AUTOMATED ROAD TRANSPORT
On the way to connected and automated mobility
HORIZON 2020
Market predictions indicate that 20% of all vehicles sold by 2020 will have a certain level of automation. Many technological, industrial, health and societal benefits are expected from this. An increase in the number of automated vehicles is expected to result in higher safety, less pollution and further decarbonised road transport. It will require a new legal framework, an adapted road infrastructure with more connectivity and the development of new professional skills.

The Innovation and Networks Executive Agency (INEA) is responsible for the implementation of many projects in the field of Automated Road Transport and the related field of intelligent transport, building up a convincing showcase at European level through collaborative research and innovation.

This brochure provides a comprehensive overview of the projects managed by INEA in the field of Automated Road Transport. I hope that you will find it informative and interesting.

INEA Director
Dirk Beckers
CHALLENGES IN AUTOMATED ROAD TRANSPORT

TECHNOLOGY CHALLENGES

H2020 Automated Road Transport aims to promote a wide market introduction of highly automated vehicles that are nearing automation level 4 under the Society of Automotive Engineers (SAE) classification system for self-driving vehicles.

New technology development is essential to achieve the required improvements in connectivity, performance, productivity and efficiency of the overall transport system. These are to be tested in large-scale pilots/trials, as a necessary step before market uptake.

Digital technologies such as Big Data, the Internet of Things and Artificial Intelligence provide a great potential for developing innovative automated driving functions and mobility solutions for the future.

Privacy, integrity and availability of the required data and communication systems will be ensured through cybersecurity solutions.

HUMAN-RELATED ASPECTS

Interactions of automated vehicles with other vehicles, with the infrastructure and with other road users have to be addressed in the engineering process. Mixed traffic situations are critical in the transition period towards the deployment of automated transport solutions.

User acceptance will be only possible if a high level of safety is ensured and if the vehicles cover all user expectations, including comfort, connectivity, and shared mobility solutions. The development of modern Human Machine Interfaces (HMI) will enable a quick adaptation to the new way of driving.

Driver behaviour and response will drastically change with the introduction of highly automated vehicles. Socio-economic and human factors have to be considered in the design of human centred solutions.

REGULATORY FRAMEWORK

Seamless and harmonised cross-border EU and national regulation is a key factor for market introduction of Automated Road Transport.

Common procedures for testing, validation and certification will allow the standardisation of solutions. Standards should also apply to data exchange and communication solutions.

Ethical, legal, environmental, safety aspects are to be regulated. The liability and responsibility of every actor in the road system has to be defined before introduction of automated driving.

Digital technologies such as Big Data, the Internet of Things and Artificial Intelligence provide a great potential for developing innovative automated driving functions and mobility solutions for the future.

Privacy, integrity and availability of the required data and communication systems will be ensured through cybersecurity solutions.
AUTOMATED ROAD TRANSPORT
OUTREACH OF PROJECTS
FUNDED BY HORIZON 2020

PARTNERS FROM
18 EU MEMBER STATES
6 NON-EU COUNTRIES

201 BENEFICIARIES
36 CITIES HOSTING 64 TEST SITES
€142 M TOTAL EU FUNDING
The ADAS&ME project develops Advanced Driver Assistance Systems (ADAS) that incorporate driver/rider state, environmental context and adaptive interaction. The goal is to automatically transfer the control between vehicle and user, that way improving efficiency, environmental impact and safety for all vehicle types: conventional and electric car, truck, bus and motorcycle.

The ADAS&ME approach is to develop driver/rider vehicle interactions that avoid critical scenarios by warning the users and automatically activating a support system. An adaptive architecture and technical implementation for all main systems and use cases has been developed and the data collection for all targeted driver states - including sleepiness, visual distraction, rest, stress, emotions and fatigue – has been conducted successfully. A multimodal adaptive Human Machine Interface (HMI) framework and personalised user profiles that take into account inter-individual differences constitute a step toward the reduction of automated systems’ development costs, better performance of sensor and data analysis systems, and optimised HMI strategies.

**Test sites:** Barcelona (Spain), Lommel (Belgium), Versailles (France), Braunschweig (Germany), Södertälje (Sweden) to Wolfsburg (Germany)

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The ARCADE project aims to build consensus across stakeholders from all sectors on a sound and harmonized deployment of Connected, Cooperative and Automated Driving (CAD) in Europe and beyond.

ARCADE federates a CAD stakeholder network through the regular organisation of workshops and the co-organisation with the European Commission of the EUCAD Conferences and symposia. It also supports the Trilateral EU-US-Japan cooperation on ART. Through the joint CAD Network activities, experts exchange on best practices and lessons learnt. They build up synergies and a common approach to development, testing and validation of CAD. A main objective is the contribution to the definition of future research and innovation priorities in Europe for the main thematic areas related to the deployment and adoption of CAD (e.g. STRIA CART and ERTRAC CAD Roadmaps).

ARCADE also consolidates an online Knowledge Base of reference information on CAD, including an overview of stakeholders, methodologies, regulations, standards, best practices, roadmaps analysis and public road test undertakings. ARCADE is open to Associated Partnerships for contributions.
The success of future complex automated vehicles will depend on how they interact, communicate and cooperate with humans. For the design of an automated system, the overall driver-automation system should be considered, where driver and automation are considered as members of one team that share the driving task, who understand and support each other in pursuing cooperatively the goal of driving safely, efficiently and comfortably from A to B.

The overall objective of Automate is to develop, evaluate and demonstrate the «TeamMate Car» concept as a major enabler of highly automated vehicles.

To achieve this objective, AutoMate has developed 9 technology enablers, including driver and environment modelling and monitoring, V2X communications, planning and execution of human-like safe manoeuvres and the implementation of an innovative concept of human-machine interaction. These enablers have been integrated into 6 demonstrators (3 vehicles and 3 simulators) that will be evaluated in simulated and real environments in the next months to measure and quantify the benefit of the TeamMate concept.

Test sites: Ulm (Germany), Versailles (France), Turin (Italy)

The AVENUE project aims to demonstrate that autonomous vehicles will be a key element of the solution for the public transportation services of tomorrow. The project will assess the road behaviour and safety of the autonomous vehicles in public transportation and complex road situations. It will also demonstrate the economic, environmental and social advantages of autonomous vehicles for both the exploiting companies and the users, opening the way for their full scale adoption and integration in public transportation services.

AVENUE is organised around four major demonstration sites, where fleets of autonomous vehicles, providing door-to-door, free and dynamic routing will be integrated to existing public transportation services. The goal will be to improve the service offerings for urban and sub-urban areas with low to medium service demand. The demonstrator sites represent the most important models in public transport in Europe in terms of business organisation, service areas, social targets, and city and road layout. All four demonstrators will operate autonomous vehicle transport services throughout the whole duration of the project, collecting valuable information on the issues related to operation and integration to existing urban public transport services. At the same time they will raise awareness among citizens and public authorities about the expected advantages of these new technologies.

Test sites: Geneva (Switzerland); Lyon (France); Copenhagen (Denmark); Luxembourg
The BRAVE project aims to improve safety and market adoption of automated vehicles. It takes into consideration the needs and requirements of the users, other road users concerned (drivers and vulnerable road users) and relevant stakeholders (i.e. policy makers, standardization bodies, certifiers, insurance companies), assuring safe integration of key enabling technology advancements.

After 18 months, the project has issued an exhaustive Multidisciplinary study of the requirements and expectations of drivers and other stakeholders regarding the use of automated vehicles, including social, economic, security and ethical considerations. Focus groups and experts’ interviews have been conducted and the next steps of the project include a population survey. These insights will lay the foundation for the integration of innovative Advanced Driving Assistance Systems and Human Machine Interface concepts. These new concepts will be validated back against the baseline requirements using an agile, iterative and incremental user-centric methodology. Propositions of advancements on the regulation will be made.

Test sites: Vransko (Slovenia), Stuttgart (Germany), Linköping (Sweden), Linas-Monthéry (France), Barcelona (Spain)

The mission of CoEXist is to systematically strengthen the capacities of road authorities and other urban mobility stakeholders in preparation for the transition towards a shared road network with an increasing share of connected and automated vehicles (CAV) at higher automation levels.

Following a trans-disciplinary approach, CoEXist has developed an automation-ready framework to support local authorities in reducing uncertainties and building up their capacity to make structured and informed decisions about CAV deployment in a mixed road environment. The project has further developed microscopic and macroscopic modelling tools to include different types of CAVs. Through their application in eight use cases in Helmond (NL), Milton Keynes (UK), Gothenburg (SE) and Stuttgart (DE), CoEXist will assess to what extent infrastructure is automation-ready and whether the introduction of CAVs improves traffic performance, space efficiency, and safety. This will help identifying needs for adaptation and design recommendations.

Test sites: Milton Keynes (UK), Stuttgart (Germany), Gothenburg (Sweden), Helmond (The Netherlands)
Platooning technology has significantly advanced in the last decade; to move ahead towards deployment of truck platooning, though, an integral multi-brand approach is required.

In this framework, ENSEMBLE will implement and demonstrate multi-brand truck platooning on European roads, enabling a single truck to platoon with any other truck. ENSEMBLE aims at realising pre-standards for interoperability between trucks, platoons and logistics solution providers, to speed up market pick up of system development and implementation and harmonise legal frameworks in the member states.

During the first year, the consortium has concentrated on setting the specifications for the implementation of multi-brand platooning. Truck manufacturers and suppliers will follow up for implementation on their own trucks during year 2, while the knowledge partners will perform impact assessments. Year 3 will focus on testing the multi-brand platoons on test tracks and international public roads. The evaluation of technical results against the initial requirements will also include the impact on fuel consumption, drivers and other road users.

HEADSTART aims to define testing and validation procedures on specific functionalities of Connected and Automated Driving (CAD) functions, including key technologies such as communications, cyber-security and positioning. The tests will be in both simulation and real-world fields to validate safety and security performance according to the key users’ needs.

The project will bring together the consortium with European and national CAD stakeholders to cluster the most relevant existing initiatives, develop methodologies, procedures and tools and drive in a harmonised European solution for testing and validation of automated road vehicles. Within the lifetime of the project, relevant stakeholders will be able to join the experts’ network to configure together the methodologies used and promote the project results’ adoption. Ultimately, the project aims to facilitate consensus by creating and managing an expert network of CAD testing.

**Test sites:** Sandhult (Sweden), Barcelona (Spain), Aldenhoven (Germany), Helmond (The Netherlands), Eindhoven (The Netherlands)
The ICT4CART project consists of 21 partners from 9 EU countries, united in their vision to build a sustainable future for connected and automated vehicles. ICT4CART’s goal is to provide an ICT infrastructure architecture to address existing gaps in the area of connected and automated driving. This high-level architecture will ensure performance and resilience for different groups of applications according to the needs of higher levels of automation (L3 & L4).

Through its architecture, by integrating a hybrid communications approach and mechanisms for seamless exchange of data, ICT4CART will address the challenges faced by the transition of advanced levels of road vehicle automation.

Instead of working on generic solutions, ICT4CART builds on four specific high-value use cases (urban and highway) which will be demonstrated and validated under real-life conditions at the project test sites in Austria, Germany, Italy and across the Italian-Austrian border.

Test sites: Lašnitzhöhe area (Austria), Ulm (Germany), Verona (Italy), Graz (Austria), Trento Centro (Italy)

The INFRAMIX project aims to design, upgrade and adapt both physical and digital elements of the road infrastructure, ensuring an uninterrupted, safe and efficient traffic in the transition period with automated and conventional vehicles. This also includes ways of informing all types of vehicles about the road operator’s control commands and proposing new visual signs and electronic signals. INFRAMIX ensures that the proposed adaptations will not jeopardize safety, quality of service and efficiency.

In order to achieve this, INFRAMIX will develop a co-simulation environment, combining the modelling of the vehicle behaviour with the traffic simulation to examine different mixed traffic scenarios. It will also design and implement novel traffic estimation, monitoring and control strategies.

The project will develop hybrid testing systems, coupling infrastructure elements and vehicles on real roads with virtual traffic environment.

Lastly, it will allocate traffic safety and user’s appreciation, and create a Road Infrastructure Classification Scheme.

Test sites: Between Barcelona and the French border (Mediterranean Corridor), Between Lašnitzhöhe and City of Graz (Austria)
The interACT project will develop novel, holistic interaction concepts for automated vehicles, that will enable their integration in mixed traffic environments in a safe and intuitive way.

interACT will study and substantially improve the communication and cooperation strategy between automated vehicles and other traffic participants. The project will provide an overview of current human interactions in traffic and will support the safe deployment of automated vehicles. It will do so by developing novel software and Human Machine Interface (HMI) hardware components for reliable and user-centric communication between automated vehicles and other traffic participants.

Concretely, interACT will use social-psychological models to compile a catalogue of interactions, identifying the main communication needs of road users in current and future traffic scenarios. It will improve software algorithms and sensor capabilities for assessing intention recognition and behaviour prediction of surrounding road users. It will also develop a Cooperation and Communication Planning Unit to integrate planning algorithms, providing synchronised and integrated communication protocols. Last but not least, the project will ensure safety of road users by developing easy-to-verify software for a safety layer, as well as novel methods for fail-safe trajectory planning.

Test sites: Munich (Germany), Turin (Italy), Braunschweig (Germany), Athens (Greece)

The European research project L3Pilot tests the viability of automated driving as a safe and efficient means of transportation on public roads with 1,000 drivers and 100 vehicles across ten European countries, including cross-border routes. The project focuses on large-scale piloting of SAE Level 3 functions, with additional assessment of some Level 4 functions.

The technologies being tested cover a wide range of driving situations, including parking, overtaking on highways and driving through urban intersections. L3Pilot covers the entire range of impact assessments, from the direct effects on driver behaviour to even the socio-economic impacts.

By the end of its duration, the L3Pilot project will have harmonised the various test sites as regards compliance with automated driving testing, thus creating a European-wide Automated Driving testing environment. To keep user desires in focus, L3Pilot will collect data on user acceptance of vehicle automation in an annually published survey. The partners will also involve various stakeholders to explore the trends and commercialisation potentials related to the L3Pilot functions.

Test sites: Aachen (Germany), Barcelona (Spain), Brussels (Belgium), Coventry (UK), London (UK), Gothenburg (Sweden), Ingolstadt (Germany), Luxembourg, The Netherlands, Munich (Germany), Offenbach (Germany), Wolfsburg (Germany), Paris (France), Turin (Italy)
LEVITATE will develop a wide-ranging evaluation framework to assess the impact of connected and automated transport (CAT) on all aspects of transport and individual mobility as well as at societal level. This framework will be used to evaluate the impacts of connected automated vehicles (CAVs) on individuals, the mobility system and society using a wide range of indicators.

The project addresses the needs of municipalities, regional authorities and national governments that wish to prepare for the increasing prevalence of connected and automated systems, understand the implications for mobility policies and identify the most effective measures to achieve wider societal objectives. Time horizons will cover short-term to long-term reflecting the progressive introduction of CAT technologies. It will apply the framework to a wide range of use cases and scenarios to forecast expected impacts of CATs and develop a back-casting methodology that will enable cities to identify the most appropriate CATs interventions to enable them to achieve their policy objectives.

Cooperative automated vehicles and Cooperative infrastructure will get more and more present in the near future. The Managing Automated Vehicles Enhances Network (MAVEN) project aims to improve traffic efficiency and safety with management functions at both vehicle and infrastructure level. The project has developed new solutions for platoon planning that also includes a tactical level. This is where platooning, lane changes and optimal speed for approaching an intersection are the main targets. The interactions with the infrastructure were organised as negotiations and supported by new and extended message sets, which are in the process of being standardised now. The project has developed a patented algorithm for dynamic traffic light controllers to support automated vehicles approaching an intersection with a predictable count-down, while maintaining high traffic efficiency. The combined use cases of platooning, speed advice and green wave have demonstrated during simulations that it is possible to eliminate stopping at intersections completely. This has a potential CO2 reduction of 80 tons per year per intersection.

Test sites: Helmond (The Netherlands), Braunschweig (Germany)
TransAID is the first European project developing hierarchical traffic management procedures to allow the smooth integration of automated vehicles in traffic systems, especially around those areas of the road where vehicle automation reaches its limits. TransAID is looking into how future vehicle automation systems are going to act on the road. Special focus is put on the behaviour of the systems when reaching system limits, i.e. when facing a situation which cannot be handled by the systems without help – for example by starting a take-over request and giving control back to the driver. The project is going to simulate this behaviour, not only for single vehicles, but for the predicted market shares in the upcoming years. This would allow the assessment of the impact on traffic safety and efficiency. Based on this, hierarchical traffic management systems will be developed, enabling a controlled movement of the vehicles by taking into account their abilities. The developed systems will be prototypically implemented and the effects will be assessed in simulation and real world tests. The findings will be aggregated to create guidelines and a roadmap for stakeholders.

Test sites: Braunschweig (Germany)

The introduction of automated vehicles to the market raises various questions and problems. One of those is the trustworthiness of the automated systems and in this connection the user’s perception and acceptance. The user’s perception is especially important during SAE level 3 automated driving, where the driver must be able to resume vehicle control, and during the initial deployment of automated systems, where mixed traffic situations occur, in which automated and human-driven vehicles share the same road space. The project TrustVehicle aims to investigate critical scenarios, especially in mixed traffic situations and under harsh weather conditions, and to improve trustworthiness.

For a user-centric approach, the driver’s impressions and feelings are crucial for L3AD driving since he/she should be able to resume vehicle control if needed. Therefore, they are strongly considered in the whole development process of the different components that constitute the automated system. Questionnaires and tests on the driver simulator are some of the measures taken within TrustVehicle to assure the involvement of the user in the development process.

Test sites: Tampere and Helsinki (Finland), Gothenburg (Sweden), Ford Otosan Inonu Proving Ground (Turkey)
Road accidents, which are mainly caused by human error, are a major safety concern nowadays. Technologies have been developed to tackle this issue, but they are often limited to monitoring the exterior of the vehicle. However, for achieving automation, both the surrounding of the vehicle as well as the driver should be deeply analysed.

Unlike other existing solutions, VI-DAS proposes the next-generation 360° connected Advanced Driver Assistance Systems (ADAS), which monitors both the outside and the driver status based on non-invasive technologies. After capturing and analysing data, the system sends feedback real-time to better understand the driving context. As a result, VI-DAS will keep the driver in the loop during mode transitions in semi-automated driving or ADAS modes.

In short, VI-DAS will take the automotive industry one step closer in the path towards autonomous driving, the long-awaited goal of our society. The main objective is to increase road safety and position Europe as the leader in the autonomous driving field. In order to reach this ambitious milestone, VI-DAS brings together leading international firms and institutions.

**Test sites:** Milovice (Czech Republic), Eindhoven (The Netherlands)
INEA’S ROLE

INEA is an Executive Agency established by the European Commission to implement parts of EU funding programmes for transport, energy and telecommunications.

The Agency provides its stakeholders with expertise and high-level programme management, while at the same time promoting synergies among programmes, in order to contribute to economic growth and benefit EU citizens.

INEA supports Road Transport research together with the European Commission’s Directorates-General for Research & Innovation (DG RTD), and for Mobility and Transport (DG MOVE).

The Agency plays a crucial role in turning road transport policy set by the Directorates-Generals into successful implementation of research and innovation projects.

HORIZON 2020

INEA is the gateway to funding under the Horizon 2020 Societal Challenges „Smart, green and integrated transport“ and „Secure, Clean and Efficient Energy“ with a total budget of over €5 billion (€2.3 billion for Transport and €3 billion for Energy) to be granted by end 2020.

INEA’s total contribution to Automated Road Transport related projects will amount to €250 million in the period 2015-2020.

ADDITIONAL ROAD TRANSPORT RESEARCH AND FUNDING OPPORTUNITIES

INEA implements most of the Connecting Europe Facility (CEF) programme budget, in total €28.7 billion out of €30.4 billion for the 2014-2010 period (€23.5 million for transport, €4.7 billion for energy, and €0.5 billion for telecommunications). The CEF Transport programme objectives are to remove bottlenecks, provide missing links, and ensure sustainable, efficient and intelligent transport systems (i.e. ITS).

While funding the deployment of ITS services along the Core Network Corridors, CEF is also supporting the implementation of C-ITS and gradually preparing the European infrastructures for the future automated road transports. Through real-life pilots, C-ITS services are deployed and evaluated, while interoperability and technical harmonisation is ensured across different Member States and road operators.