Vehicle automation: implications for city and regional authorities
Joint CoEXist/MAVEN/TransAID workshop

10 October 2017– Brussels

WORKSHOP NOTE

1. Scope and aims of workshop

The H2020 projects hosting this workshop, CoEXist, MAVEN and TransAID, are all exploring the implications of increasing vehicle automation on urban roads. 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. Further information on each of these projects is provided in the annex.

Consultation with, and outreach, to local/regional authorities, especially city authorities and traffic managers, is 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 follows a successful workshop for local authorities organised by MAVEN in Barcelona in November 2016. 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 stakeholder 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

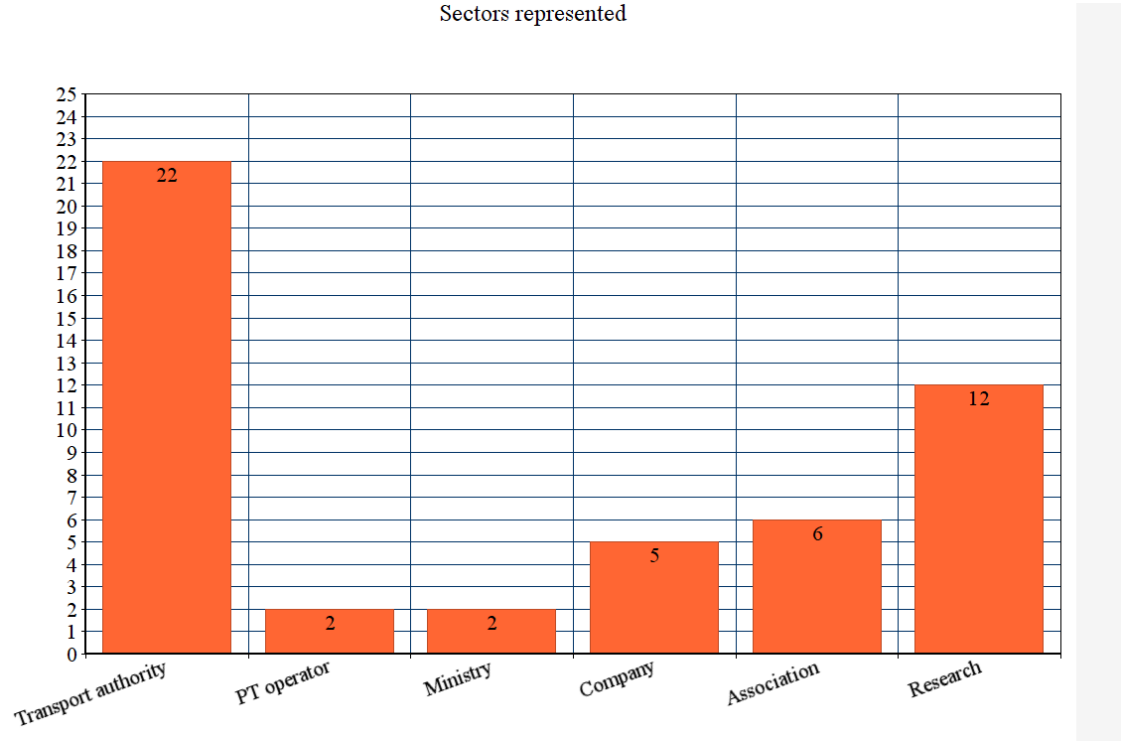
The workshop agenda was divided into two parts:

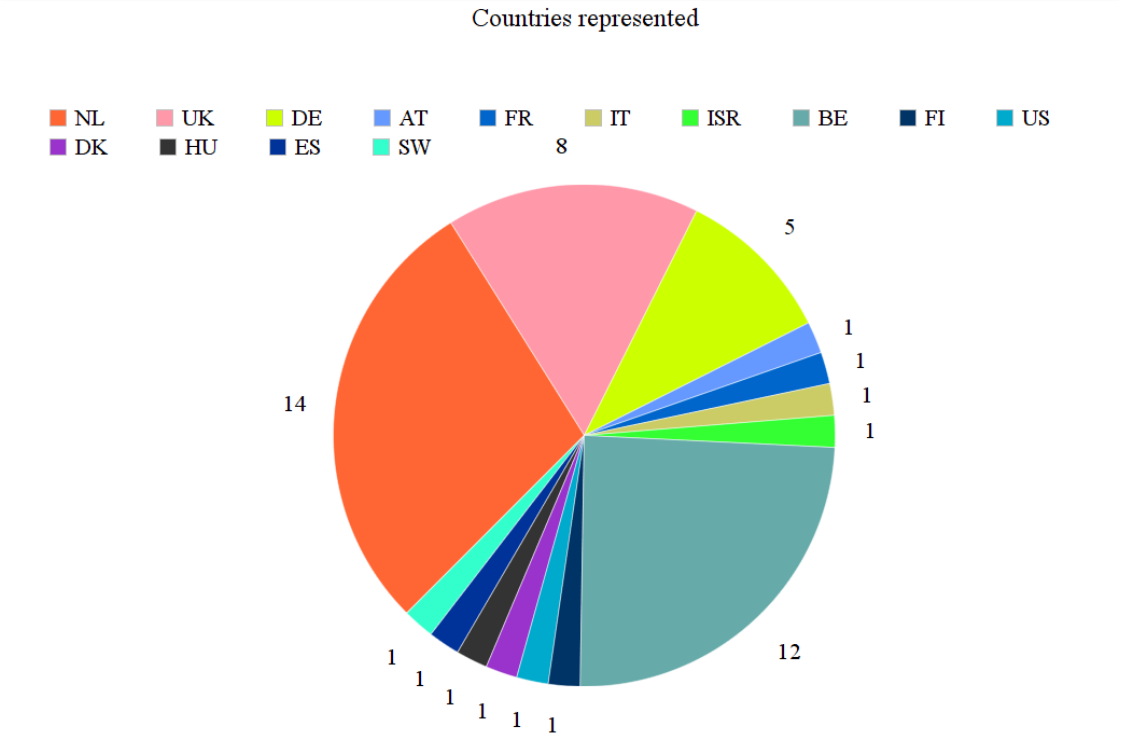
- the morning plenary session saw an introduction to the three projects, to the CAV activities of two projects' partner cities as well as insight to research in this field and the wider city/regional authority perspective on CAVs
- the afternoon session comprised project sessions in smaller groups to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

The full set of presentations is available for downloading from the following webpage: https://www.polisnetwork.eu/publicevents/481/36/Vehicle-automation-implications-for-city-and-regional-authorities-joint-CoEXist-MAVEN-TransAID-workshop

2. Workshop participants

The audience was targeted at urban transport stakeholders, with a particular emphasis on representatives of local and regional government. 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. The full list of participants can be found in the annex.





3. Plenary session

Following an introduction to the workshop' aims and audience and the complementarity of the CoExist, MAVEN and TransAid projects, BipRadia 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 session - a short description of the projects can be found in Annex III. These project overviews were complemented by a presentation from Bart van Arem (TU Delft) who pulled together the results from a wide variety of other projects and studies on the topic of vehicle automation and 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 cohorts.
- 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 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 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 it reach its sustainable goals but admits that it's not easy to establish longer-term goals due to the rapid pace of technological change. Gothenburg expects CAVs to help it achieve its policy goal of zero vision safety and also to reduce the

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

- 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 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 AV planning and policy will to some extent depend on the type of service that is offered by automation, ie, automated private 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'.

4. Small group project sessions

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

The CoEXist session 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. 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 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
  - Landuse changes

General comments about (C)AVs

Local authorities need to deal with the arrival of AVs. However, for year 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, eg, 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 make diverting traffic easier, specifically where there is vehicle-infrastructure communication (ie, 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 will rely heavily on artificial intelligence. 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 control their movements for instance. However, today's centres simply do not have the capability to control such a large number of vehicles and it's unlikely that 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 instances 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)

When cooperative automated vehicles (CAVs) emerge on urban roads, there will be areas and situations where all levels of automation can be granted, and others where highly automated driving will not be allowed or not feasible. Complex environments, missing sensor inputs or temporary road configurations are examples of such situations and at these locations CAVs are expected to degrade their level of automation. Such geographic areas are referred to as 'Transition Areas' and are associated with negative impacts on traffic safety and efficiency, in particular with mixed traffic. Therefore, the objective of TransAID is to add digital infrastructure (I2V support) to avoid transitions (i.e. to maintain the automation level) or to influence the timing of the transition (in time and/or space).

In the TransAID breakout session the concept of infrastructure assistance for CAVs was discussed. One of the aims was to identify circumstances and situation 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 aCAV 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.

In conclusion: it was not possible to identify specific circumstances and situations where infrastructure assistance for CAVs is most needed. Nevertheless, the need for some control function was acknowledged and therefore is 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).

Annex I – Final workshop agenda

10.00	Welcome and introduction	*Suzanne Hoadley, Polis&Bernard Gyergyay, Rupprecht Consult*
10:15	Brief introduction to projects and small group activities:	
	• Planning for automated vehicles (CoExist)	*Bernard Gyergyay, Rupprecht Consult*
	• Automated vehicles, traffic management and infrastructure (MAVEN)	*Meng Lu, Dynniq*
	• Situations in which automated vehicles should not be allowed (TransAID)	*Jaap Vreeswijk, MapTM*
11:00	Self-driving Cities: Will we have them? Do we need them? Do we want them?	*Bart van Arem, TU Delft*
11:15	*Break*	
11.45	The automated vehicle activities of selected cities:	
	• Greenwich	*Ben Dodds, Digital Greenwich*
	• Gothenburg	*Mikael Ivari, city of Gothenburg*
12.15	Automation in urban areas – Polis position paper	*Suzanne Hoadley, Polis*
12.30	*Lunch*	
13.15	Round I of parallel small group sessionsCoEXist, MAVEN and TransAID	
14.45	*Break*	
15.15	Round II of parallel small group sessions CoEXist, MAVEN and TransAID	
16.45	Wrap up	
17.00	Close of workshop	

Annex II - Participants list

First Name	Last Name	Organisation
Adriano	Alessandrini	UNIFI
Ammar	Anwar	University of Cambridge
Sylvain	Belloche	Cerema
Gert	Blom	City of Helmond
Judith	Boelhouwers	City of Rotterdam
Florinda	Boschetti	Polis
Martijn	Bruil	Province of Gelderland
Matthias	Buelens	Flanders
Pasquale	Cancellara	Polis
Darren	Capes	City of York Council
Ian	Catlow	London's European Office
Matthew	Cockburn	Bristol City Council
Rosemarijn	de Jong	City of Rotterdam
Eric	de Kievit	City of Amsterdam
Antoine	de Kort	Ministry of Infrastructure and the Environment
Ben	Dodds	DG Cities Ltd/RBG
Mireille	Elhajj	Digital Greenwich
Pieter	Faber	Cities Northern Netherlands
Ulrich	Fastenrath	BMW AG
Sergio	Fernández Balaguer	EMT MADRID
Maxime	Flament	ERTICO-ITS Europe
Gisa	Gaietto	City of Stuttgart
Syrus	Gomari	Rupprecht Consult
Bernard	Gyergyay	Rupprecht Consult - Forschung & Beratung GmbH
Suzanne	Hoadley	Polis
Mikael	Ivari	City of Gothenburg
Eric	Kenis	Government of Flanders - Mobility & Public Works
László Sándor	Kerényi	BKK Centre for Budapest Transport
Johannes	Liebermann	AustriaTech
Meng	Lu	Dynniq
Sven	Maerivoet	Transport & Mobility Leuven
Marian	Marsh	Reading Borough Council
Edwin	Mermans	Province of Noord-Brabant
Rick	Meynen	STIB-MIVB
John	Miles	University of Cambridge Department of Engineering
Pieter	Morlion	City of Ghent
Thomas	Mourey	Polis
Johan	Olstam	VTI
Harold	Perik	Flanders Make
Bip	Radia	INEA
Pirkko	Rämä	VTT
Siegfried	Rupprecht	Rupprecht Consult GmbH

Georgios	Sarros	INEA
Steven	Schladover	UC Berkeley
Ebtihal	Shity	Technion
Kim	Smith	DG Cities Ltd
Jörg	Sonnleitner	University of Stuttgart
Eelko	Steenhuis	Cities Northern Netherlands
Bart	van Arem	TU Delft
Frank	van den Bosch	Gemeente Helmond
Françoise	van den Broek-Serlé	Emmen
Jaap	Vreeswijk	MAP traffic management
Ceri	Woolsgrove	European Cyclists' Federation

Annex III – Project outlines

CoEXist

CoEXist(May 2017 – April 2020) aims at preparing for the transition phase during which connected automated (CAVs) and conventional vehicles (CVs) will co-exist on urban roads. Through a cross-disciplinary approach and the engagement of relevant stakeholders, CoEXist is developing an automation-ready framework for road authorities and is developing traffic simulation tools. The tools developed by CoEXist will be tested by road authorities in four cities with different urban structures and traffic compositions: Helmond (NL), Milton Keynes (UK), Gothenburg (SE) and Stuttgart (DE), in order to assess the "automation-readiness" of their locally-designed use cases.

The mission of CoEXist is to build the capacity of road authorities and other urban mobility stakeholders to prepare for the transition to a road network shared byCVs and an increasing number of CAVs. The results of the project will enable road authorities to understand in detail the impact of increasing numbers of CAVs and to plan accordingly.
www.h2020-coexist.eu

CoEXist has received funding from the European Union's Horizon 2020 Research and Innovation Framework Programme under grant agreement n° 635998.

MAVEN

MAVEN (September 2016-August 2019) is developing solutions for managing automated vehicles on urban roads with signalised intersections and mixed traffic. It is developing algorithms for organising the flow of infrastructure-assisted automated vehicles, and structuring the negotiation processes between vehicles and the infrastructure. The project expects to address a wide range of issues relevant to urban road authorities including the role of road side equipment (eg, traffic lights); interaction between the infrastructure and automated vehicle in terms of functions such as speed advisory, platooning or lane change advisory; and, the impact on vulnerable road users (pedestrians and cyclists), among others.

Furthermore, the project will contribute to the development of enabling technologies, such as telecommunication standards and high-precision maps. A roadmap for the introduction of road transport automation will be developed, to support road authorities in understanding potential future changes in their role and in the tasks of traffic management.
http://www.maven-its.eu

MAVEN has received funding from the European Union's Horizon 2020 Research and Innovation Framework Programme under grant agreement n° 690727.

TransAID

TransAID (September 2017-August 2020) is focusing on transition areas, i.e. those situations and locations where (high-level) automation is not possible or only possible with additional assistance. For these situations, TransAID will develop applicable (digital) infrastructure interventions. A preliminary list of situations and possible intervention strategies will be detailed and expanded in the early months of the project. During this phase, the project would like to receive input from local authorities, e.g. relevant situations for which they consider automation inappropriate/a threat/etc. as well as requirements.

TransAID is receiving funding from the European Union's Horizon 2020 Research and Innovation Framework Programme under grant agreement n° 723390.