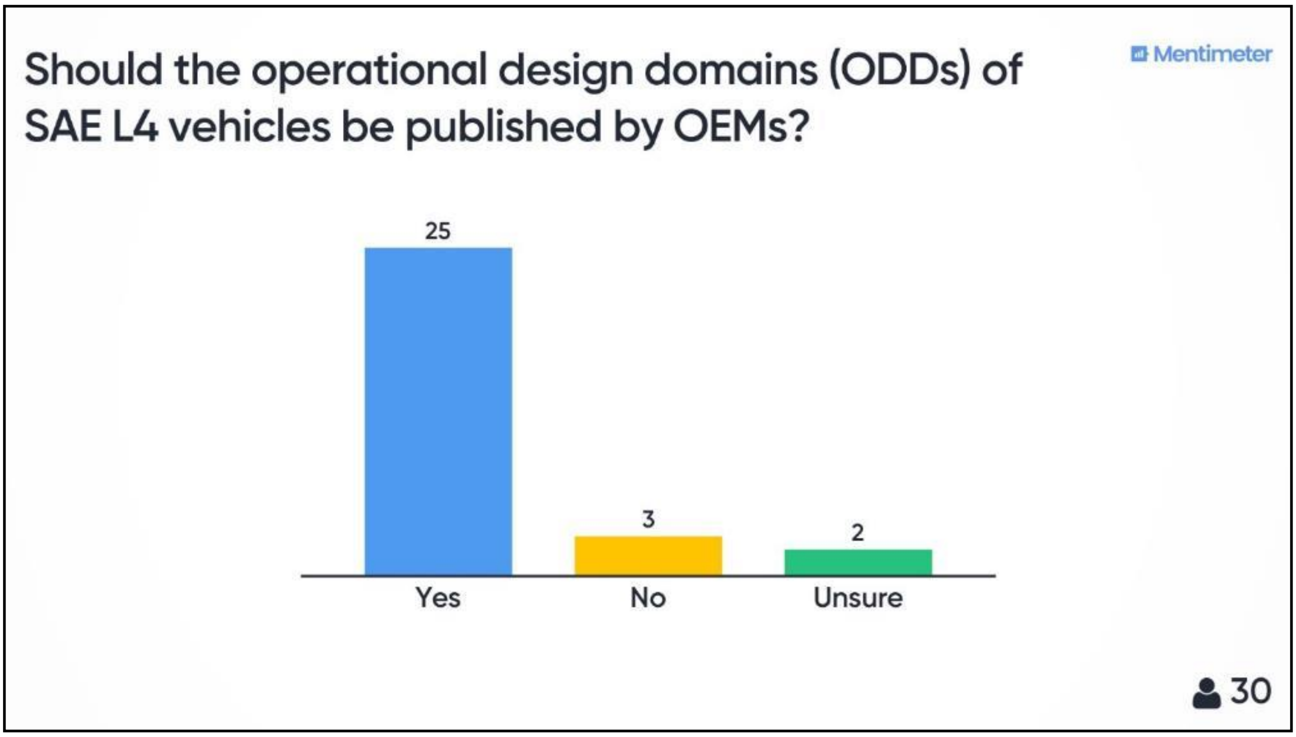

When do you expect SAE L4 vehicles to become mainstream (motorways)?
Mentimeter
1
4
7
9
3
5
2025
2030
2035
2040
2045
2050 or later
29

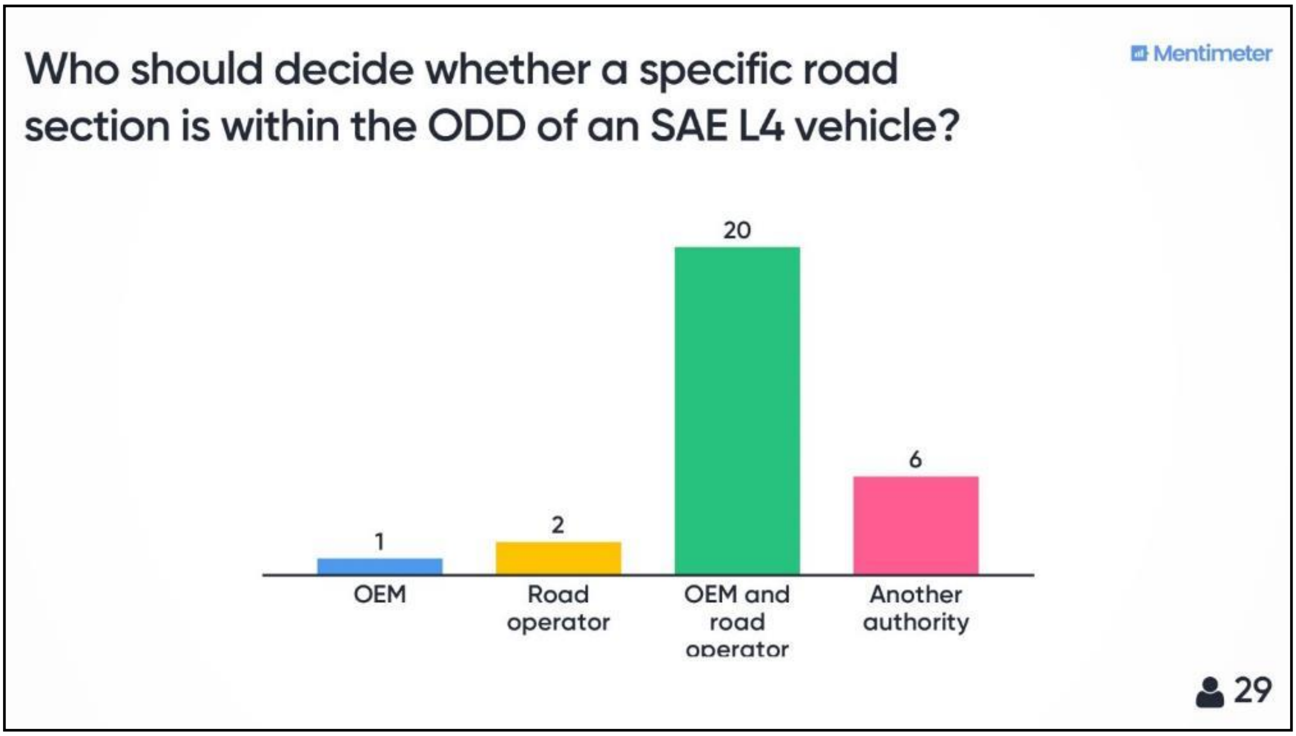

When do you expect SAE L4 vehicles to become mainstream (urban environments)?
Mentimeter
0
1
1
8
3
16
2025
2030
2035
2040
2045
2050 or later
29

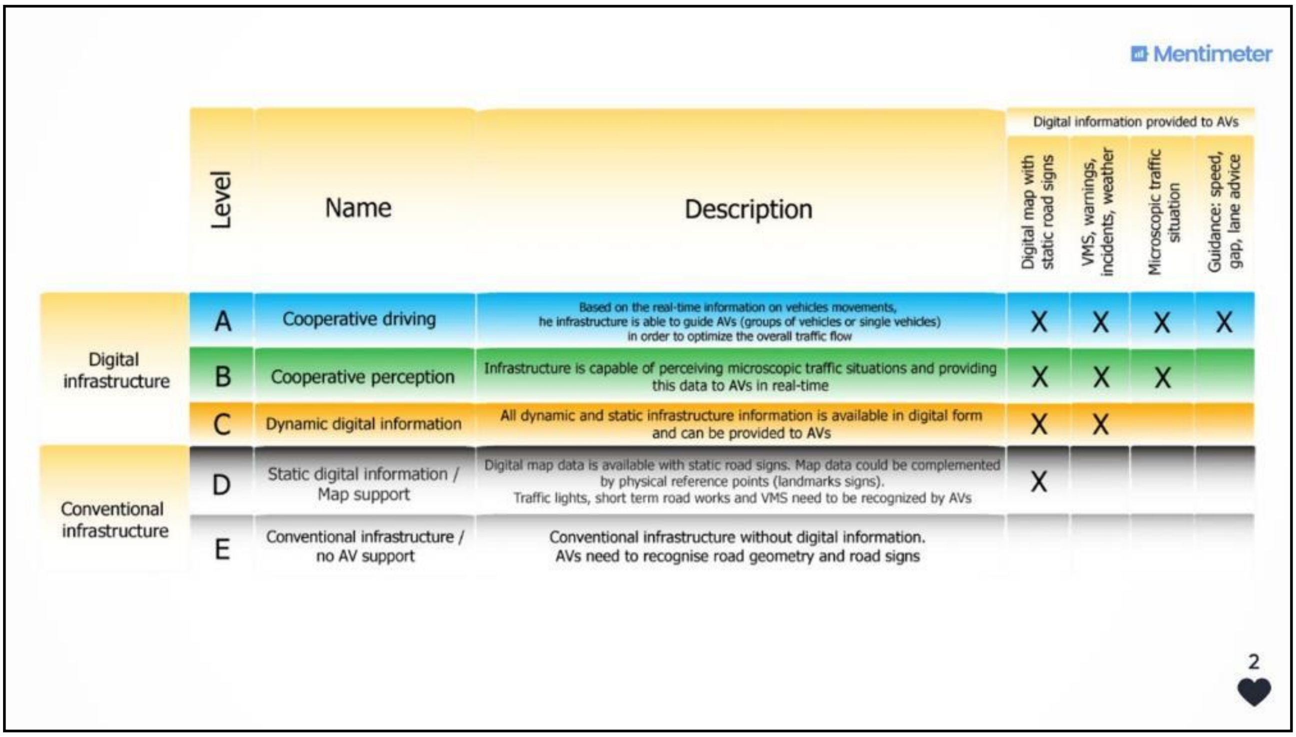

How do you expect V2X communication to be adopted?
Mentimeter
3
5
14
8
Through regulation of 4G/5G
Through regulation of G5
Through 4G/5G deployment by OEMs
Through G5 deployment by OEMs
30


Mentimeter
Is connectivity required for some levels of automation (cf. SAE L3 and higer)?
28
0
0
Yes
No
Unsure
28

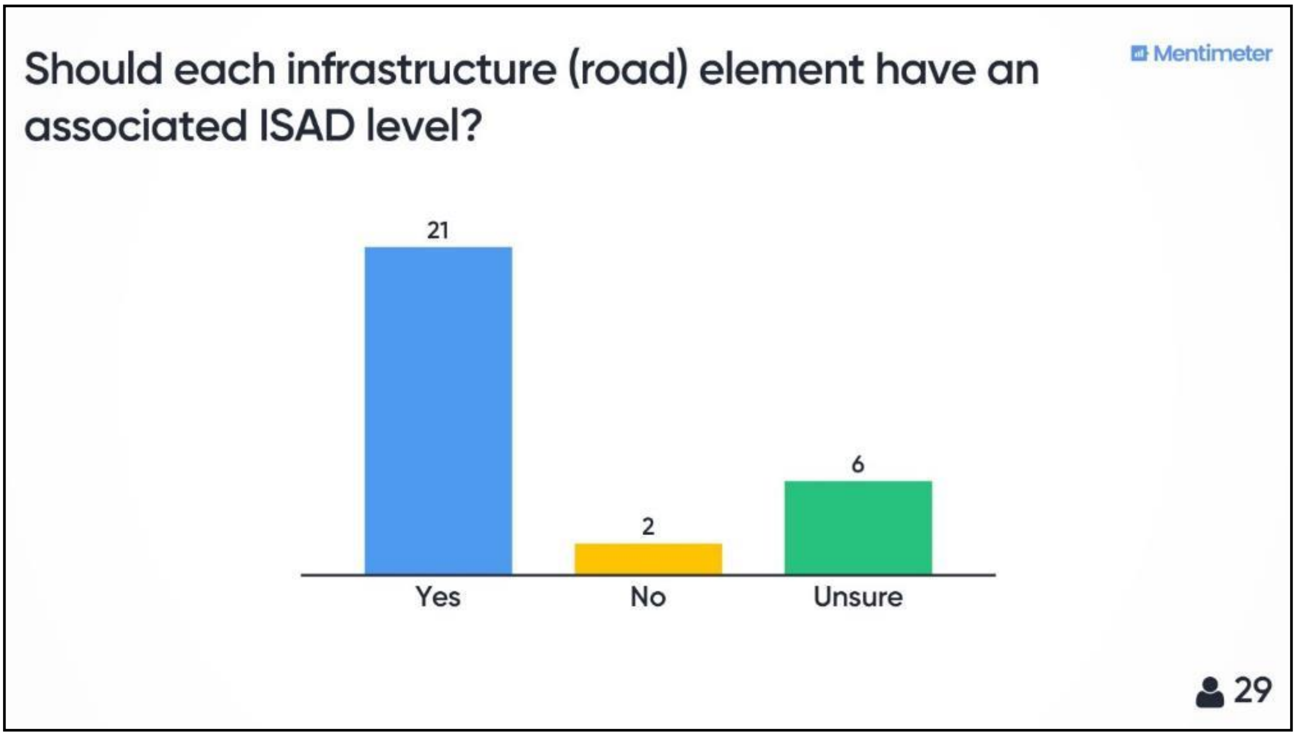

Mentimeter
Should OEMs be forced to report disengagements (ToCs) from automated driving to a road authority?
23
2
2
Yes
No
Unsure
27

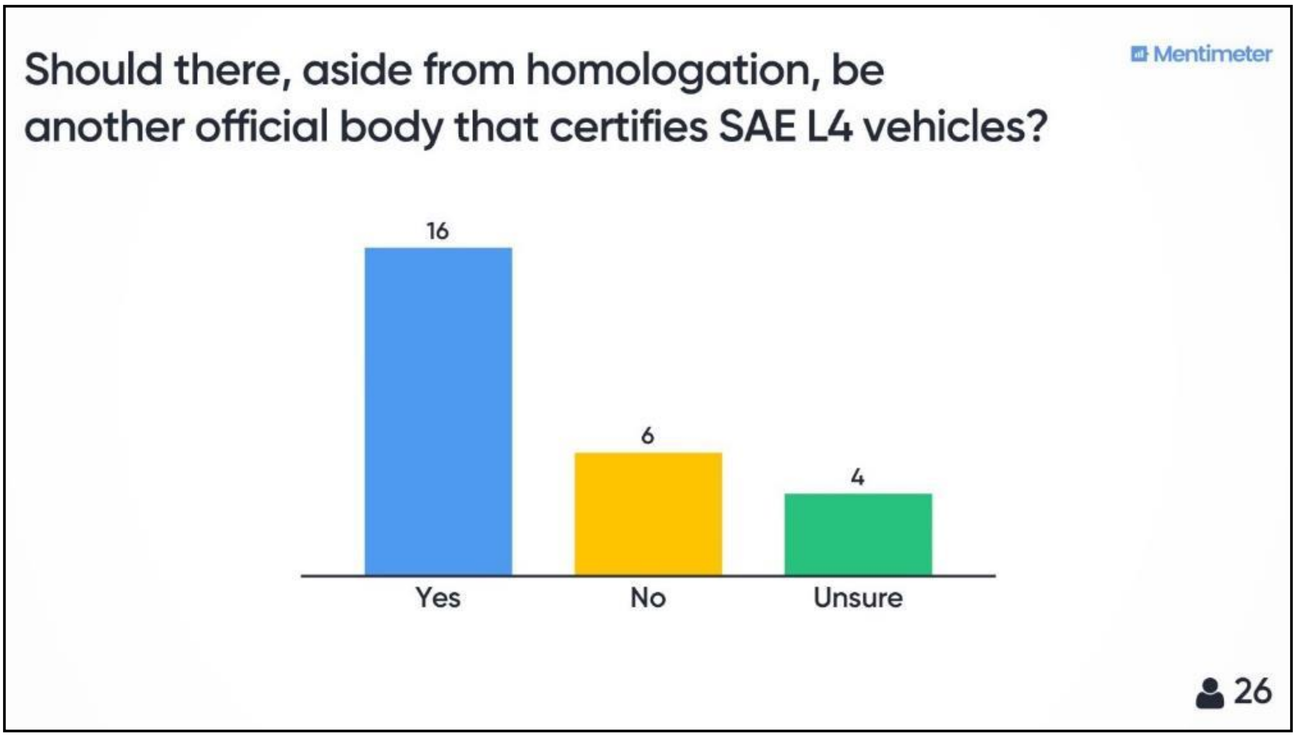

Should the operational design domains (ODDs) of SAE L4 vehicles be published by OEMs?
Mentimeter
25
3
2
Yes
No
Unsure
30

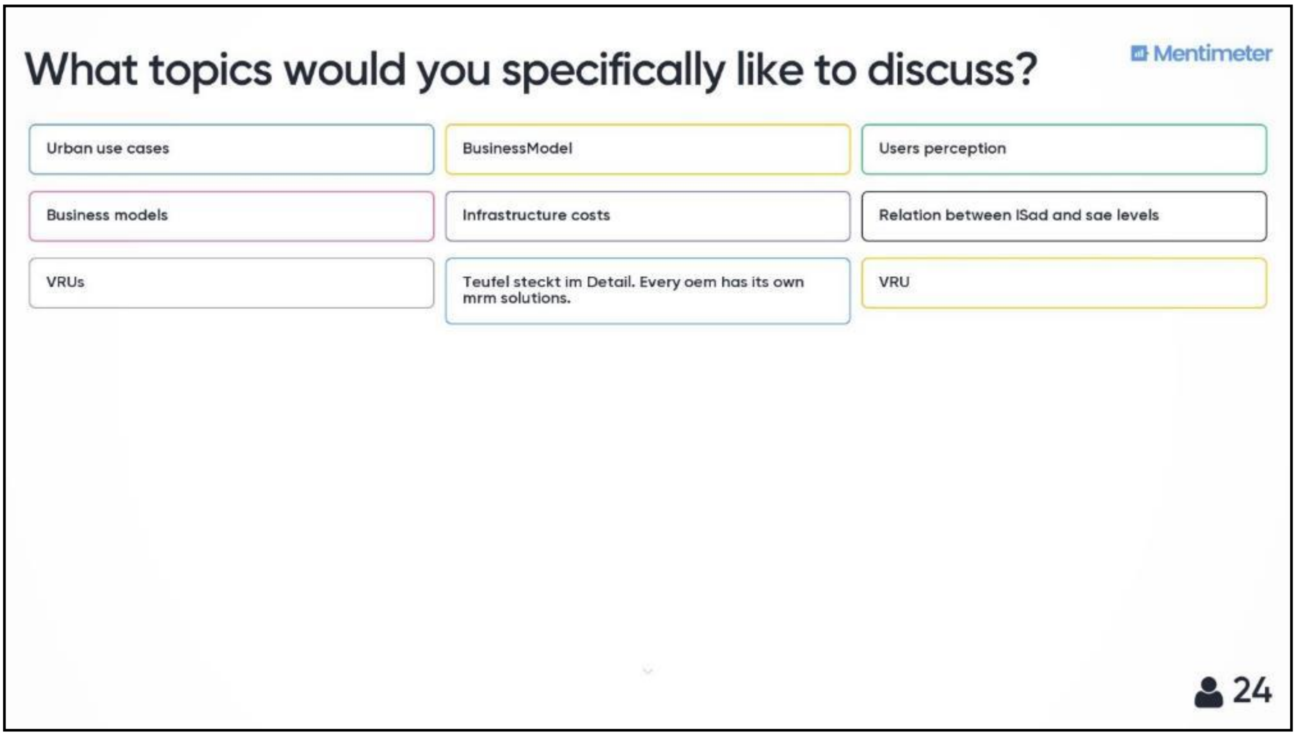

Who should decide whether a specific road section is within the ODD of an SAE L4 vehicle?
Mentimeter
20
6
1
2
OEM
Road operator
OEM and road operator
Another authority
29

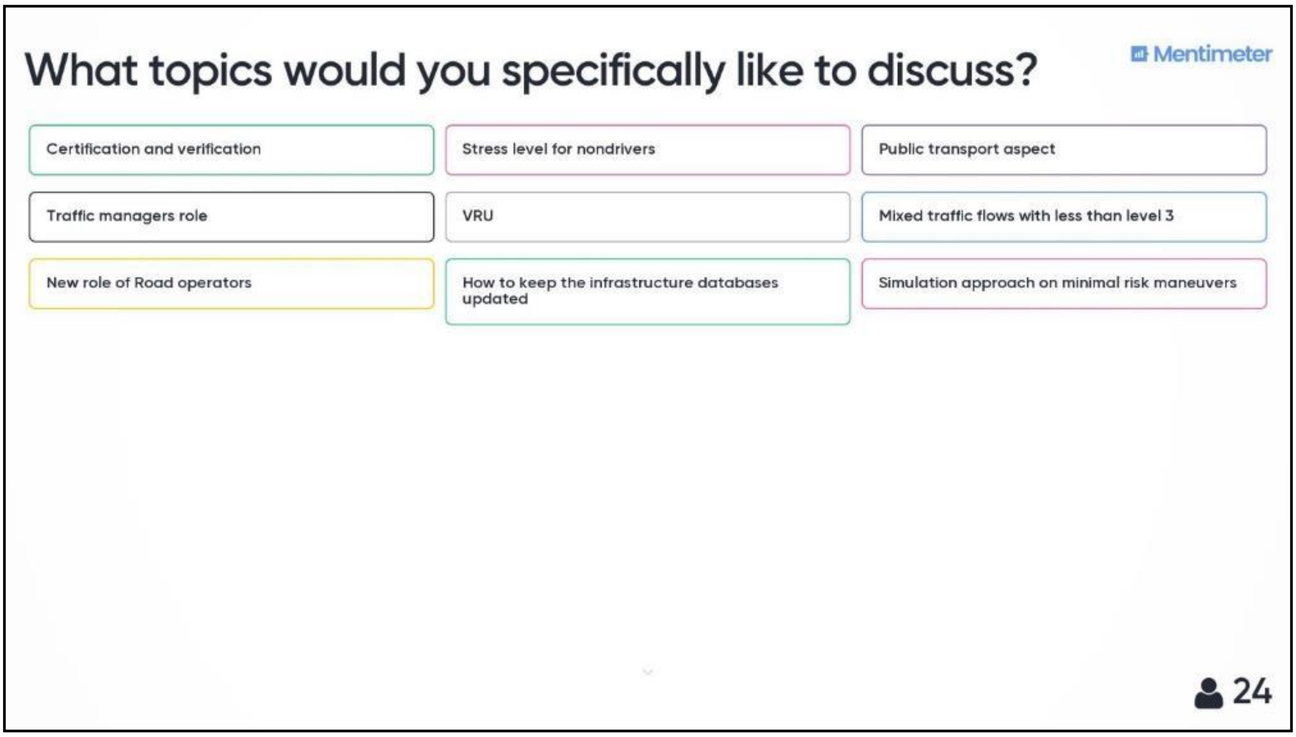


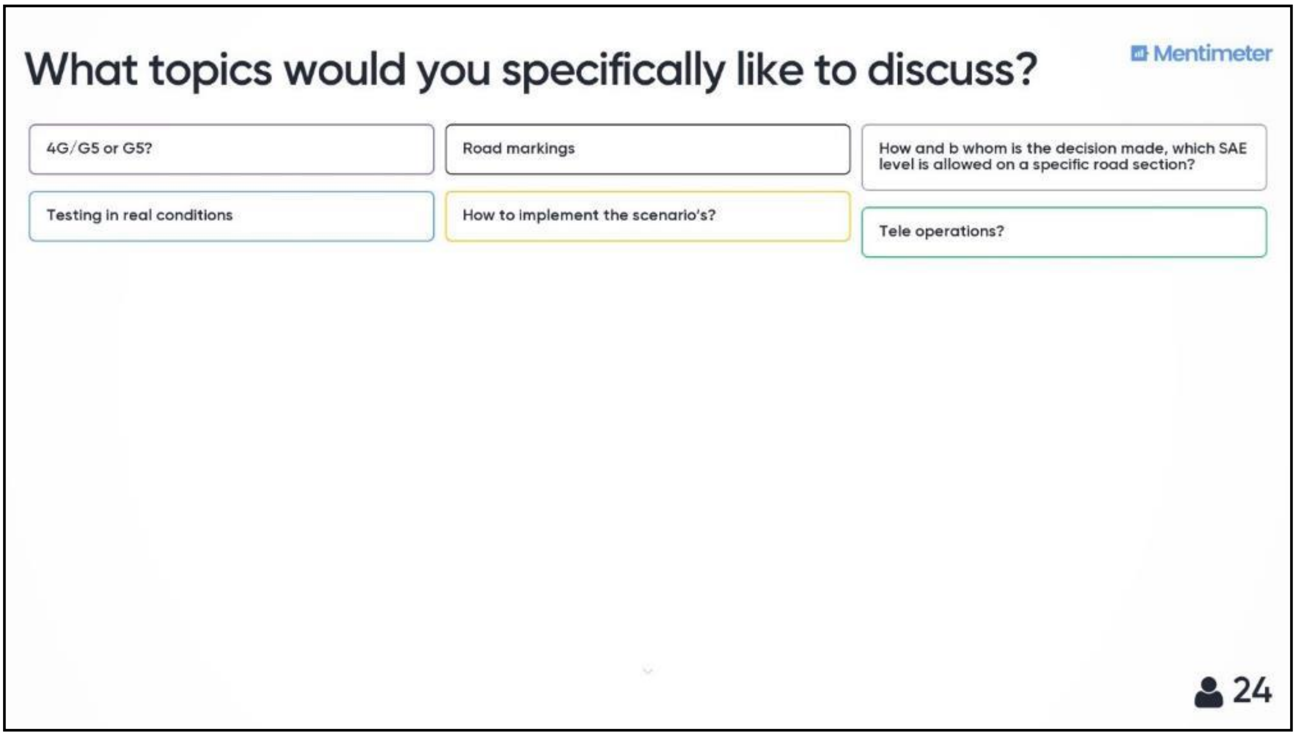
	Level	Name	Description	Digital information provided to AVs: Digital map with static road signs	VMS, warnings, incidents, weather	Microscopic traffic situation	Guidance: speed, gap, lane advice
Digital infrastructure	A	Cooperative driving	Based on the real-time information on vehicles movements, he infrastructure is able to guide AVs (groups of vehicles or single vehicles) in order to optimize the overall traffic flow	X	X	X	X
	B	Cooperative perception	Infrastructure is capable of perceiving microscopic traffic situations and providing this data to AVs in real-time	X	X	X	
	C	Dynamic digital information	All dynamic and static infrastructure information is available in digital form and can be provided to AVs	X	X		
Conventional infrastructure	D	Static digital information / Map support	Digital map data is available with static road signs. Map data could be complemented by physical reference points (landmarks signs). Traffic lights, short term road works and VMS need to be recognized by AVs	X			
	E	Conventional infrastructure / no AV support	Conventional infrastructure without digital information. AVs need to recognise road geometry and road signs				



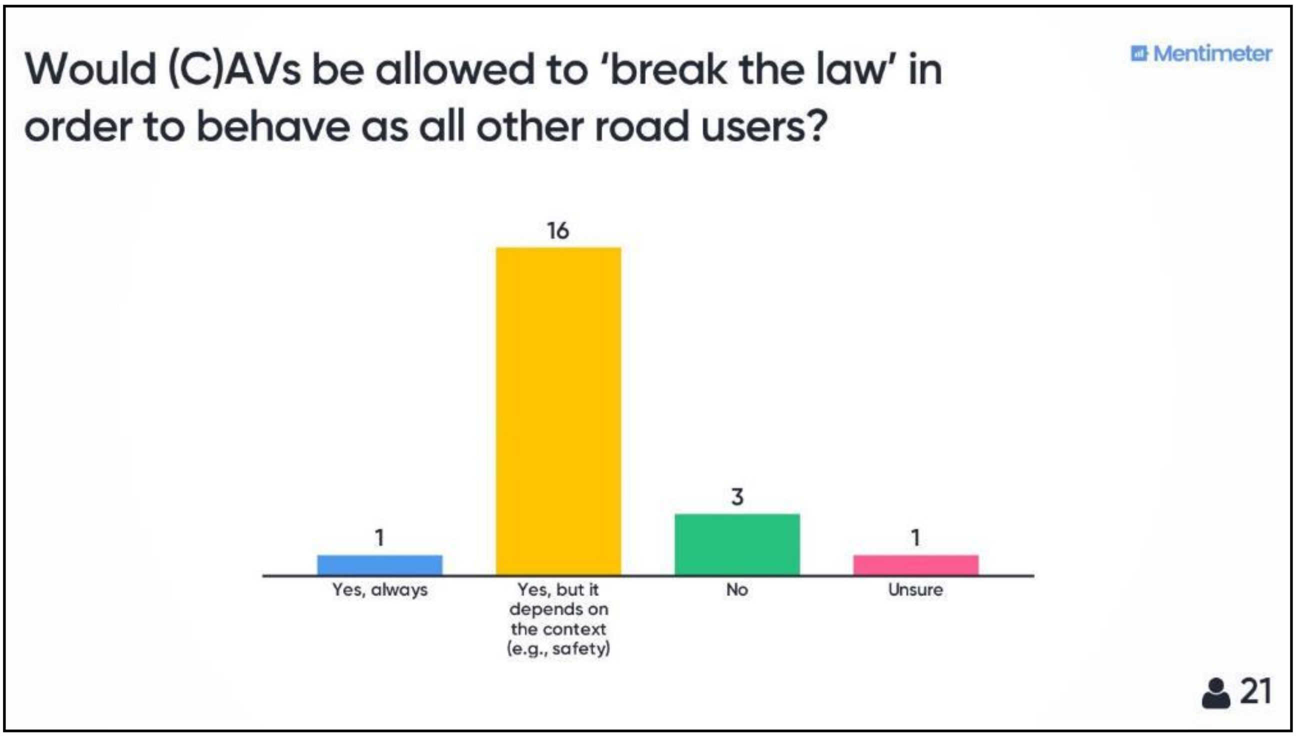

Should there, aside from homologation, be another official body that certifies SAE L4 vehicles?
Mentimeter
16
6
4
Yes
No
Unsure
26

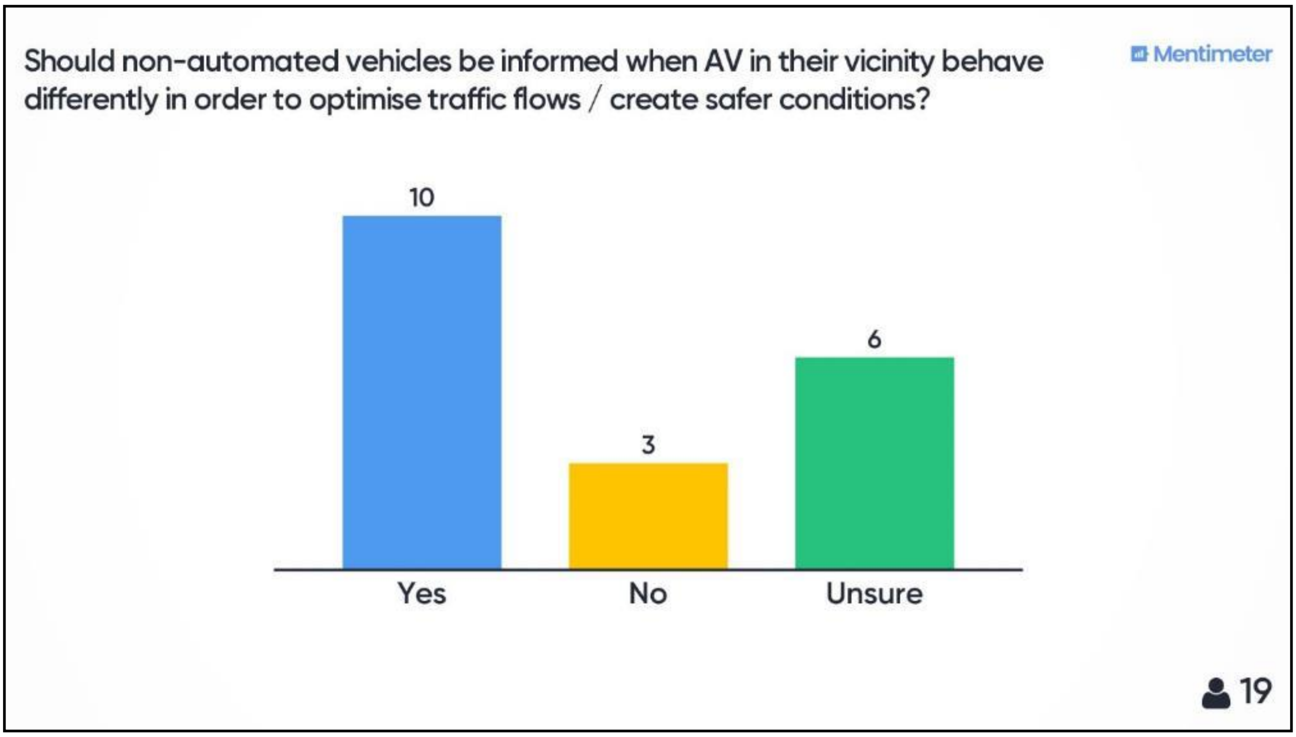

What topics would you specifically like to discuss?
Mentimeter
Urban use cases
BusinessModel
Users perception
Business models
Infrastructure costs
Relation between ISad and sae levels
VRUs
Teufel steckt im Detail. Every oem has its own mrm solutions.
VRU
24

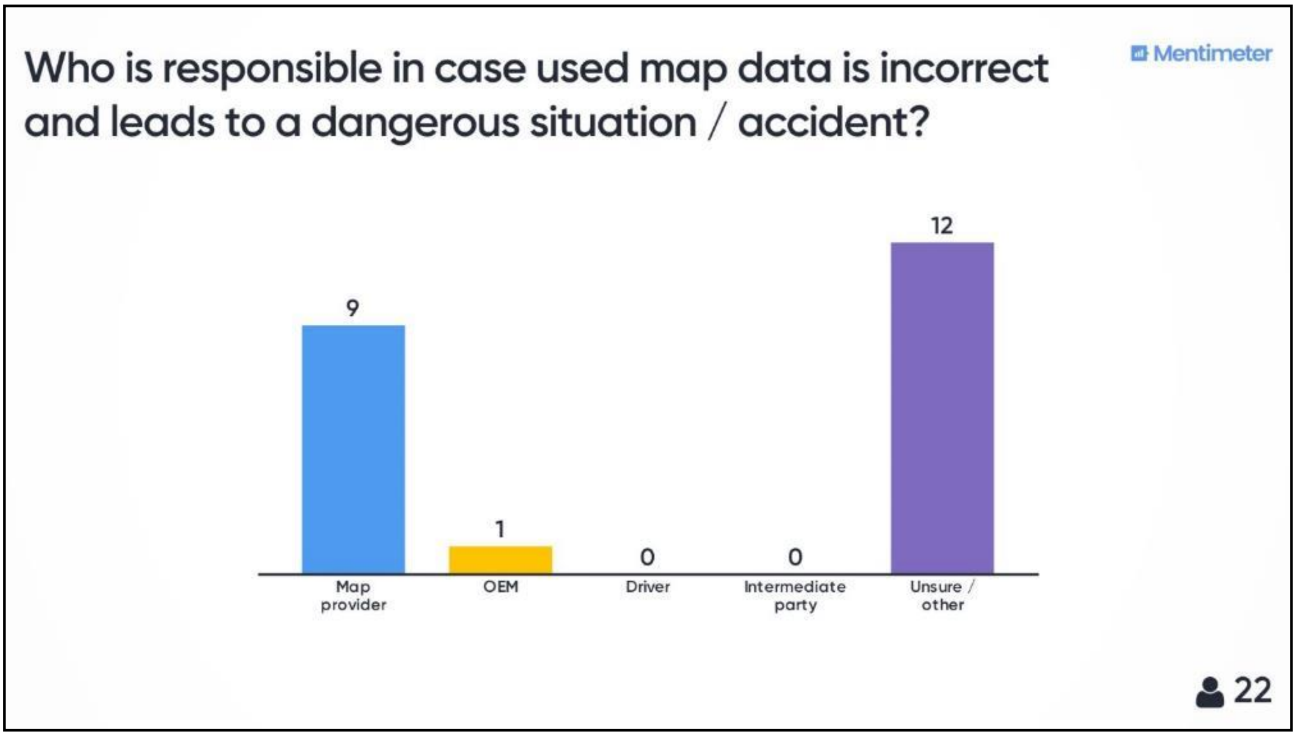

What topics would you specifically like to discuss?
Mentimeter
Certification and verification
Stress level for nondrivers
Public transport aspect
Traffic managers role
VRU
Mixed traffic flows with less than level 3
New role of Road operators
How to keep the infrastructure databases updated
Simulation approach on minimal risk maneuvers
24

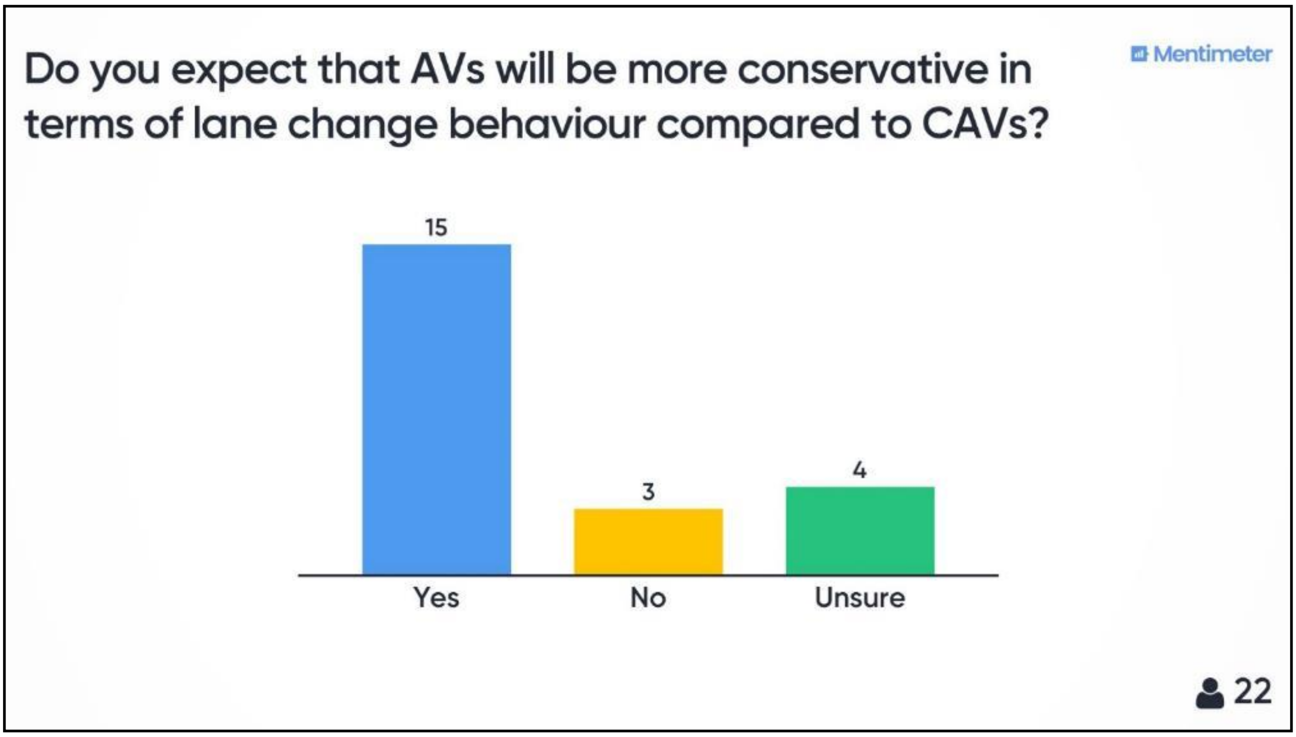

What topics would you specifically like to discuss?
Mentimeter
4G/G5 or G5?
Road markings
How and b whom is the decision made, which SAE level is allowed on a specific road section?
Testing in real conditions
How to implement the scenario's?
Tele operations?
24

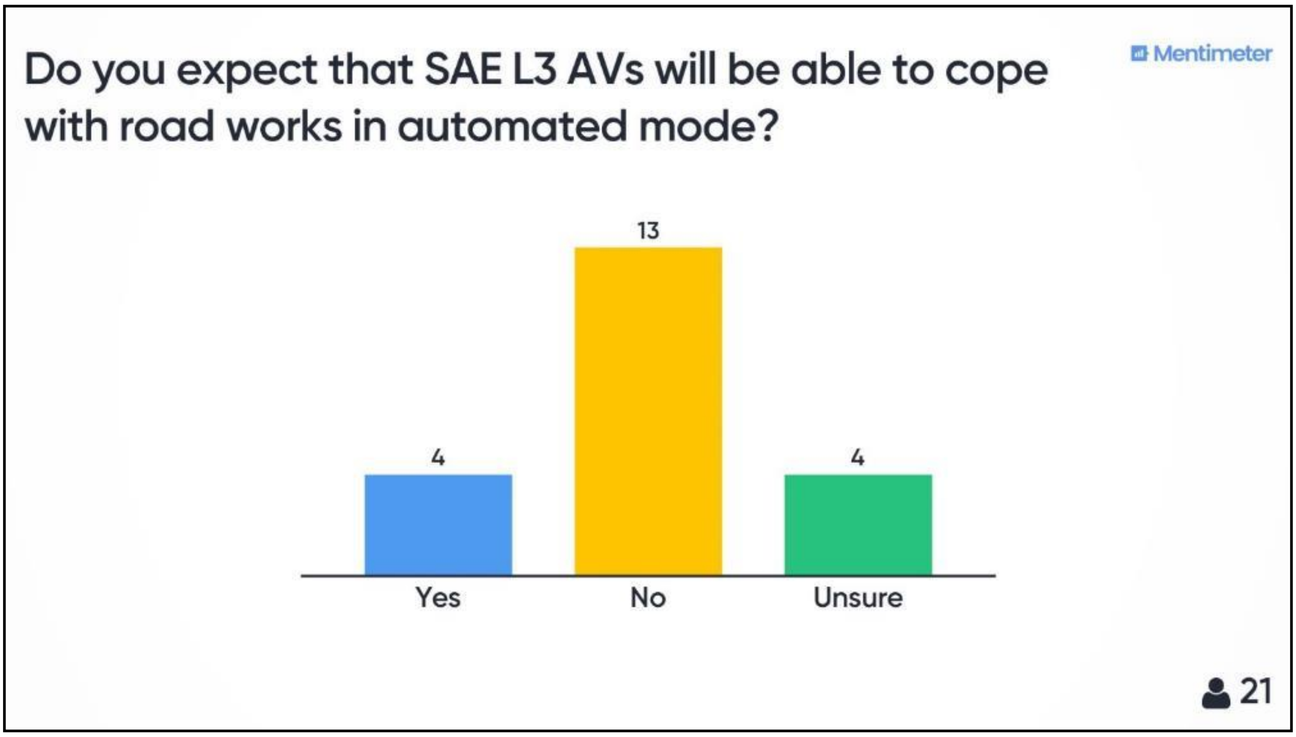
B.2 Second session results

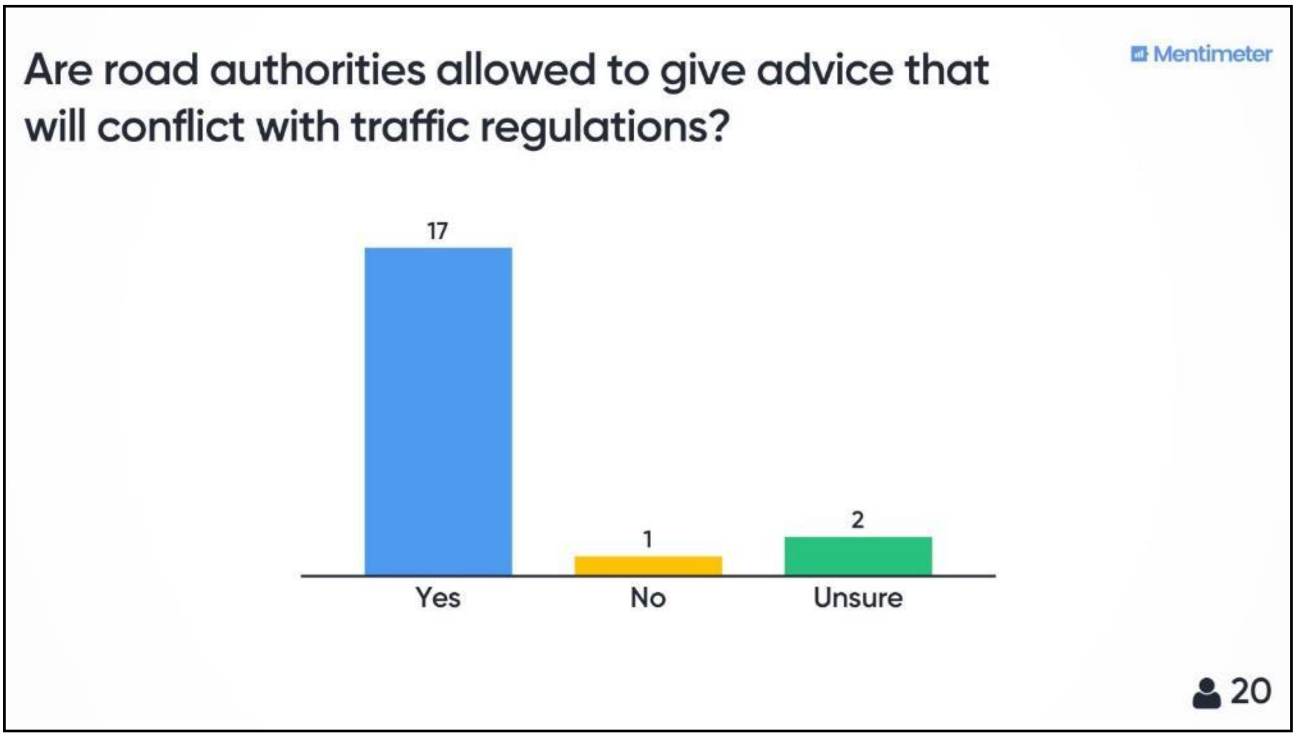


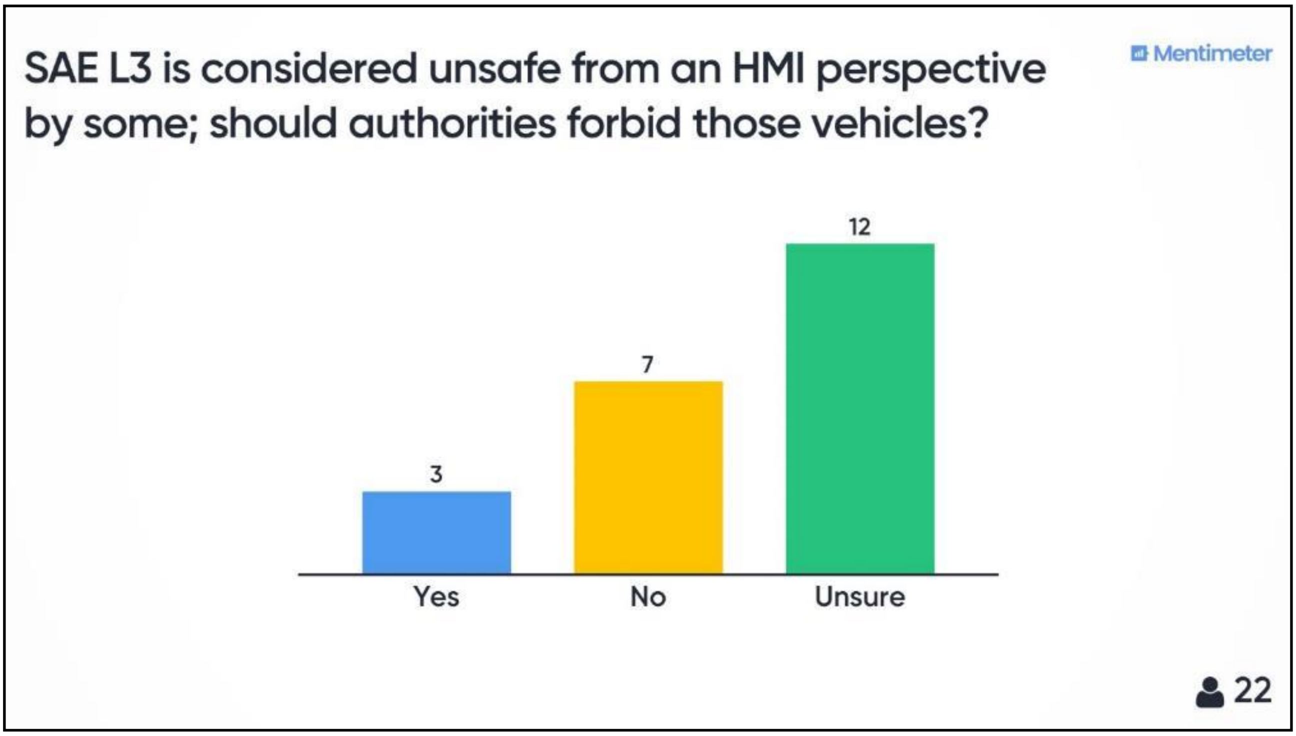

Should non-automated vehicles be informed when AV in their vicinity behave differently in order to optimise traffic flows / create safer conditions?
Mentimeter
10
3
6
Yes
No
Unsure
19

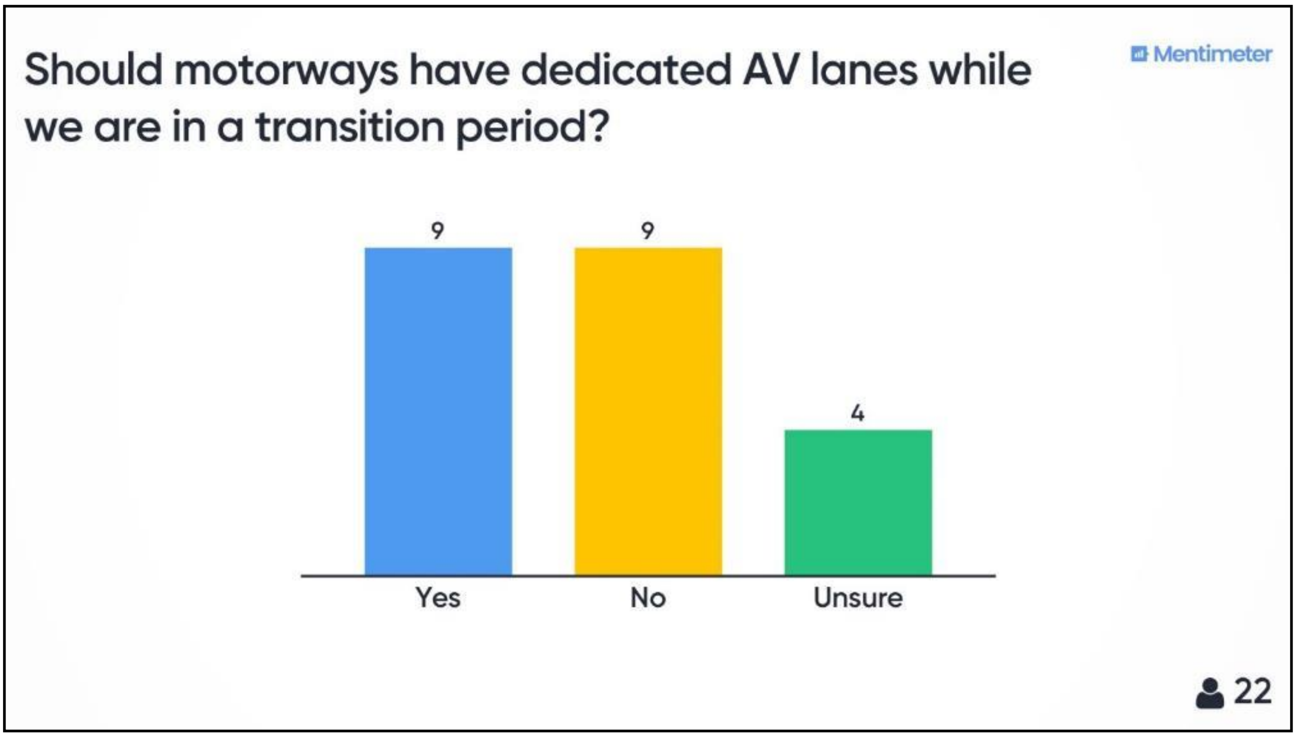

Who is responsible in case used map data is incorrect and leads to a dangerous situation / accident?
Mentimeter
9
1
0
0
12
Map provider
OEM
Driver
Intermediate party
Unsure / other
22

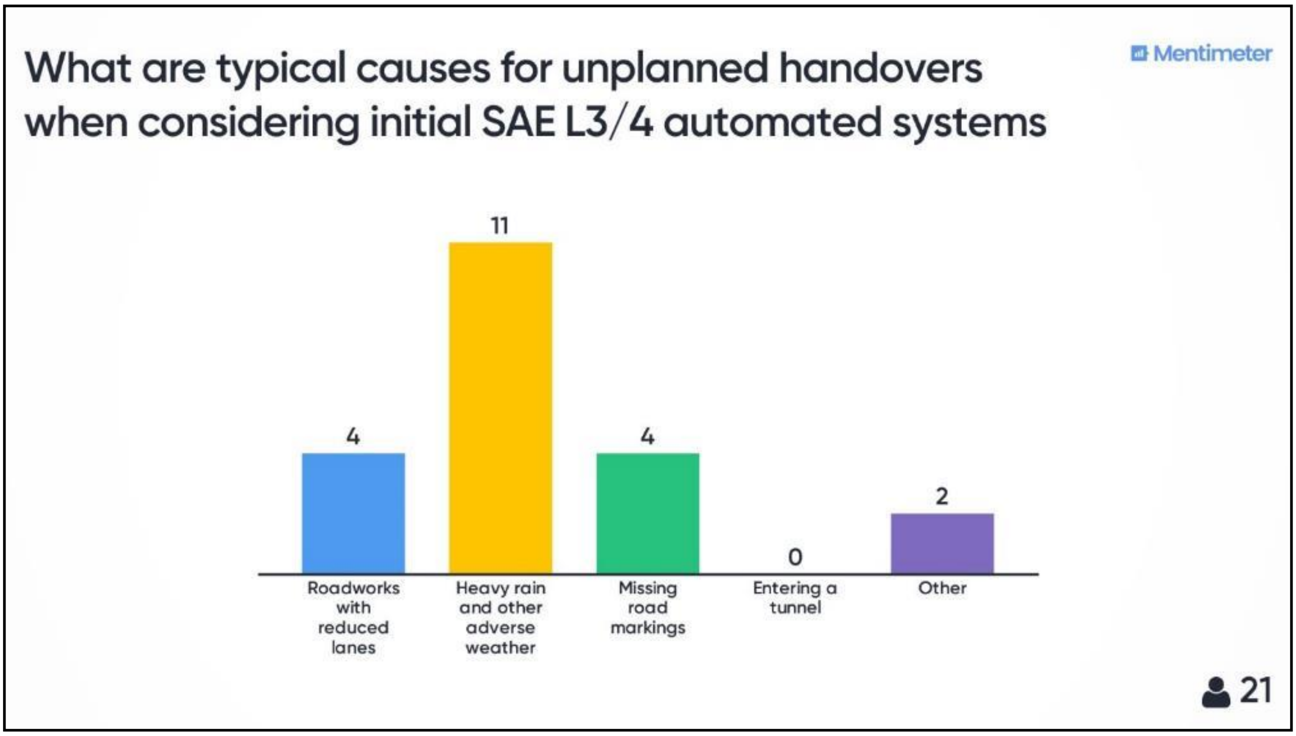

Mentimeter
Do you expect that AVs will be more conservative in terms of lane change behaviour compared to CAVs?
15
3
4
Yes
No
Unsure
22

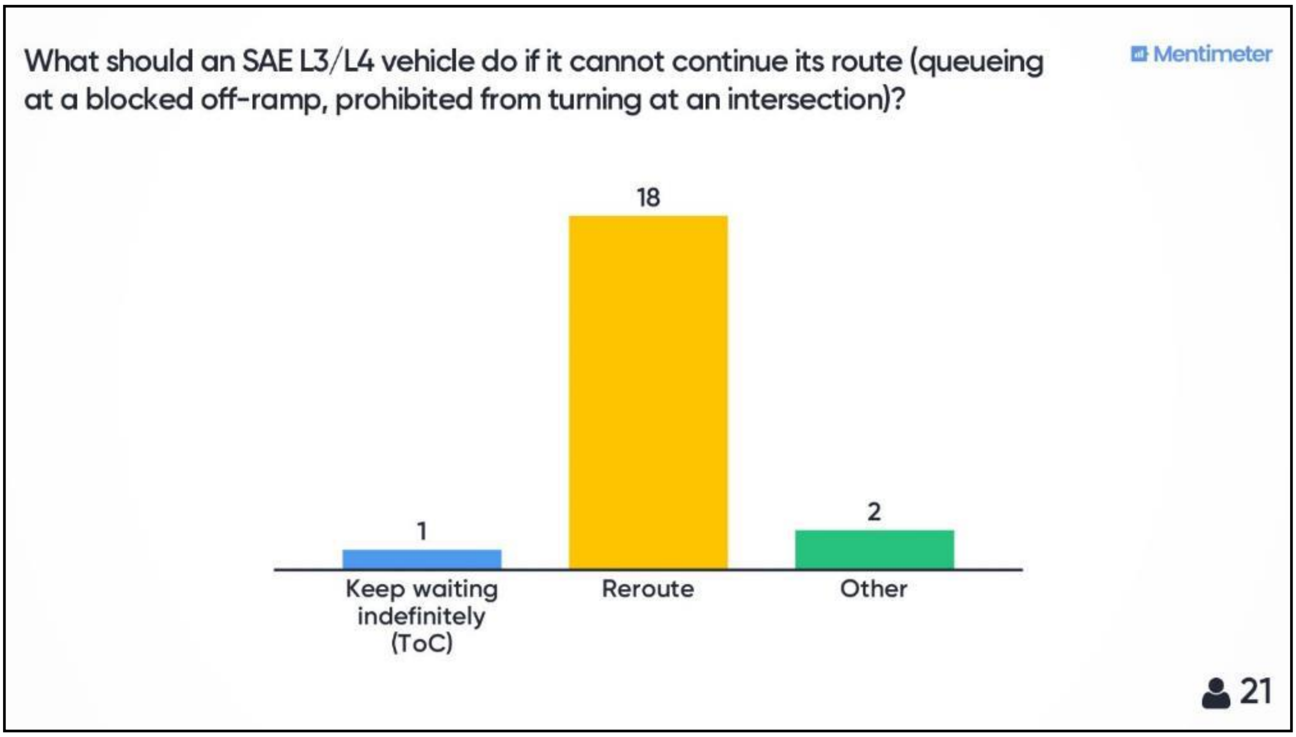

Mentimeter
Do you expect that SAE L3 AVs will be able to cope with road works in automated mode?
4
13
4
Yes
No
Unsure
21

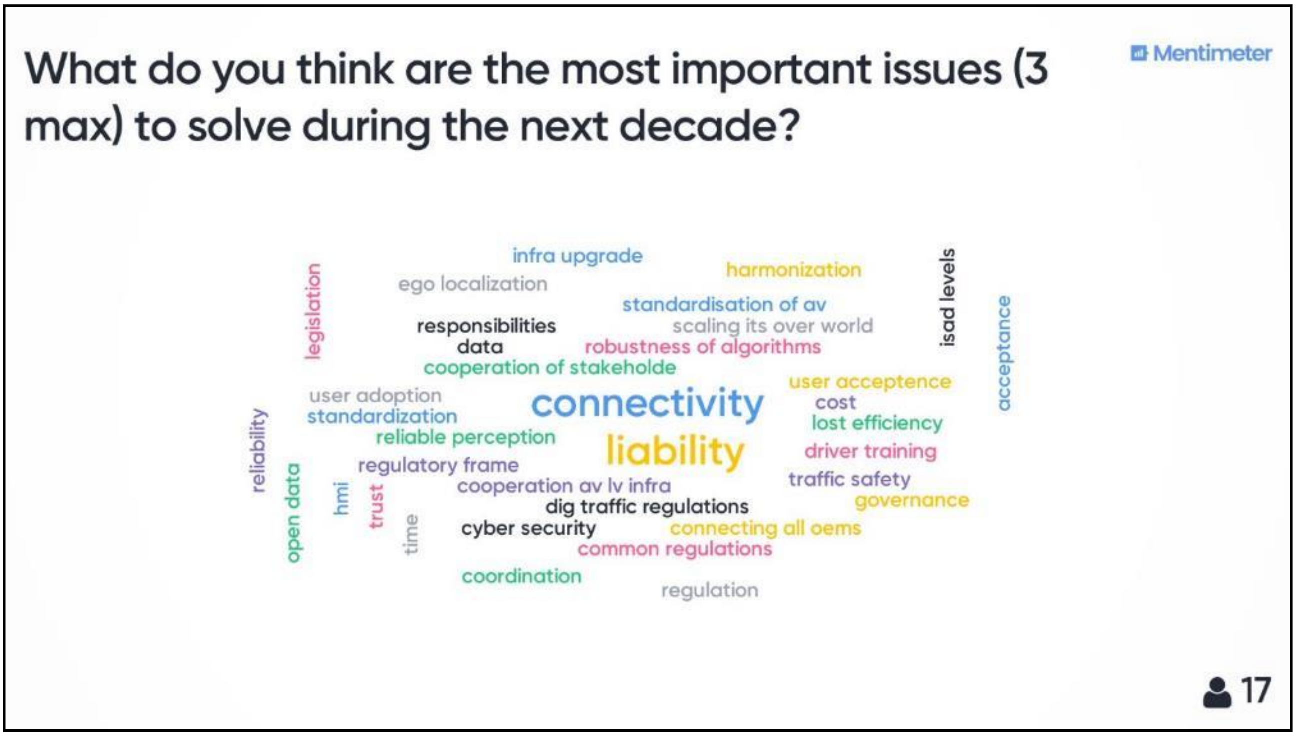

Are road authorities allowed to give advice that will conflict with traffic regulations?
Mentimeter
17
1
2
Yes
No
Unsure
20


SAE L3 is considered unsafe from an HMI perspective by some; should authorities forbid those vehicles?
Mentimeter
12
7
3
Yes
No
Unsure
22


Should motorways have dedicated AV lanes while we are in a transition period?
Mentimeter
9
9
4
Yes
No
Unsure
22


What are typical causes for unplanned handovers when considering initial SAE L3/4 automated systems
Mentimeter
11
4
4
2
0
Roadworks with reduced lanes
Heavy rain and other adverse weather
Missing road markings
Entering a tunnel
Other
21


What should an SAE L3/L4 vehicle do if it cannot continue its route (queueing at a blocked off-ramp, prohibited from turning at an intersection)?
Mentimeter
1
18
2
Keep waiting indefinitely (ToC)
Reroute
Other
21


What do you think are the most important issues (3 max) to solve during the next decade?
Mentimeter
infra upgrade
harmonization
ego localization
isad levels
legislation
standardisation of av
responsibilities
scaling its over world
data
robustness of algorithms
acceptance
cooperation of stakeholde
user acceptence
user adoption
connectivity
cost
standardization
lost efficiency
reliability
reliable perception
liability
driver training
regulatory frame
traffic safety
open data
hmi
trust
cooperation av lv infra
governance
dig traffic regulations
time
cyber security
connecting all oems
common regulations
coordination
regulation
17

Appendix C: Photos of the TransAID-INFRAMIX stakeholder workshop


TransAID services and use cases


Questions (1/3)
ODD: Which factors have the largest impact on the definition of them?
ODD: Which environments should we distinguish?
ODD: for which environments do have the highest priority? (to start with the definition work...)